APPLICATION FOR LAND USE CHANGE ACCORDING TO THE SPATIAL PLANNING AND LAND USE MANAGEMENT ACT (ACT 16 OF 2013)

GROBLERSHOOP TOWNSHIP FORMALISATION AND EXPANSION PROJECT: SUBDIVISION, CONSOLIDATION AND REZONING:

INVOLVED PROPERTY:
PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT, NO. 48, !KHEIS LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE;

SUBMISSION DATE: OCTOBER 2020

COGHSTA
Department:
CO - OPERATIVE GOVERNANCE
HUMAN SETTLEMENTS & TRADITIONAL AFFAIRS
NORTHERN CAPE

MACROPLAN
TOWN & REGIONAL PLANNERS
YOUR PARTNERS IN PROFESSIONAL PLANNING SERVICES

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GROBLERSHOOP TOWNSHIP FORMALISATION AND EXPANSION PROJECT

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Table of Contents

LIST OF FIGURES

LIST OF PHOTOS

LIST OF TABLES

LIST OF ANNEXURES

SECTION A: COMPREHENSIVE APPLICATION FORM

!Kheis Munisipaliteit Municipality

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Private Bag X2
Groblershoop
8850

Application for Land Use amendment in terms of Spatial Planning and Land Use Management Act 16 of 2013.

Application for land use amendments

(give full details in the attached motivation report, if space provided is not enough)

SECTION 1

Details of Applicant (See Planning Profession Act, Act 36 of 2002)

Name:	Macroplan	**Contact person:**	Len Fourie JP Theron
Postal address: **Code:**	P.O. Box 987 Upington 8800	**Physical address:**	4A Murray Avenue Upington 8801
Tel no:	054 332 3642	**Cell no:**	082 821 1025 082 821 1024
Fax no:	054 332 4283		
SACPLAN Reg No:	Len J. Fourie: Pr.Pln. A/1322/2006 J.P. Theron: Pr. Pln. A/2394/2016 (Annexure N)	**E-mail address:**	macroplan@mweb.co.za jptheron@mweb.co.za

Macroplan Town and Regional Planners, has been appointed by Barzani Development on behalf of the Department of Cooperative Governance, Human Settlements and Traditional Affairs (COGHSTA).

SECTION 2

Details of Land Owner (If different from Applicant)

Name:	The involved property, Portion 16 of the Farm Boegoeberg Settlement, No. 48, is owned by the !Kheis Local Municipality.	**Contact person:**	!Kheis Municipality: Fanus van Eck	Barzani Development: Marike Joubert
Postal address:	Private Bag X2 Groblershoop 8850	**Physical address:**	97 Oranje Street	9 Cambridge Office Park
Tel no:	054 833 9500	**Cell no:**	082 662 2771	066 457 5755
Fax no:	054 833 0690	**E-mail address:**	fvaneck3@gmail.com	Marike@Barzanigroup.co.za

If the applicant is not the registered owner(s), attach a power of attorney from the registered owner(s) to the application.

SECTION 3

Details of Property (In accordance with Title deed)

Erf / Farm No and portion description:	***Portion 16 of the Farm Boegoeberg Settlement, No. 48, Kenhardt RD, !Kheis Municipality, Northern Cape Province (henceforth refer to as Portion 16 of the Farm Boegoeberg Settlement, No. 48)*** .	**Area (m² or ha):**	440.5695ha
Physical address of erf/farm:	The involved property forms the town commonage, therefore no physical address has been allocated thereto. The involved property can however be found nestled between the town of Groblershoop and the neighbourhood of Sternham.	**Existing Zoning:**	The study area is zoned as Undetermined Zone.
Location from nearest town:	The study area is situated within the urban edge of Groblershoop.	**Existing land use:**	The study area, measuring 95ha in extent, is vacant for the most part, except for unused municipal infrastructure (oxidation ponds). Graves have also been identified on the study area.
Town/ suburb:	Situated within the delineated urban edge of Groblershoop.	**Area applicable to application:**	Approximately 95ha
Registration Division:	Kenhardt RD	**Title deed no:**	T2574/1978 (Annexure A)

SECTION 4

Type of Application being Submitted (Mark with an X and give detail)

Application for:

(Please mark applicable block with a cross)

The establishment of a township or the extension of the boundaries of a township.	
The rezoning from one zone to another	X
The removal, amendment or suspension of a restrictive or obsolete condition, servitude or reservation registered against the title of the land.	
The amendment or cancellation a general plan or SG Diagram	
The closure of any public place or road and street reserves	
The secondary use as provided for in the regulations (not supported by SDF)	
The departure from the development parameters of the zoning scheme	
The departure to use land for a purpose not provided for in the zoning scheme granted on a temporary basis	

The secondary use as provided for in the regulations (supported by SDF)	
The subdivision of land	X
The registration of a servitude	
The consolidation of land	
The extension of the validity period of an approval	
The application for the exemption of subdivision and consolidations as provided for in the regulations	
Any other application not provided for in the table above	

Please give a short description of the scope of the project:

Our office, Macroplan Town and Regional Planners, has been appointed (See Annexure B) by Barzani Development on behalf of the Department of Cooperative Governance, Human Settlements and Traditional Affairs (hence referred to as COGHSTA), to facilitate the needed town planning procedures involved with a township expansion project for Gtoblershoop, which is nestled between the town of Groblershoop and the neighbourhood of Sternham.

Groblershoop, along with the various smaller settlements of the !Kheis Municipality, have experienced normal population growth over the last few years, however, due to Groblershoop's status as the primary urban centre of the !Kheis Local Municipality, the town has seen a significant greater increase in residents. In contrast to the other settlements of the !Kheis Municipality, the increase in the local population has been adequately managed by the local municipality by means of allocating municipal owned land within existing communities that were meant for other purposes, such as public open spaces. The commitment from COGHSTA to address the housing backlog within the Northern Cape, provided the !Kheis Municipality with the ideal opportunity to make adequate provision for further population growth of Groblershoop. Groblershoop as the primary urban centre and administrative seat of the !Kheis Local Municipality will therefore be subject to a substantial township expansion project that will not only include 1500 residential properties, but also provide for land uses normally associated with a sustainable community/ neighbourhood, such as a school, business nodes, municipal uses and open spaces.

The goal of this application to obtain approval for the necessary town planning processes that will allow for the planned township expansion of Groblershoop on a 95ha portion of Portion 16 of the Farm Boegoeberg Settlement, No.48.

In order for the planned Groblershoop township expansion project to take place, the following land use changes are required:

1. <u>SUBDIVISION (See Figure 5)</u>:
   - 1.1. Subdivision of a 95ha portion of Portion 16 of the Farm Boegoeberg Settlement, No.48, into 1539 individual cadastral land units.

2. <u>REZONING (See Figure 6):</u>
   - 2.1. Rezoning of the newly created properties, thereby allocating appropriate land use rights to each of the newly created individual erven suitable to their future purpose within the Groblershoop township expansion project. The proposed zonings, in terms of the newly adopted !Kheis Scheme Regulations, are as follow and should be read together with the final layout plan attached as Annexure E to this submission:

Zoning	Primary Use/s	Erven Amount

Residential Zone I	Residential House	1500
Business Zone I	Business Premises	16
Institutional Zone I	Place of Instruction/ Educational building	2
Institutional Zone II	Place of Worship	3
Open Space Zone II	Public Open Spaces	15
Open Space Zone III	Private Open Spaces	2
Transport Zone II	Public Street	1
Authority Zone I	Municipal Uses	1
Total		1539

Please refer to Figures 5 & 6, Annexure E, §2.8 & §3.3 of this report for more information in this regard.

SECTION 5

Detail of application (Mark with an X and give detail where applicable)

Is the land unit currently developed (buildings etc.)?	YES		If answered YES, what is the nature & condition of the developments / improvements?	The study area, measuring 95ha in extent, is vacant for the most part, except for old municipal infrastructure (oxidation ponds) that can be located on the northern sections of the study area. Graves have also been identified on the study area and the necessary provisions within the town planning layout has been made to accommodate these graves.
Is the current zoning of the land utilised?		NO	If answered NO, what is the application / use of the land?	The study area is currently zoned as Undetermined Zone, as such no specific primary use is allocated thereto. As mentioned, graves have been identified on the study area which will have to be suitably rezoned as part of this application.
Is the property burdened by a bond?		NO	If answered YES, attach the bondholder's consent to the application:	Not applicable
Has an application for		NO	If answered YES, when and provide	The study area forms part of Portion

subdivision/ rezoning/ consent use/ departure on the property previously been considered?			particulars, including all authority reference numbers and decisions:	16 of the Farm Boegoeberg Settlement, No. 48, which functions as the town commonage of Groblershoop, as such, numerous land use changes have been conducted thereon. The details of all the land use changes that took place on Portion 16 of the Farm Boegoeberg Settlement, No. 48 are unknown to this office.
Does the proposal apply to the entire land unit?		NO	If answered NO, indicate the size of the portion of the land unit concerned, as well as what it will be used for and the same for the remaining extent:	This application for land use change only pertains to a 95ha portion of Portion 16 of the Farm Boegoeberg Settlement, No. 48.
Are there any restrictions, such as servitudes, rights, bonds, etc. with regard to the land unit in terms of the deed of transfer that should be lifted, as it might have an influence on this application?	YES		If answered YES, please provide detail description:	N/A
Are there any physical restrictions (e.g. steep inclines, unstable land formations, marshes, etc.) that might influence the intended development?	YES		If answered YES, name full particulars and state how the problem will be solved and submit detail layout plan:	A myriad of specialist studies have been conducted on account of the Groblershoop Expansion Project. For the most part the physiography of the study area is ideal for township establishment, however, the following should be noted: 1. The Ecological Assessment Report (See Annexure F) identified numerous protected vegetation. It is proposed within the report that the necessary permits from the relevant authorities be obtained for the removal of this vegetation prior to site clearance and construction; 2. The Geological Report (See Annexure G) concluded that the development site is intermediately suitable for residential

				development; 3. The Heritage Impact Assessment (Annexure H) did not encounter any above-ground evidence during their initial investigation, however the land survey did identify the presence of graves. The HIA is currently re-evaluating the site and will be updated in due course. 4. The Groblershoop Abattoir is currently utilising one of the old municipal oxidation ponds, which is located within the study area, as a waste area. Discussions between the municipality and Groblershoop Abattoir regarding the relocation of the waste area is currently in progress. The finalisation of this discussion can be uphold as a conditions to approval.
Is any portion of the land unit in a flood plain of a river beneath the 1:50 annual flood-line, or subject to any flooding?		NO	If answered YES, please provide detail description:	Not Applicable
Is any other approval that falls outside of this Act, necessary for the implementing of the intended development?	YES		If answered YES, please provide detail description:	Various approvals/ no objections/ authorisations had to be obtained in relation to the proposed residential development and they are as follow: • Environmental Authorisation: The final scoping report (Annexure J) has been submitted to DENC. The processing of the application has been limited, due to the Covid-19 protocols that have been enforced by the Department of Environment and Nature Conservation. This application for land use change is therefore submitted without the

				EA; • SANRAL: SANRAL has been furnished with a formal notification letter (Annexure K) for review on the 17th of October 2020. SANRAL has acknowledged receipt of the notification letter and an official from their office has been assigned thereto; The !Kheis Municipality has granted permission to submit this application and commence with the public participation process without the Environmental Authorisation and SANRAL no-objection. It should however be noted that this application will not proceed beyond the public participation process until the environmental authorisation and SANRAL no-objection have been obtained. Kindly note that the involved property is registered in the ownership of the !Kheis Municipality and therefore the input from the Department of Agriculture is not required.
What arrangements will be made regarding the following services for the development? (Full Engineering Reports must be supplied, where applicable). If services will be provided by the Municipality, proof of input from departments must be included as Annexure to the application.	Water supply:		BVI Consulting Engineering has been appointed to conduct a detailed services report (Annexure D) for the expansion of Groblershoop. The services report investigated the current bulk services capacity, determined the needed upgrades to accommodate the proposed expansion project and sought solutions to obtain the required funding to implement the necessary upgrades to the bulk services infrastructure. The findings of the services report for the provision of water are as follow: *"Engineering services are not in place (water and sewer) to meet the standard requirements. The infrastructure will have to be upgraded regardless of the implementation of the Groblershoop 1500 houses development in order to meet current and expected future needs. The upgrading should be done in such a way as to take into consideration the Groblershoop 1500 Houses development. "* *Kindly refer to the services report for more detail on the proposed upgrading of municipal infrastructure.*	

What arrangements will be made regarding the following services for the development? (Full Engineering Reports must be supplied, where applicable). If services will be provided by the Municipality, proof of input from departments must be included as Annexure to the application.		Funding can be applied for through the Municipal Infrastructure Grant (MIG) and Regional Bulk Infrastructure Grant (RBIG). For repair work at the water treatment works, the Water and Sanitation Infrastructure Grant (WSIG) can also be applied for.
	Electricity supply:	BVI Consulting Engineering has been appointed to conduct a detailed services report (Annexure D) for the expansion of Groblershoop. The services report investigated the current bulk services capacity, determined the needed upgrades to accommodate the proposed expansion project and sought solutions to obtain the required funding to implement the necessary upgrades to the bulk services infrastructure. The findings of the services report for the provision of this services are as follow: *"Engineering services are not in place (water and sewer) to meet the standard requirements. The infrastructure will have to be upgraded regardless of the implementation of the Groblershoop 1500 houses development in order to meet current and expected future needs. The upgrading should be done in such a way as to take into consideration the Groblershoop 1500 Houses development. "* *Kindly refer to the services report for more detail on the proposed upgrading of municipal infrastructure.* Funding can be applied for through the Municipal Infrastructure Grant (MIG) and Regional Bulk Infrastructure Grant (RBIG). For repair work at the water treatment works, the Water and Sanitation Infrastructure Grant (WSIG) can also be applied for.
	Sewerage and waste-water:	BVI Consulting Engineering has been appointed to conduct a detailed services report (Annexure D) for expansion of Groblershoop. The services report investigated the current bulk services capacity, determined the needed upgrades to accommodate the proposed expansion project and sought solutions to obtain the required funding to implement the necessary upgrades to the bulk services infrastructure. The findings of the services report for the provision of this service is as follow: "Engineering *services are not in place (water and sewer) to meet the standard requirements. The infrastructure will have to be upgraded regardless of the implementation of the Groblershoop 1500 houses development in order to meet current and expected future needs. The upgrading should be done in such a way as to take into consideration the Groblershoop 1500 Houses development. "* *Kindly refer to the services report for more detail on the proposed upgrading of*

		municipal infrastructure. Funding can be applied for through the Municipal Infrastructure Grant (MIG) and Regional Bulk Infrastructure Grant (RBIG). For repair work at the water treatment works, the Water and Sanitation Infrastructure Grant (WSIG) can also be applied for.
	Storm-Water:	Storm water drainage will take place above ground, in natural furrows and along the streets of the proposed layout. The layout plan has been designed to accommodate all storm water furrows identified in the Freshwater Report, as well as align with the general topography of the development site. No Problems are expected in this regard.
	Road Network:	The proposed development entails an extended internal road network to functionally link with Groblershoop and Sternhams` existing road infrastructure. The development site borders to the N10 National Road. Access to the planned residential expansion will have to be received from the N10 National Road, since this is the only road that can provide access to the development site. It is suggested that access to the development site be obtained through a new connection point, at the intersection between the N10 and the access road to Sternham. In addition to the proposed linkage to N10, it is proposed that the existing access to the industrial area of Groblershoop be extended into the development site, thereby allowing for a more coherent internal road network. SANRAL has been duly notified (Annexure J) of the access arrangements and their feedback will be furnished to the !Kheis Municipality and ZF Mgcawu District Municipality upon receipt thereof. It is anticipated that a traffic impact assessment and detail engineering plans will be upheld as conditions to approval. In terms of the internal road network of the residential expansion, the integration of the town of Groblershoop and the community of Sternham was a key focus as this is an important development principle that needs to be adhered to. A hierarchy of road types have been designed throughout the planned town planning layout, in order to promote accessibility and mobility.

SECTION 6

List of Attachments and supporting information required / submitted with checklist for Municipal use (Mark with an X /

number annexure)						
Checklist (for the completion by the Applicant only)				Checklist (for the use of Responsible Authority only)		
YES	NO	ANNEXURE	DOCUMENT ATTACHED	YES	NO	N/A
x		Section A	Completed Comprehensive Application form			
x		Section B	Complete Motivation Report			
x		§2.3	Alignment to the Provincial, District and Municipal SDFs			
	x		Public participation report (minutes of meetings, copies of advertisement, etc.)			
x		Annexure B	Power of Attorney (Board of Directors' / Trustees' resolution / consent)			
x		Annexure A	Copy of Title Deed(s)			
	x		Mortgage holder's consent			
x		Annexure C	Cadastral information – diagram/General Plan including servitudes, lease areas, etc.			
	x		Status report from Surveyor General – street closure or state owned land			
x		Figure 4	Topographic map/ aerial map			
x		Figure 1 & 2	Locality Map			
x		Annexure E	Site Plan			
x		Figure 3	Zoning Map			
	x		Zoning Certificate			
x		Annexure M	Land Use Map			
	x		Conveyancer's certificate			
	x		Special endorsement/proxy			
	x		Home Owners' Association consent			
x		Annexure E	Proposed design/layout plan			
x		Figure 5	Proposed subdivision plan			
	x		Proposed consolidation plan			
	x		Proposed development plan			
	x		Mineral rights certificate (together with mineral holder's consent) and/or prospecting contract			
	x		Mineral impact assessment (MIA)			
x		Annexure J *(Final Scoping Report)*	Environmental Impact Assessment (EIA – EA) including Heritage Impact Assessment (approval from Dept Sport, Arts and Culture) and Archaeological Impact Assessment (AIA) (approval from relevant Department - SAHRA)			
x		Annexure D	Detail Engineering Services report (Bulk and internal)			
x		Annexure K	Traffic impact study **(SANRAL & DRPW no-objections)**			
x		Annexure G	Geo-technical report (including geology) report (NHRB Standards)			
	x		Social impact assessment			
	x		Flood line assessment (1:50 and 1:100 years)			
	x		Coastal setback report (consent from Dept of Environmental Affairs)			
	x		Subdivision of agricultural land (consent of the Dept of Agriculture)			

	x		List of sections in Title Deed conditions to be removed /amended			
x		**Annexure N**	Adherence to planning legislation including the Planning Profession Act 36 of 2002			
x			**At least three (3)** sets of full colour documentation copies			

SECTION 7

Declaration

Note: *If application is made by a person other than the owner, a Power of Attorney is compulsory. If the property is owned by more than one person, the signature of each owner is compulsory. Where the property is owned by a company, trust, or other juristic person, a certified copy of the Board of Directors/Trustees' resolution is compulsory.*

I hereby certify the information supplied in this application form to be complete and correct and that I am properly authorised to make this application.

Applicant's / Owner's Signature:		Date:	2	0	2	0	1	0	2	5
Full name (print):	Justus Petrus Theron									
Professional capacity:	Professional Town and Regional Planner									
Applicant's ref:	Pr. Pln. A/2394/2016									
Applicant's / Owner's Signature:		Date:	2	0	2	0	1	0	2	5
Full name (print):	Len Jacobus Fourie									
Professional capacity:	Professional Town and Regional Planner – Senior Town Planner									
Applicant's ref:	Pr.Pln. A/1322/2006									

SECTION 8

Prescribed Notice and advertisement procedures

(for the completion and use of Responsible Authority only)

Checklist for required advertisement procedure			Checklist for required proof of advertisement		
YES	NO	DOCUMENTATION AND STEPS TO BE TAKEN	YES	NO	DOCUMENTATION TO BE PROVIDED AS PROOF
		Notice to be placed in the Local Newspaper			**Proof of Notice in Local Newspaper** Note: The original newspaper advertisement or full colour copy, indicating page number and date.
		Notice to be placed in the Provincial Gazette (for 2 consecutive weeks)			**Proof of Notice in the Provincial Gazette** Note: The original newspaper advertisement or full colour copy, indicating page number and date.
		Notices to neighbours Note: The map indicating the neighbouring erven and list of neighbours will be provided. If the applicant chooses to deliver the notices per hand (Option 1), two copies of the notice must			**Proof of Notice to neighbours** Note: Option 1: The signed notices of all surrounding neighbours, as identified by the Responsible Authority, must be provided. Note: Option 2: The proof of the registered mail must be

		be provided on or before the date of the notice to each neighbour. One copy of the notice must be signed by the respective party (neighbour) to be handed back to the Responsible Authority. Alternatively (Option 2), the notices can be sent via registered post.			provided to the Responsible Authority
		Notice to be placed on the site Note: The notice provided must be placed on the site in a laminated A3 format (two language formats separate on A3) on or before the date of the notice.			**Proof of Notice in site** Two colour photos of the notice on site must be provided of which one is close up and the other one is taken from a distance in order to see the placing on the site itself.
		Public Meeting Note: The holding of a public meeting in order to inform the general public of the application.			**Proof of Public Meeting** The applicant must provide proof of the agenda, the attendance register and minutes of the meeting to the Responsible Authority.
		Any Additional components:			**Proof of additional components:**

SECTION B: MOTIVATIONAL REPORT

1. INTRODUCTION

1.1. BACKGROUND

GENERAL BACKGROUND

The Northern Cape Province is currently experiencing growth and development in a number of the urban centres throughout the province. The downscaling and slowing of the general economic market of South Africa, is however countered by development in the Renewable Energy field in some areas of the Northern Cape Province. This is due to the fact that a lot of the focus areas of the Renewable Energy Zones, are based in the mentioned province and brought new development opportunities through diversification. The diversification brought about by this economic sector has benefitted existing and new businesses/ industries and moved the primary focus of some Municipal areas away from the normal agriculture, mining and tourism basis.

The !Kheis Local Municipality which is situated alongside the mighty Orange River, was able to benefit from intensive agricultural activities and growth in this sector. In the context of the aforementioned, urban centres in the municipality clustered around the Orange River with Groblershoop having become the seat of local governance and primary town. The growth in the agricultural sector of !Kheis has not only had an economic impact, but has also led to an increase in the population of the municipality where it could be expected that such increase took place both in the form of immigration and natural growth. This, in turn, has caused for an escalated need for housing opportunity, especially in the Groblershoop area. Vacant land between the town of Groblershoop and the community of Sternham has been identified as an ideal development area, where vacant, under-utilised land, present the ideal opportunity to provide houses and simultaneously contribute to integration ideals. This land use change application, compiled within the clear context of the Spatial Planning and Land Use Management Act (Act 16 of 2013), forms the legal framework under which the provision of sub-economic housing for the ever-growing population of Groblershoop are proposed. Groblershoop as the primary urban centre and administrative seat of the !Kheis Local Municipality has been awarded a substantial township expansion project that will not only include 1500 residential properties, but also provide for land uses normally associated with a sustainable community/ neighbourhood, such as a school, business nodes, municipal uses and open spaces.

It is important that all developments must align with the provisions of the Spatial Development Framework (SDF) of the local or district municipality, as well as the applicable scheme regulations of a municipality. In cases where a development proposal does not align with the provisions of the SDF, site specific motivations need to be provided as to allow the District Municipal Planning Tribunal to make informed decisions.

1.2. CURRENT REALITY

The undertaking of the township expansion project, consisting of 1500 residential erven, for the Groblershoop Community by Macroplan, derives from an indirect appointment by COGHSTA and is therefore a project of national and provincial importance. The development site comprises of a 95ha portion of Portion 16 of the Farm Boegoeberg Settlement, No. 48, which is located to the west of the community of Sternham, south-east of the industrial area of Groblershoop and south-east of the town of Groblershoop. The study area is owned by the !Kheis Local Municipality and borders directly to the N10 National Road to the west. The proposed township establishment project will mainly provide sub-economic housing with the end goal of securing ownership of land for future residents. A small fraction of the development scope will cater to middle-income housing, which will provide much needed income tax to the local municipality.

At present the development site is not being occupied by any informal structures, due to the municipality`s admirable management of informal houses and the preparation of other municipal owned land as a temporary solution. This provides for a development site on which a town planning layout can be designed that complies with planning principles and promotes sustainability. The Groblershoop township expansion will not only provide housing and economic opportunities for the future residents of Groblershoop, but will also play an integral role in connecting the community of Sternham with the town of Groblershoop. Integration and accessibility of land are key planning principles on which town planning legislation are based on and this had to be kept in mind during the design of the town planning layout.

The objectives of this application, which is handled in the terms of the provisions of the Spatial Planning and Land Use Management Act (Act 16 of 2013), !Kheis SPLUMA By-laws & the !Kheis Land Management Scheme are as follow:

1. Provide 1500 residential properties (60 erven for middle-income housing) for current housing backlog and future population increases;
2. Incorporate land uses normally associated with large residential neighbourhoods, such as institutional, recreational and business uses;
3. Create a coherent internal road network that adequately links to the existing road network of Sternham and Groblershoop and promotes easy and accessible movement throughout.

The following table provides a breakdown of the involved land portions, in terms of size, land use and zoning:

Property Description	Property Size	Land Use	Zoning Status Quo
Portion 16 of the Farm Boegoeberg Settlement, No. 48, Kenhardt RD	**440.5695ha**	**Mostly vacant, except for old municipal infrastructure (oxidation ponds). Graves have also been identified on the study area.**	**Undetermined Zone**

Table 1: Breakdown of property information.

The title deed of the involved property has been scrutinised to determine if there are any restrictive conditions that needs to be removed in order for the land use change processes to take place. No such restrictive title deed conditions have been found within the title deed of the involved property (Annexure A).

In order to achieve the objective of providing sub-economic housing for the town of Groblershoop, this formal land use change application, pertaining to subdivision & rezoning, is submitted to the !Kheis Local Municipality as municipality of first instance. This application for land use change (subdivision, consolidation and rezoning) is therefore submitted to the !Kheis Municipality in order to ensure legal compliance with the clear context of the Spatial Planning and Land use Management Act (Act 16 of 2013).

1.3. ASSIGNMENT

Our office, Macroplan Town and Regional Planners, has been appointed by Barzani Development on behalf of COGHSTA, to facilitate the needed town planning procedures involved with the residential expansion of Groblershoop. The appointment letter from Barzani Development, as well as the preceding appointment letter from the !Kheis Municipality, serve as the power of attorney for this application for land use change. Please refer to Annexure B of this submission for the said authorising documentation.

1.4. OBJECTIVE

The objectives of this report are as follow:

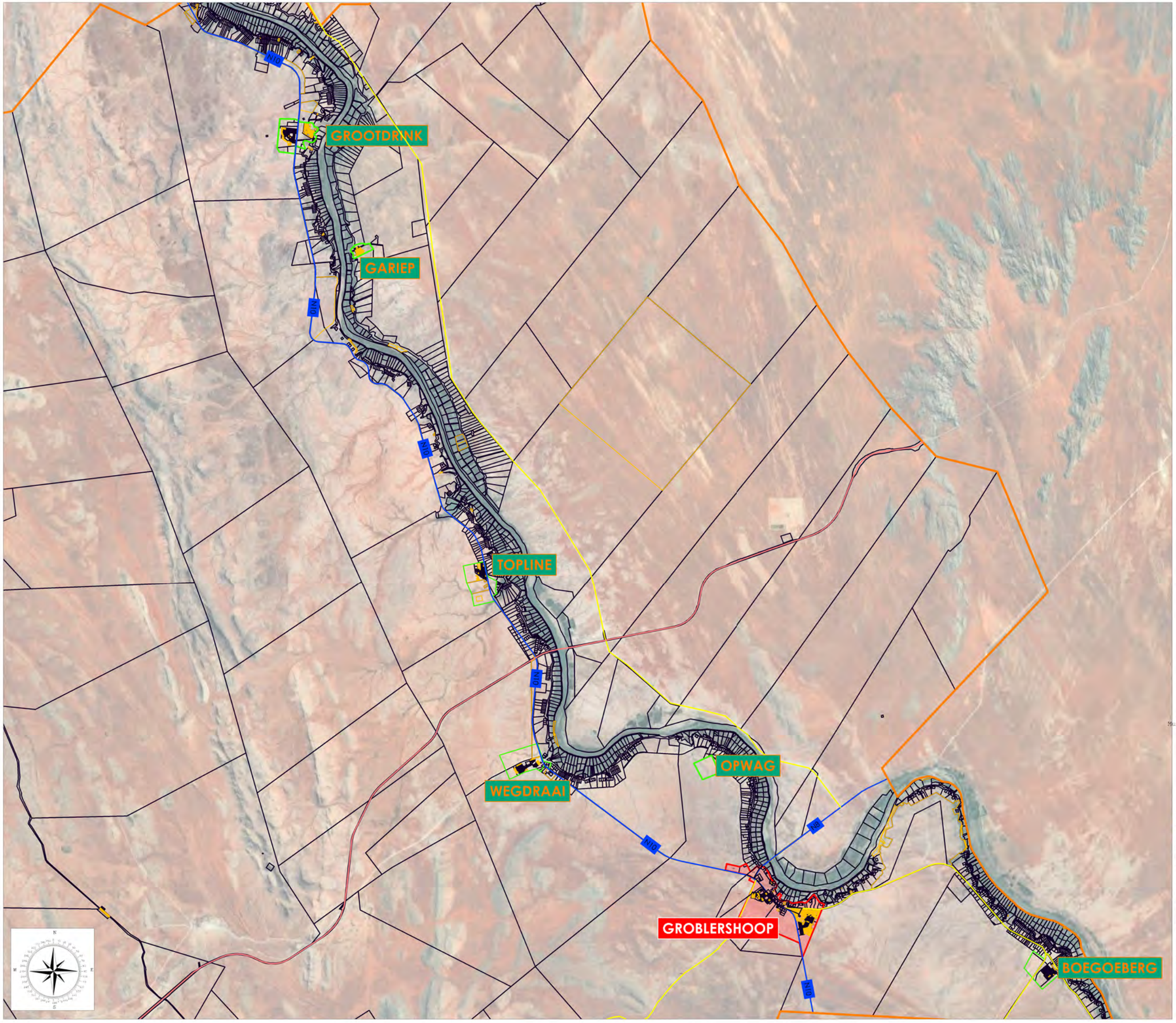
1. **SUBDIVISION (See Figure 5):**
   - 1.1. **Subdivision of a 95ha portion of Portion 16 of the Farm Boegoeberg Settlement, No.48, into 1539 individual cadastral land units.**
2. **REZONING (See Figure 6):**
   - 2.1. **Rezoning of the newly created properties, thereby allocating appropriate land use rights to each of the newly created individual erven suitable to their future purpose within the Groblershoop township expansion project. The proposed zonings, in terms of the newly adopted !Kheis Scheme Regulations, are as follow and should be read together with the final layout plan attached as Annexure E to this submission:**

Zoning	Primary Use/s	Erven Amount
Residential Zone I	Residential House	1500

Business Zone I	Business Premises	16
Institutional Zone I	Place of Instruction/ Educational building	2
Institutional Zone II	Place of Worship	3
Open Space Zone II	Public Open Spaces	15
Open Space Zone III	Private Open Spaces	2
Transport Zone II	Public Street	1
Authority Zone I	Municipal Uses	1
Total		1539

Please refer to Figures 5 & 6, Annexure E, §2.8 & §3.3 of this report for more information in this regard.

3. To serve as a support system for the !Kheis Local Municipality, in order for all the formalities to be handled correctly



Date:
17

Title:
Figure 1: Locality Map: Region

Property Description:
Portion 16 of the farm Boegoeberg Settlement, No. 48, !Kheis Municipality, Northern Cape Province.

Legend

- Groblershoop
- National Roads
- Regional Roads
- Railway Line
- Municipal Boundary

Municipality:

T. 054 833 9500
F. 054 883 9509
E. davyj@kheis.co.za
W. www.kheis.co.za

!Kheis Munisipaliteit Municipality

Consultant:
MACROPLAN
TOWN & REGIONAL PLANNERS
YOUR PARTNERS IN PROFESSIONAL PLANNING SERVICES
054 332 3642
4A Murray Avenue, Upington 8801 macroplan@mweb.co.za
PO Box 987, Upington 8800 www.macroplan.info

Reference
(FIG1) 200806 Groblershoop Township Establishment

Designed	Date
JP Theron	August 2020
Drawn	Scale
JP Theron	1: 175 000

Date:

Title:

Figure 2: Locality Map: Local

Property Description:

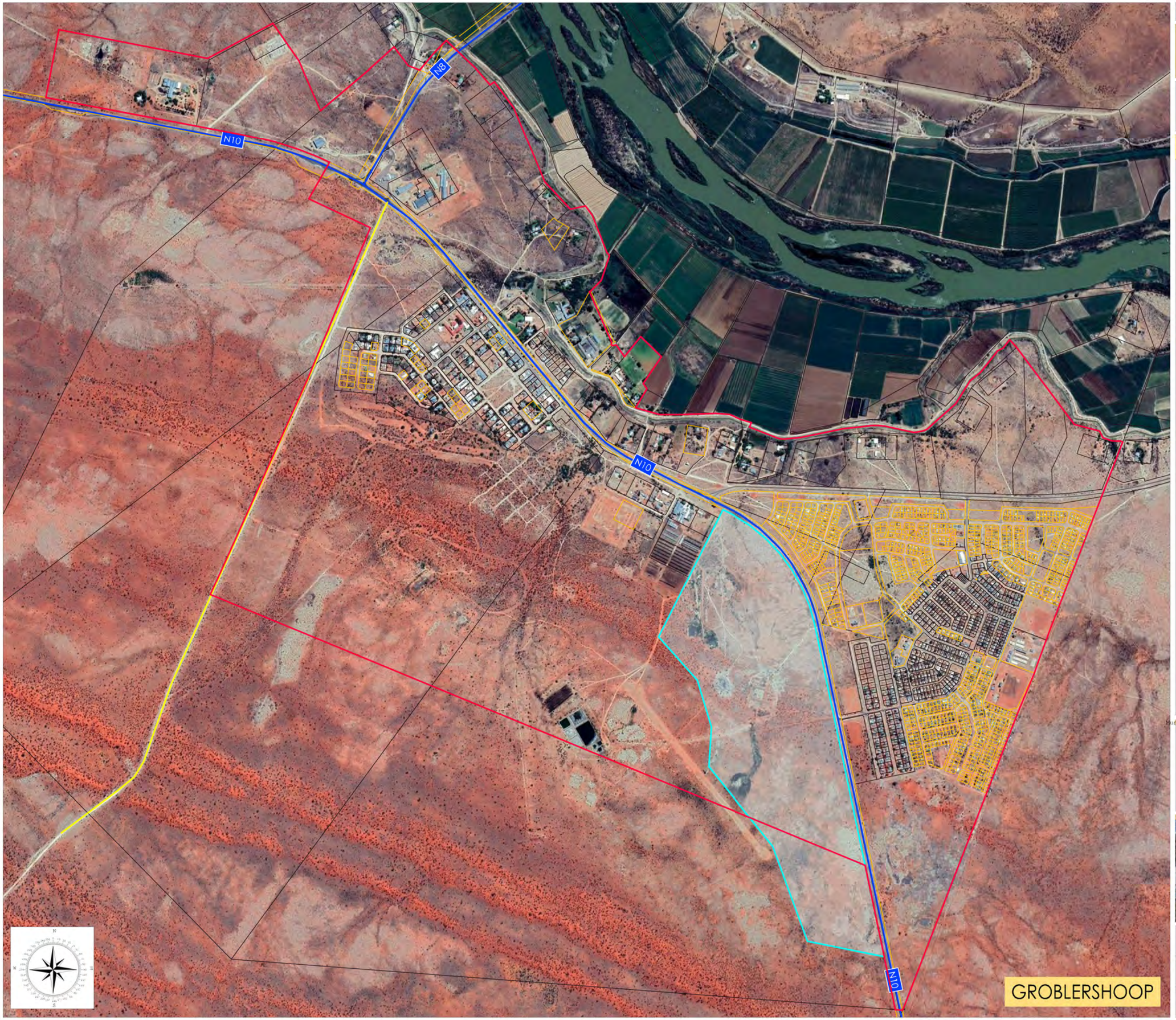
Portion 16 of the farm Boegoeberg Settlement, No. 48, !Kheis Municipality, Northern Cape Province.

Legend

- Study Area
- National Roads
- Regional Roads
- Urban Edge

Cadastral Information:

- Registered Erven
- Surveyed Erven



Municipality:

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PO Box 987, Upington 8800 www.macroplan.info

Reference	
(FIG2) 200806 Groblershoop Township Establishment	
Designed: JP Theron	Date: August 2020
Drawn: JP Theron	Scale: 1: 15 500

1.5. JURISDICTION

The !Kheis Municipality recently approved the all-inclusive Land Use Management System (LUMS) for the entire !Kheis Local Municipal area, as such the entire municipal area will make use of the same planning policy and municipal SPLUMA by-laws. The !Kheis LUMS has been informed, guided and developed in terms of SPLUMA and will also be enacted in these terms. §26 of SPLUMA states the following:

(2) Land may be used for the purposes permitted –

(a) By a land use scheme;

(b) By a town planning scheme, until such scheme is replaced by a land use scheme;

With the enactment of SPLUMA, the delegations of jurisdictions in terms of the decision making on land use change matters are however interpreted as follows:

§26(4): A permitted land use may, despite any other law to the contrary, be changed with the approval of a Municipal Planning Tribunal in terms of this Act.

§33(1): …all land development applications must be submitted to a municipality as the authority of first instance.

§34(2): A district municipality may, with the agreement of the local municipalities within the area of such district municipality, establish a Municipal Planning Tribunal to receive and dispose of land development applications and land use applications within the district area.

§35(1): A municipality must, in order to determine land use and land development applications within its municipal area, establish a Municipal Planning Tribunal.

The !Kheis Municipality has established its own decision-making authority in terms of the parameters of SPLUMA. In the light of the above, this land use application is submitted to the !Kheis Municipality as the authority of first instance, for processing, administration and subsequent referral to the relevant decision-making authority.

Page:
20

Title:

Figure 3:
General Land uses

Property Description:

PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT, NO. 48, KENHARDT RD, !KHEIS LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE;

Legend:

- Stemham Community
- National Road
- Industrial Area
- Municipal Infrastructure
- Vacant Land
- Study Area

Groblershoop

Municipality:

!Kheis Munisipaliteit Municipality

Private Bag X2,
Groblershoop
8850

Tel: 054 833 9500
Fax: 054 833 9509

Consultant:

MACROPLAN
TOWN & REGIONAL PLANNERS
YOUR PARTNERS IN PROFESSIONAL PLANNING SERVICES

4A Murray Avenue, Upington 8801
PO Box 987, Upington 8800

054 332 3642
macroplan@mweb.co.za
www.macroplan.info

Reference

(FIG3.SUB.REZ.) 201022Ptn 16 of the Farm Boegoeberg Sttlement, No. 48

Designed
JP Theron (A/2394/2016)

Date
October 2020

Drawn
JP Theron (A/2394/2016)

Scale
1: 8000

Photo 1: Community of Sternham

The community of Sternham, which is located to the east of the development site, can be seen in the image above, as seen from a westerly direction. The proposed Groblershoop township expansion will comply with the planning principle of addressing spatial injustice by integrating the community of Sternham with the town of Groblershoop.

Photo 2: Development site in relation to N10

The development site borders to the N10 National Road to the east and this road will play an integral role in providing access to the proposed township expansion, since this is the only road that can provide access to the study area. It is proposed that a new connection to the N10 at the intersection of the Sternham arterial road and the N10 be created, as well as utilising the existing access to the Groblershoop Industrial Area.

Photo 3: Illegal Dumping

The development site has unfortunately been subject to dumping of building material and rubble. The !Kheis Local Municipality will be responsible for clearing the development site from any materials that will impede on the functionality of the development proposal.

Photo 4: Unused Municipal Infrastructure

As mentioned throughout this report, unused municipal infrastructure are located within the outlined study area. The town planning layout has been designed to incorporate the used municipal infrastructure within public open spaces and the school premises. Future rehabilitation will be needed before the mentioned properties can be used in accordance to the purpose thereof.

Photo 5: Southern Section of Development Site

The southern section of the study area is visible in the image above, as seen from a south-westerly direction. As visible in the image above the study area has a downward slope in a southern direction, however this downward slope is not significant and will not negatively impact on the proposed residential expansion.

Photo 6: Central Section of Development Site

The central section of the development site can be seen in the image above, as seen from an easterly direction. From the image above it is evident that the topography of the study area is suitable of the proposed residential expansion.

Photo 7: Northern Section of the Development Site

The northern section of the development site is visible in the image above, as seen from a north-westerly direction. The Botanical Assessment has identified the presence of numerous vegetation species that are listed as protective species. It is however recommended that the necessary permits be obtained before site clearance takes place.

Photo 8: South-Eastern Section of the Development Site

The south-eastern section, along the N10 National Road, can be seen in the image above, as seen from a southerly direction. This section of the involved property is extreme flat and ideal for residential development.

Photo 9: Northern section of study area.

The northern section of the development site, as seen from the pedestrian railway crossing in the image above, as seen from an easterly direction. It should be noted that numerous species of protected vegetation were identified during the Ecological Assessment. The necessary permits will have to be obtained prior to site clearance and construction.

Photo 10: View of entire study area

The entire development site can be seen in the image above, as seen from the N10 National Road. SANRAL was notified of the planned housing development and their no-objection is attached as Annexure K to this submission.

1.6. COMPLIANCE WITH PRINCIPLES

SPLUMA sets out certain development principles (§7) to guide the development of land in the republic and any land use application should be considered with due cognisance of these principles. These principles may be briefly listed as follows:

1. **THE PRINCIPLE OF SPATIAL JUSTICE;**
2. **SPATIAL SUSTAINABILITY;**
3. **EFFICIENCY;**
4. **SPATIAL RESILIENCE; AND**
5. **GOOD ADMINISTRATION.**

The following sub-paragraphs may be highlighted in terms of this application, along with an explanation of their relevance:

(a) The principle of spatial justice, whereby –

(i) Past spatial and other development imbalances must be redressed though improved access to and use of land;

Relevance: This application for land use change submitted with the purpose of establishing sub-economic housing in Groblershoop complies with the principle of spatial justice, since this residential expansion will improve the access between the community of Sternham and the town of Groblershoop.

(ii) Spatial development frameworks and policies at all spheres of government must address the inclusion of persons and areas that were previously excluded, with an emphasis on informal settlements, former homeland areas and areas characterised by widespread poverty and depravation;

Relevance: This component is applicable to public entities such as municipalities and government department; it is therefore not the responsibility of an applicant to adhere thereto.

(iii) Spatial planning mechanisms, including land use schemes, must incorporate provisions that enable redress in access to land by disadvantaged communities and persons;

Relevance: This component is applicable to public entities such as municipalities and government departments; it is therefore not the responsibility of an applicant to adhere thereto.

(iv) Land use management systems must include all areas of a municipality and specifically include provisions that are flexible and appropriate for the management of disadvantaged areas, informal settlements and former homeland areas.

Relevance: This component is applicable to public entities such as municipalities and government departments; it is therefore not the responsibility of an applicant to adhere thereto.

(v) Land development procedures must include provisions that accommodate access to secure tenure and the incremental upgrading of informal areas; and

Relevance: This component is applicable to public entities such as municipalities and government departments; it is therefore not the responsibility of an applicant to adhere thereto.

(vi) A Municipal Planning Tribunal considering an application before it, may not be impeded or restricted in the exercise of its discretion solely on the ground that the value of land or property is affected by the outcome of the application.

Relevance: This component is applicable to public entities such as municipalities and government departments; it is therefore not the responsibility of an applicant to adhere thereto.

(b) The principle of spatial sustainability, whereby spatial planning and land use management systems must –

(i) Promote land development that is within the fiscal, institutional and administrative means of the Republic;

Relevance: It is the opinion of this office that the proposed development will not place an unreasonable amount of stress on the fiscal, institutional and administrative capabilities of the area in which it will be situated, seeing as this request for township expansion will incorporate various uses that will address the additional pressure that such an expansion may cause; fiscally, institutionally and administratively speaking.

(ii) Ensure that special consideration is given to the protection of prime and unique agricultural land;

Relevance: The !Kheis Municipality is the registered landowner of the land unit involved in this submission for land use change, as such the involved property is exempted from the provision of the Act 70 of 1970 as clearly described in the definition of agricultural land which reads as follow:

***"Agricultural land"** means any land, except-*

(a) land situated in the area of jurisdiction of a municipal council, city council, town council, village council, village management board, village management council, local board, health board or health committee, and land forming part of, in the province of the Cape of Good Hope, a local area established under section 6(1)(i) of the Divisional Councils Ordinance, 1952 (Ordinance 15 of 1952 of that province), and, in the province of Natal, a public health area as defined in section I of the Local Health Commission (Public Health Areas Control) Ordinance, 1941 (Ordinance 20 of 1941 of the last-mentioned province), and in the province of the Transvaal, an area in respect of which a local area committee has been established under section 21(1) of the Transvaal Board for the Development of Peri-Urban Areas Ordinance, 1943 (Ordinance 20 of 1943 of the Transvaal), and, in South-West Africa, a peri-urban area established under section 9 of the Peri-Urban Development Board Ordinance, 1970 (Ordinance 19 of 1970 of South-West Africa), but excluding any such land declared by the Minister after consultation with the executive committee concerned and by notice in the Gazette to be agricultural land for the purposes of this Act;

(c) land of which the State or the administration of the territory of South-West Africa is the owner or which is held in trust by the State or a Minister or the Administrator of the said territory for any person;

(iii) Uphold consistency of land use measures in accordance with environmental management instruments;

Relevance: The magnitude of the proposed housing development necessitates the undertaking of an Environmental Impact Assessment (EIA), under the guidance of the National Environmental Management Act (107 of 1998). At present the EIA is still in process, due to the constraints brought forth by the Covid-19 pandemic. The Environmental Authorisation will be provided to the !Kheis Local Municipality and the ZF Mgcawu District Municipal Planning Tribunal upon receipt thereof.

(iv) Promote and stimulate the effective and equitable functioning of land markets;

Relevance: It is the opinion of this office that the proposed development will contribute to the value of land in the area surrounding thereto, but that it will not necessarily unfairly increase the cost thereof.

(v) Consider all current and future costs to all parties for the provision of infrastructure and social services in land developments;

Relevance: This application for the township expansion falls under the jurisdiction of the !Kheis Municipality, as such the provision of services will be the responsibility of the !Kheis Municipality. A services report was compiled on the basis of the proposed residential expansion, with the general findings being that the existing bulk service infrastructure is not sufficient to accommodate the additional erven. The !Kheis Local Municipality will be responsible for procuring funding from the various bulk services infrastructure grants.

(vi) Promote land development in locations that are sustainable and limit urban sprawl; and

Relevance: The area that comprise the study area is confined by the urban edge of Groblershoop, as such this application does not contribute to urban sprawl. In terms of sustainability the study area is also included in the !Kheis Spatial Development Framework.

(vii) Result in communities that are viable.

Relevance: This application does not include any land use changes that will cause the developments on the properties to be at odds with the SDF, it is therefore perceivable that it will not have an adverse effect on the Groblershoop community.

(c) The principle of spatial efficiency, whereby –

(i) Land development optimises the use of existing resources and infrastructure;

Relevance: Please refer to §2.5 of this submission for details regarding the rendering of services;

(ii) Decision-making procedures are designed to minimise negative financial, social, economic or environmental impacts; and

Relevance: The SPLUMA By-laws and Land Use Management Scheme of the !Kheis Local Municipality indicates the specific procedures that are to be followed with a land use change application such as this. This will ensure that both the Municipality, the relevant community and our client will be guarded against negative social, economic and environmental impacts.

(iii) Development application procedures are efficient and streamlined and timeframes are adhered to by all parties.

Relevance: As the applicant in this instance, our office will do our very best to adhere to the timelines set by the local municipality. If this is not possible we will, if need be, endeavour to consult the municipality in these matters and find a solution thereto.

(d) The principle of spatial resilience, whereby flexibility in spatial plans, policies and land use management systems are accommodated to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and environmental shocks.

Relevance: This component is applicable to public entities such as municipalities and government departments, it is therefore not the responsibility of an applicant to adhere thereto.

(e) The principle of good administration, whereby –

(i) All spheres of government ensure an integrated approach to land use and land development that is guided by the spatial planning and land use management systems as embodied in this Act;

Relevance: This component is applicable to public entities such as municipalities and government departments, it is therefore not the responsibility of an applicant to adhere thereto.

(ii) All government departments must provide their sector inputs and comply with any other prescribed requirements during the preparation or amendment of spatial development frameworks;

Relevance: This component is applicable to public entities such as municipalities and government departments, it is therefore not the responsibility of an applicant to adhere thereto.

(iii) The requirements of any law relating to land development and land use are met timeously;

Relevance: Various approvals/ no objections/ authorisations had to be obtained in relation to the proposed residential development and they are as follow:

- *Environmental Authorisation: The final scoping report (Annexure J) has been submitted to DENC. The processing of the application has been limited, due to the Covid-19 protocols that have been enforced by the Department of Environment and Nature Conservation. This application for land use change is therefore submitted without the EA;*
- *SANRAL: SANRAL has been furnished with a formal notification letter (Annexure K) for review on the 17th of*

October 2020. SANRAL has acknowledged receipt of the notification letter and an official from their office has been assigned thereto;

The !Kheis Municipality has granted permission to submit this application and commence with the public participation process without the Environmental Authorisation and SANRAL no-objection. It should however be noted that this application will not proceed beyond the public participation process until the environmental authorisation have been obtained. Kindly note that the involved property is registered in the ownership of the !Kheis Municipality and therefore the input from the Department of Agriculture is not required.

(iv) The preparation and amendment of spatial plans, policies, land use schemes as well as procedures for development applications, include transparent processes of public participation that afford all parties the opportunity to provide inputs on matters affecting them; and

Relevance: The Land Use Management Scheme of the !Kheis Local Municipality stipulates that the applicant (in this case our office) will be responsible for the application procedures that is to follow the submission of an application. Our office takes public participation very seriously and will follow all the by-law stipulations very closely to ensure full compliance, which will result in a completely transparent process.

(v) Policies, legislation and procedures must be clearly set in order to inform and empower members of the public.

Relevance: This component is applicable to public entities such as municipalities and government departments; it is therefore not the responsibility of an applicant to adhere thereto.

2. PLANNING CONSIDERATIONS

2.1. LOCATION OF STUDY AREA

The !Kheis Municipality is situated in the central sections of the Northern Cape Province, within the ZF Mgcawu District Municipality, and may be described as being one of the northernmost municipalities in the province. The urban heart of the municipality may be described as being Groblershoop, which is located in the north-eastern sections of the municipality on the banks of the Orange River.

The development site comprises of a 95ha portion of Portion 16 of the Farm Boegoeberg Settlement, No. 48, which is located to the west of the community of Sternham, south-east of the industrial area of Groblershoop and south-east of the town of Groblershoop. The study area is furthermore being bordered by the N10 National Road to the east.

Coordinates of the site are as follow:

LAT: 28°54'38.22"S

LONG: 21°59'44.70"E

Please refer to the figures attached to this submission for a visual interpretation regarding the locality of the study area.

2.2. PHYSIOGRAPHY

The physiography of the area within which the study area is located is discussed briefly.

2.2.1. TOPOGRAPHY

The proposed Groblershoop township expansion project necessitated the completion of numerous specialist studies that inform the Environmental Impact Assessment. The assessment has scrutinised the area earmarked for expansion, thereby addressing the physiography in more detail. The draft scoping report, as well as other specialist studies, are attached as Annexures to this submission. No problems are anticipated in this regard.

2.2.2. SOIL/GEOLOGICAL CONDITIONS

The undertaking of a geotechnical investigation was required for the Groblershoop township expansion project. The Geological Report (Annexure G) concluded that the study area is intermediately suitable for normal township expansion, with the study area being classified under geotechnical zones I(a), I(b), II(a), II(b), III(a), III(b). These geotechnical zones have intermediate development potential and the construction type thereof ranging from normal to modified normal. No problems are expected in this regard.

2.2.3. FAUNA AND FLORA

The proposed Groblershoop township expansion project necessitated the completion of numerous specialist studies that inform the Environmental Impact Assessment. It is worth mentioning that the Botanical Assessment (See Annexure F) identified numerous protected species and proposes that a NFA permit, as well as a NCNCA permit be acquired for the removal of these species.

The draft scoping report, as well as other specialist studies, are attached as Annexures to this submission. No problems are anticipated in this regard.

2.3. INTEGRATED PLANNING

The Spatial Planning and Land Use Management Act (Act 16 of 2013) stipulates that each Municipality must prepare a spatial development framework (SDF) that interprets and represents the spatial development vision of the competent Authority. All proposed developments, specifically pertaining to land use change applications within a municipality, must be measured against an approved Spatial Development Framework (SDF) of such a municipality, which may be seen as the spatial translation of the Integrated Development Plan (IDP). The planning legislation states that no land development decision can be made if the proposed development is inconsistent with the municipal spatial development framework. However, the District Municipal Planning Tribunal may depart from the provisions of the SDF only if site-specific circumstances justify a departure from the provisions of such SDF, as envisaged in §22 (2).

!KHEIS SPATIAL DEVELOPMENT FRAMEWORK:

The !Kheis SDF was revised in 2016 to align with the principles of the Spatial Planning and Land Use Management Act (Act 16 of 2013) and has since been a valid and weight bearing document for spatial guidance. The SDF of the !Kheis Municipality adheres to the basic SDF requirements as stipulated in the Spatial Planning and Land Use Management Act (Act 16 of 2013), therefore providing a potential investor with adequate information to plan a development according to the spatial vision of the municipality.

Within the !Kheis SDF, the portion of land identified for the Groblershoop Expansion Project falls within the urban edge of Groblershoop and has furthermore been earmarked (See Annexure L) for low-cost housing, as such the development proposal is in line with the spatial vision of Groblershoop

2.4. CHARACTER OF THE AREA

As mentioned throughout this report, the study area forms part of Portion 16 of the Farm Boegoeberg Settlement, No. 48, which is one of the land portions in municipal ownership that serves as the town commonage of Groblershoop and as a result a contrast between vacant areas and built-up areas can be expected. The study area itself is vacant and covers a large area, with the undeveloped character clearly visible when visiting the study area. The study area is however situated directly adjacent to the community of Sternham and N10 National Road, with the industrial area of Groblershoop bordering to the north. The town of Groblershoop is situated to the north-west of the study area, but not visible from the study area due to the topography of the area. Vacant land can be located to the south of the development site.

The proposed Groblershoop township expansion will go a long way in addressing the spatial justice that can be encountered in the area. The development proposals will therefore fit well in with the existing residential character brought forth by the community of Sternham, whilst reducing spatial justice.

2.5. INFRASTRUCTURE

2.5.1. WATER

BVI Consulting Engineering has been appointed to conduct a detailed services report (Annexure D) for the expansion of Groblershoop. The services report investigated the current bulk services capacity, determined the needed upgrades to accommodate the proposed expansion project and sought solutions to obtain the required funding to implement the necessary upgrades to the bulk services infrastructure. The findings of the services report for the provision of water are as follow:

"Engineering services are not in place (water and sewer) to meet the standard requirements. The infrastructure will have to be upgraded regardless of the implementation of the Groblershoop 1500 houses development in order to meet current and

expected future needs. The upgrading should be done in such a way as to take into consideration the Groblershoop 1500 Houses development. "

Kindly refer to the services report for more detail on the proposed upgrading of municipal infrastructure.

Funding can be applied for through the Municipal Infrastructure Grant (MIG) and Regional Bulk Infrastructure Grant (RBIG). For repair work at the water treatment works, the Water and Sanitation Infrastructure Grant (WSIG) can also be applied for.

2.5.2. SEWERAGE

BVI Consulting Engineering has been appointed to conduct a detailed services report (Annexure D) for the expansion of Groblershoop. The services report investigated the current bulk services capacity, determined the needed upgrades to accommodate the proposed expansion project and sought solutions to obtain the required funding to implement the necessary upgrades to the bulk services infrastructure. The findings of the services report for the provision of this service is as follows:

*"*Engineering *services are not in place (water and sewer) to meet the standard requirements. The infrastructure will have to be upgraded regardless of the implementation of the Groblershoop 1500 houses development in order to meet current and expected future needs. The upgrading should be done in such a way as to take into consideration the Groblershoop 1500 Houses development. "*
Kindly refer to the services report for more detail on the proposed upgrading of municipal infrastructure.

Funding can be applied for through the Municipal Infrastructure Grant (MIG) and Regional Bulk Infrastructure Grant (RBIG). For repair work at the water treatment works, the Water and Sanitation Infrastructure Grant (WSIG) can also be applied for.

2.5.3. ELECTRICITY

BVI Consulting Engineering has been appointed to conduct a detailed services report (Annexure D) for the expansion of Groblershoop. The services report investigated the current bulk services capacity, determined the needed upgrades to accommodate the proposed expansion project and sought solutions to obtain the required funding to implement the necessary upgrades to the bulk services infrastructure. The findings of the services report for the provision of this service is as follow:

"Engineering services are not in place (water and sewer) to meet the standard requirements. The infrastructure will have to be upgraded regardless of the implementation of the Groblershoop 1500 houses development in order to meet current and expected future needs. The upgrading should be done in such a way as to take into consideration the Groblershoop 1500 Houses development. "

Kindly refer to the services report for more detail on the proposed upgrading of municipal infrastructure.

Funding can be applied for through the Municipal Infrastructure Grant (MIG) and Regional Bulk Infrastructure Grant (RBIG). For repair work at the water treatment works, the Water and Sanitation Infrastructure Grant (WSIG) can also be applied for.

2.5.4. STORM WATER

Storm water drainage will take place above ground, in natural furrows and along the streets of the proposed layout. The layout plan has been designed to accommodate all storm water furrows identified in the Freshwater Report, as well as align with the general topography of the development site. No Problems are expected in this regard.

2.5.5. ROAD NETWORK

The proposed development entails an extended internal road network to functionally link with Groblershoop and Sternhams` existing road infrastructure. The development site borders to the N10 National Road. Access to the planned residential expansion will have to be received from the N10 National Road, since this is the only road that can provide access to the development site. It is suggested that access to the development site be obtained through a new connection point, at the intersection between the N10 and the access road to Sternham. In addition to the proposed linkage to N10, it is proposed that the existing access to the industrial area of Groblershoop be extended into the development site, thereby allowing for a more coherent internal road network. SANRAL has been duly notified (Annexure J) of the access arrangements and their feedback will be furnished to the !Kheis Municipality and ZF Mgcawu District Municipality upon receipt thereof. It is anticipated that a traffic impact assessment and detail engineering plans will be upheld as conditions to approval.

In terms of the internal road network of the residential expansion, the integration of the town of Groblershoop and the community of Sternham was a key focus as this is an important development principle that needs to be adhered to. A hierarchy of road types have been designed throughout the planned town planning layout, in order to promote accessibility and mobility.

2.6. SIZE, ZONINGS AND REGULATIONS

The development site pertains to a 95ha portion of Portion 16 of the Farm Boegoeberg Settlement, No. 48, Kenhardt RD, !Kheis Municipality, Northern Cape Province, which is held under the ownership of the !Kheis Local Municipality. Portion 16 of the Farm Boegoeberg Settlement, No. 48 covers an area of 440.5695ha (Annexures A for deedsweb request) and serves as the town commonage of Groblershoop. The development site carries an Undetermined Zone zoning, in terms of the newly adopted !Kheis Land Use Management Scheme. The detail land survey conducted on the development site captured old oxidation ponds and graves thereon, with these features being adequately accommodated within the planned town planning layout.

The purpose of this application is to obtain the approval of the necessary land use changes needed for the township expansion of Groblershoop. The following land use changes have to be followed:

1. SUBDIVISION (See Figure 5):
   1.1. Subdivision of a 95ha portion of Portion 16 of the Farm Boegoeberg Settlement, No.48, into 1539 individual cadastral land units.
2. REZONING (See Figure 6):
   2.1. Rezoning of the newly created properties, thereby allocating appropriate land use rights to each of the newly created individual erven suitable to their future purpose within the Groblershoop township expansion project. The proposed zonings, in terms of the newly adopted !Kheis Scheme Regulations, are as follow and should be read together with the final layout plan attached as Annexure E to this submission:

Zoning	Primary Use/s	Erven Amount
Residential Zone I	Residential House	1500
Business Zone I	Business Premises	16
Institutional Zone I	Place of Instruction/ Educational building	2
Institutional Zone II	Place of Worship	3
Open Space Zone II	Public Open Spaces	15
Open Space Zone III	Private Open Spaces	2
Transport Zone II	Public Street	1
Authority Zone I	Municipal Uses	1
Total		1539

Please refer to Figures 5 & 6, Annexure E, §2.8 & §3.3 of this report for more information in this regard.

The title deed of the involved property has been scrutinised to determine if there are any restrictive conditions that needs to be removed in order for the land use change processes to take place. No such restrictive title deed conditions have been found within the title deed of the involved property (Annexure A).

In order to achieve the objective of providing sub-economic housing for the town of Groblershoop, this formal land use change application, pertaining to subdivision & rezoning, is submitted to the !Kheis Local Municipality as municipality of first instance. This application for land use change (subdivision, consolidation and rezoning) is therefore submitted to the !Kheis Municipality in order to ensure legal compliance with the clear context of the Spatial Planning and Land Use Management Act (Act 16 of 2013).

2.7. SUMMARY

During the consideration of the approval of this application, it is necessary to keep the following in mind:

a) *This application is in line with the principles set out in Chapter 2, §7 of the Spatial Planning and Land Use Management Act, Act 16 of 2013;*
b) *This application complies with the provisions of the !Kheis Land Use Management Scheme;*
c) *Addresses the backlog of housing as encountered within numerous settlements in the Northern Cape Province;*
d) *This application complies with the general principles as prescribed in Chapter 1 of the Spatial Planning and Land Use Management Act (Act 16 of 2013);*
e) *The proposed residential expansion of Groblershoop aligns with the provisions of the !Kheis SDF;*

2.8. LAYOUT PRINCIPLES

LOW-COST HOUSING

The Groblershoop township expansion will make provision for approximately 1540 sub economic properties, ranging between 300m² to 350m².

MIDDLE INCOME HOUSING

The Groblershoop township expansion will also include a total of 60 middle income residential properties. These properties will be subject to property taxation and will therefore provide much needed financial backing to the !Kheis Local Municipality.

SUPPORTING LAND USES

The magnitude of the Groblershoop township expansion, which will create 1500 residential erven, necessitated the inclusion of numerous supportive land uses, in order to ensure that this development can function within a sustainable and viable manner. All land uses included in the layout designed, have been requested by the !Kheis Local Municipality after engaging with the community. These land uses will include a primary school, business nodes for economic prosperity, religious uses and municipal uses. Kindly note that the ad hoc business properties on intersections of collector and arterial roads have also been requested by the !Kheis Local Municipality.

MOVING/ RELOCATION OF HOUSES

As mentioned previously in this report, the !Kheis Municipality managed to temporarily accommodate the population growth by allocating other municipal owned land meant for other purposes, such as public open spaces for municipal utilisation. At present the development site is not being occupied by any informal structures, as such a town planning layout can be designed that complies with planning principles and promotes sustainability.

STORM WATER FURROWS

The Fresh Water Report (Annexure I) captured one faint storm water furrow to the north of the development site. The layout plan for the Groblershoop township expansion adequately accommodates this storm water furrow, as such no problems are expected in this regard.

ROAD NETWORK

The proposed development entails an extended internal road network to functionally link with Groblershoop and Sternhams` existing road infrastructure. The development site borders to the N10 National Road. Access to the planned residential expansion will have to be received from the N10 National Road, since this is the only road that can provide access to the development site. It is suggested that access to the development site be obtained through a new connection point, at the intersection between the N10 and the access road to Sternham. In addition to the proposed linkage to the N10, it is proposed that the existing access to the industrial area of Groblershoop be extended into the development site, thereby allowing for a more coherent internal road network. SANRAL has been duly notified (Annexure K) of the access arrangements and their feedback will be furnished to the !Kheis Municipality and ZF Mgcawu District Municipality upon receipt thereof. It is anticipated that a traffic impact assessment and detail engineering plans will be upheld as conditions to approval.

In terms of the internal road network of the residential expansion, the integration of the town of Groblershoop and the community of Sternham was a key focus as this is an important development principle that needs to be adhered to. A hierarchy of road types have been designed throughout the planned town planning layout, in order to promote accessibility and mobility.

3. PROPOSED LAND USE CHANGE

3.1. PLANNING APPROACH

During the motivation of the project, the following objectives were kept in mind:

- *Addressing housing backlog and providing housing opportunity for the future population growth of Groblershoop;*
- *The physiography, as evident by the findings of the geotechnical report, botanical Assessment report and the freshwater report, of the area is capable to accommodate the planned housing development;*
- *Promoting integration between Sternham and the town of Groblershoop;*
- *Accommodating old municipal infrastructure and graves that were identified on the development site;*
- *Providing supporting land uses that will contribute to a sustainable community;*
- *Incorporating land uses derived by community engagement with the !Kheis Municipality;*
- *Complying with any provisions that the Municipality may enforce on the application;*
- *The proposed layout complies with the findings and recommendations of the specialist studies.*

3.2. PUBLIC PARTICIPATION

As contemplated in SPLUMA, a land use change implies an amendment to the Scheme and where an amendment to a scheme is to be considered, according to §28(2), a public participation process must be undertaken to ensure that all affected parties have the opportunity to make representations on, object to and appeal the decision. For the purpose of land use applications in the !Kheis Municipality at this stage, we will be guided by the requirements of the municipality, and we anticipate this to include:

1. Notice placed in local print media, which will be followed by a limited period (30 days) within which any member of public may provide inputs and/or objections to this development at the offices of the local municipality. No late inputs will be considered relevant with the cut-off date being clearly indicated in the public notice.
2. The same notice published in the local print media will be placed at the entrance to the involved property, at the same time as publication, allowing an expanded audience to be reached by the notice.
3. The said notice will be forwarded to the surrounding land owners via registered mail or hand delivery, further expanding the audience for inputs.

Should any inputs be received at the offices of the !Kheis Municipality, it would be the responsibility of the receiving official to place the date stamp of the municipality on the received input, proving that it was acquired within the limited timeframe. Upon the closure of the public participation period, any inputs received must be forwarded to the applicant whereupon the applicant will have a maximum of 30 days to provide a written response to the inputs. The application will then be forwarded to the decision-making body for consideration.

3.3. PROPOSED LAND USES

After approval, the following land uses will be established on the study area in terms of the !Kheis Land Use Management Scheme – Please refer to Figure 6 for the layout plan with appropriate zoning notations:

Residential Zone I	Indication on map: colour	**Yellow**	
	Primary use/s	**Dwelling House / Residential House**	Means a building containing only one residential unit – a self-contained interlinking group of rooms for the accommodation and housing of a single family, or a maximum of four persons who do not satisfy the definition of a "family", together with such outbuildings as are ordinarily used therewith.

1500 land units created will be given this zoning with the objective of addressing housing backlog, as well as make provision for future population growth.

Business Zone I	Indication on map: colour	**Red**	
	Primary use/s	**Business Building / Premises**	Means a site and/or building or part thereof used or intended to be used as shops and/or offices and it includes hotels, restaurants, dry-cleaners, financial institutions, professional offices, places of assembly, doctors consulting rooms, stock or product exchanges, put-put course, flats above ground floor and buildings for similar uses, but it excludes bottle stores, taverns, places of entertainment, a casino, adult entertainment, institutional buildings, funeral parlours, public garages, service stations, repairing or related replacing functions, industrial buildings, offensive industries, heavy vehicle overnight facilities or any wholesale business.

16 land units created will be given this zoning within the layout, providing economic prosperity to the residents of the proposed community.

Institutional Zone I	Indication on map: colour	**Light Blue**	
	Primary use/s	**Place of Instruction / Educational building**	Means a school (both primary, secondary, special and private schools), college, technical institute, academy, university, lecture hall or other centre of instruction, and includes a hostel appertaining thereto, and a convent, dormitory, public library, art gallery, museum, gymnasium, training centre and creche, but does not include a building used or intended to be used wholly or primarily as a certified reformatory or industrial school or as a school for the mentally handicapped;

2 land units created will be given this zoning within the layout, providing educational opportunities for the residents of the proposed community.

Institutional Zone II	Indication on map: colour	**Light Blue**	
	Primary use/s	**Place of Worship**	Means a church, synagogue, mosque, temple, chapel or other place for practising religion. This includes any building in connection therewith, for instance a hall, Sunday school classes or parsonage, but does not include funeral parlours (Office & Facility), including chapels forming part of such funeral parlours;

3 land units created will be given this zoning within the layout, providing religious properties for the residents of the proposed community.

Open Space Zone II	Indication on map: colour	**Green**	
	Primary use/s	**Public open space**	*Means any land which falls under, or is intended to come under the ownership of the local authority, which is not leased or intended to be leased on a long-term basis, and which is utilised by the public as an open space, park, garden, picnic site, square, playground or recreational site, whether it appears on an approved general plan or not.*

15 land units created will be given this zoning within the layout, accommodating storm-water furrows & site topography.

Open Space Zone III	Indication on map: colour	**Light Green**	
	Primary use/s	**Private open space**	Means any land which has been set aside in this scheme for use as a private site for sport, playing, rest and recreation facilities or as an ornamental garden or pleasure-garden, provided that the land is under the long-term management of a private person or authority, and also a cemetery or show grounds, whether public or private.

2 land unit created will be given this zoning within the layout, accommodating the existing graves as located on the development site, as well as provide a new cemetery to the south of the study area for future use.

Transport Zone I	Indication on map: colour	**Light Grey**	
	Primary use/s	**Public Street**	Means any land indicated on a plan or diagram or is specified within this zoning scheme, reserved for street purposes and where the ownership as such vests in a competent authority and includes facilities for public transport.

1 land unit created will be given this zoning within the layout, accommodating the internal road network.

Authority Zone I	Indication on map: colour	**Light Red**	
	Primary use/s	**Municipal Use**	Means land/erven and buildings utilised by Local and District Municipality to carry out its mandatory functions, of which the extent thereof is of such nature that is cannot be classified or defined under any other usage in these regulations and include uses such as stores, warehouses, cemeteries, commonage, nursery,

			waste disposal site and water purification works, etc. The land/erven zoned for this purpose must be registered in the name of the Municipality.

1 land unit created will be given this zoning within the layout, providing community related uses.

4. RECOMMENDATION

It is thus evident from the previous discussions that this application for land use change (Subdivision and Rezoning) for the proposed township expansion of Groblershoop is desirable for development within the !Kheis Local Municipality and should be positively considered for approval by the JMPT.

4.1. APPROVAL OF THE APPLICATION

The !Kheis Municipality is therefore requested to:

1. Give the go-ahead for advertising the application according to and in terms of the procedures adopted by themselves as part of their commitment to the provisions of the Spatial Planning and Land Use Management Act, Act 16 of 2013. The public participation process will be handled by this office and proof thereof will be sent to the Municipality.
2. Communicate the relevant Administrative fee to this office after accepting the application and stipulating its requirements.
3. Recommend the approval of this land use application to the JMPT after the closure of the public participation process.

The JMPT is therefore requested to:

1. Favourably consider this application for subdivision, consolidation and rezoning by means of approving it in terms of the recommendation from the office of the !Kheis Municipality.

FIGURE 4: PROPOSED SUBDIVISION

Design:	JP Theron (Pr. Pln. A/2394/2016)
Drawn:	JP Theron (Pr. Pln. A/2394/2016)
Date:	October 2020
Scale:	1:6000
Plan nr:	(FIG4) 201022 Ptn. 16 of the Farm Boegoeberg Settlement, No 48

Legend:

- Existing Cadastral of Sternham & Groblershoop
- Study Area
- Subdivision Lines

Drawn:
MACROPLAN
TOWN & REGIONAL PLANNERS
JP THERON
PR. PLN A/2394/2016
T: 054 332 3642 • C: 082 821 1024
E: jptheron@mweb.co.za
Head Office
4A Murray Avenue, Upington 8801
Kimberley Office
4 Hemming Way, Kimberley 8301

Checked:
MACROPLAN
TOWN & REGIONAL PLANNERS
LEN T FOURIE
PR. PLN A/1322/2006
T: 054 332 3642 • C: 082 821 1025
E: macroplan@mweb.co.za
Head Office
4A Murray Avenue, Upington 8801
Kimberley Office
4 Hemming Way, Kimberley 8301

Municipality:
!Kheis
Munisipaliteit
Municipality
Private Bag X2,
Groblershoop
8850
Tel: 054 833 9500
Fax: 054 833 9509

Client:
COGHSTA
Department:
CO - OPERATIVE GOVERNANCE
HUMAN SETTLEMENTS & TRADITIONAL AFFAIRS
NORTHERN CAPE

FIGURE 5: PROPOSED REZONING

Design:	JP Theron (Pr. Pln. A/2394/2016)
Drawn:	JP Theron (Pr. Pln. A/2394/2016)
Date:	August 2020
Scale:	1:3000 (A1)

Plan nr:

(FIG5) 201022 Pln. 16 of the farm Boegoeberg Settlement No. 48

Proposed Land Uses in terms of Land Use Management System

Colour & Numbers	Land Use Description	Total Units	Schedule of Sizes: average size per erf	Schedule of Sizes: total area covered by land use	Schedule of Sizes: percentage of study area covered by use	Colour & Numbers	Land Use Description	Total Units	Schedule of Sizes: average size per erf	Schedule of Sizes: total area covered by land use	Schedule of Sizes: percentage of study area covered by use
	Open Space Zone I						Undetermined Zone				
	Open Space Zone II	16					Business Zone I	16			
	Open Space Zone III	1					Business Zone II				
	Agricultural Zone I						Business Zone III				
	Agricultural Zone II						Business Zone IV				
	Resort Zone II						Business Zone V				
	Residential Zone I	1500	310m²	46.5ha			Business Zone VI				
	Residential Zone II						Industrial Zone I				
	Residential Zone III						Industrial Zone II				
	Residential Zone IV						Industrial Zone IV				
	Residential Zone V						Industrial Zone IV				
	Residential Zone VI						Utility Zone I				
	Institutional Zone I	2					Utility Zone II				
	Institutional Zone II	3					Utility Zone III				
	Institutional Zone III						Transport Zone I				
	Authority Zone I	1					Transport Zone II				
	Authority Zone II						Transport Zone III				
	Special Zone					Total:		1539		95ha	

Drawn:
MACROPLAN
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JP THERON
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Kimberley Office
4 Hemming Way, Kimberley 8301

Municipality:
!Kheis Municipality
Private Bag X2,
Groblershoop
8850
Tel: 054 833 9500
Fax: 054 833 9509

Client:
COGHSTA
Department: CO-OPERATIVE GOVERNANCE HUMAN SETTLEMENTS & TRADITIONAL AFFAIRS NORTHERN CAPE

ANNEXURE A: COPY OF TITLE DEED

GD 059-00530

Wet op die Beskikking oor Staats= grond, 1961.

REPUBLIEK VAN SUID-AFRIKA

GRONDBRIEF NO.

NADEMAAL blykens Sertifikaat gedateer 18 Oktober 1977, magtiging verleen is vir die uitreiking van 'n grond= brief ten gunste van

MUNISIPALITEIT VAN GROBLERSHOOP

ten / ....

ten aansien van

(i) Gedeelte 16 van die plaas Boegoeberg-nedersetting no 48;

(ii) Gedeelte 17 van die plaas Boegoebergneder-setting no 48, albei gelee in die Administra-tiewe Distrik Kenhardt, die eiendomme van die Republiek van Suid-Afrika kragtens Sertifi-kaat van Vereenigde Titel no 7083/1938 gedateer 13 Julie 1938;

(iii) Perseel 2020 gedeelte van Perseel 1018 Boegoe-bergnedersetting, gelee in die Administratiewe Distrik Kenhardt;

die eiendom van die Republiek van Suid-Afrika kragtens Sertifikaat van Geregistreerde Titel no 8210/1941 gedateer 19 Augustus 1941, watter eiendomme deur die Republiek van Suid-Afrika verkoop is op 19 November 1970 aan die genoemde,

MUNISIPALITEIT VAN GROBLERSHOOP

vir die bedrag van seshonderd nege en sestig rand tagtig sent (R669,80).

SO GETUIG hierdie Akte dat kragtens die be-palings van die Wet op Beskikking oor Staatsgrond 1961 en be-houdens die regte van die Staat, die Republiek van Suid-Afrika hierby aan die genoemde

MUNISIPALITEIT VAN GROBLERSHOOP

die se opvolgers in titel of regverkrygendes toeken,

afstaan / .....

afstaan en transporteer:

I. GEDEELTE 16 van die plaas Boegoeberg-nedersetting No. 48 geleë in die Administratiewe Distrik Kenhardt gehou deur die Republiek van Suid-Afrika kragtens Sertifikaat van Verenigde Titel No. 7083/1938 gedateer 13 Julie 1938;

GROOT vierhonderd en vyftig komma vyf ses nul nege (450,5609) hektaar soos voorgestel en omskryf in die hieraangehegte kaart L.G. No. 3823/76.

A. ONDERWORPE aan sodanige voorwaardes soos na verwys word in Sertifikaat van Verenigde Titel No. 7082/1938 geregistreer 13 Julie 1938.

B. HIERDIE TOEKENNING geskied verder behoudens:

(a) die voorbehoud van alle regte op edelgesteentes, edelmetale, onedele minerale en aardolie, soos in die mineraalwette omskryf vir die Staat;

(b) die voorwaardes soos volledig uiteengesit in skedule B tot hierdie Grondbrief.

II. GEDEELTE 17 van die plaas Boegoeberg-nedersetting No. 48 geleë in die Administratiewe Distrik Kenhardt gehou deur die Republiek van Suid-Afrika kragtens Sertifikaat van Verenigde Titel No. 7083/1938 gedateer 13 Julie 1938;

GROOT Eenhonderd ses en sewentig komma drie vier ses twee (176,3462) hektaar soos voorgestel en omskryf in die hieraangehegte kaart LG No. 3824/76.

A. ONDERWORPE aan sodanige voorwaardes soos verwys word in Sertifikaat van Verenigde Titel No. 7082/1938 gedateer 13 Julie 1938.

B. HIERDIE TOEKENNING geskied verder behoudens voorwaardes B(a) en (b) volledig uiteengesit in paragraaf I van hierdie Grondbrief ingevolge waarvan, onder meer, alle regte op edelgesteentes, edelmetale, onedele minerale en aardolie soos in die Mineraalwette omskryf vir die Staat voorbehou word.

III. PERSEEL / .....

III. PERSEEL 2020 gedeelte van Perseel 1018 Boegoebergnedersetting geleë in die Administratiewe Distrik Kenhardt gehou deur die Republiek van Suid-Afrika kragtens Sertifikaat van Geregistreerde Titel No. 8210/1941 gedateer 19 Augustus 1941;

GROOT drie en negentig komma ses een nege nege (93,6199) hektaar, soos voorgestel en omskryf in die kaart LG No. 3832/76, geliaseer onder No. 9321.

A. HIERDIE TOEKENNING geskied behoudens voorwaardes B(a) en (b) volledig uiteengesit in paragraaf I van hierdie Grondbrief ingevolge waarvan, onder meer, alle regte op edelgesteentes, edelmetale, onedele minerale en aardolie soos in die Mineraalwette omskryf vir die Staat voorbehou word.

ALDUS GEDOEN en ONDERTEKEN deur die Administratiewe Beheerbeampte, Departement van Landboukrediet en Grondbesit, te PRETORIA op ..21..... dag van ..November... 1977 kragtens behoorlike magtiging volgens die Wet op die Beskikking oor Staatsgrond, 1961.

..
ADMINISTRATIEWE BEHEERBEAMPTE
DEPARTEMENT VAN LANDBOUKREDIET
EN GRONDBESIT
Volmag No. 340/1976
Item No. (17)(a)(v)

GEREGISTREER in die Register van plase, en erwe gehou te Kenhardt en Boegoeberg Nedersetting

BOEK ..... FOLIO Para 148/16/1 Kenhardt
BOEK ..... FOLIO " 2)148/17/1 "
BOEK ..... FOLIO " 3)Pers. 2020 Boegoeberg
hierdie ..20ste..... dag van ..Februarie..... nedersetting
Eenduisend negehonderd agt en sewentig (1978).

..
REGISTRATEUR VAN AKTES

BLADSY/PAGE 5

ENDOSSEMENT OP
ENDORSEMENT ON T 2574 / 1978

EIENDOM/PROPERTY Ged 16 van die
Plaas Boegoebergnedersetting No 48
Afdeling: Kenhardt ens

1321/A

Para 2

Certificate of Registered Title No. T / issued in terms of
Sertifikaat van Geregistreerde Titel No. uitgereik kragtens
Sect. Art. 43 Act No. Wet No. 47/1937, in respect of the ten opsigte van
Erf 208 meas 3412 m2.

Remainder Restant 176,0050 ha

DEEDS OFFICE, AKTESKANTOOR, CAPE TOWN KAAPSTAD
31-01-1979
ASST. REGISTRAR. ASST.-REGISTRATEUR.

BC 2088 / 1979

Para 2.
Kansellasie van voorwaardes in terme van Artikel 2 A (2) Wet 49/1961.

Voorwaardes (a) (b) (i) en (ii), (c) en (f) vervat in Skedule B is gekanselleer ten gunste van erf 208 gehou kragtens T1321/1979 gedateer 31-1-1979

31-1-1979
Aktekantoor
Kaapstad

Asst. Registrateur van Aktes.

Para 3.

DIE GROND HIERIN BESKRYWE
THE LAND DESCRIBED HEREIN
IS GEREGISTREER EN MOET IN DIE TOEKOMS BESKRYWE WORD AS
IS REGISTERED AS, AND MUST IN FUTURE BE DESCRIBED AS

Perseel 2020
Boegoebergnedersetting

AKTEKANTOOR,
DEEDS REGISTRY,
KAAPSTAD,
CAPE TOWN,
10-03-1979

HOOF REGISTRASIEAMPTENAAR.
CHIEF REGISTRATION OFFICER.

BLADSY/PAGE 6

ENDOSSEMENT OP / ENDORSEMENT ON T 2574/1978

EIENDOM/PROPERTY Ged. 16 van die Nas Boedelbeskikkingsnedersetting Nr 48, Afd. Kenhardt, ens.

~~Expropriated~~

Para. 1.

~~Ged.~~ Ged. 48 - Groot 9975 m²

Ex propriated + K.S.A. in sy

GETRANSPORTEER / TRANSFERRED Aan / To Administrasie van Spoorweë en Hawens

No. T 38960 R/Rest ?/Remainder 449,5634 ha

Asst.-registrateur/Asst. Registrar

VIR ENDOSSEMENTE KYK BLADSY / FOR ENDORSEMENTS SEE PAGE 7 ET SEQ.

BLADSY/PAGE 7

ENDOSSEMENT OP
ENDORSEMENT ON T 2574/78

EIENDOM/PROPERTY Ged 16 v/d
Paaas Boegoebergnedersetting
NC 118

PARA 3
1) PERSEEL 2283 = 10,2743 HA
PARA 2 ~~PARA 2)~~ PERSEEL 2284 = 4,6332 HA

GETRANSPORTEER 1982-03-18
TRANSFERRED
No. T 30531/82
Aan SUID-AFRIKAANSE
To DROËVRUGTE KOÖPERASIE BEPERK
Restant Para 3 85,3456 HA.
Remainder Para 2 171,2147 HA
Regisrateur.
Registrar.

Para 3 1) Perseel 2286 meas 1,3126 HA.
Para 2 2) Perseel 2287 mees 1571 m².

GETRANSPORTEER
TRANSFERRED
No. T 35774/85
1985-09-30
Aan ORANJE KOÖPERASIE BEPERK.
To
Restant PARA 3 82,0330 HA
Remainder PARA 2 171,2147 HA.
Registrateur
Registrar

PARA 1
GED 49 GROOT: 1,0000 HA.

GETRANSPORTEER
TRANSFERRED
No. T 18979/89
Aan ESKOM.
To
Restant 448,5634 HA.
Remainder
1989-04-07
Registrateur/Registrar.

VIR ENDOSSEMENTE KYK BLADSY 8
FOR ENDORSEMENTS SEE PAGE

Para1.
ged 51. groot: 4978 m²

GETRANSPORTEER Aan J. J. de Witt
TRANSFERRED To en een order.
No. T51837/91 Restant/Remainder 448,0659ha.

20 08 91

Para 3
Perseel 2320 = 1000 m²

GETRANSPORTEER AAN / TRANSFERRED TO
P. P. du Plessis

RESTANT/REMAINDER 81,9330.ha

T 37376 93

07 05 93

REGISTRATEUR/REGISTRAR

VIR ENDOSSEMENTE KYK BLADSY 9
FOR ENDORSEMENTS SEE PAGE

VA 9382 /1993

Cape Town/Kaapstad
1993-10-25
Asst. Registrar of Deeds,
Asst. Registrateur van Aktes.

Para1: Gedeelte 58 meas. 1,000 ha

GETRANSPORTEER AAN / TRANSFERRED TO
L.A.W. Wholesale Meat Distributors BK

RESTANT/REMAINDER 447,0659 ha

T 92481 93

29 11 93

REGISTRATEUR/REGISTRAR

SKEDULE B (VERKOPE)

(a) Die grond is onderworpe aan ewigdurende serwitute van waterleiding en/of dreinering, soos omskryf in artikel 139, met insluiting van die regte bepaal in artikels 141(3) en 142(1)(a), (b) en (c) van die Waterwet, 1956, soos gewysig, ten aansien van enige bestaande kanale en afvoerslote gebou onder hierdie Staatswaterskema, ten gunste van die Republiek van Suid-Afrika en is verder onderworpe aan die reg van die Minister of ander bevoegde gesag om enige verandering of vervanging te maak in die konstruksie of roete van die gesegde kanale en afvoerslote en om addisionele kanale en/of afvoerslote te bou. Die Staat sal onder geen omstandighede aanspreeklik wees vir enige skade of verlies wat deur die eienaars gely mag word oor of op die gedeeltes wat aan die gesegde serwitute onderworpe is nie;

(b) (i) Die Minister van Landbou of ander bevoegde gesag by wie die verpligting vir die onderhoud van die verdelingsvore en afleivore hierna mag berus het die reg om damme, reservoirs, geleidings, watervore, geute, pypleidings en afleivore op die grond aan te lê vir die toevoer van water na, of die afvoer van water van ander hoewes, of Staats- of privaatgrond, of vir publieke of ander doeleindes en om die nodige paaie langs sulke vore of afleivore te maak. Die behoorlik gemagtigde amptenare van die Staat of ander gemagtigde persone het te alle tye langs die genoemde paaie vrye deurgang oor die grond vir die doel om sluise te reël en om, ingeval van belemmering van stroom die vore of afleivore te ondersoek, skoon te maak en te herstel.

(ii) Die Minister van Landbou of ander bevoegde gesag het altyd die reg om afleivore en dreineringsvore oor die grond aan te lê en om materiaal daarvan te neem, benodig vir herstel of onderhoud van die leivore en dreineringsvore. Die skoonmaak, instandhou en herstel van die gesegde leivore en dreineringsvore moet deur die eienaar gesamentlik en afsonderlik met ander eienaars en/of huurders van hoewes binne die nedersetting onderneem word;

(c) Die Staat, waterraad of ander bevoegde liggaam aanvaar geen aanspreeklikheid vir enige verlies wat die eienaar van die grond mag ly as gevolg van waterskaarste of enige beperking van water of enige misoeste as gevolg daarvan, of enige skade wat deur oorstroming, deursypeling of enige oorloop van water veroorsaak is nie, en die eienaar het geen eis teen die Staat, waterraad of ander bevoegde liggaam vir enige vergoeding ten aansien daarvan nie;

(d) Alle paaie en deurgange wat wettig op die grond aangelê is moet vry en onbelemmerd bly tensy sodanige paaie en deurgange op bevoegde gesag opgehef, gesluit of verander word;

(e) 'n Reg-van-weg ten gunste van die huurders en/of eienaars van aangrensende of naburige hoewes op die nedersetting in 'n geskikte rigting na die naaste publieke pad moet te alle tye oor die grond toegestaan word, ten gunste van die eienaars, huurders of okupeerders van die ander gedeeltes op die nedersetting, mits sodanige reg-van-weg volgens die mening van bevoegde gesag nodig is;

(f) Die eienaar moet, ingeval die hele of enige gedeelte van die grond gebruik word vir die weiding van vee van watter soort ookal, die grense daarvan asook die kante van alle besproeiingskanale, vore of afleivore wat daaroor gaan, omhein ooreenkomstig spesifikasies deur die Minister van Landbou vasgestel.

Para 1 Ged 52 = 9988 m²

GETRANSPORTEER AAN / TRANSFERRED TO
T. E. Coetzee

RESTANT/REMAINDER 446,0671 ha
T 84332 94
8 11
REGISTRATEUR/REGISTRAR

PARA 3:
Ged 319 = 1000 m²
Ged 321 = 609 m²

GETRANSPORTEER AAN / TRANSFERRED TO
T. J. S. Du Toit

RESTANT/REMAINDER 81,72 ha
T 50568 96
03 07 96
REGISTRATEUR/REGISTRAR

PARA 5
Ged 319 = 1000 m²

GETRANSPORTEER AAN / TRANSFERRED TO
A. J. Du Toit

RESTANT/REMAINDER 81,62 ha
T 50570 96
03 07 96
REGISTRATEUR/REGISTRAR

Para 3.

ARTIKEL 16 VAN WET 47 VAN 1937 GETRANSPORTEER AAN / SECTION 16 OF ACT 47 OF 1937 TRANSFERRED TO
Grabbershoop Plaaslike Oorgangsraad
T 50567 96
03 07 96
REGISTRATEUR/REGISTRAR

Further encls See Pg 10

Gedeeltes
= Ged 59 = 1000 ha
Para 1 = Ged 61 = 2000 ha

GE TRANSPORTEER AAN / TRANSFERRED TO
LAW wholesale meat distributors eiendoms Beperk
RESTANT/REMAINDER 445, 0659 ha
T 21506 2000
2002-05-22
REGISTRATEUR/REGISTRAR

Para 3 ~~Perseel 2682 ...~~

SERTIFIKAAT VAN GEREGISTREERDE TITEL UITGEREIK
CERTIFICATE OF REGISTERED TITLE ISSUED
TEN OPSIGTE VAN / IN RESPECT OF Perseel 2682 Boegoeberg nedersetting
groot 2,4724 ha
RESTANT / REMAINDER 79,1597 ha
T 062299 * 2001
2001-06-10
REGISTRATEUR/REGISTRAR

ARTIKEL 16 VAN WET 47 VAN 1937	SECTION 16 OF ACT 47 OF 1937
GETRANSPORTEER AAN	TRANSFERRED TO
DIE ~~REPUBLIEK VAN SUID-AFRIKA~~	~~THE REPUBLIC OF SOUTH AFRICA~~
MUNISIPALITEIT	!KHEIS
T 00040130 / 2004	
2002-05-30	REGISTRATEUR/REGISTRAR

Perc 1 Gedeelte 63 meas 2,0001 ha.

GE TRANSPORTEER AAN / TRANSFERRED TO
LAW WHOLESALE MEAT
DISTRIBUTORS (NAMAQUA) BEPERK
RESTANT/REMAINDER 441 0659 ha.
T 44255/2002
2002-05-30

VIR ENDOSSEMENTE KYK BLADSY
FOR ENDORSEMENTS SEE PAGE

GED 50 = 4975 m²

GETRANSPORTEER AAN / TRANSFERRED TO
J. P. S. DU TOIT

RESTANT/REMAINDER 440 5695 HA

T 044283/2002

2002-05-10

REGISTRATEUR/REGISTRAR

Lua 3 - Erf 2698 = 2,4549 ha

GETRANSPORTEER AAN / TRANSFERRED TO
P. C. Struwig

RESTANT/REMAINDER 76 7048 ha

T

04 MAY 2004

REGISTRATEUR/REGISTRAR

ANNEXURE B: AUTHORISING DOCUMENTATION

info@barzanigroup.co.za
www.barzanigroup.co.za

Gauteng (Head Office)

Tel: +27 12 881 0210
Fax: +27 86 476 7573

Building 9 Cambridge Office Park
5 Bauhinia Street, Highveld
Techno Park, Centurion, 0169

North West

Tel: +27 18 468 4876
Fax: +27 86 476 7573

52 Ian Street, Wilkoppies
Klerksdorp, 2571
(PO Box 6468 Flamwood, 2572)

Northen Cape

Tel: +27 53 831 3249
Fax: +27 86 476 7573

Sub Office: Agri Office Park
Building 2, Unit 1
South Kimberly, 8301

Eastern Cape

Tel: +27 43 050 0828
Fax: +27 86 476 7573

Leadwood House, Cedar Square
Bonza Bay Road
Beacon Bay, 5241

Kwazulu-Natal

Tel: +27 31 944 1635
Fax: +27 86 476 7573

Office 15, Ground Floor A Block
BCX Durban 1, 1 Frosterley Cresent
La Lucia Ridge, Umhlanga, 4091

Mpumalanga

Tel: +27 13 590 0952
Fax: +27 86 476 7573

2nd Floor, North Tower Suites 202, 1
Aqua Street, Riverside 1226

Amendment 1 to Appointment

Date : 28 May 2020

To **: Macroplan Town & Regional Planners (Pty) Ltd (Consultant)**
Represented by *: Len Fourie*

From **: Barzani Holdings (Employer)**
Represented by *: Roelof Van Den Berg & Ian Van Der Westhuizen*

Reference: NC/21/2018/PP (Groblershoop 1500)

WHEREAS the Employer appointed the Consultant for town planning services at the Groblershoop 1500 project.

AND WHEREAS the parties are desirous to change the Employer's name from Barzani Holdings (Pty) Ltd to Barzani Development (Pty) Ltd.

The Parties agree that the provisions of the Appointment will be amended as follows:

1. Amendment

The Parties agree that the Employer be changed to Barzani Development (Pty) Ltd with registration number 2009/001909/07. The signatories for the amended Employer remain the same and the Employer accordingly agrees

info@barzanigroup.co.za
www.barzanigroup.co.za

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Tel: +27 12 881 0210
Fax: +27 86 476 7573

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Mpumalanga

Tel: +27 13 590 0952
Fax: +27 86 476 7573

2nd Floor, North Tower Suites 202, 1
Aqua Street, Riverside 1226

that the Consultant will by no means be prejudiced by the amendment in any possible way. The signatories wave all rights that Barzani Holdings (Pty) Ltd enjoyed with the original Appointment Letter.

2. General

Save for the amendments and additional provisions stipulated under this amendment, the balance of the provisions and interpretations of the Appointment Letter and all relevant contracts remain to be in full force and effect.

Roelof van den Berg: _____ **Date:** 23/05/2020
Director

Ian van der Westhuizen: _____ **Date:** 28/05/2020
Director

Herewith do we accept this appointment letter, together with all the terms and conditions

Date: 01-06-2020

Service Provider Representative: Len J Fourie

Signature: _____

ANNEXURE C: SG DIAGRAM

DE VILLIERS & REID
Landmeters, Kaapstad

3823/76

	SYE Meter	RIGTINGS -HOEKE		KOÖRDINATE Y Stelsel Lo 21° X	
		Konstant		- 90 000,00	+3 190 000,00
AB	1 225,03	294.53.50	A	- 6 511,25	+ 8 197,98
BC	22,62	27.08.30	B	- 7 622,43	+ 8 713,71
CD	127,11	116.12.20	C	- 7 612,11	+ 8 733,84
DE	174,12	26.51.30	D	- 7 498,07	+ 8 677,71
EF	91,87	339.28.05	E	- 7 419,40	+ 8 833,05
FG	92,03	346.31.40	F	- 7 451,62	+ 8 919,08
GH	1 781,08	349.43.40	G	- 7 473,06	+ 9 008,58
HJ	3 005,32	96.14.58	H	- 7 790,68	+ 10 761,11
JA	2 813,70	217.22.33	J	- 4 803,22	+ 10 433,95
		Sternham	△	- 4 529,04	+ 3 444,74
		Padkop	△	- 10 303,04	+ 7 910,62

BAKENS:

A. - Swaar ysterpaal gelyk met grond.
B. - Geen baken.
C. - 15mm ronde ysterpen.
D.E.F.G.H. - Ysterpaal.
J. - Swaar ysterpaal in beton.

Die figuur A.B.C.D.E.F.G.H.J.

stel voor 450,5609 Hektaar grond, synde

GEDEELTE 16 VAN DIE PLAAS BOEGOEBERGNEDERSETTING No. 48

geleë in Administratiewe Distrik

Kenhardt, Provinsie Kaap die Goeie Hoop.

Opgemeet in Julie 1975 - April 1976

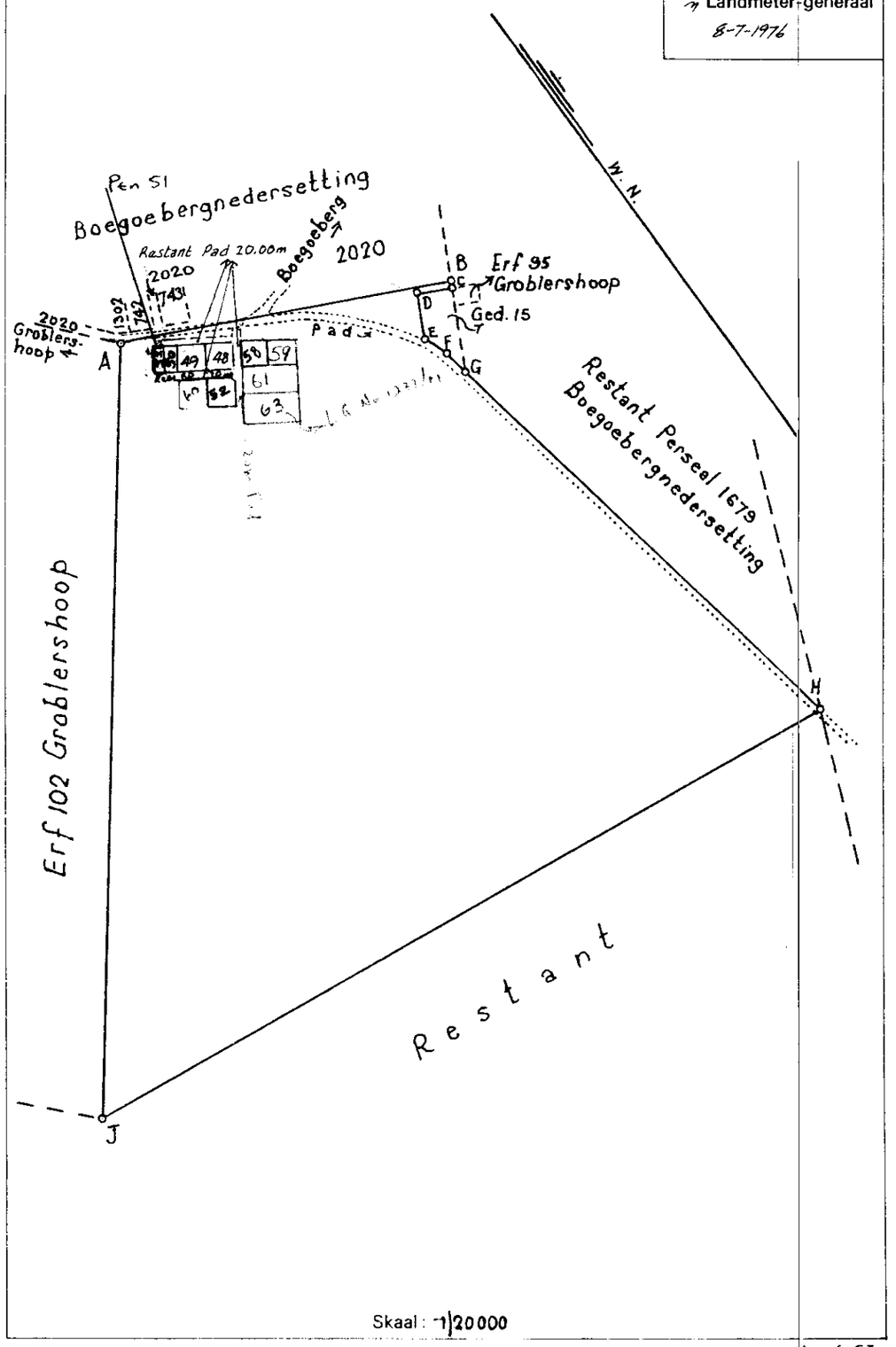
deur ~~my~~ ons,

T. Chiddy Landmeters

Hierdie kaart is geheg aan G/B Nr. 2574/78 gedateer t.g.v. Registrateur van Aktes	Die oorspronklike kaart is Nr. 612/1932 geheg aan Transport/~~Grondbrief~~ Nr. 1938-129-7083	Lêer Nr. S.3945/5 M.S. Nr. E.1134/76 Komp. GL-7CAA (5648) GL-7(5645) GK-8(5628)

KANTOORAFSKRIF

L.G. Nr.
F 3823/76
Goedgekeur
Landmeter-generaal
8-7-1976



Skaal : 1/20000

Artcraft, C.T.

E2042/79	6782/79	Ged 48.	9975	38960/81	mf	
E 1098/81	3235/81	Ged. 49.	1,0000 ha	18979/89		
"	3236/81	Ged. 50	5000 m²	144286/2002		
E.2413/81	7513/81	Ged. 51	4975 s.m	51837/91		
E.750/84	2443/84	" 52	9988 m²	84332/94	WF	
E 3623/92	11494/92	Ged 58	1,0000 ha	92481/93	WF	
E 3470/94	10415/94	Ged 59				
E 2915/96	7546/96	Ged. 60				
E 2038/97	5196/97	Ged. 61				
510/2001	1237/2001	Ged 63.				

ARTIKEL 1. C ✓

ARTIKEL 2 (a)

ARTIKEL 2 (a)

LANDMÄTARE

ANNEXURE D: SERVICES REPORT

GROBLERSHOOP 1500 HOUSING DEVELOPMENT

Engineering Services Investigation Report

Investigation of the available and required bulk civil and electrical services for the Groblershoop village development in the !Kheis municipal

AUGUST 2020

Prepared for:
MACROPLAN

Attention: Mr Len Fourie

Prepared by:
BVi Northern Cape (Pty) Ltd
55 Bult Street,
Upington, 8801

Contact persons: Mr Niël Maritz (Civil)
& Mr Ricardo Humphries (Electrical)

Tel: 054 337 6600
Cell No: 078 824 5253 (R. Humphries)
082 783 5951 (N. Maritz)
Email: ricardoh@bvinc.co.za
nielm@bvinc.co.za

bvi ENGINEERING PROCUREMENT MANAGEMENT

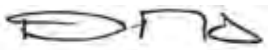
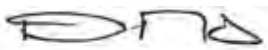
DOCUMENT CONTROL RECORD

Project Name:	Groblershoop 1500 Stands – Engineering Services Investigation Report
Project Number:	34167 – GROBLERSHOOP
Report for:	MACROPLAN

REVISIONS:

Rev #	Date	Revision Details/Status	Prepared by / Author	Reviewed / Approved by
03	2020/068/25	Draft report to be circulated to relevant parties.	F.D. MARITZ	F.D. Maritz (Pr.Eng)

APPROVAL:

Author signature		Approver signature	

EXECUTIVE SUMMARY

This report was compiled to investigate the bulk infrastructure serving the Groblershoop village and to determine whether the bulk infrastructure is adequate for the development of an additional 1500 stands, through a low-cost housing development.

The bulk engineering services report includes the following categories:

- Bulk Water Infrastructure
- Bulk Sewer Infrastructure
- Bulk Road and Storm Water Infrastructure
- Bulk Electrical Infrastructure

After investigating the infrastructure, it was found that the existing bulk infrastructure is not sufficient to accommodate the Groblershoop 1500 Houses project. The bulk services for each category that require attention before the project can commence is summarised below:

- **Bulk Water Infrastructure**

  Upgrading of the entire bulk water supply system is required as these 1500 houses will almost double the demand related to the existing 1548 houses.

- **Bulk Sewer Infrastructure**

  A newly Sewer Pump Station for Sternheim and Witblok extentions are in construction implementation phase (data and flows not available). In addition the proposed new 1500 stands development shall rquire a new bulk sewer infrastructure as follow:

  the Construction of two new sewer pump stations (2 x40 l/s).
  the Construction of new 200mm rising mains (1.3km and 2.1km).
  the Upgrading of existing 670 kL/day WWTW facility to upgraded 1.6 ML WWTW facility.

- **Bulk Electrical Infrastructure**

  Upgrading and exstension of the exsiting bulk electrical supply system is required by Eskom,the exstension of the electrical system will not be a problem as the main sub-station in Grobelaarshoop is currently being upgraded and will be commissioned in December 2020 .

This report can be used both for business plans and funding applications from the various funding schemes available.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Disclaimer

This is a draft report and only outlines some of the findings of the investigation to date and should not be used as the final or complete report. No recommendations or conclusions have been made and some portions of the report may be incomplete as the investigation is still in process.

1.2 Terms of Reference

I. BVI Consulting Engineers was appointed by Macroplan to undertake this Bulk Engineering Services Study (Water, Sewer, Electricity and Roads & Storm Water) for the proposed Groblershoop 1500 housing project. Groblershoop is one of six villages located close to the Orange river within the jurisdiction of !Kheis Local Municipality.

1.3 Site Location

I. The site is situated at Groblershoop Town on the N10 some 115km to the south east of Upington enroute to Prieska in the Northern Cape (Figure 1 – Locality Plan).

II. The development is located at the following coordinates: 28°54'27.00"S; 21°59'40.00"E

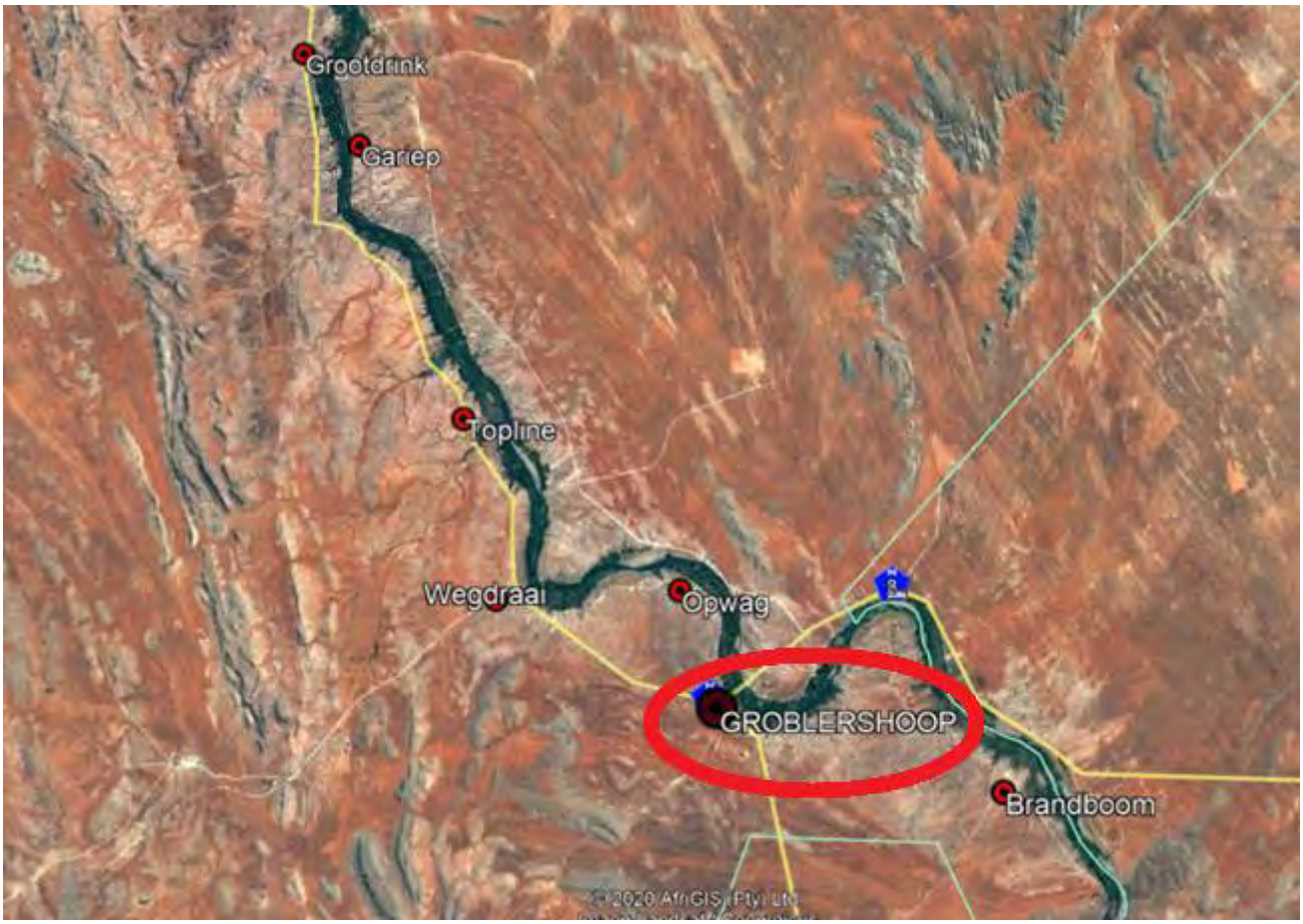


Figure 1: Groblershoop 1500 Housing Development Locality Plan

II. The planned development consists of 1500 low-cost houses next to the existing Sternham and Witblok village, adjacent to N10 national public road enroute to Prieska town (Figure 2: 1500 Stands Development Area)

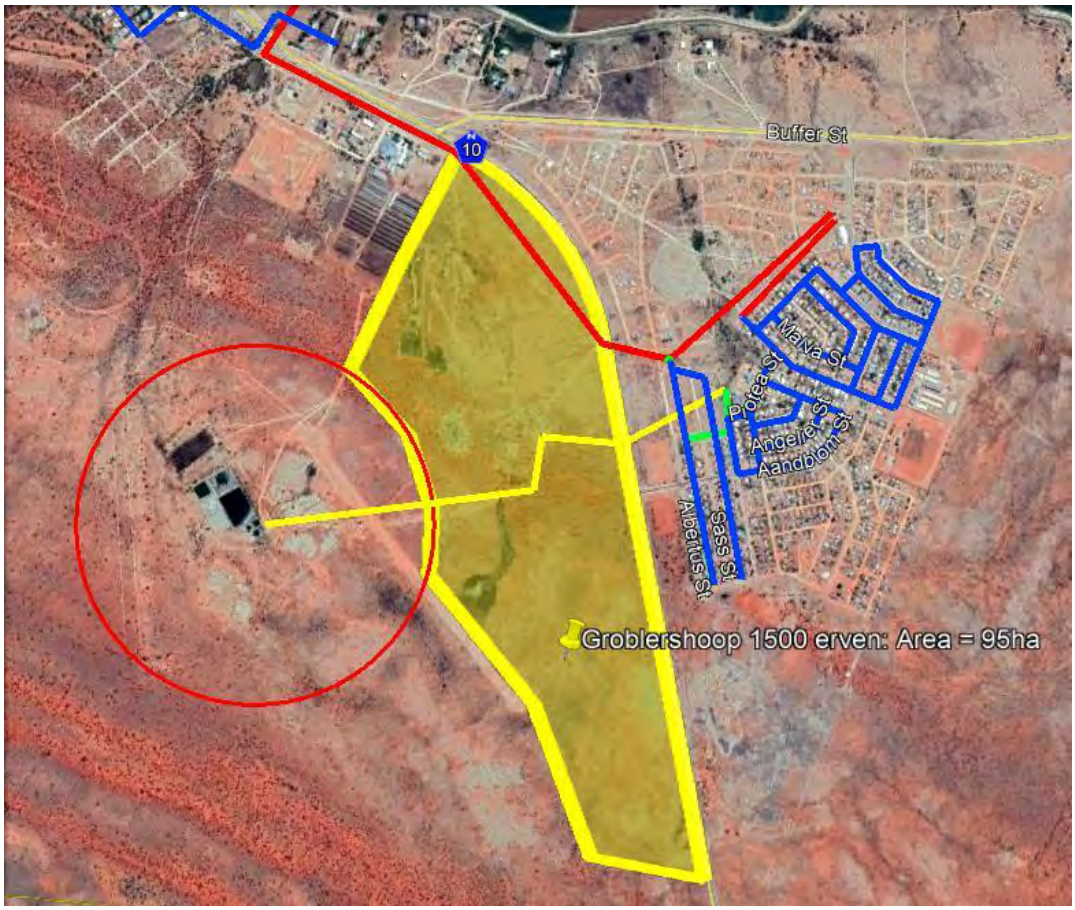


Figure 2: Groblershoop 1500 Housing Development Development Area

III. The purpose of the Bulk Engineering Services Assessment is to determine the availability and capacity of existing bulk services to service the proposed development. This report presents the findings of a preliminary visual inspection and desktop investigation relating to bulk services and further sets out the criteria and standards for the internal services for the new development.

IV. The Bulk Engineering Services addressed in this report are the following:

- Water Supply
- Sewerage
- Roads and Access
- Storm Water Management
- Electricity Supply

2. TOPOGRAPHY

The physical characteristics of the site can be summarized as follows:

- Ground cover comprises mostly of natural veld with short grass;
- Topographically, the site has a relatively gentle sloping terrain from the middle of the village
- Calcrete is close to the surface of the natural ground level, which makes excavations very hard.

3. WATER SUPPLY

3.1 Existing Water Infrastructure

Overview

The bulk water infrastructure supplying Groblershoop village with water can be summarised as follows:

- A raw water river pump station delivering 6l/s;
- A 1,660m long, 160mm diameter PVC Class 6 raw water supply line between the river and the water purification works on the side of the village
- The water treatment works consisting of:
  - An open raw water storage dam
  - Raw water pump station
  - A package type water treatment plant (1200 m3/day),
  - A RC Concrete Clearwater storage tank
  - A Clearwater Pump station to :
    - 1.2ML RC Storage Reservoirs (Old Town)
    - 0.8ML Sternham Sectional steel reservoir (incl. Highlift Pumpstation & Elevated Tank)
    - 55kL Witblok & Abbatoir Elevated Tank
- 130kL Sternham Elevated Tank with High lift pump station
- 55kL Witblok & Abbatoir Elevated Tank
- Distribution into the village

Figure 5 shows the existing bulk water infrastructure that supply water to Groblershoop Village

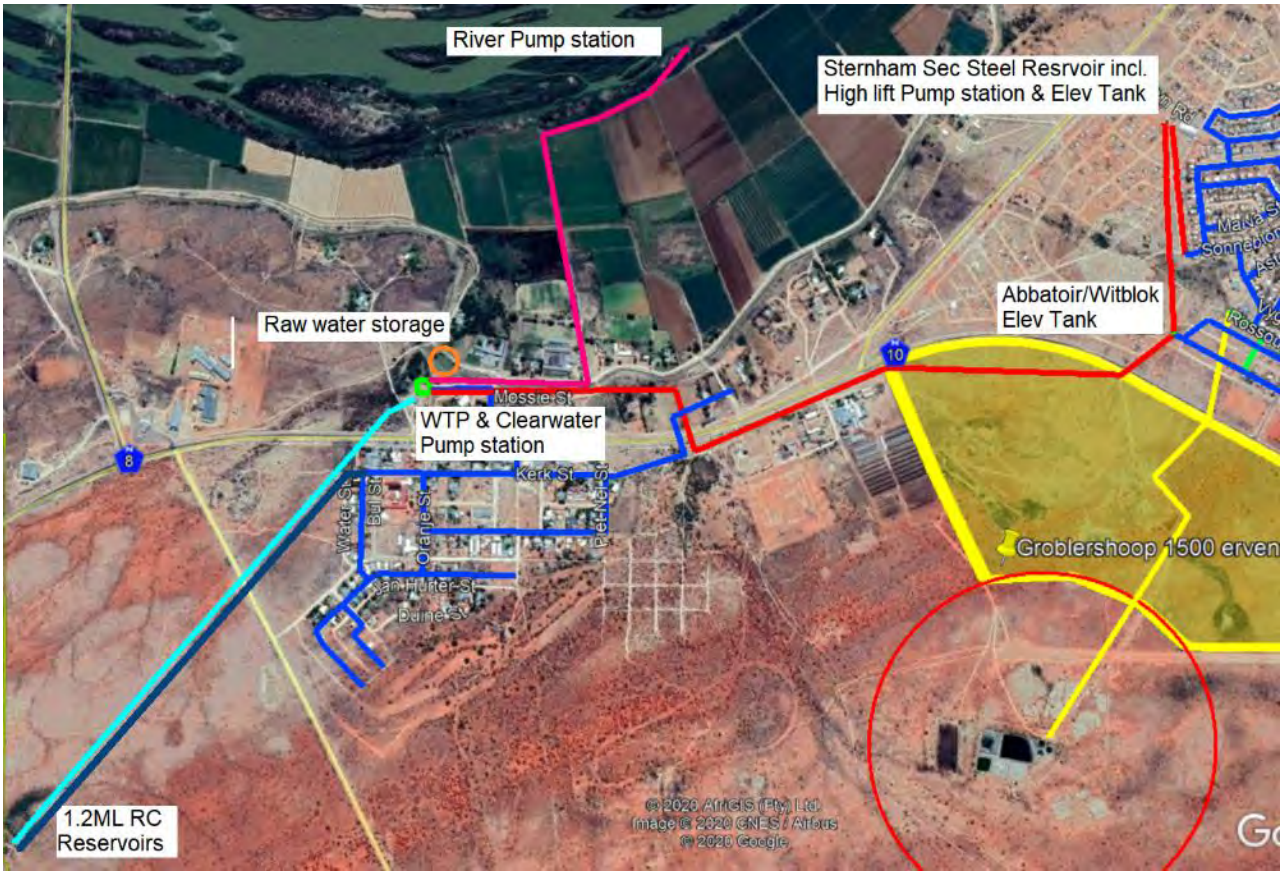


Figure 5: Existing Bulk Water Infrastructure

Raw Water Supply

Water supplied to Groblershoop is extracted from Orange River by means of a mobile pump station fitted on a trailer with the switchgear fitted to the trailer. The pump station consists of one pump that delivers 6l/s. The suction point is under the 1:10 year flood because of a sand bank on the northern side of the river.

Raw water is pumped from the rivier pump station to the purification plant, delivering a maximum flow rate of 6l/s through a 1,660 long, 160mm diameter Class 6 PVC pipeline to a 1,200 m^3 raw water storage dam next to the Package Plant Water Treatment Works in the village. The raw water pump spumps the raw watervfrom raw water storage reservoir to the Package Plant Water Treatment Works.

Water Treatment Plant and Clear water storage Pump station

The images below shows the site layout where the treatment works, clear water pump station and clear water sump is located. The Package Plant Water Treatment Works (WTW) was constructed in 2008 to supply water at a rate of 28 l/s (100.8 m3/h).






Water is pumped from the raw water storage dam through the Water Treatment Plant to a 150 m^3 rc concrete clear water sump situated beneath the Clear water pump stations. From there, it is pumped via the Old Town, Sternham and Abbatoir/Witblok clear water pump stations to the following storage reservoirs from where it feeds into the village gravitational network :

- 1.2ML RC Storage Reservoirs (Old Town)
- 0.8ML Sternham Sectional steel reservoir (incl. Highlift Pumpstation & Elevated Tank)
- 130kL Sternham Elevated Tank with High lift pump station
- 55kL Witblok & Abbatoir Elevated Tank

The photo's below shows the Old Town, Sternham and Abbatoir/Witblok clear water pump stations:

Potable Water Storage Reservoirs

The clear water pumpstation pumps potable water to the following :

- 1.2ML RC Storage Reservoirs (Old Town)
- 0.8ML Sternham Sectional steel reservoir (incl. Highlift Pumpstation & 130kL Elevated Tank)
- 55kL Witblok & Abbatoir Elevated Tank

Photo's below shows the potable water storage reservoirs and elevated tanks for Old Town, Sternham and Abbatoir/Witblok :

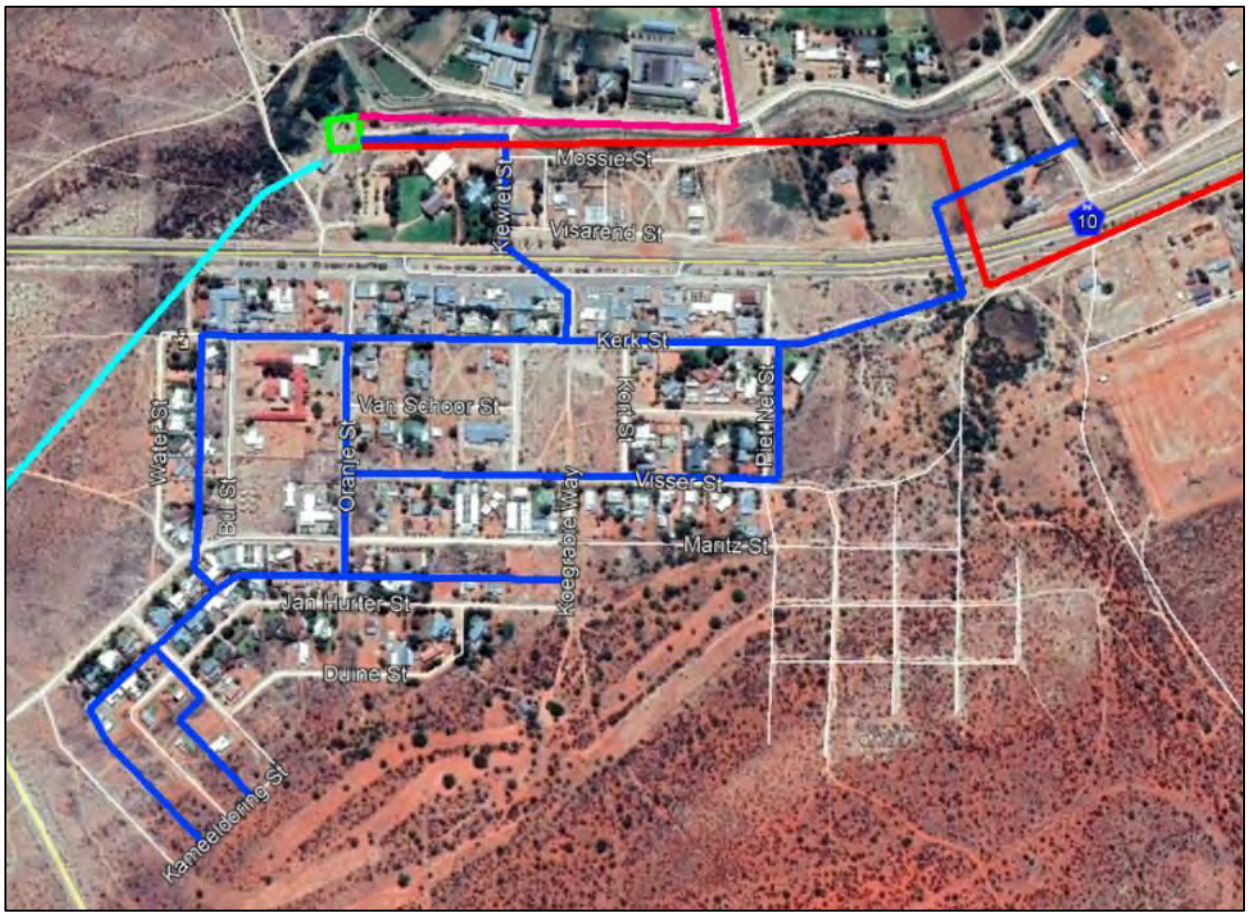
Reticulation System

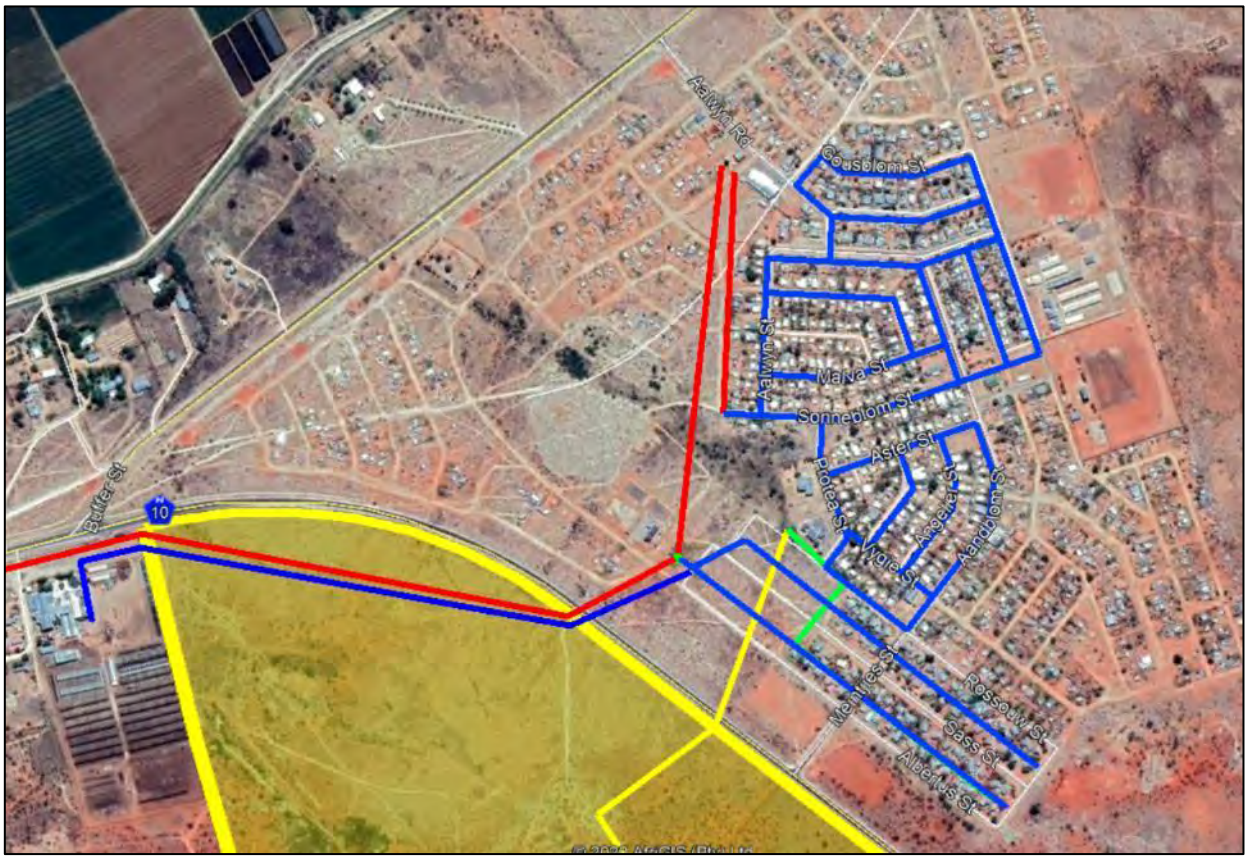
The potable water is delivered from the 1.2ML Old town potable storage reservoirs into the old town reticulation network via a 160mm diameter uPVC Class 6 pipeline.

The Sternham high lift pump station pumps the potable water from the sectional steel Sternham potable water 0.8ML reservoir, to the Sternham 130kL elevated storage tank. From there the water is delivered into the reticulation network via a 200mm diameter uPVC Class 6 pipeline.

The remaining potable water is delivered from the 0.55kL Abbatoir/Witblok elevated storage tank into the Abbatoir/Witblok reticulation network via a 110mm diameter uPVC Class 6 pipeline..

The reticulation network is shown in the images below.





Condition of the water supply system

Most of the elements of the water supply system are currently manually operated. These include the river pump, the water treatment works, and the reservoir levels. The elevated tank is not functional, and water is distributed to the village from the sectional steel reservoir that stores pottable water. Most of the water meters and pressure gauges are out of service.

3.2 Current water demands and capacity of the existing bulk water supply system

The Red Book was used as basis for calculations of the theoretical capacity for the current bulk water supply system as well as required infrastructure.

The table blow shows factors capacities and operating hours used in the calculations:

FACTORS	1	Design Loss Factor Water treatment works (LFw)		10.0%	
	2	Design Loss Factor Total conveyance losses (LFr)		15.0%	
	3	Summer peak factor (SPF)		1.5	
	4	Peak factor reticulation (PFR) From Red Book (Instantenous Peak)		8	
OPERATING HOURS	1	Source Pump Station (SPSH)	(Maximum operating hours per day that required volume of w	16	hours
	2	Water purification plant (WTPH)	(Maximum operating hours per day that required volume of w	16	Hours
	3	Lifting Pump Station **(LPS%)**	(% of Instantanious peak flow)	150%	
STORAGE	1	Storage in elevated tanks	(Hours of Instantanous Peak Demand)	4	hours
	2	Potable Water Storage Reservoirs	(Hours of Annual Average Daily Demand*SPF)	48	hours
	3	Raw Water Storage Reservoirs	(Hours of Summer Average Daily Demand)	1	days

The table on the next page shows the current theoretical demands and capacity of the existing bulk water infrastructure:

	BULK AND CONNECTOR SERVICES CAPACITY CALCULATION : CURRENT					
	NO.	DESCRIPTION	UNITS		DEMAND PER UNIT	Criteria
GENERAL	1	Sub-Economical Houses (Existing)	1346	Houses	600 l/ household per day	807.6 m^3/d
	2	Sub-Economical Houses (135 houses development)	0	Houses	600 l/ household per day	0 m^3/d
	3	Economical Houses (Existing)	202	Houses	1000 l/ household per day	202 m^3/d
	4	Economical Houses (135 houses development)	0	Houses	1200 l/ household per day	0 m^3/d
	5	Primary School Hostel	80	Learners	150 l/ Learner per day	12 m^3/d
	6	Primary Schools	350	Learners	25 l/ Learner per day	8.75 m^3/d
	7	High School Hostel	120	Learners	150 l/ Learner per day	18 m^3/d
	8	High School	670	Learners	25 l/ Learner per day	16.75 m^3/d
	9	Clinics	1600	m^2 x	500 l/100m^2 per day	8 m^3/d
	10	Businesses, Government and Municipal	4800	m^2 x	400 l/100m^2 per day	19.2 m^3/d
	11	Abbatoirs	350	Carcass	70 l/carcass per day	24.5 m^3/d
	12	Developed Parks, Sportsgrounds and Day Cares	0.20	ha	5 mm water per day	10 m^3/d
		ANNUAL AVERAGE DAILY DEMAND (AADD)				**1127 m^3/d**

							CURRENT CAPACITY	
THEORETICAL DEMANDS	1	Annual Average Daily Demand (AADD)	AADD	##### m^3/day	47.0 m^3/hour	13.0 l/s		
	2	Gross Annual Average Daily demand (GAADD)	(1+Lfr)*AADD	##### m^3/day	54.0 m^3/hour	15.0 l/s		
	3	Summer Gross Daily Demand (SGDD)	SPF*GAADD	##### m^3/day	81.0 m^3/hour	22.5 l/s		
	4	Instantanious Peak Demand (IPD) (Main supply pipeline to reticulation)	AADD*PFR		375.6 m^3/hour	104.3 l/s		
	5	Storage Capacity Elevated Storage	hours*IPD			1502.4 m^3	10.0 m^3	1%
	6	Lifting Pump Station Capacity and Pipeline Flow between Main Storage and Elevated tank	IPD***LPS%**	446 mm dia	563.4 m^3/hour	156.5 l/s	10.0 l/s	6%
	7	Potable Water Storage Capacity (Main Storage)	hours*AADD			2253.6 m^3	116.0 m3	5%
	8	**Water Treatment Plant Capacity (WTPC)**	**SGDD*24/WTPH**	**##### m3/day**	**121.5 m3/hour**	**33.7 l/s**	**1.7 l/s**	**5%**
	9	**Source Pump Station Capacity and Pipeline Flow**	**WTPC*(1+LFW)*24/SP**	**272 mm dia**	**209.6 m3/hour**	**58.2 l/s**	**6.0 l/s**	**10%**
	10	Raw Water Storage Capacity	Days*SGDD			1944.0 m^3	60.0 m3	3%

It is clear from the table that the existing infrastructure is already under pressure to handle the demand. Water from the raw water storage dam is also used to irrigate the sportsfield. The biggest problems are with bulk and elevated storage, along with the small capacity 150m3 clear water sump.

3.3 Bulk Water Infrastructure Requirements

The table below compares the current infrastructure capacities with the capacity that is required for the 1500 stands development. Cells highlighted in red would require upgrading in order to accommodate the expected demands.

NO.	DESCRIPTION		UNITS	DEMAND PER UNIT		Criteria		
	EXISTING - ANNUAL AVERAGE DAILY DEMAND (AADD)					**1127**	**m^3/d**	
1	Sub-Economical Houses (Existing)		1493 Houses x	600 l/ household per day		895.8	m^3/d	
10	Businesses, Government and Municipal		18 m^2 x	400 l/100m^2 per day		0.072	m^3/d	
	FUTURE - ANNUAL AVERAGE DAILY DEMAND (AADD)					**895.9**	**m^3/d**	
1	Annual Average Daily Demand (AADD)	AADD	895.9 m^3/day	37.3 m^3/hour	**10.4** l/s	CURRENT CAPACITY		
2	Gross Annual Average Daily demand (GAADD)	(1+Lfr)*AADD	1030.3 m^3/day	42.9 m^3/hour	**11.9** l/s			
3	Summer Gross Daily Demand (SGDD)	SPF*GAADD	1545.4 m^3/day	64.4 m^3/hour	**17.9** l/s			
4	Instantanious Peak Demand (IPD) (Main supply pipeline to reticulation)	AADD*PFR		186.6 m^3/hour	**51.8** l/s			
5	**Storage Capacity Elevated Storage**	hours*IPD			**746.6** m^3	10.0	m^3	**1%**
6	Lifting Pump Station Capacity and Pipeline Flow between Main Storage and Elevated tank	IPD***LPS%**	315 mm dia	280.0 m^3/hour	**77.8** l/s	10.0	l/s	**13%**
7	**Potable Water Storage Capacity (Main Storage)**	hours*AADD			**1791.7** m^3	116.0	m3	**6%**
8	**Water Treatment Plant Capacity (WTPC)**	**SGDD*24/WTPH**	**2318.1 m3/day**	**96.6 m3/hour**	**26.8 l/s**	**1.7**	**l/s**	**6%**
9	**Source Pump Station Capacity and Pipeline Flow**	**WTPC*(1+LFW)*24/SP**	**243 mm dia**	**166.6 m3/hour**	**46.3 l/s**	**6.0**	**l/s**	**13%**
10	Raw Water Storage Capacity	Days*SGDD			**1545.0** m^3	60.0	m3	**4%**

Recommended upgrades to the Groblershoop bulk water infrastructure are as follows (shown on the drawing below):

Future Bulk Water Demand

a) New River Pump Station

- Pump Station Building via RC concrete base with steel cage superstructure
- Existing river abstraction rising main 160mm dia. And pump sets to be upgraded and refurbished.
- Add extra River abstraction rising main 160mm dia uPVC CL.6 at 1,660 m long over 35m total head, next to existing 160mm dia rising main pipeline.
- Two(2) river abstraction pump and motor sets duty and standby at 46 L/s @ 15 kW motor each

b) Raw Water Storage (WTP)

- Existing 1,200m3 raw water storage pond not suitable and to be upgraded to double the capacity to 2,400m3 storage capacity via HDPE lined earth dam.
- Existing raw water rising main 160mm dia. & pump sets to be upgraded and refurbished.
- Add extra Raw water rising main 160mm dia uPVC CL.6 at 100 m long over 10m total head
- Two(2) raw water pump and motor sets duty and standby at 46 L/s @ 7.5 kW motor each

c) Water Treatment Plant (WTP)

- Existing water treatment plant to be upgraded to double existing capacity from 1,200 m3/h to 2,400m3/h via
- Upgrade addition of double the settling clarifiers from 100m3/h to 200m3/h including coagulant dosing system for batch plant WTP.
- Upgrade by doubling the sand pressure filters, pressure filtration pump sets, chlorination dosing

d) Clear Water Sump

- Existing CW sump not sufficient at 150m3 storage and to be upgraded.
- Construction of new CW sump by utilizing adjacent rc dams with new lining and floating roof cover to 1,200m3 capacity.

e) Existing Old Town Booster Pump Station

- Existing booster pump and motor sets to be refurbished to existing flow and pressure ratings.
- Existing Old Town 160mm dia rising main unchanged and sufficient, along with 160mm gravity feed to Old Town distribution network.
- Existing Old Town 1.2ML rc storage reservoirs are over capacity and sufficient.

f) Existing Sternham Booster Pump Station

- Existing booster pump and motor sets to be refurbished to existing flow and pressure ratings.
- Existing Sternham rising main unchanged and sufficient as recently refurbished.
- Existing Sternham 0.8 ML sectional steel storage unchanged on current refurbishment programme with option of omitting.
- Option of pumping directly into Sternham 130kL elevated steel storage tank via Sternham rising booster main pipeline.
- Existing elevated booster pump station unchanged and sufficient with option of by-passing and omitting.

g) Existing Abattoir (Witblok) Booster Pump Station

- Existing booster pump and motor sets to be refurbished to existing flow and pressure ratings.
- Existing Witblok rising main unchanged and sufficient as recently refurbished.
- Existing Witblok 55 kL elevated steel storage tank unchanged and sufficient.
- Existing Witblok 55 kL elevated steel storage tank feed from Sternham elevated storage are sufficient.

h) New 1500 Erven Booster Pump Station & Infrastructure

- Construction of new development booster pump and refurbish existing booster pump stations.
- Construct new 160mm dia uPVC CL.9 rising main over 3,500m over 35m head.
- Construct new 1.75ML potable water sectional steel storage reservoir at NGL=885m level.
- Construct new 750 kL elevated steel storage tank at 10m height from NGL=885m level.
- Option to feed to existing Abattoir/Witblok development water reticulation, and omit 55kL Abattoir/Witblok elevated tank.
- Construct new 140mm dia uPVC CL.6 bulk ring feed pipe network for new 532 erven North development, as well as 961 erven South development.

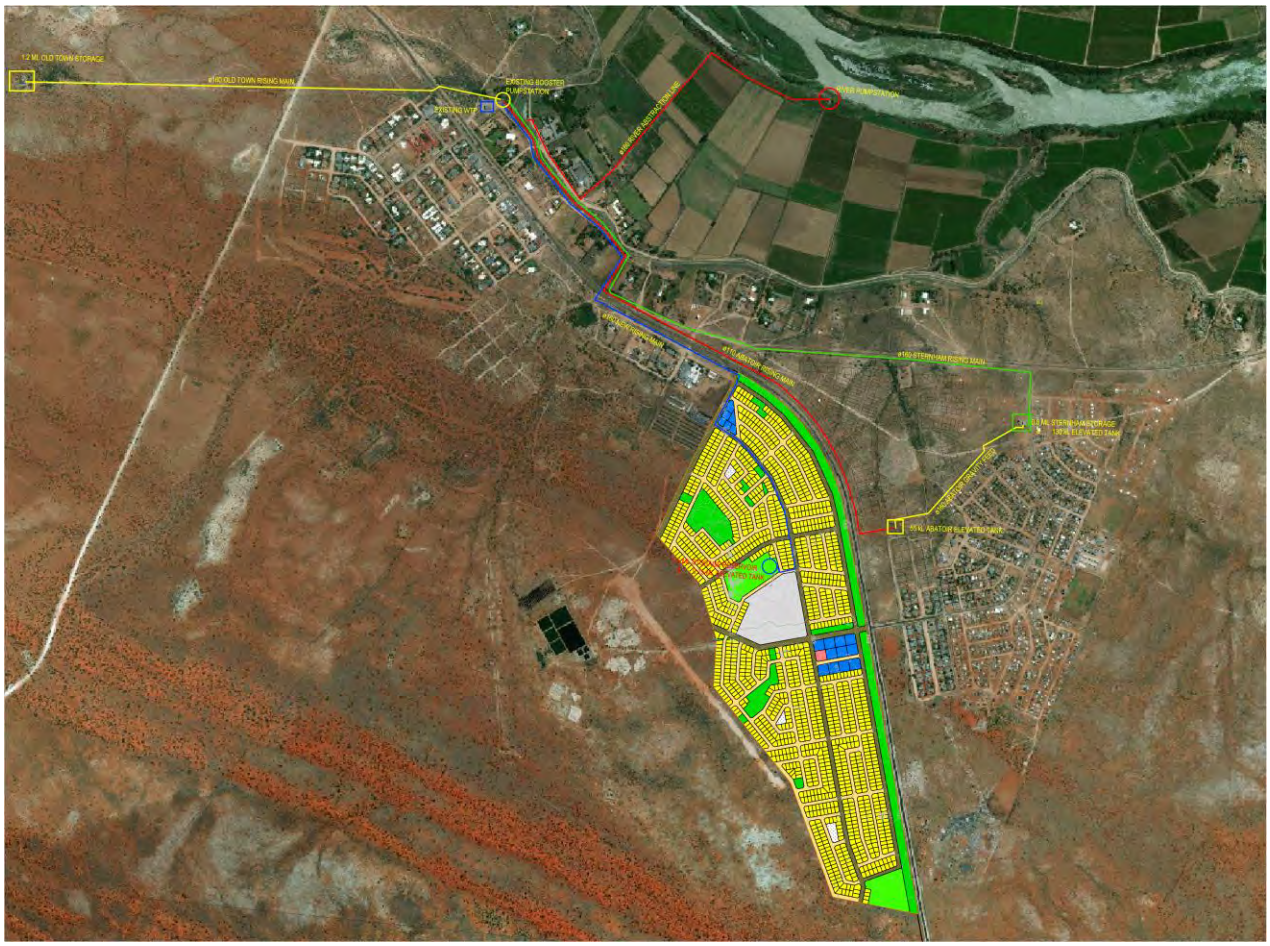


Figure 5: Proposed Water Bulk Infrastructure

Fire Fighting Requirements

Areas to be protected by a fire service should be classified according to a fire-risk category. The new development can be classified as a “Low risk – Group 4” according to the “Guidelines for Human Settlement Planning and Design”.

No specific provision for fire fighting water is required in water storage, or reticulation mains in these areas. Hydrants should, however, be located at convenient points in the area on all mains of 75 mm nominal internal diameter and larger, and in the vicinity of all schools, commercial areas and public buildings.

Fire fighting in areas zoned “Low-risk – Group 4” should generally be carried out using trailer-mounted water tanks or fire appliances that carry water, which can be replenished from the hydrants provided in the reticulation, if necessary.

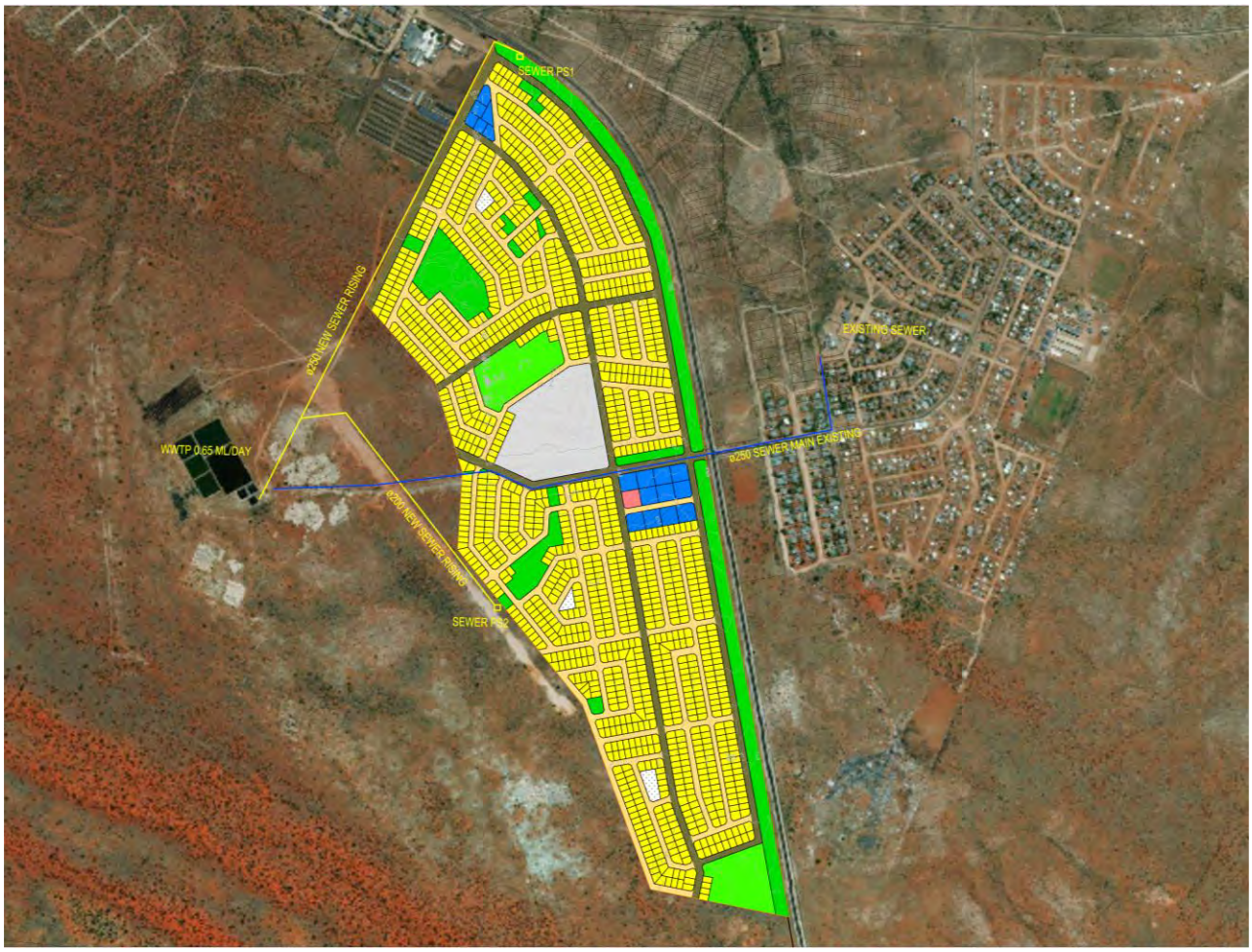
4. SEWERAGE

4.1 Existing Sewage Infrastructure overview

All the houses in the Groblershoop village is currently serviced by VIP toilets. There are no sewer bulk infrastructure.

4.2 Bulk Sewer Infrastructure Requirements

If a full borne sewer sewerage system is required for the new 1500 houses development, the associated bulk infrastructure will most possibly consist of a pumpstation, rising main pipeline and oxidation ponds as shown on the Google image below.



The total sewer flow is calculated as follows:

GROBLERSHOOP TOTAL SEWER FLOW					
Sewer flow per day - Sub economical houses	1346	sub economical houses @	500 l/day	**673 000**	**l/day**
Sewer flow per day - Economical houses	202	economical houses @	750 l/day	**151 500**	**l/day**
Sewer flow per day - Hostels	200	persons @	140 l/day	**28 000**	**l/day**
Sewer flow per day - Schools	1020	persons @	20 l/day	**20 400**	**l/day**
Sewer flow per day - Abbatoir	350	carcasses @	42 l/day	**14 700**	**l/day**
Businesses and State Institutions	20	buildings	100 l/day	**2 000**	**l/day**
SEWER FLOW PER DAY - TOTAL				**889 600**	**l/day**

The sizes and capacities of the proposed Two(2) number of new Sewer Pump stations required for the prposed new 1,500 sub-economical development with sewer rising mains were calculated as follows:

PUMP STATION No 1 AND RISING MAIN					
Sewer flow per day - Sub economical houses	961	sub economical houses @	500 l/day	**480500**	**l/day**
Businesses and State Institutions	12	buildings	100 l/day	**1200**	**l/day**
SEWER FLOW PER DAY - TOTAL				**481700**	**l/day**
Average sewer flow				**5.6**	**l/s**
Factor for inflow from other sources	30%			**1.7**	**l/s**
Sewer flow with inflow from other sources				**7.2**	**l/s**
PEAK NETWORK SEWER FLOW	7.2		3.5	**25.4**	**l/s**
FLOWRATE FROM OTHER PUMP STATIONS				**0**	**l/s**
TOTAL PEAK FLOW				**25.37**	**l/s**
ACTUAL PUMP ABILITY	**1.84**	times peak flow		**46.7**	**l/s**
Theoretical pump station capacity for normal pump operation	1	hours of peak flow		**91**	**m^3**
Theoretical pump station capacity for emergency storage	4	hours of normal flow		**104**	**m^3**
TOTAL REQUIRED THEORETICAL PUMP STATION CAPACITY				**196**	**m^3**
Pump details		1 x Duty & 1 x Standby		**7.5**	**kW**
Rising main diameter				**250**	**mm**
Rising main material				**PVC**	
Rising main length				**750**	**m**
Total pump height				**32**	**m**

PUMP STATION No 2 AND RISING MAIN					
Sewer flow per day - Sub economical houses	532	sub economical houses @	500 l/day	**266000**	**l/day**
Businesses and State Institutions	6	buildings	100 l/day	**600**	**l/day**
SEWER FLOW PER DAY - TOTAL				**266600**	**l/day**
Average sewer flow				**3.1**	**l/s**
Factor for inflow from other sources	30%			**0.9**	**l/s**
Sewer flow with inflow from other sources				**4.0**	**l/s**
PEAK NETWORK SEWER FLOW	4.0		3.5	**14.0**	**l/s**
FLOWRATE FROM OTHER PUMP STATIONS				**0**	**l/s**
TOTAL PEAK FLOW				**14.04**	**l/s**
ACTUAL PUMP ABILITY	**1.84**	times peak flow		**25.8**	**l/s**
Theoretical pump station capacity for normal pump operation	1	hours of peak flow		**51**	**m^3**
Theoretical pump station capacity for emergency storage	4	hours of normal flow		**58**	**m^3**
TOTAL REQUIRED THEORETICAL PUMP STATION CAPACITY				**108**	**m^3**
Pump details		1 x Duty & 1 x Standby		**4.5**	**kW**
Rising main diameter				**200**	**mm**
Rising main material				**PVC**	
Rising main length				**1200**	**m**
Total pump height				**32**	**m**

Future Bulk Sewer Demand

The site is divided by water separation into two(2) sewer gravitational network runoffs for 532 erven (North) and 961 erven (South)

1.1 Sewer Pump Station 1 (North) –

- Pump Sump Capacity 110m3 at 4.5x4.5x5.5m depth incl. 58m3 emergency & 51m3 pump storage
- Sewer rising main 200mm dia uPVC CL.6 at 1,200 m long over 15m total head
- Two(2) self-priming pump and motor sets duty and standby at 26 L/s @ 7.5 kW motor each

1.2 Sewer Pump Station 2 (South) –

- Pump Sump Capacity 190m3 at 4.5x8.0x5.5m depth incl. 100m3 emergency & 90m3 pump storage
- Sewer rising main 250mm dia uPVC CL.6 at 750 m long over 15m total head

- Two(2) self-priming pump and motor sets duty and standby at 47 L/s @ 9.0 kW motor each

1.3 Existing Oxidation Ponds WWTW

- Existing Oxidation Pond System at 650m3/day load capacity is un-sufficient and to be upgraded to 750m3/day for minimum 45 day total retention period.
- Upgrade construction of increasing Anaerobic pond size and depths for 60% COD breakdown with 7-day retention each.
- Upgrade construction of Facultative Pond to 1.5 times current storage load retention.
- Remainder of Secondary and Final Storage ponds to remain unchanged.

5. ROADS AND STORMWATER

5.1 Roads and Access

Access to the development will be from the existing Residential Collector Streets (Class 4b), as shown on the drawing below:

No problems are foreseen regarding roads and access.

5.2 Stormwater Management

The guiding principle underlying the storm water management strategy is that, where possible, the peak run-off from the post-developed site should not exceed that of the pre-developed site for the full range of storm return periods (1:2 to 1:50). Where possible, measures should be incorporated into the site development plan to attenuate the post-development flows to pre-development rates.

The storm water network must be designed to accommodate (flood frequencies as prescribed by "The Red Book") the minor storm event (1:5 year) in open channels or side drains of streets. The major storm (1:50 year) should be managed through controlled overland flows, above-ground attenuation storage (if required) and berms at the higher end of the site (if required). As no formal storm water system exists in the area, concentration of storm water must be avoided as far as possible. Earthworks on plots should therefore encourage free drainage of the area.

Groblershoop is a small village that generally drains from the centre. Existing roads will be adequate for this purpose.

6. SOLID WASTE

7. ELECTRICAL SUPPLY

7.1 Electrical Demands and Availability

This section of the report covers the availability of the Bulk Electrical connection to the future 1500 Community stands, an expected additional load of the proposed development will initially be 162KVA as per INEP guidelines and the accommodation of this load will form the basis of this report. The community of Groblershoop falls directly under “Eskom Distribution” and the existing electrified homes in the community purchase electricity directly from Eskom and not through the Kheis local Municipality.

The bulk connection to the community / town is via a 22kV overhead line fed from the 10MVA Grobelaarshoop sub-station

7.2 Existing Electrical Network

The bulk connection to the community / town is via a 22kV overhead line fed from the Eskom 10MVA Grobelaarshoop sub-station , this sub-station is currently in the process of being upgraded to 20MVA and will be commissioned in December 2020.

The existing MV electrical network in the Groblershoop runs through the town via 22 KV overhead line feeder connecting to various pole mounted transformers (see figure 1 below). The existing overhead line feed is running through a section of the proposed development “Groblershoop Site 1 - 3ha”.

The existing feeder can easily handle the future additional 162kVA load only after the upgraded Eskom Groberlaarshoop sub-station is brought online as indicated by Eskom’s network planning department.

7.3 Electrical Network Extension

The internal electrical network extension in the Groblershoop community will only be done by Eskom after the formulation processes are completed as this area falls under the Eskom Distribution

8. COST ESTIMATE

The cost estimate for the proposed activities are as provided below. The level of accuracy is commensurate with a concept level design.

Description	Amount
Water Bulk Services	
New mobile 12l/s river pump station	R 850 000,00
0,85km 125mm Ø supply line	R 722 500,00
Upgrading of Water Treatment Works	R 700 000,00
New 360m^3 storage reservoir	R 900 000,00
New 240m^3 storage reservoir	R 840 000,00
New 24l/s lifting pump station	R 240 000,00
0,3km 200mm Ø line from lifting PS to elevated storage	R 285 000,00
Sub-Total (Water)	R 4 537 500,00
Bulk Sewer Services	R -
New 0,25 ML oxidation pond system	R 2 675 662,36
New sewer pump station No 1	R 1 676 508,10
New sewer pump station No 2	R 1 676 508,10
2,1km 110mm Ø uPVC rising main (PS No.1)	R 2 233 596,40
1,3km 110mm Ø uPVC rising main (PS No.2)	R 1 451 837,66
Sub-Total (Sewer)	R 8 262 274,95
Roads and Access	R -
None	R -
Stormwater	R -
None	R -
Electrical	R -
O/H ACSR line ring	R 2 300 000,00
Circuit breaker (11kV, LC1&2)	R 1 550 000,00
O/H ACSR line to POC	R 1 850 000,00
Sub-Total (Electrical)	R 5 700 000,00
Sub-Total	R 18 499 774,95
15% P&G's	R 2 774 966,24
Sub-Total	R 21 274 741,19
10% Contingencies	R 2 127 474,12
Sub-Total	R 23 402 215,31
10% Professional fees	R 2 340 221,53
Sub-Total	R 25 742 436,84
15% VAT	R 3 861 365,53
Grand Total	R 29 603 802,37

Notes:

1) Base date of the calculations is April 2020;
2) No provision was made for EIA, registration and/or land acquisition;
3) No allowance was made for institutional and/or social development.

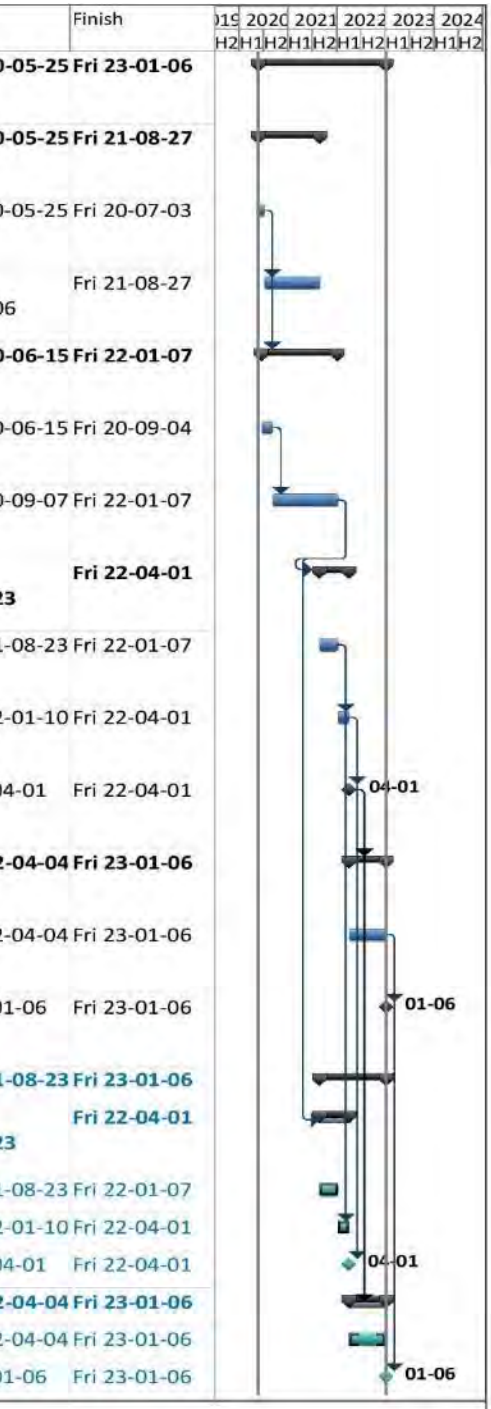
7.1 Funding

Funding can be applied for through the Municipal Infrastructure Grant (MIG) and Regional Bulk Infrastructure Grant (RBIG). For repair work at the water treatment works, the Water and Sanitation Infrastructure Grant (WSIG) can also be applied for.

This report can be used for funding application from the various schemes available.

9. PROJECT TIMELINE

ID	Task Mode	Task Name	Duration	Start	Finish
1		**BULK INFRASTRUCTURE TIMELINE**	**685 days?**	**Mon 20-05-25**	**Fri 23-01-06**
2		**APPLICATION FOR FUNDS**	**330 days**	**Mon 20-05-25**	**Fri 21-08-27**
3		Application for RBIG & Mig funding	30 days	Mon 20-05-25	Fri 20-07-03
4		Approval of feasibility study & readyness report	300 days	Mon 20-07-06	Fri 21-08-27
5		**EIA PROCESS**	**410 days**	**Mon 20-06-15**	**Fri 22-01-07**
6		Appointment of EIA Specialist	60 days	Mon 20-06-15	Fri 20-09-04
7		EIA study	350 days	Mon 20-09-07	Fri 22-01-07
8		**DESIGN, DOCUMENTATION AND PROCUREMENT**	**160 days**	**Mon 21-08-23**	**Fri 22-04-01**
9		Design and documentation	100 days	Mon 21-08-23	Fri 22-01-07
10		Procurement	60 days	Mon 22-01-10	Fri 22-04-01
11		Contractor appointed	0 days	Fri 22-04-01	Fri 22-04-01
12		**CONSTRUCTION**	**200 days**	**Mon 22-04-04**	**Fri 23-01-06**
13		Construction period	200 days	Mon 22-04-04	Fri 23-01-06
14		Construction completed	0 days	Fri 23-01-06	Fri 23-01-06
15		**INTERNAL SERVICES CONSTRUCTION**	**360 days?**	**Mon 21-08-23**	**Fri 23-01-06**
16		**DESIGN, DOCUMENTATION AND PROCUREMENT**	**160 days**	**Mon 21-08-23**	**Fri 22-04-01**
17		Design and documentation	100 days	Mon 21-08-23	Fri 22-01-07
18		Procurement	60 days	Mon 22-01-10	Fri 22-04-01
19		Contractor appointed	0 days	Fri 22-04-01	Fri 22-04-01
20		**CONSTRUCTION**	**200 days?**	**Mon 22-04-04**	**Fri 23-01-06**
21		Construction period	200 days	Mon 22-04-04	Fri 23-01-06
22		Construction completed	0 days	Fri 23-01-06	Fri 23-01-06



Project: 34702 Gamakor Developm
Date: Sat 20-05-23

Task		Inactive Summary	
Split		Manual Task	
Milestone		Duration-only	
Summary		Manual Summary Rollup	
Project Summary		Manual Summary	
External Tasks		Start-only	
External Milestone		Finish-only	
Inactive Task		Deadline	
Inactive Milestone		Progress	

10. CONCLUSION

Engineering services were assessed to determine spare capacity on the existing bulk infrastructure and compared to the estimated demand of the newly proposed Groblershoop 1500 houses development.

The findings and conclusions in this report are based on a preliminary desktop study, as well as site visits.

10.1 Bulk Water Infrastructure –

The current capacity of the bulk water infrastructure is not enough to accommodate the proposed 1500 houses development as is. It is proposed that the infrastructure should be upgraded, not only to provide adequate capacity for the Gamakor development, but also for future water demand increases. The following upgrades are proposed:

a) New River Pump Station

- Pump Station Building via RC concrete base with steel cage superstructure
- Existing river abstraction rising main 160mm dia. And pump sets to be upgraded and refurbished.
- Add extra River abstraction rising main 160mm dia uPVC CL.6 at 1,660 m long over 35m total head, next to existing 160mm dia rising main pipeline.
- Two(2) river abstraction pump and motor sets duty and standby at 46 L/s @ 15 kW motor each

b) Raw Water Storage (WTP)

- Existing 1,200m3 raw water storage pond not suitable and to be upgraded to double the capacity to 2,400m3 storage capacity via HDPE lined earth dam.
- Existing raw water rising main 160mm dia. & pump sets to be upgraded and refurbished.
- Add extra Raw water rising main 160mm dia uPVC CL.6 at 100 m long over 10m total head
- Two(2) raw water pump and motor sets duty and standby at 46 L/s @ 7.5 kW motor each

c) Water Treatment Plant (WTP)

- Existing water treatment plant to be upgraded to double existing capacity from 1,200 m3/h to 2,400m3/h via
- Upgrade addition of double the settling clarifiers from 100m3/h to 200m3/h including coagulant dosing system for batch plant WTP.

- Upgrade by doubling the sand pressure filters, pressure filtration pump sets, chlorination dosing

d) Clear Water Sump

- Existing CW sump not sufficient at 150m3 storage and to be upgraded.
- Construction of new CW sump by utilizing adjacent rc dams with new lining and floating roof cover to 1,200m3 capacity.

e) Existing Old Town Booster Pump Station

- Existing booster pump and motor sets to be refurbished to existing flow and pressure ratings.
- Existing Old Town 160mm dia rising main unchanged and sufficient, along with 160mm gravity feed to Old Town distribution network.
- Existing Old Town 1.2ML rc storage reservoirs are over capacity and sufficient.

f) Existing Sternham Booster Pump Station

- Existing booster pump and motor sets to be refurbished to existing flow and pressure ratings.
- Existing Sternham rising main unchanged and sufficient as recently refurbished.
- Existing Sternham 0.8 ML sectional steel storage unchanged on current refurbishment programme with option of omitting.
- Option of pumping directly into Sternham 130kL elevated steel storage tank via Sternham rising booster main pipeline.
- Existing elevated booster pump station unchanged and sufficient with option of by-passing and omitting.

g) Existing Abattoir (Witblok) Booster Pump Station

- Existing booster pump and motor sets to be refurbished to existing flow and pressure ratings.
- Existing Witblok rising main unchanged and sufficient as recently refurbished.
- Existing Witblok 55 kL elevated steel storage tank unchanged and sufficient.
- Existing Witblok 55 kL elevated steel storage tank feed from Sternham elevated storage are sufficient.

h) New 1500 Erven Booster Pump Station & Infrastructure

- Construction of new development booster pump and refurbish existing booster pump stations.

- Construct new 160mm dia uPVC CL.9 rising main over 3,500m over 35m head.
- Construct new 1.75ML potable water sectional steel storage reservoir at NGL=885m level.
- Construct new 750 kL elevated steel storage tank at 10m height from NGL=885m level.
- Option to feed to existing Abattoir/Witblok development water reticulation, and omit 55kL Abattoir/Witblok elevated tank.
- Construct new 140mm dia uPVC CL.6 bulk ring feed pipe network for new 532 erven North development, as well as 961 erven South development.

10.2 Bulk Sewage Infrastructure –

There is currently no bulk sewer infrastructure. Recommended Groblershoop bulk sewer infrastructure construction (excluding internal sewer lines) are as follows (shown on the drawing above):

The site is divided by water separation into two(2) sewer gravitational network runoffs for 532 erven (North) and 961 erven (South)

a) Sewer Pump Station 1 (North) –

- Pump Sump Capacity 110m3 at 4.5x4.5x5.5m depth incl. 58m3 emergency & 51m3 pump storage
- Sewer rising main 200mm dia uPVC CL.6 at 1,200 m long over 15m total head
- Two(2) self-priming pump and motor sets duty and standby at 26 L/s @ 7.5 kW motor each

b) Sewer Pump Station 2 (South) –

- Pump Sump Capacity 190m3 at 4.5x8.0x5.5m depth incl. 100m3 emergency & 90m3 pump storage
- Sewer rising main 250mm dia uPVC CL.6 at 750 m long over 15m total head
- Two(2) self-priming pump and motor sets duty and standby at 47 L/s @ 9.0 kW motor each

c) Existing Oxidation Ponds WWTW

- Existing Oxidation Pond System at 650m3/day load capacity is un-sufficient and to be upgraded to 750m3/day for minimum 45 day total retention period.
- Upgrade construction of increasing Anaerobic pond size and depths for 60% COD breakdown with 7-day retention each.
- Upgrade construction of Facultative Pond to 1.5 times current storage load retention.
- Remainder of Secondary and Final Storage ponds to remain unchanged.

- Roads and Access: No bulk infrastructure upgrading required on the roads.
- Storm Water Management: No bulk infrastructure upgrading required on the storm water.

- Electricity Supply – Formal bulk upgrade process to be finalised between Eskom and !Kheis Municipality.
- Electrical Load Centre – The existing Load Centre "Keimoes Nommer 2" can accommodate the future additional load, with only minor modification to be done in the Load Centre and as agreed with the Municipality's Electrical Department.

In conclusion, the engineering services are not in place (water and sewer) to meet the standard requirements. The infrastructure will have to be upgraded regardless of the implementation of the Groblershoop 1500 houses development in order to meet current and expected future needs. The upgrading should be done in such a way as to take into consideration the Groblershoop 1500 Houses development.

ANNEXURE E: DETAIL LAYOUT

IKHEIS MUNICIPALITY

CONCEPT TOWNSHIP ESTABLISHMENT

Design:	JP Theron (Pr. Pln. A/2394/2016)
Drawn:	JP Theron (Pr. Pln. A/2394/2016)
Date:	August 2020
Scale:	1:3000 (A1)

Plan nr:

Concept Layout Plan
(DWG.TE) 200824 Groblershoop

Proposed Land Uses in terms of Land Use Management System

Colour & Numbers	Land Use Description	Total Units	Schedule of Sizes: average size per erf	Schedule of Sizes: total area covered by land use	Schedule of Sizes: percentage of study area covered by use
	Open Space Zone I				
	Open Space Zone II	16			
	Open Space Zone III	1			
	Agricultural Zone I				
	Agricultural Zone II				
	Resort Zone II				
	Residential Zone I	1500	310m²	46.5ha	
	Residential Zone II				
	Residential Zone III				
	Residential Zone IV				
	Residential Zone V				
	Residential Zone VI				
	Institutional Zone I	2			
	Institutional Zone II	3			
	Institutional Zone III				
	Authority Zone I	1			
	Authority Zone II				
	Special Zone				
	Undetermined Zone				
	Business Zone I	16			
	Business Zone II				
	Business Zone III				
	Business Zone IV				
	Business Zone V				
	Business Zone VI				
	Industrial Zone I				
	Industrial Zone II				
	Industrial Zone IV				
	Industrial Zone IV				
	Utility Zone I				
	Utility Zone II				
	Utility Zone III				
	Transport Zone I				
	Transport Zone II				
	Transport Zone III				
	Total:	1539		95ha	

Addisional Information:

Contours	
Pipeline	
Sewerage Line	
Powerlines	
Buildings	
High Voltage Powerlines	
Telephone Lines	

Drawn:
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Department:
CO - OPERATIVE GOVERNANCE
HUMAN SETTLEMENTS & TRADITIONAL AFFAIRS
NORTHERN CAPE

ANNEXURE F: BOTANICAL ASSESSMENT

PB CONSULT
ENVIRONMENTAL MANAGEMENT SERVICES

BOTANICAL ASSESSMENT

GROBLERSHOOP HOUSING PROJECT

PROPOSED FORMALIZATION AND DEVELOPMENT OF 1 500 NEW ERVEN ON PORTION 16 OF THE FARM BOEGOEBERG, SETTLEMENT NO 48, GROBLERSHOOP, !KHEIS LOCAL MUNICIPALITY,NORTHERN CAPE PROVINCE

25 June 2020

P.J.J. Botes (Pr.Sci.Nat: 400184/05)

Registered Professional Botanical, Environmental and Ecological Scientist

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EXECUTIVE SUMMARY

VEGETATION TYPE

Bushmanland Arid Grassland and Gordonia Duneveld

Both these vegetation types are classified as "Least Threatened" (GN 1002, December 2011) although statutory conservation targets have not yet been met.

VEGETATION ENCOUNTERED

The activity is expected to result in a permanent transformation of approximately 95 ha of land, of which approximately 60 - 70% is still covered by indigenous vegetation in good condition.

CONSERVATION PRIORITY AREAS

According to the Northern Cape CBA maps the proposed site falls within a CBA area. However, there is no alternative on Municipal land that will not impact on the CBA.

The site will not impact on any recognised centre of endemism.

CONNECTIVITY

The transformation of the site will destroy connectivity on the site, but should not result in a significant impact on the surrounding area, where connectivity is still excellent.

LAND-USE

The footprint is on municipal land in close proximity to the town of Groblershoop. Portions of the footprint is heavily disturbed as a result of illegal dumping, old ponds (e.g. sewerage works) and other physical disturbances. Although the area is grazed by livestock from the local community most of the footprint still supports indigenous vegetation in good condition.

PROTECTED PLANT SPECIES

The most significant botanical aspect of this site is the presence of a 14 protected Sheppard trees (*Boscia albitrunca*), some of which were in excellent condition (refer to Table 2). A number of Northern Cape Nature Conservation Act, protected species were also observed (Refer to Table 3).

MAIN CONCLUSION

The proposed development footprint is located on Municipal property, adjacent to existing town developments. The activity is expected to result in a permanent transformation of approximately 95 ha of land, of which approximately 60 - 70% is still covered by indigenous vegetation in good condition. The site overlaps an identified critical biodiversity area (according to the 2016, Northern Cape Critical Biodiversity Areas maps). In addition, 14 protected Sheppard trees (*Boscia albitrunca*), and a number of Northern Cape Nature Conservation Act, protected species were observed within the footprint.

According to the impact assessment given in Table 6 the development is likely to result in a relative **Medium-Low** impact, which can be reduced to a **Low** impact with good environmental control during construction.

With the correct mitigation it is unlikely that the development will contribute significantly to any of the following:

- Significant loss of vegetation type and associated habitat.
- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities.
- Loss of local biodiversity and threatened plant species.
- Loss of ecosystem connectivity.

WITH THE AVAILABLE INFORMATION IT IS RECOMMENDED THAT PROJECT BE APPROVED, WITH THE PROPOSED MITIGATION ACTIONS.

NO-GO OPTION

The No-Go option is not likely to result in a "no-impact" scenario, as constant slow degradation is expected to continue as a result of urban activities and poor management of the site (illegal dumping & construction activities).

There is also an urgent need for the establishment of additional residential erven in the !Kheis Municipality, which is likely to outweigh the No-Go option.

INDEPENDENCE & CONDITIONS

PB Consult is an independent entity with no interest in the activity other than fair remuneration for services rendered. Remunerations for services are not linked to approval by decision making authorities and PB Consult have no interest in secondary or downstream development as a result of the authorization of this proposed project. There are no circumstances that compromise the objectivity of this report. The findings, results, observations and recommendations given in this report are based on the author's best scientific and professional knowledge and available information. PB Consult reserve the right to modify aspects of this report, including the recommendations if new information become available which may have a significant impact on the findings of this report.

RELEVANT QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Mr Peet Botes holds a BSc. (Hons.) degree in Plant Ecology from the University of Stellenbosch (Nature Conservation III & IV as extra subjects). Since qualifying with his degree, he had worked for more than 20 years in the environmental management field, first at the Overberg Test Range (a Division of Denel) managing the environmental department of OTR and being responsible for developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve).

In 2005 he joined Enviroscientific, an independent environmental consultancy specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity en environmental legal compliance audits.

During 2010 he joined EnviroAfrica in order to move back to the biodiversity aspects of environmental management. Experience with EnviroAfrica includes NEMA EIA applications, environmental management plans for various industries, environmental compliance audits, environmental control work as well as more than 70 biodiversity & botanical specialist studies.

Towards the end of 2017, Mr Botes started his own small environmental consulting business focusing on biodiversity & botanical assessments, biodiversity management plans and environmental compliance audits.

Mr Botes is a registered Professional Botanical, Environmental and Ecological Scientists at SACNASP (South African Council for Natural Scientific Professions) as required in terms of Section 18(1)(a) of the Natural Scientific Professions Act, 2003, since 2005.

DECLARATION OF INDEPENDENCE

THE INDEPENDENT PERSON WHO COMPILED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS

I Petrus, Jacobus, Johannes Botes, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014, as amended, and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 13 of GN No. R. 326.

Note: The terms of reference must be attached.

Signature of the specialist:

PB Consult (Sole Proprietor)

Name of company:

25 June 2020

Date:

CONTENTS

LIST OF TABLES:

LIST OF PHOTOS:

1. INTRODUCTION

There is an urgent need for the establishment of additional residential erven in the sub-economical market in the !Kheis Local Municipality. Seven towns have been identified for the proposed development of a number of new erven at each town. They are:

- Boegoeberg: 550 erven;
- Gariep: 135 erven;
- Groblershoop: 1500 erven;
- Grootdrink: 370 erven;
- Opwag: 730 erven;
- Topline: 248 erven; and
- Wegdraai: 360 erven.

Macroplan has been appointed by the Barzani Group (on behalf of COGHSTA) as Town and Regional Planners to manage the town planning process in terms of SPLUMA (Act 16 of 2013).

The proposed project will trigger listed activities under the National Environmental Management Act, (Act 107 of 1998) (NEMA) and the EIA regulations (as amended). As result EnviroAfrica was appointed to perform the NEMA EIA application and PB Consult was appointed to conduct a botanical assessment of the proposed sites, which, although disturbed in some areas, still supports natural vegetation.

This report refers to the proposed development of approximately 1 500 new erven on a 95 ha piece of land on Portion 16 of the Farm Boegoeberg (Settlement No. 48), next to Groblershoop.

The proposed land supports two vegetation types namely, namely Bushveld Arid Grassland and Gordonia Duneveld (both considered "Least Threatened" in terms of the National list of ecosystems that are threatened and in need of protection). However, the desktop study suggests that portions of the footprint are already disturbed, or subject to disturbance as a result of its proximity to the adjacent urban development.

However, the site also falls within a proposed terrestrial critical biodiversity area (CBA1) as identified in the 2017 Northern Cape Biodiversity Spatial Plan.

1.1. TERMS OF REFERENCE

The terms of reference for this appointment were to:

- Evaluate the proposed site(s) in order to determine whether any significant botanical features will be impacted as a result of the proposed development.
- Determine and record the position of any plant species of special significance (e.g. protected tree species, or rare or endangered plant species) that should be avoided or that may require "search & rescue" intervention.
- Locate and record sensitive areas from a botanical perspective within the proposed development footprint that may be interpreted as obstacles to the proposed development.
- Make recommendations on impact minimization should it be required
- Consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

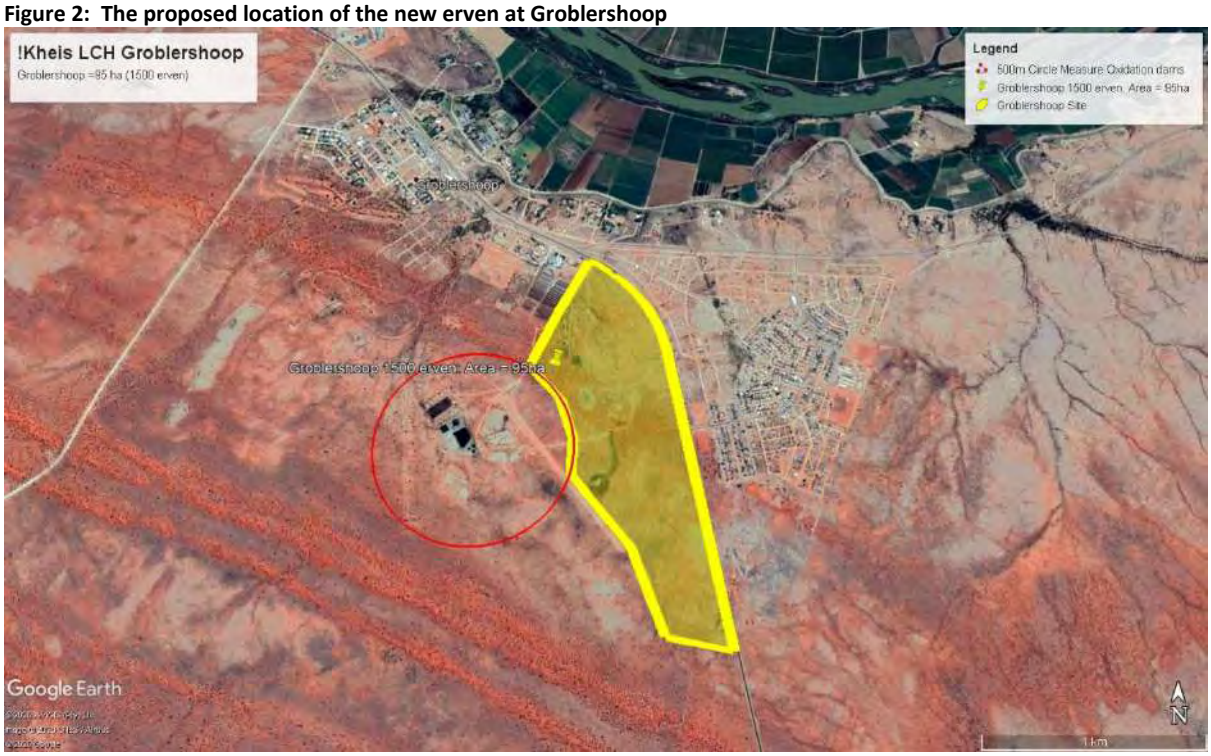
2. STUDY AREA

2.1. LOCATION & LAYOUT

Groblershoop is located on the N10 between Upington (117 km to the north) and Prieska (132 km to the south), in the !Kheis Local Municipality of the Northern Cape Province (Figure 1). The proposed new erven will be located to the south of Groblershoop, west of the N10 (just west of the Stutterheim settlement) on Portion 16 of the Farm Boegoeberg, Settlement no. 48 (GPS Coordinates 28°54'32.64"S; 21°59'47.71"E).

Figure 1: Map showing the location of Groblershoop in relation to Upington in the Northern Cape Province

Figure 2: The proposed location of the new erven at Groblershoop



2.2. CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. Groblershoop receives less than a 100 mm of rain per year, mainly in mid-summer December to March the highest (40 mm) in February/March, with its lowest rainfall (0 mm)during winter (June to August). It is also important to note that rainfall can be highly erratic and can vary significantly per annum on any specific location. Daily temperatures vary from 23°C – 37°C during the hot summer months (December / January) and drops down to between 8°C - 17°C during the colder winter months (June – July) (www.worldweatheronline.com).

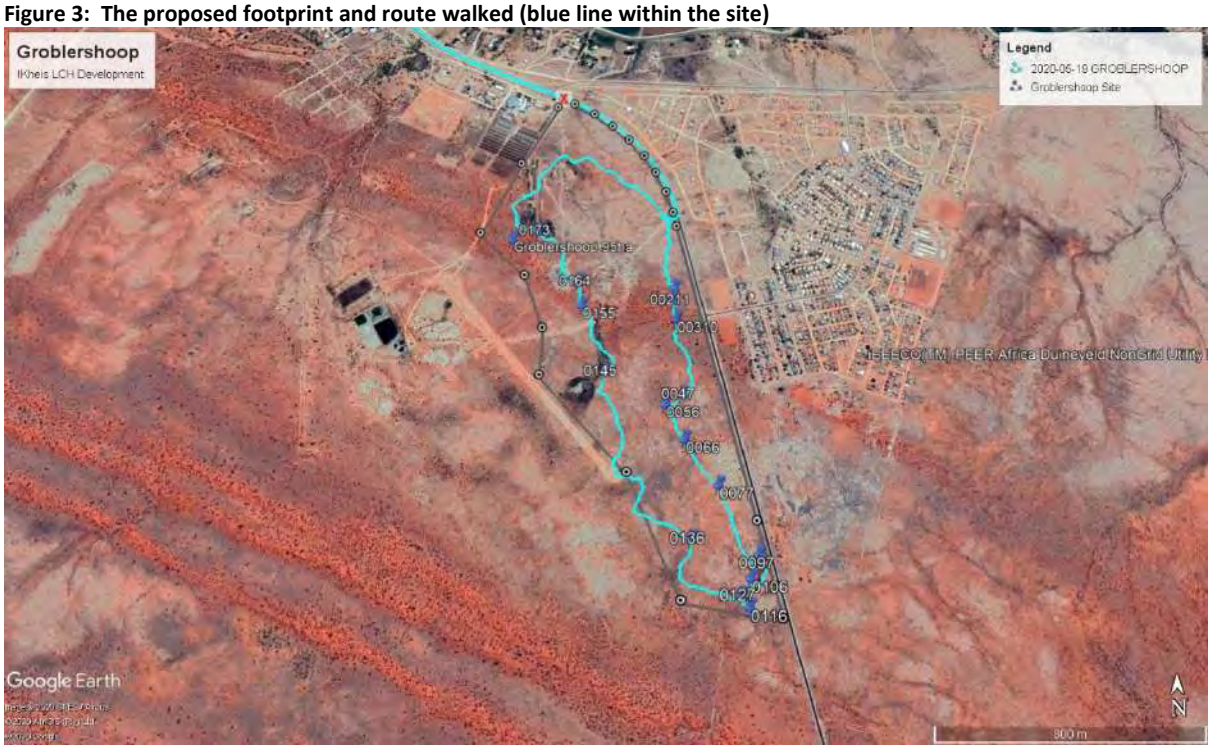
2.3. TOPOGRAPHY & SOILS

The proposed Groblershoop town extension is located on slightly irregular plains with a slight slope towards the east (towards the Orange River). The soils varies from shallow soils with calcrete outcrops in the areas covered by Bushmanland Arid Grassland dissected by deeper red sandy in the area covered by Gordonia Duneveld.

3. EVALUATION METHOD

Desktop studies coupled with a site visit were performed. The site visit was conducted on the 19st of May 2020. The timing of the site visit was reasonable in that, even though the veld was very dry, almost all perennial plants were identifiable. It must be noted that the Northern Cape is currently experiencing one of its worst drought periods in a long time, and although some summer rains had fallen (deducted from the presence of a number of grass species) it was not yet enough to really trigger a display of annual herbs.

Figure 3: The proposed footprint and route walked (blue line within the site)



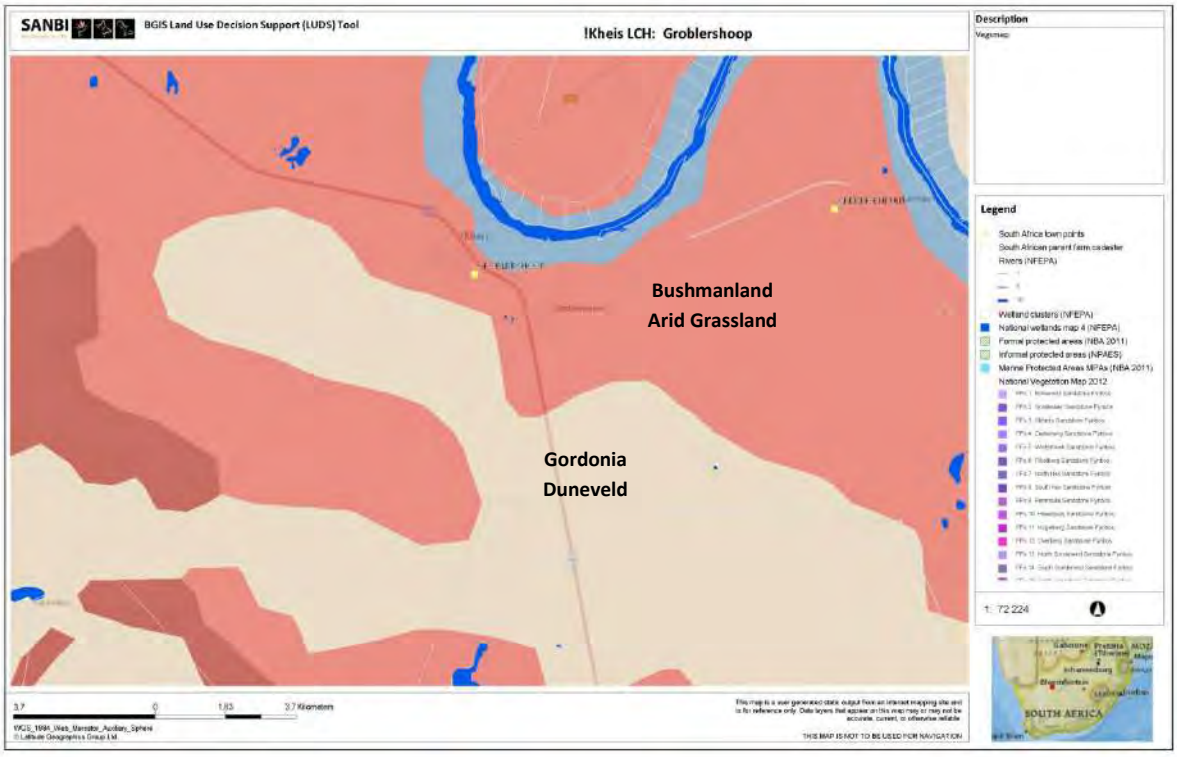
However, the author is confident that a fairly good understanding of the biodiversity status of the site was obtained. The survey was conducted by walking the site and examining, marking and photographing any area of interest. Confidence in the findings is high. During the site visit the author endeavoured to identify and locate all significant biodiversity features, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

4. THE VEGETATION

The Northern Cape contains about 3500 plant species in 135 families and 724 genera, with about 25% of this flora endemic to the region. It is also home to an exceptionally high level of insect and reptile endemism, with new species still being discovered. However, it must be noted that this remarkable diversity is not distributed evenly throughout the region, but is concentrated in many local centres of endemism. The Karoo used to support millions of antelope, mainly springbuck, but also numerous other larger antelope (and other grazing animal). These animals roamed the vast plains of the Karoo, utilizing different selections of plants and allowing for long "rest" periods as they move around, and as a result preventing overgrazing (Shearing, 1994).

The Groblershoop area would be classified as a desert region. In accordance with the Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006, as updated in the 2012 beta version) two broad vegetation types are expected within the proposed footprint, namely **Bushmanland Arid Grassland** and **Gordonia Duneveld (Error! Reference source not found.)**. Both these vegetation types are classified as "Least Threatened" (GN 1002, December 2011) although statutory conservation targets have not yet been met.

Figure 4: Vegetation map of South Africa (2012 beta 2 version), showing the expected vegetation types



4.1. THE VEGETATION IN CONTEXT

4.1.1. Nama-Karoo Biome

Bushmanland Arid Grassland is part of the Nama-Karoo Biome, which is a large arid landlocked region on the central plateau of the western half of South Africa, extending into Namibia. It is flanked by the Succulent Karoo to the west and south, desert to the northwest, arid Kalahari Savanna to the north, Grassland to the northeast, Albany Thicket to the southeast and small parts of Fynbos to the south. In South Africa, only the Desert Biome has a higher variability in annual rainfall and only the Kalahari Savanna greater extremes in temperature. The Nama-Karoo receives most of its rainfall in summer, especially in late summer (Mucina *et. al*., 2006).

Climate is essentially continental and with almost no effect of the ameliorating influences of the oceans. Rainfall is low and unreliable, peaking in March. Droughts are unpredictable and often prolonged. Summers are hot and winters cold with temperature extremes ranging from -5°C in winter to 43°C in summer. However, rainfall intensity can be high (e.g. episodic thunderstorm and hail storm events). This coupled with the generally low vegetation cover associated with aridity and grazing pressure by domestic stock over the last two centuries, raises the potential for soil erosion. In semi-arid environments such as the Nama-Karoo, nutrients are generally located near the soil surface, making it vulnerable to sheet erosion (Mucina *et. al*., 2006).

In contrast with the Succulent Karoo, the Nama-Karoo is not particularly rich in plant species and does not contain any centre of endemism. Local endemism is very low, which might indicate a relative youthful biome linked to the remarkable geological and environmental homogeneity of the Nama-Karoo. Rainfall seasonality and frequency are too unpredictable and winter temperatures too low to enable leaf succulent dominance (as in the Succulent Karoo). It is also too dry in summer for dominance by perennial grasses alone and the soils generally to shallow and rainfall too low for dominance by trees. But soil type, soil depth and local differences in moisture availability can cause abrupt changes in vegetation structure and composition (e.g. small drainage lines support more plant species than surrounding plains) (Mucina *et. al*., 2006).

4.1.2. Gordonia Duneveld

Gordonia Duneveld is part of the Eastern Kalahari Bushveld Bioregion, which is a sub-bioregion for the Savanna Biome. The Savanna Biome is the most widespread Biome in Africa and also occupies most of the far-northern part of the Northern Cape, including the Kalahari Duneveld. According to Rutherford *et. al.* (2006), the Savanna in South Africa has a low species to area ratio, and become even lower in the southern Kalahari part of the biome (with a sharply decreasing diversity of trees from east to west). On the other hand, Savanna is well known for its diversity of mammals. Rainfall seasonality and frequency are too unpredictable and winter temperatures too low to enable leaf succulents to dominate (like in the Succulent Karoo), while summers are too dry for dominance by perennial grasses alone, and the soils are generally too shallow and rainfall too low for trees.

Most Savanna has an herbaceous layer dominated by grass species and discontinuous to sometimes very open tree layer. In many Savanna areas in southern Africa the term bushveld is appropriate since the woody component does often not form a distinct layer but rather presents an irregular series of interlocking, often low, canopies with openings and sometimes little distinction between all shrubs and trees. The woody component is important to animals and can determine available browse, can form impenetrable barriers or determine available shade and protection against predators or scavengers. There is often excellent correlation between vegetation patterns and soil types, but rainfall gradients can result in large floristic variation even on similar substrates.

Kimberley Thornveld vegetation occurs in the North West, Free State and Northern Cape Provinces: Most of the Kimberley, Hartswater, Bloemhof and Hoopstad Districts as well as substantial parts of the Warrenton, Christiana, Taung, Boshof and to some extent the Barkley West District at altitudes varying between 1050m – 1400m (Mucina & Rutherford, 2006).

4.2. VEGETATION ENCOUNTERED

The proposed development footprint is about 95 ha in size. The site includes various areas already degraded or disturbed, this include a number of illegal dumping sites, an area which seems to contain old sewerage ponds and an area where sewerage is running through the veld from a potentially broken pipeline.

4.2.1. Existing disturbance footprint

Figure 5 gives an overview of the disturbed areas, which includes;

- (Area 1) An area of general disturbance (physical disturbances like excavations, dumping etc.), about 6 ha in size, marked by the blue polygon (Photo 1 & Photo 2);
- (Area 2) Old ponds (probably old sewage ponds), about 1.2 ha in size, marked by one of the red polygons (Photo 3);
- (Area 3) A second set of old ponds (probably old sewerage ponds), about 2.7 ha in size;
- (Area 4) An illegal dumping site (Photo 4);
- (Area 5) An area covered by raw sewerage running through the veld (seemingly a pipe had been broken by excavations, which now releases raw sewerage into the veld) (Photo 5 & Photo 6);
- (Area 6) A small man-made dam (Photo 7).

Figure 5: An overview of the site, showing most significant disturbed areas

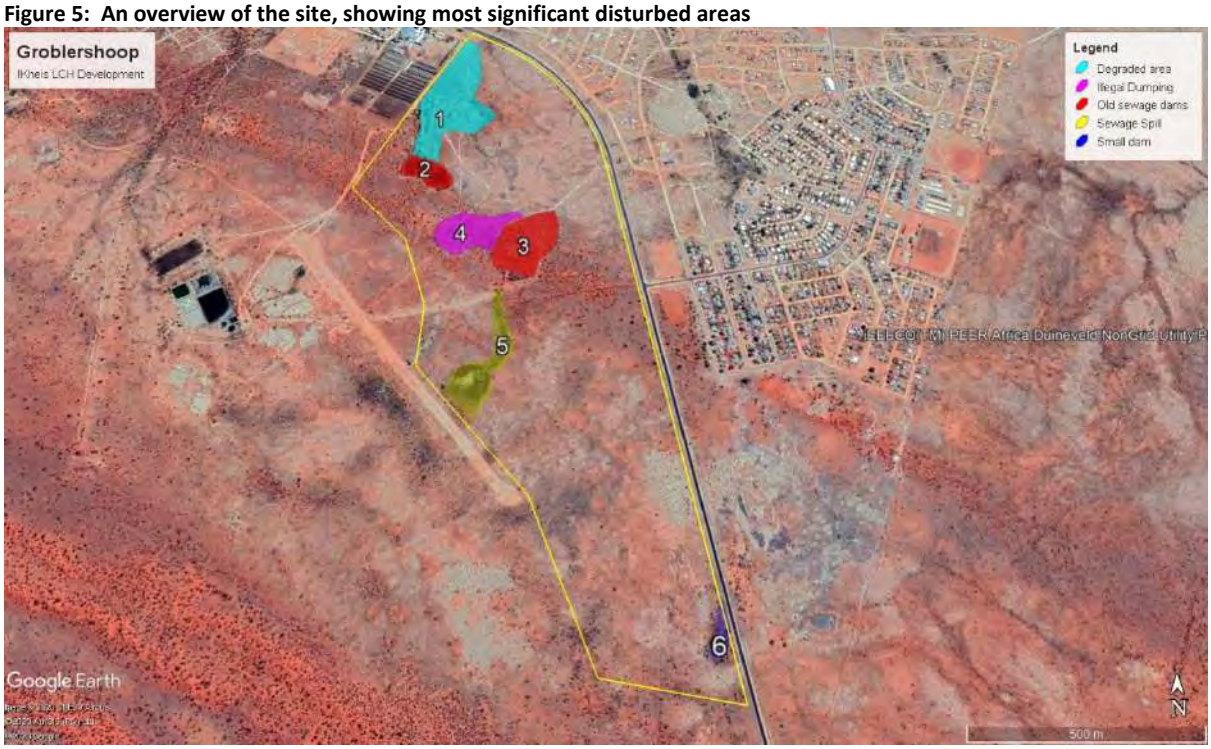


Photo 1: A photo showing some of the disturbance (both physical and illegal dumping encountered in area 1.

Photo 2: Another photo taken in the disturbance area marked by Area 1 in Figure 5. This area was also characterized by significant *Prosopis* infestation.

Photo 3: One of the old ponds encountered in Area 2. These ponds seem to represent old sewerage works.

Photo 4: A photo showing the illegal dumping site marked by Area 3 in Figure 5.

Photo 5: A picture showing the sewerage spill marked by area 5 in Figure 5.

Photo 6: An excavated area, that seems to have resulted in the raw sewerage leakage shown in Photo 5, above.

Photo 7: A small dam encountered at the south-eastern corner of the site. Note the larger trees associated with the dam wall.

Photo 8: One of the interesting sightings was these rectangles demarcated by *Aloe claviflora* plants harvested in the surrounding veld. It turns out that these are potential erven that has been demarcated by local residents for constructing their dwellings.

4.2.2. Shallow soils with calcrete outcrops

The northern and north-eastern corner of the site (nearest to Groblershoop) was mostly covered by a low white grass dominated sparse shrubland typical of the variation of Bushmanland Arid Grassland vegetation found on shallow soils dominated by calcrete (calcrete outcrops was often observed throughout the site). Although the Northern Cape are in the midst of a severe drought (the last 5 – 7 yeas), the effect of recent rains can be seen in the display of grasses and even the shrub layer encountered. However, the rain was apparently not yet enough to trigger a display of annual herbaceous species. Bulb species were also rarely observed.

The vegetation varied from an open grassland dominated by white grasses to a sparse low (<0.5 m) shrubland dominated by the white stemmed *Justicia australis (=Monechma)* in combination with *Tetraena decumbens*, *Salsola zeyheri*, *Tetraena microcarpa* (Photo 9 & Photo 10). Dense stands of *Aloe claviflora* were often encountered, in fact they are so common that the local people uses them to demarcate erven (Photo 8). The following plants were also observed scattered throughout the small ("verneuk halfmensie") *Acanthopsis disperma*, the common *Aptosimum spinescens, Barleria lichtensteiniana*, *Boscia albitrunca*, patches of *Cynanchum viminale,* the nine-awned grass *Enneapogon cenchroides, Euphorbia gariepina,* and occasionally

the smaller *Euphorbia spinea*, *Geigeria ornativa, Justicia incana, Kleinia longiflora, Lacomucinaea lineata (= Thesium lineatum), Leucosphaera bainesii, Lycium cinereum, Rhigozum trichotomum, Senegalia mellifera* (occasionally) and the creeping *Trianthema parvifolia.* In the disturbed northern corner of the site, the vegetation was often dominated by dense stands of the alien *Prosopis* tree (Refer to Photo 1 & Photo 2).

Photo 9: Typical low shrubland dominated by white grasses as encountered to the north and north eastern corner of the site. Note the *Justicia australis* and *Tetraena decumbens* in the foreground.

Photo 10: Another picture showing new erven being demarcated by *Aloe claviflora*.

4.2.3. Deeper (red) sandy soils

The remainder of the property was characterised by red sandy soils that varied in depth, but also showed outcrops of calcrete scattered throughout. At the higher lying western boundary of the site (near area 5 in Figure 5) even quartzite was exposed in small patches. The vegetation varied depending on the depth of the sand, Deeper sandy soils was characterized by denser and larger stands of small trees like *Senegalia mellifera* and larger shrubs like *Phaeoptilum spinosum*, *Lycium cinereum* and *Rhigozum trichotomum* (e.g. Photo 11).

Photo 11: Vegetation encountered in deeper sandy soils. Note the *Rhigozum trichotomum* in the foreground, with *Senegalia mellifera* and a small *Boscia albitrunca* in the back ground.

By far the largest portion of the site was covered by varying depths of red sandy soils covered by a transitional form of vegetation between duneveld and arid grassland (Photo 12). The plant species seems to overlap between the two vegetation types (depending on the soil depth and occurrence of calcrete) and many of the species encountered on the shallow rocky soils, where also encountered on the deeper sandy soils, but the structural composition were very different with the plants normally denser and larger the deeper the sands (Photo 11).

Photo 12: The Groblershoop sport fields, indicating the proposed location for the small balancing reservoir.

Plant species encountered included the following*:* The small *Acanthopsis hoffmannseggiana, Aizoon burchellii, Aloe claviflora, Aptosimum spinescens, Asparagus* cf. *capensis, Asparagus* species, *Boscia albitrunca, patches of Cynanchum viminale, Euphorbia gariepina, Euphorbia braunsii, Euphorbia spinea, Galenia africana, Geigeria ornativa, Justicia incana, Kleinia longiflora, Lacomucinaea lineata (= Thesium lineatum), Leucosphaera bainesii, Lycium cinereum,* the climbing balsam pear, *Momordica balsamina, Phaeoptilum spinosum,* the common *Rhigozum trichotomum, Rogeria longiflora,* the spiny *Ruschia divaricata, Salsola kali, Salsola zeyheri, Senegalia mellifera, Tapinanthus oleifolius* and *Ziziphus mucronata.*

Photo 13: The Groblershoop sport fields, indicating the proposed location for the small balancing reservoir.

The most significant feature encountered were a number of beautiful and well protected Sheppard trees (*Boscia albitrunca*) scattered throughout the site (refer to Table 2).

4.3. CRITICAL BIODIVERSITY AREAS MAPS

The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). The 2016 Northern Cape

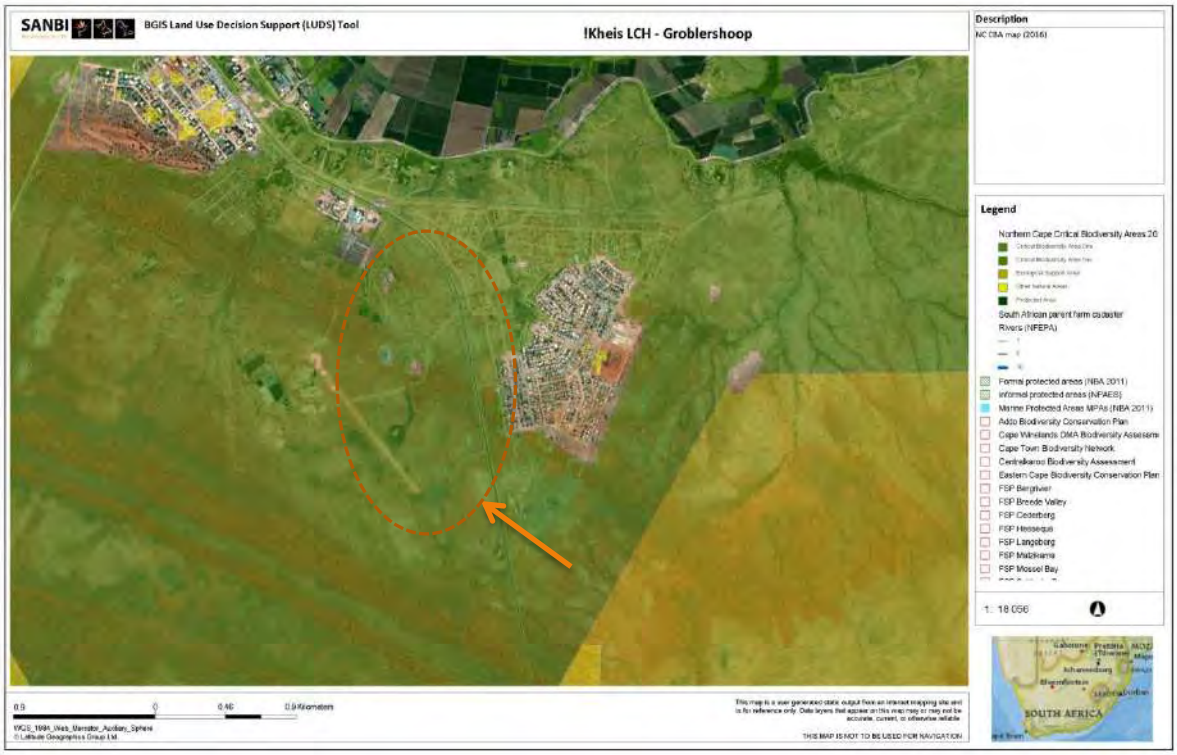
Critical Biodiversity Area (CBA) Map updates, revises and replaces all older systematic biodiversity plans and associated products for the province (including the Namakwa District Biodiversity Sector Plan, 2008). Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes.

Critical biodiversity areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). The primary purpose of CBA's is to inform land-use planning in order to promote sustainable development and protection of important natural habitat and landscapes. CBA's can also be used to inform protected area expansion and development plans.

- **Critical biodiversity areas (CBA's)** are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

- **Ecological support areas (ESA's)** are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

Figure 6: The Northern Cape Critical Biodiversity Areas Map (2016) showing the proposed development



From a land-use planning perspective it is useful to think of the difference between CBA's and ESA's in terms of where in the landscape the biodiversity impact of any land-use activity action is most significant:

- For CBA's the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat).
- For ESA's a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity).

According to the Northern Cape CBA map (Figure 6), the proposed development will overlap both a terrestrial CBA. However, it must be noted that large portions of the proposed site is already disturbed, and that there is no real alternative site within the Municipal town boundaries that is not located within the CBA.

4.4. POTENTIAL IMPACT ON CENTRES OF ENDEMISM

The proposed development will not impact on any recognised centre of endemism (Van Wyk & Smith, 2001).

4.5. FLORA ENCOUNTERED

Table 2 gives a list of the plant species encountered during this study. Because of the limitations (timing and a single site visit as well as the drought) it is likely that a number of annuals might have been missed.

Table 1: List of indigenous species encountered within or near the proposed footprint

No.	Species name	FAMILY	Status	Alien & invader plant (AIP)
1.	*Acanthopsis disperma*	ACANTHACEAE	LC	
2.	*Acanthopsis hoffmannseggiana*	ACANTHACEAE	LC	
3.	*Aizoon burchellii*	AIZOACEAE	Not evaluated NCNCA, Schedule 2 Protected (all species in this Family)	**Apply for a NCNCA Flora permit (DENC)**
4.	*Aloe claviflora*	ASPODELACEAE	LC NCNCA, Schedule 2 Protected (all species in this Family)	**Apply for a NCNCA Flora permit (DENC)**
5.	*Aptosimum spinescens*	SCROPHULARIACEAE	LC	
6.	*Aristida adscensionis*	POACEAE	LC	
7.	*Aristida congesta*	POACEAE	LC	
8.	*Asparagus* cf. *capensis*	ASPARAGACEAE	LC	
9.	*Asparagus* species	ASPARAGACEAE	LC	
10.	*Barleria lichtensteiniana*	ACANTHACEAE	LC	
11.	*Boscia albitrunca*	BRASSICACEAE (CAPPARACEAE)	LC NFA protected species NCNCA, Schedule 2 Protected (all species of Boscia)	**Apply for a NFA Tree permit (DAFF)** **Apply for a NCNCA Flora permit (DENC)**
12.	*Cynanchum viminale* (=*Sarcostemma viminale*)	APOCYNACEAE	LC NCNCA, Schedule 2 Protected	**Apply for a NCNCA Flora permit (DENC)**

No.	Species name	FAMILY	Status	Alien & invader plant (AIP)
			(all species in this Family)	
13.	*Enneapogon cenchroides*	POACEAE	LC	
14.	*Euphorbia braunsii*	EUPHORBIACEAE	LC NCNCA, Schedule 2 Protected (all species in this Genus)	**Apply for a NCNCA Flora permit (DENC)**
15.	*Euphorbia gariepina*	EUPHORBIACEAE	NCNCA, Schedule 2 Protected (all species in this Genus)	**Apply for a NCNCA Flora permit (DENC)**
16.	*Euphorbia spinea*	EUPHORBIACEAE	LC NCNCA, Schedule 2 Protected (all species in this Genus)	**Apply for a NCNCA Flora permit (DENC)**
17.	*Galenia africana*	AIZOACEAE	LC NCNCA, Schedule 2 Protected (all species in this Family)	**Apply for a NCNCA Flora permit (DENC)**
18.	*Geigeria ornativa*	ASTERACEAE	LC	
19.	*Justicia australis (=Monechma genistifolium)*	ACANTHACEAE	LC	
20.	*Justicia incana (=Monechma incanum)*	ACANTHACEAE	LC	
21.	*Kleinia longiflora*	ASTERACEAE	LC	
22.	*Lacomucinaea lineata (=Thesium lineatum)*	SANTALACEAE	LC	
23.	*Leucosphaera bainesii*	AMARANTHACEAE	LC	
24.	*Lycium cinereum*	SOLANACEAE	LC	
25.	*Momordica balsamina*	CUCURBITACEAE	LC	
26.	*Parkinsonia africana*	FABACEAE	LC	
27.	*Phaeoptilum spinosum*	NYCTAGINACEAE	LC	
28.	*Prosopis* species	FABACEAE	**Alien invasive plant species**	
29.	*Rhigozum trichotomum*	BIGONACEAE	LC	
30.	*Rogeria longiflora*	PEDALIACEAE	LC	
31.	*Ruschia divaricata*	AIZOACEAE	Protected in terms of schedule 2 of the NCNCA	**Apply for a NCNCA Flora permit (DENC)**
32.	*Salsola kali*	AMARANTHACEAE	Naturalised invasive	**1b**
33.	*Salsola zeyheri*	AMARANTHACEAE	LC	
34.	*Senegalia mellifera (=Acacia mellifera)*	FABACEAE	LC	
35.	*Stipagrostis* species	POACEAE	LC	
36.	*Stipagrostis uniplumis*	POACEAE	LC	
37.	*Tapinanthus oleifolius*	LORANTHACEAE	LC	
38.	*Tetraena decumbens (=Zygophyllum decumbens)*	ZYGOPHYLLACEAE	LC	
39.	*Tetraena microcarpa (=Zygophyllum microcarpum)*	ZYGOPHYLLACEAE	LC	
40.	*Tetraena simplex (=Zygophyllum simplex)*	ZYGOPHYLLACEAE	LC	
41.	*Trianthema parvifolia*	AIZOACEAE	LC NCNCA, Schedule 2 Protected (all species in this Family)	
42.	*Ziziphus mucronata*	RHAMNACEAE	LC	

4.6. THREATENED AND PROTECTED PLANT SPECIES

South Africa has become the first country to fully assess the status of its entire flora. Major threats to the South African flora are identified in terms of the number of plant taxa Red-Listed as threatened with extinction

as a result of threats like, habitat loss (e.g. infrastructure development, urban expansion, crop cultivation and mines), invasive alien plant infestation (e.g. outcompeting indigenous plant species), habitat degradation (e.g. overgrazing, inappropriate fire management etc.), unsustainable harvesting, demographic factors, pollution, loss of pollinators or dispersers, climate change and natural disasters (e.g. such as droughts and floods). South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the Red List of South African plants. However, due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction, but may nonetheless be of high conservation importance. As a result a SANBI uses an amended system of categories in order to highlight species that may be of low risk of extinction but are still of conservation concern (SANBI, 2015).

In the Northern Cape, species of conservation concern are also protected in terms of national and provincial legislation, namely:

- The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the "*Lists of critically endangered, endangered, vulnerable and protected species*" (GN. R. 152 of 23 February 2007).
- National Forest Act, Act 84 of 1998, provides for the protection of forests as well as specific tree species through the "*List of protected tree species*" (GN 908 of 21 November 2014).
- Northern Cape Nature Conservation Act, Act of 2009, provides for the protection of "*specially protected species*" (Schedule 1), "*protected species*" (Schedule 2) and "*common indigenous species"* (Schedule 3).

4.6.1. Red list of South African plant species

The Red List of South African Plants online provides up to date information on the national conservation status of South Africa's indigenous plants (SANBI, 2015).

- **No red-listed species** was observed.

4.6.2. NEM: BA protected plant species

The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the "Lists of critically endangered, endangered, vulnerable and protected species" (GN. R. 152 of 23 February 2007).

- **No NEM: BA protected species was observed.**

4.6.3. NFA Protected plant species

The National Forests Act (NFA) of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species (as updated).

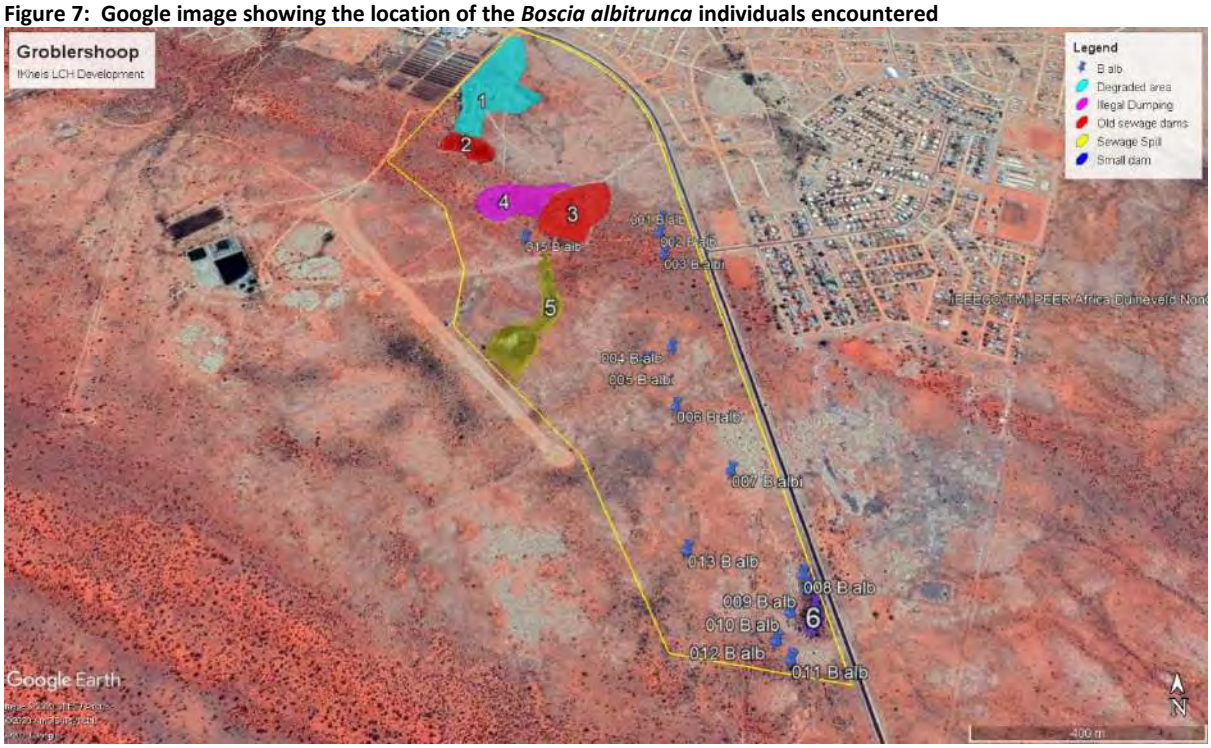
- **One species protected in terms of the NFA** was observed, namely ***Boscia albitrunca***. The following table give locations for each tree as well as recommendations for impact minimisation.

Table 2: Location of NFA protected trees observed within or near the footprint

NO.	SPECIES NAME	COMMENTS	RECOMMENDATIONS
001 B alb	*Boscia albitrunca* S28° 54' 33.4" E21° 59' 54.2"	Small shrub in poor condition (1.4 m tall)	A NFA permit as well as a NCNCA permit will be required for removal of this plant.
002 B alb	*Boscia albitrunca* S28° 54' 35.1" E21° 59' 54.0"	Medium size tree, poor condition (1.8 m tall)	A NFA permit as well as a NCNCA permit will be required for removal of this plant.
003 B alb	*Boscia albitrunca* S28° 54' 37.5" E21° 59' 54.2"	Medium size tree in poor condition (2.1 m tall).	A NFA permit as well as a NCNCA permit will be required for removal of this plant.

NO.	SPECIES NAME	COMMENTS	RECOMMENDATIONS
004 B alb	*Boscia albitrunca* S28° 54' 46.8" E21° 59' 54.5"	Magnificent tree (2.3 m tall).	**Do not disturb, if possible.** A NFA permit as well as a NCNCA permit will be required for removal of this plant.
005 B alb	*Boscia albitrunca* S28° 54' 47.9" E21° 59' 52.3"	Magnificent tree (4 m tall).	**Do not disturb, if possible** A NFA permit as well as a NCNCA permit will be required for removal of this plant.
006 B alb	*Boscia albitrunca* S28° 54' 52.1" E21° 59' 54.6"	Small tree in poor condition (1.4 m tall).	A NFA permit as well as a NCNCA permit will be required for removal of this plant.
007 B alb	*Boscia albitrunca* S28° 54' 57.4" E21° 59' 58.4"	Medium size tree in good condition (2.4 m tall).	A NFA permit as well as a NCNCA permit will be required for removal of this plant.
008 B alb	*Boscia albitrunca* S28° 55' 05.0" E22° 00' 02.6"	Magnificent tree (3.2 m tall).	**Do not disturb, if possible** A NFA permit as well as a NCNCA permit will be required for removal of this plant.
009 B alb	*Boscia albitrunca* S28° 55' 06.0" E22° 00' 02.8"	Magnificent tree (3 m tall).	**Do not disturb, if possible** A NFA permit as well as a NCNCA permit will be required for removal of this plant.
010 B alb	*Boscia albitrunca* S28° 55' 07.4" E22° 00' 01.5"	Medium tree (3 m tall).	A NFA permit as well as a NCNCA permit will be required for removal of this plant.
011 B alb	*Boscia albitrunca* S28° 55' 10.4" E22° 00' 01.1"	Magnificent tree (5 m tall).	**Do not disturb, if possible** A NFA permit as well as a NCNCA permit will be required for removal of this plant.
012 B alb	*Boscia albitrunca* S28° 55' 09.2" E22° 00' 00.3"	Medium tree (2.1 m tall).	A NFA permit as well as a NCNCA permit will be required for removal of this plant.
013 B alb	*Boscia albitrunca* S28° 55' 03.2" E21° 59' 54.7"	Magnificent tree (5.5 m tall).	**Do not disturb, if possible** A NFA permit as well as a NCNCA permit will be required for removal of this plant.
015 B alb	*Boscia albitrunca* S28° 54' 35.6" E21° 59' 42.0"	Medium tree (3.5 m tall).	**Do not disturb, if possible** A NFA permit as well as a NCNCA permit will be required for removal of this plant.

Figure 7: Google image showing the location of the *Boscia albitrunca* individuals encountered



4.6.4. NCNCA protected plant species

The Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, and also provides for the sustainable utilization of wild animals, aquatic biota and plants. Schedule 1 and 2 of the act give extensive lists of specially protected and protected fauna and flora species in accordance with this act. NB. Please note that all indigenous plant species are protected in terms of Schedule 3 of this act (e.g. any work within a road reserve).

- The following species protected in terms of the NCNCA were encountered. Recommendations on impact minimisation also included.

Table 3: Plant species protected in terms of the NCNCA encountered within the study area

NO.	SPECIES NAME	COMMENTS	RECOMMENDATIONS
1.	*Aizoon burchellii* **Schedule 2 protected**	Occasionally observed in deeper sandy areas.	Species protection through topsoil conservation.
2.	*Aloe claviflora* **Schedule 2 protected**	Very common in the north eastern part of the property.	Very common plant in this area.
3.	*Boscia albitrunca* **Schedule 2 protected**	Refer to Table 2.	
4.	*Cynanchum viminale* **Schedule 2 protected**	Occasionally observed within the footprint.	Larger *Cynanchum* plants are expected to transplant poorly. Species protection through topsoil conservation.
5.	*Euphorbia braunsii* **Schedule 2 protected**		**Search & rescue:** Occasionally observed. Individuals within footprint to be transplanted to surrounding area.
6.	*Euphorbia gariepina* **Schedule 2 protected**		Very common plant in this area. Species protection through topsoil conservation.
7.	*Euphorbia spinea* **Schedule 2 protected**		Very common plant in this area. Species protection through topsoil conservation.
8.	*Galenia africana* **Schedule 2 protected**	This plant is weedy a disturbance indicator and commonly found in Erf 1654.	No special measures needed, this is a weedy pioneer species.
9.	*Ruschia divaricata* **Schedule 2 protected**		Very common plant in this area. Species protection through topsoil conservation.
10.	*Trianthema parvifolia* **Schedule 2 protected**		A common plant. Species protection through topsoil conservation.

5. IMPACT ASSESSMENT METHOD

The objective of this study was to evaluate the botanical diversity of the property area in order to identify significant environmental features which might have been impacted as a result of the development. The Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al*., 2005), were used to evaluate the botanical significance of the property with emphasis on:

- Significant ecosystems
    - Threatened or protected ecosystems
    - Special habitats
    - Corridors and or conservancy networks
- Significant species
    - Threatened or endangered species
    - Protected species

5.1. DETERMINING SIGNIFICANCE

Determining impact significance from predictions of the nature of the impact has been a source of debate and will remain a source of debate. The author used a combination of scaling and weighting methods to determine significance based on a simple formula. The formula used is based on the method proposed by Edwards (2011). However, the criteria used were adjusted to suite its use for botanical assessment. In this document significance rating was evaluated using the following criteria (Refer to Table 4).

Significance = Conservation Value x (Likelihood + Duration + Extent + Severity) (Edwards 2011)

Table 4: Categories and criteria used for the evaluation of the significance of a potential impact

ASPECT / CRITERIA	LOW (1)	MEDIUM/LOW (2)	MEDIUM (3)	MEDIUM/HIGH (4)	HIGH (5)
CONSERVATION VALUE Refers to the intrinsic value of an attribute or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species	The attribute is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss.	The attribute is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss.	The attribute is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.	The attribute is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.	The attribute is considered critically endangered or is part of a proclaimed provincial or national protected area.
LIKELIHOOD Refers to the probability of the specific impact occurring as a result of the proposed activity	Under normal circumstances it is almost certain that the impact will not occur.	The possibility of the impact occurring is very low, but there is a small likelihood under normal circumstances.	The likelihood of the impact occurring, under normal circumstances is 50/50, it may or it may not occur.	It is very likely that the impact will occur under normal circumstances.	The proposed activity is of such a nature that it is certain that the impact will occur under normal circumstances.
DURATION Refers to the length in time during which the activity is expected to impact on the environment.	Impact is temporary and easily reversible through natural process or with mitigation. Rehabilitation time is expected to be short (1-2 years).	Impact is temporary and reversible through natural process or with mitigation. Rehabilitation time is expected to be relative short (2-5 years).	Impact is medium-term and reversible with mitigation, but will last for some time after construction and may require on-going mitigation. Rehabilitation time is expected to be longer (5-15 years).	Impact is long-term and reversible but only with long term mitigation. It will last for a long time after construction and is likely to require on-going mitigation. Rehabilitation time is expected to be longer (15-50 years).	The impact is expected to be permanent.
EXTENT Refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur.	Under normal circumstances the impact will be contained within the construction footprint.	Under normal circumstances the impact might extent outside of the construction site (e.g. within a 2 km radius), but will not affect surrounding properties.	Under normal circumstances the impact might extent outside of the property boundaries and will affect surrounding land owners or –users, but still within the local area (e.g. within a 50 km radius).	Under normal circumstances the impact might extent to the surrounding region (e.g. within a 200 km radius), and will regional land owners or –users.	Under normal circumstances the effects of the impact might extent to a large geographical area (>200 km radius).
SEVERITY Refers to the direct physical or biophysical impact of the activity on the surrounding environment should it occur.	It is expected that the impact will have little or no affect (barely perceptible) on the integrity of the surrounding environment. Rehabilitation not needed or easily achieved.	It is expected that the impact will have a perceptible impact on the surrounding environment, but it will maintain its function, even if slightly modified (overall integrity not compromised). Rehabilitation easily achieved.	It is expected that the impact will have an impact on the surrounding environment, but it will maintain its function, even if moderately modified (overall integrity not compromised). Rehabilitation easily achieved.	It is expected that the impact will have a severe impact on the surrounding environment. Functioning may be severely impaired and may temporarily cease. Rehabilitation will be needed to restore system integrity.	It is expected that the impact will have a very severe to permanent impact on the surrounding environment. Functioning irreversibly impaired. Rehabilitation often impossible or unfeasible due to cost.

5.2. SIGNIFICANCE CATEGORIES

The formal NEMA EIA application process was developed to assess the significance of impacts on the surrounding environment (including socio-economic factors), associated with any specific development proposal in order to allow the competent authority to make informed decisions. Specialist studies must advise the environmental assessment practitioner (EAP) on the significance of impacts in his field of specialty. In order to do this, the specialist must identify all potentially significant environmental impacts, predict the nature of the impact and evaluate the significance of that impact should it occur. Potential significant impacts are evaluated, using the method described above, in order to determine its potential significance. The potential significance is then described in terms of the categories given in Table 5.

Table 5: Categories used to describe significance rating (adjusted from DEAT, 2002)

SIGNIFICANCE	DESCRIPTION
Insignificant or Positive (4-22)	There is no impact or the impact is insignificant in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or the impact may be positive.
Low (23-36)	An impact barely noticeable in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or will be of very short-term or is unlikely to occur. Impact is unlikely to have any real effect and no or little mitigation is required.
Medium Low (37-45)	Impact is of a low order and therefore likely to have little real effect. Mitigation is either easily achieved. Social, cultural and economic activities can continue unchanged, or impacts may have medium to short term effects on the social and/or natural environment within site boundaries.
Medium (46-55)	Impact is real, but not substantial. Mitigation is both feasible and fairly easily possible, but may require modification of the project design or layout. Social, cultural and economic activities of communities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long term effect on the social and/or natural environment, within site boundary.
Medium high (56-63)	Impact is real, substantial and undesirable, but mitigation is feasible. Modification of the project design or layout may be required. Social, cultural and economic activities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long-term effect on the social and/or natural environment, beyond site boundary within local area.
High (64-79)	An impact of high order. Mitigation is difficult, expensive, time-consuming or some combination of these. Social, cultural and economic activities of communities are disrupted and may come to a halt. These impacts will usually result in long-term change to the social and/or natural environment, beyond site boundaries, regional or widespread.
Unacceptable (80-100)	An impact of the highest order possible. There is no possible mitigation that could offset the impact. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt. The impact will result in permanent change. Very often these impacts cannot be mitigated and usually result in very severe effects, beyond site boundaries, national or international.

6. DISCUSSING BOTANICAL SENSITIVITY

The aim of impact assessment is to determine the vulnerability of a habitat to a specific impact. In order to do so, the sensitivity of the habitat should be determined by identifying and assessing the most significant environmental aspects of the site against the potential impact(s). For this development the following biodiversity aspects was considered:

- **Location**: The proposed development footprint is located on Municipal property, adjacent to existing town developments. Portions of the footprint had already been degraded as a result of past practices.
- **Activity**: The proposed activity is expected to result in a permanent transformation of approximately 95 ha of land, of which approximately 60 - 70% is still covered by indigenous vegetation in good condition.
- **Geology & Soils**: No special features such as true quarts patches or heuweltjies were observed in or near to the larger footprint area that may result in specialised plant habitat.
- **Land use and cover**: The footprint is on municipal land in close proximity to the town of Groblershoop. Portions of the footprint is heavily disturbed as a result of illegal dumping, old ponds (e.g. sewerage works) and other physical disturbances. Although the area is grazed by livestock from the local community most of the footprint still supports indigenous vegetation in good condition.
- **Vegetation status**: The vegetation is not considered a threatened vegetation type, but conservation targets have not yet been met.
- **Conservation priority areas:** According to the Northern Cape CBA maps the proposed site falls within a CBA area. However, there is no alternative on Municipal land that will not impact on the CBA. The site will not impact on any recognised centre of endemism.
- **Connectivity**: The transformation of the site will destroy connectivity on the site, but should not result in a significant impact on the surrounding area, where connectivity is still excellent.
- **Watercourses and wetlands**: Not evaluated in this study as a separate freshwater impact assessment has been commissioned as part of the NEMA EIA process.
- **Protected or endangered plant species**: The most significant botanical aspect of this site is the presence of a 14 protected Sheppard trees (*Boscia albitrunca*), some of which were in excellent condition (refer to Table 2). A number of Northern Cape Nature Conservation Act, protected species were also observed (Refer to Table 3).
- **Alien and Invasive Plant species**: A number of *Prosopis* trees were observed, with denser stands in the northern portion of the property. These plants should be removed responsibly before development commence.

6.1. IMPACT ASSESSMENT

Table 6 rates the significance of environmental impacts associated with the proposed development. It also evaluates the expected accumulative effect of the proposed development as well as the No-Go option.

Table 6: Impact assessment associated with the proposed development

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Geology & soils: Potential impact on special habitats (e.g. true quartz or "heuweltjies")	Without mitigation	2	1	5	2	1	18	No special habitats observed.
	With mitigation	2	1	3	1	1	12	Protect all significant indigenous tree species (even if it has to be incorporated within the development).
Landuse and cover: Potential impact on socio-economic activities.	Without mitigation	2	3	5	2	2	24	Permanent transformation of approximately 95ha of indigenous vegetation used for grazing to housing.
	With mitigation	2	2	3	1	1	14	Potential beneficial socio-economic impact (much needed housing project).
Vegetation status: Loss of vulnerable or endangered vegetation and associated habitat.	Without mitigation	2	3	5	3	3	28	Permanent transformation of 95 ha of slightly disturbed Bushmanland Arid Grassland (Least Threatened).
	With mitigation	2	2	3	2	2	18	Protect all significant indigenous tree species and search & rescue other potentially significant protected plant species.
Conservation priority: Potential impact on protected areas, CBA's, ESA's or Centre's of Endemism.	Without mitigation	3	3	5	3	3	42	The development will impact on a proposed CBA. However, there is no alternative location on the property that will not impact on the same CBA.
	With mitigation	2	2	3	2	2	18	Protect all significant indigenous tree species and search & rescue other potentially significant protected plant species.
Connectivity: Potential loss of ecological migration corridors.	Without mitigation	2	3	5	3	3	28	The transformation will destroy connectivity within the site, but will not result in a significant impact on the surrounding area, where connectivity is still excellent
	With mitigation	2	2	3	2	2	18	Protect all significant indigenous tree species and search & rescue other potentially significant protected plant species.
Watercourses and wetlands: Potential impact on natural water courses and its ecological support areas.	Without mitigation						0	N/a (Refer to the Freshwater specialist report).
	With mitigation						0	
Protected & endangered plant species: Potential impact on threatened or protected plant species.	Without mitigation	3	3	5	3	3	42	A number of protected species were observed, most notably a number of nationally protected tree species.
	With mitigation	2	2	3	1	2	16	Protect all significant indigenous tree species and search & rescue other potentially significant protected plant species.
Invasive alien plant species: Potential invasive plant infestation as a result of the activities.	Without mitigation	3	3	4	3	3	39	For most of the property, only the occasional Prosopis trees were observed. However, towards the northern portions of the site, denser stands were observed.
	With mitigation	2	1	2	1	1	10	Special care must be taken during their removal (in order to avoid re-sprouting).

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Veld fire risk: Potential risk of veld fires as a result of the activities.	Without mitigation	1	2	3	3	2	10	Veld fire risk low.
	With mitigation	1	1	1	1	1	4	Address fire danger throughout construction.
Cumulative impacts: Cumulative impact associated with proposed activity.	Without mitigation	3	3	5	3	3	42	Permanent transformation of approximately 95 ha of natural veld for urban development.
	With mitigation	2	2	3	2	2	18	Refer to all the mitigation recommendations above.
The "No-Go" option: Potential impact associated with the No-Go alternative.	Without mitigation	3	3	4	2	3	36	Slow degradation of natural veld as a result of illegal dumping, physical disturbances and grazing practices.
	With mitigation						0	

According Table 6, the main impacts associated with the proposed development will be:

- The transformation of 95 ha of indigenous vegetation within a proposed CBA; and
- The potential impact on a number of nationally protected trees as well as provincially protected plant species.

However, there is no logical alternative site, located on Municipal land that will not impact on the same CBA. In this case, about 30 – 40% of the proposed footprint is already impacted as result of urban related activities of the past and present.

The No-Go option is not likely to result in a “no-impact” scenario, as constant slow degradation is expected to continue as a result of urban activities and poor management of the site (illegal dumping & construction activities).

The cumulative impact (even without mitigation) is expected to be relatively **Medium-Low**, but this can be reduced to **Low or Very Low** through mitigation.

7. IMPACT MINIMISATION RECOMMENDATIONS

The proposed development footprint is located on Municipal property, adjacent to existing town developments. The activity is expected to result in a permanent transformation of approximately 95 ha of land, of which approximately 60 - 70% is still covered by indigenous vegetation in good condition. The site overlaps an identified critical biodiversity area (according to the 2016, Northern Cape Critical Biodiversity Areas maps). In addition, 14 protected Sheppard trees (*Boscia albitrunca*), and a number of Northern Cape Nature Conservation Act, protected species were observed within the footprint.

According to the impact assessment given in Table 6 the development is likely to result in a relative **Medium-Low** impact, which can be reduced to a **Low** impact with good environmental control during construction.

With the correct mitigation it is unlikely that the development will contribute significantly to any of the following:

- Significant loss of vegetation type and associated habitat.
- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities.
- Loss of local biodiversity and threatened plant species.
- Loss of ecosystem connectivity.

7.1. MITIGATION ACTIONS

The following mitigation actions should be implemented to ensure that the proposed development does not pose a significant threat to the environment:

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must include the recommendations made in this report.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase in terms of the EMP and any other conditions pertaining to specialist studies.
- **Before any work is done** protected tree species must be marked and demarcated (Refer to Table 2).
- **Before any work is done** search & rescue as discussed in Table 3 must be completed.
- Lay-down areas or construction sites must be located within the construction footprint.
- No clearing of any area outside of the construction footprint may be allowed.
- All waste that had been illegally dumped within the footprint must be removed to a Municipal approved waste disposal site.
- An integrated waste management approach must be implemented during construction.
    - Construction related general and hazardous waste may only be disposed of at Municipal approved waste disposal sites.
- Alien invasive *Prosopis* plants within the footprint (and immediate surroundings) must be removed in a responsible way (to ensure against regrowth).

8. REFERENCES

Acocks, J.P.H. 1953. Veld types of South Africa. *Mem. Bot. Surv. .S. Afr*. No. 28: 1-192.

Anon, 2008. Guideline regarding the determination of bioregions and the preparation and publication of Bioregional Plans. April 2008. Government Notice No. 291 of 16 March 2009.

De Villiers C.C., Driver, A., Brownlie, S., Clark, B., Day, E.G., Euston-Brown, D.I.W., Helme, N.A., Holmes, P.M., Job, N. & Rebelo, A.B. 2005. Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape. Fynbos Forum, c/o Botanical Society of South Africa: Conservation Unit, Kirstenbosch, Cape Town.

DEAT, 2002. Impact significance. Integrated Environmental Management, Information series 5. Department of Environmental Affairs and Tourism (DEAT). Pretoria.

Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria

Driver, A., Maze, K., Rouget, M., Lombard, A.T., Nel, J.L., Turpie, J.K., Cowling, R.M., Desmet, P., Goodman, P., Harris, J., Jonas, Z., Reyers, B., Sink, K. & Strauss, T. 2005. National spatial biodiversity assessment 2004: priorities for biodiversity conservation in South Africa. Strelitzia, 17. South African National Biodiversity Institute, Pretoria.

Edwards, R. 2011. Environmental impact assessment method. Unpublished report for SiVest (Pty) Ltd. Environmental division. 9 May 2011.

Holness, S. & Oosthuysen, E. 2016. Critical Biodiversity Areas of the Northern Cape: Technical Report. Available from the Biodiversity GIS website at http://bgis.sanbi.org/project.asp

Le Roux, A. 2015. Wild flowers of Namaqualand. A botanical society guide. Fourth revised edition. Struik Nature. Cape Town.

Low, A.B. & Rebelo, A.(T.)G. (eds.) 1996. *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Manning, J. 2008. Namaqualand Eco Guide. Briza Publications. Pretoria

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

Mucina, L., Rutherford, M.C., Palmer, A.R., Milton, S.J., Scott, L., Lloyd, J.W., Van der Merwe, B., Hoare, D.B., Bezuidenhout, H., Vlok, J.H.J., Euston-Brown, D.I.W., Powrie, L.W. and Dold, A.P. 2006. Nama-Karoo Biome. In Mucina, L. &Rutherford, M.C. 2006. (Eds.). The Vegetation of South Africa. Lesotho & Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria. Pp. 325 – 347.

NDBSP. 2008. Namakwa District Biodiversity Sector Plan. A report compiled for the Namaqualand District Municipality in order to ensure that biodiversity information can be accessed and utilized by local municipalities within the Namakwa District Municipality (NDM) to inform land use planning and development as well as decision making processes within the NDM.

Pool-Starvliet, R. 2017. Northern Cape Biodiversity Spatial Plan Handbook. Biodiversity GIS Home. http://bgis.sanbi.org.

Rouget, M., Reyers, B., Jonas, Z., Desmet, P., Driver, A., Maze, K., Egoh, B. & Cowling, R.M. 2004. South Africa National Spatial Biodiversity Assessment 2004: Technical report. Volume 1: Terrestrial Component. Pretoria: South African National Biodiversity Institute.

Rutherford, M.C., Mucina, L., Lötter, M.C., Bredenkamp, G.J., Smit, J.H.L., Scott-Shaw, C.R., Hoare, D.B., Goodman, P.S., Bezuidenhout, H., Scott, L., Ellis, F., Powrie, L.W., Siebert, F., Mostert, T.H., Henning, B.J., Venter, C.E., Camp, K.G.T., Siebert, S.J., Matthews, W.S., Burrows, J.E., Dobson, L., Van Rooyen, N., Schmidt, E., Winter, P.J.D., Du Preez, P.J., Ward, R.A., Williamson, S. & Hurter, P.F.H. Savanna Biome. In Mucina, L. & Rutherford, M.C. 2006. (eds.) The Vegetation of South Africa. Lesotho & Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria. pp. 439 – 538.

Shearing, D. 1994. Karoo. South African Wild Flower Guide 6. Botanical Society of South Africa. Kirstenbosch.

South African National Biodiversity Institute. 2006. South African National Botanical Institute: Biodiversity GIS Home. http://bgis.sanbi.org (as updated).

South African National Biodiversity Institute. 2012. Vegetation map of South Africa, Lesotho and Swaziland [vector geospatial dataset] 2012.

South African National Biodiversity Institute. 2015. Statistics: Red List of South African Plants version (as updated). Downloaded from Redlist.sanbi.org on 2017/06/15.

Van Wyk, A.E., & Smith, G.F. 2001. Regions of floristic endemism in South Africa. A review with emphasis on succulents. Umdaus press. Hatfield.

APPENDIX 1: COMPLIANCE WITH APPENDIX 6 OF GN. NO. 982 (4 DECEMBER 2014)

Specialist reports

1. A specialist report prepared in terms of these regulations must contain -	
a) Details of –	**Refer to:**
(i) The specialist who prepared the report; and	Refer to Page ii & Appendix 2
(ii) The expertise of the specialist to compile a specialist report including a curriculum vitae;	Refer to Appendix 2
b) A declaration that the specialist is independent in a form as may be specified by the competent authority;	Refer to Page ii
c) An indication of the scope of, and the purpose for which the report was prepared;	Refer to Heading 1.1
d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Refer to Heading 3
e) A description of the methodology adopted in preparing the report or carrying out the specialist process inclusive of equipment and modelling used;	Refer to Heading 3
f) Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructures, inclusive of a site plan identifying site alternatives;	Refer to Headings 4.1, 4.2, 4.3, 4.4, 4.6.
g) An identification of any areas to be avoided, including buffers;	Refer to Figure 7
h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Refer to Figure 7
i) A description of any assumptions made and any uncertainties or gaps of knowledge;	Refer to Heading 3
j) A description of the findings and potential implications of such findings on the impact of the proposed activity, [including identified alternatives on the environment] or activities;	Refer to Heading 6
k) Any mitigation measures for inclusion in the EMPr;	Refer to Heading 7.1
l) Any conditions for inclusion in the environmental authorization;	None
m) Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Refer to Heading 7.1
n) A reasoned opinion -	
(i) [as to] whether the proposed activity, activities or portions thereof should be authorized;	Refer to the "*Main conclusion*" within the executive summary (Page i)
(iA) regarding the acceptability of the proposed activity or activities; and	
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable the closure plan;	Refer to Heading 7.1
o) A description of any consultation process that was undertaken during the course of preparing the specialist report;	N/a
p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/a
q) Any information requested by the competent authority.	N/a
2. Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	

Curriculum Vitae: Peet JJ Botes

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Nationality:	South African
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Profession:	Environmental Consultant & Auditing
Specializations:	Botanical & Biodiversity Impact Assessments
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	Environmental Impact Assessment
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Qualifications:	**BSc** (Botany & Zoology), with Nature Conservation III & IV as extra subjects; Dept. of Natural Sciences, Stellenbosch University 1989.
	Hons. BSc (Plant Ecology), Stellenbosch University, 1989
	More than 20 years of experience in the Environmental Management Field (Since 1997 to present).
Professional affiliation:	Registered Professional Botanical, Environmental and Ecological Scientist at SACNASP (South African Council for Natural Scientific Professions) since 2005.
SACNAP Reg. No.:	400184/05

BRIEF RESUME OF RELEVANT EXPERIENCE

1997-2005: Employed by the Overberg Test Range (a Division of Denel), responsible for managing the environmental department of OTB, developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve).

2005-2010: Joined Enviroscientific, as an independent environmental consultant specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and

strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity and environmental legal compliance audits.

2010-2017: Joined EnviroAfrica, as an independent Environmental Assessment Practitioner and Biodiversity Specialist, responsible for Environmental Impact Assessments, Biodiversity & Botanical specialist reports and Environmental Compliance Audits. During this time Mr Botes compiled more than 70 specialist Biodiversity & Botanical impact assessment reports ranging from agricultural-, pipelines- and solar developments.

2017-Present: Establish a small independent consultancy (PB Consult) specialising in Environmental Audits, Biodiversity and Botanical specialist studies as well as Environmental Impact Assessment.

LIST OF MOST RELEVANT BOTANICAL & BIODIVERSITY STUDIES

Botes. P. 2007: Botanical assessment. Schaapkraal, Erf 644, Mitchell's Plain. A preliminary assessment of the vegetation in terms of the Fynbos Forum: Ecosystem guidelines. 13 November 2007.

Botes. P. 2008: Botanical assessment. Schaapkraal Erf 1129, Cape Town. A preliminary assessment of the vegetation using the Fynbos Forum Terms of Reference: Ecosystem guidelines for environmental Assessment in the Northern Cape. 20 July 2008.

Botes, P. 2010(a): Botanical assessment. Proposed subdivision of Erf 902, 34 Eskom Street, Napier. A Botanical scan and an assessment of the natural vegetation of the site to assess to what degree the site contributes towards conservation targets for the ecosystem. 15 September 2010.

Botes, P. 2010(b): Botanical assessment. Proposed Loeriesfontein low cost housing project. A preliminary Botanical Assessment of the natural veld with regards to the proposed low cost housing project in/adjacent to Loeriesfontein, taking into consideration the National Spatial Biodiversity Assessment of South Africa. 10 August 2010.

Botes, P. 2010(c): Botanical assessment: Proposed Sparrenberg dam, on Sparrenberg Farm, Ceres. . A Botanical scan and an assessment of the natural vegetation of the site. 15 September 2010.

Botes, P. 2011: Botanical scan. Proposed Cathbert development on the Farm Wolfe Kloof, Paarl (Revised). A botanical scan of Portion 2 of the Farm Wolfe Kloof No. 966 (Cathbert) with regards to the proposed Cathbert Development, taking into consideration the National Spatial Biodiversity Assessment of South Africa. 28 September 2011.

Botes, P. 2012(a): Proposed Danielskuil Keren Energy Holdings Solar Facility on Erf 753, Danielskuil. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 17 March 2012.

Botes, P. 2012(b): Proposed Disselfontein Keren Energy Holdings Solar Facility on Farm Disselfontein no. 77, Hopetown. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 28 March 2012.

Botes, P. 2012(c): Proposed Kakamas Keren Energy Holdings Solar Facility on Remainder of the Farm 666, Kakamas. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 13 March 2012.

Botes, P. 2012(d): Proposed Keimoes Keren Energy Holdings Solar Facility at Keimoes. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 9 March 2012.

Botes, P. 2012(e): Proposed Leeu-Gamka Keren Energy Holdings Solar Facility on Portion 40 of the Farm Kruidfontein no. 33, Prince Albert. A Biodiversity Assessment (with botanical input) taking

into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 27 March 2012.

Botes, P. 2012(f): Proposed Mount Roper Keren Energy Holdings Solar Facility on Farm 321, Kuruman. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 28 March 2012.

Botes, P. 2012(g): Proposed Whitebank Keren Energy Holdings Solar Facility on Farm no. 379, Kuruman. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 27 March 2012.

Botes, P. 2012(h): Proposed Vanrhynsdorp Keren Energy Holdings Solar Facility on Farm Duinen Farm no. 258, Vanrhynsdorp. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 13 April 2012.

Botes, P. 2012(i): Askham (Kameelduin) proposed low cost housing, Mier Municipality Residential Project, Northern Cape. A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required. 1 November 2012.

Botes, P. 2013(a): Groot Mier proposed low cost housing, Mier Municipality Residential Project, Northern Cape. A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required. January 2013.

Botes, P. 2013(b): Loubos proposed low cost housing, Mier Municipality Residential Project, Northern Cape. A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required. January 2013.

Botes, P. 2013(c): Noenieput proposed low cost housing, Mier Municipality Residential Project, Northern Cape. A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required. January 2013.

Botes, P. 2013(d): Rietfontein proposed low cost housing, Mier Municipality Residential Project, Northern Cape. A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required. January 2013.

Botes, P. 2013(e): Welkom proposed low cost housing, Mier Municipality Residential Project, Northern Cape. A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required. January 2013.

Botes, P. 2013(f): Zypherfontein Dam Biodiversity & Botanical Scan. Proposed construction of a new irrigation dam on Portions 1, 3, 5 & 6 of the Farm Zypherfontein No. 66, Vanrhynsdorp (Northern Cape) and a scan of the proposed associated agricultural enlargement. September 2013.

Botes, P. 2013(g): Onseepkans Canal: Repair and upgrade of the Onseepkans Water Supply and Flood Protection Infrastructure, Northern Cape. A Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required). August 2013.

Botes, P. 2013(h): Biodiversity scoping assessment with regards to a Jetty Construction On Erf 327, Malagas (Matjiespoort). 24 October 2013.

Botes, P. 2013(i): Jacobsbaai pump station and rising main (Saldanha Bay Municipality). A Botanical Scan of the area that will be impacted by the proposed Jacobsbaai pump station and rising main. 30 October 2013.

Botes, P. 2014(a): Brandvlei Bulk Water Supply: Proposed construction of a 51 km new bulk water supply pipeline (replacing the existing pipeline) from Romanskolk Reservoir to the Brandvlei Reservoir, Brandvlei (Northern Cape Province). A preliminary Biodiversity & Botanical scan

in order to identify significant environmental features (and to identify the need for additional studies if required). 24 February 2014.

Botes, P. & McDonald Dr. D. 2014: Loeriesfontein Bulk Water Supply: Proposed construction of a new bulk water supply pipeline and associated infrastructure from the farm Rheeboksfontein to Loeriesfontein Reservoir, Loeriesfontein. Botanical scan of the proposed route to determine the possible impact on vegetation and plant species. 30 May 2014.

Botes, P. 2014(b): Kalahari-East Water Supply Scheme Extension: Phase 1. Proposed extension of the Kalahari-East Water Supply Scheme and associated infrastructure to the Mier Municipality, ZF Mgcawu District Municipality, Mier Local Municipality (Northern Cape Province). Biodiversity & Botanical scan of the proposed route to determine the possible impact on biodiversity with emphasis on vegetation and plant species. 1 July 2014.

Botes, P. 2014(c): The proposed Freudenberg Farm Homestead, Farm no. 419/0, Tulbagh (Wolseley Area). A Botanical scan of possible remaining natural veld on the property. 26 August 2014.

Botes, P. 2014(d): Postmasburg WWTW: Proposed relocation of the Postmasburg wastewater treatment works and associated infrastructure, ZF Mgcawu District Municipality, Tsantsabane Local Municipality (Northern Cape Province). Biodiversity and botanical scan of the proposed pipeline route and WWTW site. 30 October 2014.

Botes, P. 2015(a): Jacobsbaai pump station and rising main (Saldanha Bay Municipality) (Revision). A Botanical Scan of the area that will be impacted by the proposed Jacobsbaai pump station and rising main. 21 January 2015.

Botes, P. 2015(b): Steenkampspan proving ground. Proposed establishment of a high speed proving (& associated infrastructure) on the farm Steenkampspan (No. 419/6), Upington, ZF Mgcawu (Siyanda) District Municipality, Northern Cape Province. Biodiversity and Botanical Scan of the proposed footprint. 20 February 2015.

Botes, P 2015(c): Proposed Bredasdorp Feedlot, Portion 10 of Farm 159, Bredasdorp, Cape Agulhas Municipality, Northern Cape Province. A Botanical scan of the area that will be impacted. 28 July 2015.

Botes, P. 2016(a): OWK Raisin processing facility, Blaauwskop Settlement, Erf 151, Kenhardt, Northern Cape Province. A Botanical scan of the proposed footprint. 26 May 2016.

Botes, P. 2016(b): Onseepkans Agricultural development. The proposed development of ±250 ha of new agricultural land at Onseepkans, Northern Cape Province. Biodiversity and Botanical Scan. January 2016.

Botes, P. 2016(c): Henkries Mega-Agripark development. The proposed development of ±150 ha of high potential agricultural land at Henkries, Northern Cape Province. Biodiversity and Botanical Scan of the proposed footprint. 28 February 2016.

Botes, P. 2016(d): Proposed Namaqualand Regional Water Supply Scheme high priority bulk water supply infrastructure upgrades from Okiep to Concordia and Corolusberg. Biodiversity Assessment of the proposed footprint. March 2016.

Botes, P. 2017: The proposed new Namaqua N7 Truck Stop on Portion 62 of the Farm Biesjesfontein No. 218, Springbok, Northern Cape Province. Botanical scan of the proposed footprint. 10 July 2017.

Botes, P. 2018(a): Kamieskroon Bulk Water Supply – Ground water desalination, borehole- and reservoir development, Kamiesberg, Northern Cape Province. Botanical scan of the proposed footprint. 20 February 2018

Botes, P. 2018(b): Rooifontein Bulk Water Supply – Ground water desalination, borehole- and reservoir development, Rooifontein, Northern Cape Province. Botanical scan of the proposed footprint. 23 February 2018

Botes, P. 2018(c): Paulshoek Bulk Water Supply – Ground water desalination, borehole- and reservoir development, Paulshoek, Northern Cape Province. Botanical scan of the proposed footprint. 27 March 2018.

Botes, P. 2018(d): Kakamas Waste Water Treatment Works Upgrade – Construction of a new WWTW and rising main, Khai !Garib Local Municipality, Northern Cape Province. Botanical assessment of the proposed footprint. 1 August 2018.

Botes, P. 2018(e): Kakamas Bulk Water Supply – New bulk water supply line for Kakamas, Lutzburg & Cillie, Khai !Garib Local Municipality, Northern Cape Province. Botanical assessment of the proposed footprint. 4 August 2018.

Botes, P. 2018(f): Wagenboom Weir & Pipeline – Construction of a new pipeline and weir with the Snel River, Breede River Local Municipality, Northern Cape Province. Botanical assessment of the proposed footprint. 7 August 2018.

Botes, P. 2018(g): Steynville (Hopetown) outfall sewer pipeline – Proposed development of a new sewer outfall pipeline, Hopetown, Northern Cape Province. Botanical assessment of the proposed footprint. 8 October 2018.

Botes, P. 2018(h): Tripple D farm agricultural development – Development of a further 60 ha of vineyards, Erf 1178, Kakamas, Northern Cape Province. Botanical assessment of the proposed footprint. 8 October 2018.

Botes, P. 2018(i): Steynville (Hopetown) outfall sewer pipeline – Proposed development of a new sewer outfall pipeline, Hopetown, Northern Cape Province. Botanical assessment of the proposed footprint. 8 October 2018.

Botes, P. 2019(a): Lethabo Park Extension – Proposed extension of Lethabo Park (Housing Development) on the remainder of the Farm Roodepan No. 70, Erf 17725 and Erf 15089, Roodepan Kimberley. Sol Plaaitje Local Municipality, Northern Cape Province. Botanical assessment of the proposed footprint (with biodiversity inputs). 15 May 2019.

Botes, P. 2019(b): Verneujkpan Trust agricultural development – The proposed development of an additional ±250 ha of agricultural land on Farms 1763, 2372 & 2363, Kakamas, Northern Cape Province. 27 June 2019.

ANNEXURE G: GEOTECHNICAL REPORT

GEOTECHNICAL CONDITIONS ON PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT 48: A REPORT FOR THE EXPANSION AND FORMALISATION OF GROBLERSHOOP COMMUNITY

2020/J09/MCP_01

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EXECUTIVE SUMMARY

1 INTRODUCTION

It is envisaged to develop some 95 hectare of land on Portion 16 of the farm Boegoeberg Settlement 48 as an expansion of the existing Groblershoop community. For this purpose Cedar Land Geotechnical Consult (Pty) Ltd was appointed as subconsultant to Macroplan to conduct a geotechnical investigation on the property.

2 TERMS OF REFERENCE

The requirements of the following documents were adhered to in the conduct of the investigation and reporting of the project :

- *The document Geotechnical Site Investigations for Housing Developments (Generic Specification GFSH-2), issued by the National Department of Housing in September 2002.*
- *The document SANS 634-1 : Geotechnical Investigations for Township Development, issued by SABS in February 2012.*

3 SITE DESCRIPTION

3.1 Site Location

The area of investigation for the extension of Groblershoop is located on the south western side of National Route N10 to Marydale, opposite of the existing Sternham ; but directly adjacent to the south east of the industrial area of Groblershoop. Access to the area is directly from National Route N10. The size of the property is 95 hectare.

3.2 Topography and Drainage

The land investigated is located between 885,0mamsl and 868,0mamsl. Topographical it can be described as being located on the southern limit of undulating dunes encroaching from the north overlying level plain to the south. The dunes have been partially mechanically reworked and the slope of the dunes is variable up to approximately 4%. The plain to the south has possibly in been exposed by erosive action of wind and the river. The slope across the plain is less than 2% and generally towards the south.

Drainage takes place by means of surface sheetwash. Two non-perennial streams originate from the dunes and drain towards the north. The drainage courses are contained in narrow, shallow sloping and well defined gullies.

3.3 Vegetation and Landscape

The area of investigation is referred to as Bushmanland Arid Grassland. The landscape features are described as consisting of extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses giving this vegetation type the character of semi-desert steppe. In places low shrubs change the vegetation structure. On site it was found that in the areas where natural vegetation is present it consists of a sparse stand of Acacia melliflora and prosopis glandulosa. Stands of aloe claviflora are present. A few examples of Acacia erioloba and Aloe hereroensis were encountered during the investigation.

3.4 Climatic Conditions

The area is located in a summer-rainfall region with mean annual precipitation between 70mm to 200mm ; mean maximum summer temperature of 38°C and mean minimum winter temperature of -0,6°C. Frost incidence varies between 10 and 35 days per year. The development of whirl winds are common on hot summer days. The Thornthwaithe moisture index is less than -40 ; and the Weinert N value approximately 35. The climate can thus be described as arid.

3.5 Existing Facilities

The area can be divided into two zones as follows :

3.5.1 Vacant Land

The portion of level land occupying the southern part of the property can be described as vacant. It may have been used historically for grazing.

3.5.2 Utilised Land

The northern part of the property can be described as utilised land. Several obsolete and active waste water pipes are present. The area is characterized by the present of stockpiles of waste, mostly construction material and excavated calcrete. Unused, apparently obsolete, oxidations ponds and a small grave yard were encountered during the investigation ; so too an active oxidation dam for waste water from the nearby abattoir and areas of sewerage disposal.

4 NATURE OF INVESTIGATION

4.1 Test Pitting

Fifty test pits were excavated with a Bell 315SK TLB on hire from ALS Plant Rentals. Generally test pits were excavated to refusal. Excavation through the aeolian sands were terminated if collapse of the sidewalls occurred. This happened often at depths as shallow as 400mm. The test pits were profiled by a professionally registered geotechnical engineer.

4.2 Materials Testing

Soil testing consisted of the following :

- Conductivity and pH determinations on ten samples of the in-situ materials to determine the corrosivity thereof.
- Foundation indicator testing on 15 samples of the in-situ materials to determine possible conditions of heave or settlement.
- CBR and road indicator testing on four samples to determine the suitability of the in-situ materials to be utilized as road layerworks.

5 GEOLOGY, SOIL PROFILE AND GROUNDWATER

5.1 Geology

The available information shows that the area of investigation is located on a subduction zone dating approximately 1000 million years old. The zone is located between the lithology of the Kaapvaal Craton and the Namaqua-Natal mobile belt. The remains of the original geology in the area are referred to as the Kaaien Terrane and the site is located on the Groblershoop Formation of the Brulpan Group. Bedrock on site occurs as lineal bands of grey, micaceous quartzite associated with a wider distributed quartz-amphibole schist of the Groblershoop Formation, Brulpan Group. Occasionally the quartzite tends to be muscovite-rich.

5.2 Soil Profile

5.2.1 Gordonia Formation

Aeolian sand of the Gordonia Formatio,n Kalahari Group, was encountered in a reworked form in the southern area of the site and in a pure form in the northwestern part thereof. These deposits are light red in colour, very loose, fine sand with an intact matrix. The thickness of the horizon varied between 800mm and 1900mm in the test pits.

5.2.2 Colluvium

Gravelly colluvium as surface deposit was found over the entire site. Being older than the aeolian sand, it underlies the dunes where they were encountered. The colluvium is a homogenous material, consisting light brown fine sand and clasts of gravels and cobbles of quartz and some calcrete. The horizon of colluvium was between 600mm and 1400mm thick in the test pits.

5.2.3 Mokalanen Formation

Calcrete was encountered as the dominant lithic material on site, in virtually a continuous cover over the quartzite and schist, with the latter outcropping occasionally. The calcrete is present as very dense hardpan or boulder calcrete. The calcrete is present as outcrops ; or underlies the transported materials, occurring from depths between zero and 800mm minimum, extending to 100mm to 1200mm maximum. It is described as dirty white to dirty light yellow white, very fine grained, very dense calcrete. Some fine sand may occasionally be contained in voids in the matrix of the calcrete.

5.2.4 Residual Quartzite

On site residual quartzite was encountered as surface material or underlying the gravelly colluvium. It consists of cobbles and boulders of quartzite with diameter less than 500mm contained a matrix of dirty white, calcareous cemented sand. The soil matrix is medium dense. The horizon of residual quartzite extended to a depth of 700mm where encountered.

5.3 Groundwater

5.3.1 Perched Water

Perched groundwater was not encountered in any of the test pits excavated for this investigation. It is anticipated that perched water will generally not prove problematic on the site. However, seepage water may be encountered in the vicinity of the waste water disposal areas.

5.3.2 Permanent Groundwater

The probability for drilling successfully for water in the area is between 40% and 60%, and the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths less than 15 meters in compact, argillaceous strata.

6 SITE CLASS DESIGNATION

The area is regarded as suitable for residential development as follows :

6.1 Geotechnical Zone I(a)

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 28% of the proposed area for development. Slope across the land is less than 2%. Considering the limited slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on bedrock or very dense pedocrete.

6.2 Geotechnical Zone I(b)

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 36% of the proposed area for development. Slope across the land is approximately between 2% and 6%. The use of slab-on-the-ground foundations will require additional works in the form of the construction of an engineered fill or cutting to establish a level platform for construction. The more viable foundation alternative therefore remains founding by conventional strip foundations.

6.3 Geotechnical Zone II(a)

The zone is classed as S, meaning that the proposed horizon for founding is stable and less than 10mm rapid compression settlement is expected. The distribution thereof encompasses 3% of the proposed area for development. Slope across the land is less than 2%. Considering the limited slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on gravelly colluvium or aeolian sand. The latter option is regarded as the better solution of the two alternatives.

6.4 Geotechnical Zone II(b)

The zone is classed as S, meaning that the proposed horizon for founding is slightly compressible and rapid compression settlement less than 10mm is expected. The distribution thereof encompasses 17% of the proposed area for development. Slope across the land is between 2% and 6%. Considering the slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on gravelly colluvium or aeolian sand. The more viable foundation alternative therefore remains founding by conventional strip foundations.

6.5 Geotechnical Zone III(a)

The zone is classed as S1, meaning that the proposed horizon for founding is fairly compressible and the foundation design need to incorporate measures to counter the effects of the geotechnical conditions. Between 10mm and 20mm rapid compression settlement is expected. The distribution thereof encompasses 3% of the proposed area for development. Slope across the land is less than 2%. Considering the limited slope and the intermediate geotechnical site classification, two foundation design alternatives are applicable to the zone, namely reinforced strip foundations or replacement of the in-situ soils underneath individual footings. From a geotechnical viewpoint both alternatives are regarded as suitable solutions for the founding conditions.

6.6 Geotechnical Zone III(b)

The zone is classed as S1, meaning that the proposed horizon for founding is fairly compressible and the foundation design need to incorporate measures to counter the effects of the geotechnical conditions. Between 10mm and 20mm rapid compression settlement is expected. The distribution thereof encompasses 7% of the proposed area for development. Slope across the land is between 2% and 6%. Considering the intermediate geotechnical site classification, two foundation design alternatives are applicable to the zone, namely reinforced strip foundations or replacement of the in-situ soils underneath individual footings. From a geotechnical viewpoint both alternatives are regarded as suitable solutions for the founding conditions.

6.7 Geotechnical Zone IV

The zone is classed as S2, meaning that the proposed horizon for founding is highly compressible and the foundation design need to incorporate measures to counter the effects of the geotechnical conditions. In excess of 20mm rapid compression settlement is expected. The distribution thereof encompasses 6% of the proposed area for development. Slope across the land is between 2% and 6%. Considering the intermediate geotechnical site classification, two foundation design alternatives are applicable to the zone, namely reinforced strip foundations or reinforced concrete rafts. From a geotechnical viewpoint both alternatives are regarded as suitable solutions for the founding conditions. However, the selection of which alternative to use must be made individually for each stand. All foundations to be designed by a suitably experienced professional engineer.

7 CONDITIONS OF EXCAVATION

7.1 Conditions of Hard Rock Excavation

On average over the entire site bedrock or refusal of excavation on very dense hardpan calcrete, bedrock of quartz-amphibole schist or quartzite was encountered at depths between 100mm minimum

and 1500mm maximum, averaging 700mm deep. The implication of this is that should trenches require excavated depths to 1000mm, 30% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 53% of the excavation may be classified as hard.

7.1.1 Geotechnical Zones I(a) and I(b)

These zones are classified as R. The average depth to bedrock or very dense pedocrete is 185mm. Refusal of excavation occurred at an average depth of 550mm. The implication of this is that should trenches require excavated depths to 1000mm, 45% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 63% of the excavation may be classified as hard.

7.1.1ii) Geotechnical Zones II(a) and II(b)

These zones are classified as S. The average depth to bedrock or very dense pedocrete is 620mm. Refusal of excavation occurred at an average depth of 850mm. The implication of this is that should trenches require excavated depths to 1000mm, 15% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 43% of the excavation may be classified as hard.

7.1.1(iii) Geotechnical Zones III(a and b)

These zones are classified as S1. The average depth to bedrock or very dense pedocrete is 780mm. Refusal of excavation occurred at an average depth of 1200mm. The implication of this is that should trenches require excavated depths to 1000mm, zero percent of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 20% of the excavation may be classified as hard.

7.1.1(iv) Geotechnical Zone IV

This zones is classified as S2. The average depth to bedrock or very dense pedocrete is 1370mm. Refusal of excavation occurred at an average depth of 1470mm. The implication of this is that should trenches require excavated depths to 1000mm, zero percent of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 2% of the excavation may be classified as hard.

7.2 Sidewall Stability

In all cases where aeolian sand or reworked aeolian sand may occur such material may be regarded

as potentially unstable and subject to collapse. However, especially in Geotechnical Zone S2 where deep, very loose sand is present, such conditions are dangerous and can prove fatal if collapses occur while workmen are occupied in trenches.

8 LAND SLOPE

The average slope across 66% of the land is between 2% and 6% and over 34% it is less than 2%.

The slope of less than 2% has a detrimental influence on especially the design of a stormwater disposal system depending on gravity to dissipate of the surface water due to downpours. The land slope also affects the design of the sewerage disposal but to a lesser extent as the gradient of the pipes can be adjusted according to design requirements.

9 MATERIALS UTILIZATION

- Trench Backfilling : Only the aeolian sand can be regarded as suitable for selected fill or pipe bedding. With exception of the hardpan calcrete all materials can be used for normal backfill.
- Layerworks for Paved or Segmental Block Paving : The hardpan calcrete and colluvium are of G6 quality and hence suitable for the construction of layerworks up to subbase and base course level for lightly trafficked roads.
- Wearing Course for Gravel Roads in Urban Areas : None of the soil materials are 100% suitable for this purpose. The use of these materials will generally result in a road surface subject to raveling and corrugations.

10 SPECIAL PRECAUTIONARY MEASURES

10.1 Soil and Water Contamination

Prior to development of the area possible conditions of soil and groundwater contamination due to the presence of the cemetery, obsolete oxidation dams, existing oxidation dam and sewer dumping area need to be resolved.

Even though no in-situ testing was conducted to determine whether these items are responsible for, or have historically been responsible for soil or water contamination, it can be stated that such conditions may have occurred. Due to the relative absence of groundwater of any sort close to the surface and an impermeable barrier formed by the calcrete and bedrock it is unlikely that groundwater contamination may have taken place, but contamination of surface water could have occurred. Similarly could bacterial contamination of the surface soils have taken place.

10.2 Dune Stability

Although the dunes in this area have been stable and not subject to movement over a very long time, it has been found that with the removal of vegetation the effects of wind result in the displacement of the sand. It is therefore important that any development of the dune area be done in conjunction with an environmental specialist who can provide guidance with regard to revegetating the dunes and development of infrastructure in these conditions.

11 OTHER CONSIDERATIONS

- *Undermining : The area is not subject to undermining.*
- *Seismic Activity : The Peak Ground Acceleration expected in 50 years is 0,05g. A low risk for the development of earth tremors therefore exist.*
- *Soil Corrosivity : The in-situ soils and pedocretes are not corrosive due to acidic properties. All soil materials can be regarded as corrosive due to high soluble salt contents.*
- *Dolomite : The area of investigation is not subject to any restrictions due to the presence of dolomite. Bedrock of dolomite does not occur in the area of investigation.*

GEOTECHNICAL CONDITIONS ON PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT 48: A REPORT FOR THE EXPANSION AND FORMALISATION OF GROBLERSHOOP COMMUNITY

2020/J09/MCP_01

INDEX

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GEOTECHNICAL CONDITIONS ON PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT 48 : A REPORT FOR THE EXPANSION AND FORMALISATION OF GROBLERSHOOP COMMUNITY

1 INTRODUCTION

It is envisaged to develop some 95 hectare of land on Portion 16 of the farm Boegoeberg Settlement 48 as an expansion of the existing Groblershoop community. For this purpose Cedar Land Geotechnical Consult (Pty) Ltd was appointed as subconsultant to Macroplan as per the minutes of the start-up meeting of the project held in the offices of Macroplan on 20 May 2020 to conduct a geotechnical investigation on the property.

2 TERMS OF REFERENCE

The requirements of the following documents were adhered to in the conduct of the investigation and reporting of the project :

- The document *Geotechnical Site Investigations for Housing Developments (Generic Specification GFSH-2)*, issued by the National Department of Housing in September 2002.
- The document *SANS 634-1 : Geotechnical Investigations for Township Development*, issued by SABS in February 2012.

3 AVAILABLE INFORMATION

The following source of available information recording available data obtained in the larger Upington to Groblershoop area have been consulted for background information :

- *Breytenbach FJ* : Report on the Geotechnical Conditions on Erf 2785 Boegoeberg Settlement, issued by Soilkraft cc on behalf of KLK Petroleum on 25 April 2015.

- *Breytenbach FJ* : Geotechnical Conditions on Erf 2790 Sternham : A Phase 3 Report for the Proposed Construction of a New Library, issued by Soilkraft cc on behalf of Ukhukhula Consulting Engineers on 18 October 2012.
- *Breytenbach FJ* : Contract NRA N010-110-2012/1F : Geotechnical Investigation for Four Bridge Widenings on the National Route 10 Section 11 between Groblershoop (km 0,0) and Lambrechtsdrift (km 61,1), issued by Soilkraft cc on behalf of Bvi Engineers on 8 March 2012.
- *Breytenbach FJ* : Geotechnical Conditions on Five Areas of the Farm Buchuberg 48 : A Report for Extending the Existing Residential Area of Sternham near Groblershoop, issued by Soilkraft on behalf of Macroplan on 21 December 2011.

4 SITE DESCRIPTION

4.1 Site Location

The area of investigation for the extension of Groblershoop is located on the south western side of National Route N10 to Marydale, opposite of the existing Sternham ; but directly adjacent to the south east of the industrial area of Groblershoop. Access to the area is directly from National Route N10. It is some 120km southeast of Upington and located on Portion 16 of the farm Boegoeberg Settlement 48. The size of the property is 95 hectare.

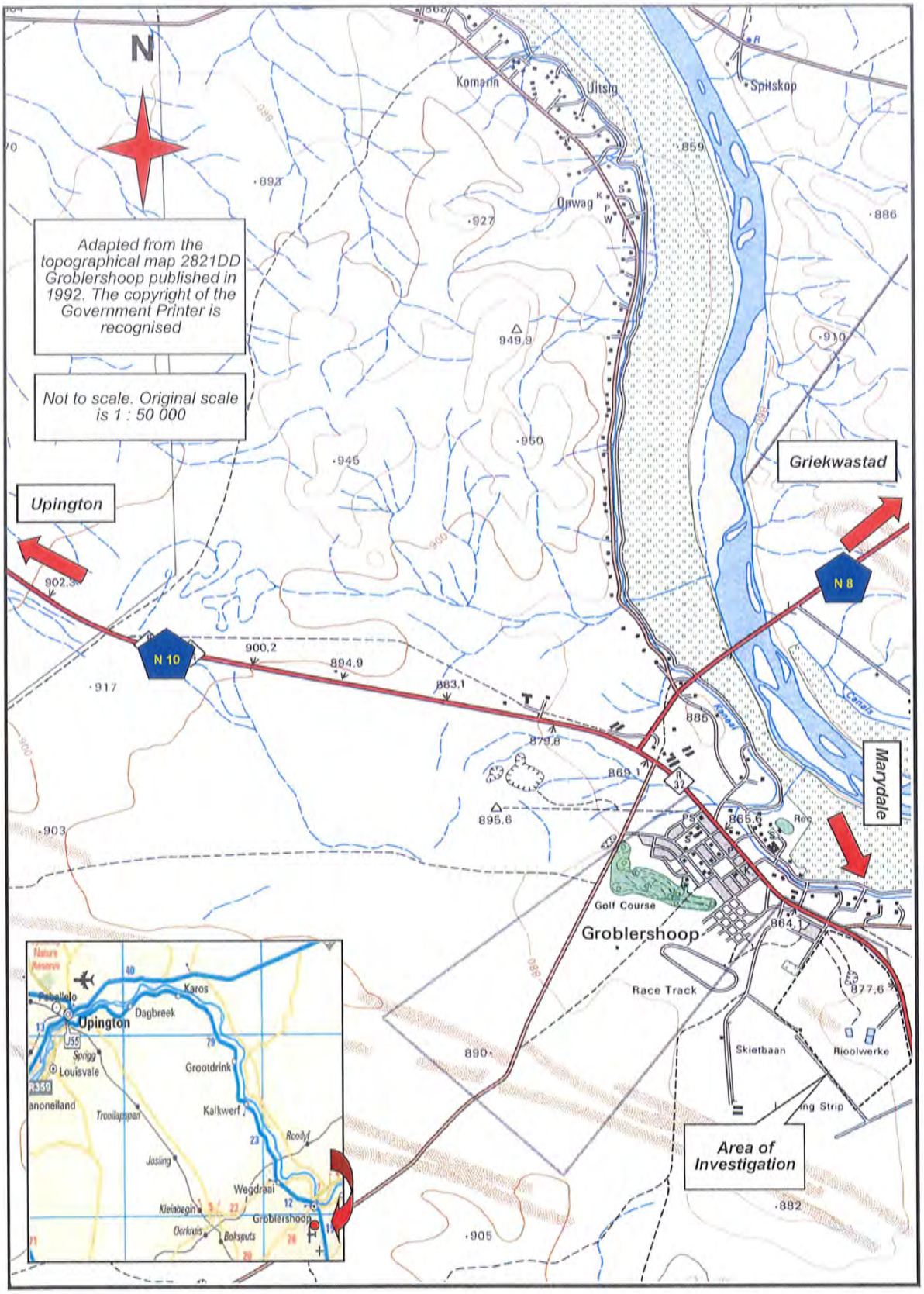
Refer to the attached Figure 1 : Locality Plan.

4.2 Topography and Drainage

The land investigated is located between 885,0mamsl and 868,0mamsl. Topographical it can be described as being located on the southern limit of undulating dunes encroaching from the north overlying level plain to the south. The dunes have been partially mechanically reworked and the slope of the dunes is variable up to approximately 4%.

The plain to the south has possibly in been exposed by erosive action of wind and the river. The slope across the plain is less than 2% and generally towards the south.

Drainage takes place by means of surface sheetwash. Two non-perennial streams originate from the dunes and drain towards the north. The drainage courses are contained in narrow, shallow sloping and well defined gullies.



C.L.G.C.

LOCALITY PLAN

FIGURE 1

4.3 Vegetation and Landscape

Based on the work done by Mucina[Reference 14.1] the area of investigation is referred to as Bushmanland Arid Grassland. The landscape features are described as consisting of extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses giving this vegetation type the character of semi-desert steppe. In places low shrubs change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected. On site it was found that in the areas where natural vegetation is present it consists of a sparse stand of Acacia melliflora and prosopis glandulosa. Stands of aloe claviflora are present. A few examples of Acacia erioloba and Aloe hereroensis were encountered during the investigation.

4.4 Climatic Conditions

The area is located in a summer-rainfall region with mean annual precipitation between 70mm to 200mm ; mean maximum summer temperature of 38°C and mean minimum winter temperature of -0,6°C. Frost incidence varies between 10 and 35 days per year. The development of whirl winds are common on hot summer days. The Thornthwaithe moisture index is less than -40 ; and the Weinert N value approximately 35. The climate can thus be described as arid. The importance of this is that mechanical breakdown of bedrock will take place rather than chemical decomposition, limiting the formation of secondary minerals such as expansive montmorillonite clay.

4.5 Existing Facilities

Site conditions are illustrated on Photo 1 : Site Conditions.

The area can be divided into two zones as follows :

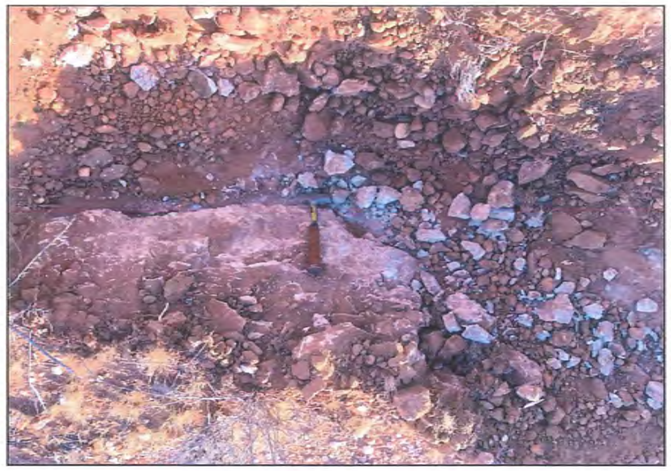
4.5.1 Vacant Land

The portion of level land occupying the southern part of the property can be described as vacant. It may have been used historically for grazing, but no sign of recent human occupation or disturbance could be identified during the investigation.

4.5.2 Utilised Land

The northern part of the property, adjacent to the existing infrastructure of Groblershoop can be described as utilised land. Several obsolete and active waste water pipes are present. The area is characterized by the present of stockpiles of waste, mostly construction material and

TILTED OUTCROPS OF QUARTZ-AMPHIBOLE SCHIST THROUGH AEOLIAN SAND



CONDITIONS OF HARD EXCAVATION IN CALCRETE

CONDITIONS IN UNDISTURBED VELD

DRIED SPILL OF SEWER WASTE

STOCKPILES OF MIXED WASTE MATERIAL

CONDITIONS OF HARD EXCAVATION IN QUARTZ-AMPHIBOLE SCHIST

C.L.G.C.

CONDITIONS IN GROBLERSHOOP AREA FOR DEVELOPMENT

PHOTO 1

excavated calcrete. Unused, apparently obsolete, oxidations ponds and a small grave yard were encountered during the investigation ; so too an active oxidation dam for waste water from the nearby abattoir and areas of sewerage disposal. These latter areas of sewerage disposal cannot be regarded as professionally designed oxidation dams or similar features.

5 NATURE OF INVESTIGATION

5.1 Test Pitting

In compliance with the requirements of SANS 634 and GFSH-2 test pitting was conducted to provide applicable geotechnical information. On 9 and 10 July 2020 50 test pits were excavated with a Bell 315SK TLB on hire from ALS Plant Rentals. The TLB was equipped with a 600mm wide bucket. Generally test pits were excavated to refusal. Excavation through the aeolian sands were terminated if collapse of the sidewalls occurred. This happened often at depths as shallow as 400mm.

The test pits were profiled by a professionally registered geotechnical engineer. For the benefit of the non-geotechnical reader of this document, the guidelines for test pit profiling are summarized in the attached Table 1 : Soil Profiling Parameters. The profiles of the test pits may be found in Addendum A to this report. The positions of the test pits are indicated on the attached Figure 2 : Site Plan. Provisional co-ordinates for property beacons A to U are indicated on this figure.

5.2 Materials Testing

Soil testing was undertaken by Roadlab in Upington. As a matter of quality control duplicate samples were sent to the Roadlab branch in Germiston for independent testing to verify the results. Due to general limited vertical extent of the soil profile and coarse nature thereof, it was not feasible to retrieved undisturbed samples to determine properties of settlement or collapse fairly accurately.

Soil testing consisted of the following :

- Conductivity and pH determinations on ten samples of the in-situ materials to determine the corrosivity thereof.
- Foundation indicator testing on 15 samples of the in-situ materials to determine possible conditions of heave or settlement.
- CBR and road indicator testing on four samples to determine the suitability of the in-situ materials to be utilized as road layerworks.

TABLE 1 : SOIL PROFILING PARAMETERS

CONSISTENCY : GRANULAR SOILS

SPT N	GRAVELS & SANDS Generally free draining soils		DRY DENSITY (kg/m^3)
<4	Very loose	Crumbles very easily when scraped with geological pick. Requires power tools for	<1450
4-10	Loose	Small resistance to penetration by sharp pick point, requires many blows by pick point	1450-1600
10-30	Medium dense	Considerable resistance to penetration by sharp pick point.	1600-1750
30-50	Dense	Very high resistance to penetration by sharp pick point. Requires many blows by pick point for excavation.	1750-1925
>50	Very dense	High resistance to repeated blows of geological pick. Requires power tools for excavation.	>1925

CONSISTENCY : COHESIVE SOILS

SPT N	SILTS & CLAYS and combinations with SANDS Generally slow draining soils		UCS (kPa)
<2	Very soft	Pick point easlily pushed in 100mm. Easily moulded by fingers.	<50
2-4	Soft	Pick point easlily pushed in 30mm to 40mm. Moulded by fingers with some pressure.	50-125
4-8	Firm	Pick point penetrates to 10mm. Very difficult to mould with fingers.	125-250
8-15	Stiff	Slight indentation by pick point. Cannot be moulded by fingers. Penetrated by thumb nail.	250-500
15-30	Very stiff	Slight indentation by blow of pick point. Requires power tools for excavation.	500-1000

SOIL TYPE

SOIL TYPE	PARTICLE SIZE(mm)
Clay	<0,002
Silt	0,002-0,06
Sand	0,06-2,0
Gravel	2,0-60,0
Cobbles	60,0-200,0
Boulders	>200,0

MOISTURE CONDITION

Dry	No water detectable
Slightly moist	Water just discernable
Moist	Water easily discernable
Very moist	Water can be squeezed out
Wet	Generally below water table

COLOUR

Speckled	Very small patches of colour <2mm
Mottled	Irregular patches of colour 2-6mm
Blotched	Large irregular patches 6-20mm
Banded	Approximately parallel bands of varying colours
Streaked	Randomly orientated streaks of colour
Stained	Local colour variations : Associated with discontinuity surfaces

SOIL STRUCTURE

Intact	No structure present.
Fissured	Presence of discontinuities, possibly cemented.
Slickensided	Very smooth, glossy, often striated discontinuity planes.
Shattered	Presence of open fissures. Soil break into gravel size blocks.
Micro shattered	Small scale shattering, very closely spaced open fissures. Soil breaks into sand size crumbs.
Residual structures	Residual bedding, laminations, foliations etc.

ORIGIN

Transported	Alluvium, hillwash, talus etc.
Residual	Weathered from parent rock, eg residual granite
Pedocretes	Ferricrete, silcrete, calcrete etc.

DEGREE OF CEMENTATION OF PEDOCRETES

TERM	DESCRIPTION	UCS (MPa)
Very weakly cemented	Some material can be crumbled between finger and thumb. Disintegrates under knife blade to a friable state.	0,1-0,5
Weakly cemented	Cannot be crumbled between strong fingers. Some material can be crumbled by strong pressure between thumb and hard surface. Under light hammer blows disintegrate to a friable state.	0,5-2,0
Cemented	Material crumbles under firm blows of sharp pick point. Grains can be dislodged with some difficulty by a knife blade.	2,0-5,0
Strongly cemented	Firm blows of sharp pick point on hand-held specimen show 1-3mm indentations. Grains cannot be dislodged by knife blade.	5,0-10,0
Very strongly cemented	Hand-held specimen can be broken by single firm blow of hammer head. Similar appearance to concrete.	10,0-25

The results of the soil testing may be found in Addendum B. However, for easy reference, these results are summarized in the attached Table 2 : Summary of Soil Testing. The data sheets contained in Addendum B are copies of the originals, which are available from Roadlab.

6 SITE GEOLOGY AND GEOHYDROLOGY

The geology of the area between Upington and Groblershoop appears to consist of granitoid rock in the north, grading into metamorphic rocks towards Groblershoop, but it is in fact highly complex and from a stratigraphical viewpoint provides complicated formation. As a background to the site geology an effort is made in this subparagraph to provide a simplified

COORDINATES – GROBLERSHOOP		
System: WGS84 WG21		
Point	Y	X
A	-96976.477	3198767.421
B	-97021.372	3198792.034
C	-97098.145	3198844.224
D	-97166.237	3198904.949
E	-97227.500	3198971.054
F	-97282.715	3199047.935
G	-97323.356	3199125.923
H	-97356.992	3199214.001
J	-97379.208	3199304.780
K	-97388.844	3199364.554
L	-97648.880	3200799.048
M	-97330.921	3200734.961
N	-97174.050	3200307.397
P	-96884.085	3199947.421
Q	-96895.228	3199768.167
R	-96831.818	3199558.067
S	-96668.300	3199375.374
T	-96814.540	3199068.473
U	-96956.923	3198804.408

FIGURE 2 :
SITE PLAN

LEGEND

TP1 TEST PIT POSITION

BOSCIA ALBITRUNCA (TO BE CONSERVED)

VERY ROCKY

TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12 TP13 TP14 TP15 TP16 TP17 TP18 TP19 TP20 TP21 TP22 TP23 TP24 TP25 TP26 TP27 TP28 TP29 TP30 TP31 TP32 TP33 TP34 TP35 TP36 TP37 TP38 TP39 TP40 TP41 TP42 TP43 TP44 TP45 TP46 TP47 TP48 TP49 TP50

Gate

A B C D E F G H J K L M N P Q R S T U

N

80m 240m 400m
0m 160m 320m

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cedarland.mariette@breede.co.za (Mariette)

TAAK: JOB NAME:	Expansion and Formalisation of Groblershoop Community
LIGGING: SITE:	Portion 16 of the Farm Boegoeberg Settlement no 48
KLIENT: CLIENT:	!Kheis Municipality
TEKENING NO: DRAWING NO:	Figure 2 : Site Plan
DATUM: DATE:	22 September 2020

TABLE 2 : SUMMARY OF SOIL TESTING

TEST PIT NO	SAMPLE NO (CLG)	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GM	PI	LL	ACTIVITY	pH	CONDUCTIVITY (Sm^{-1})	% < 0,002mm	OMC	MDD	SOIL CLASS		
														COLTO	PRA	UNIFIED
2	U9309	200-600	Hardpan calcrete	Sandy gravel	2,20	2	20	Low	7,76	0,16	0,4				A-1-a(0)	GW-GC
9	U9310	0-800	Rock fragments	Gravelly sand	1,70	2	16	Low	7,90	0,03	0,8	6,5	2179	G6	A-1-b(0)	SC
15	U9307	100-500	Boulder calcrete	Sandy gravel	2,50	1	19	Low	7,77	0,12	0,3				A-1-a(0)	GW-GC
17	U9308	0-300	Boulder calcrete	Sandy gravel	2,20	2	24	Low			0,8				A-1-b(0)	GM
22	U9304	0-700	Boulder calcrete	Gravelly sand	1,80	4	26	Low	7,52	0,11	0,4	7,7	2146	G6	A-1-b(0)	SM
23	U9306	0-400	Colluvium	Gravelly sand	1,70	2	18	Low			1,2				A-2-4(0)	SC
25	U9305	0-600	Aeolian sand	Fine sand	0,90	NP	16	Low	7,63	0,13	0,3				A-2-4(0)	SC
30	U9303	0-500	Aeolian sand	Fine sand	1,00	6	30	Low	7,56	0,15	0,3				A-2-4(0)	SM
33	U9299	300-500	Rock fragments	Sandy gravel	2,10	6	34	Low			0,5				A-1-b(0)	SM
37	U9298	0-600	Aeolian sand	Fine sand	1,0	NP	12	Low	7,50	0,18	0,5				A-2-4(0)	SC
38	U9293	300-500	Rock fragments	Sandy gravel	2,20	5	24	Low			0,3				A-1-a(0)	GM-GC
40	U9297	0-300	Colluvium	Sandy gravel	2,30	2	24	Low	7,73	0,05	0,5	5,7	2096	G6	A-1-a(0)	GM
44	U9296	0-500	Colluvium	Sandy gravel	1,50	3	28	Low			0,9				A-2-4(0)	SM
46	U9295	0-700	Aeolian sand	Fine sand	1,10	NP	12	Low	7,70	0,09	0,4				A-2-4(0)	SC
50	U9294	200-1000	Rock fragments	Sandy gravel	2,30	6	30	Low	7,78	0,06	0,4	11,3	1957	G6	A-1-a(0)	GW-GM

explanation of the regional geology of the area. For this purpose publications by McCarthy[Reference 14.2], Cornell[Reference 14.3] and Moen[Reference 14.4] were consulted. Of these three references, the latter two can be regarded as site specific. However, there is disagreement between the two sources regarding the stratigraphic classification of the major subdivisions of the Namaqua-Natal province. As the work produced by Cornell is regarded as the reference document, his approach is adopted for this report.

Some concepts must be identified :

- *Craton* : A craton is a block of ancient crust, formed 3000 million years ago and its rocks have essentially remained unchanged. Cratons form the larger parts of the land-building mass.
- *Province* : A tectono-stratigraphic province is defined as a large area of contiguous structural fabric with well-defined boundaries which formed during a particular, geochronologically defined, tectono-metamorphic event. A province is further subdivided in sub-provinces and sub-provinces into terranes.

- *Terrane* : A terrane is a term for a tectonostratigraphic unit, which is a fragment of crustal material formed on, or broken off from, one tectonic plate and accreted or "sutured" to crust lying on another plate. The crustal block or fragment preserves its own distinctive geologic history, which is different from that of the surrounding areas.

6.1 Regional Geology

The geological processes by which the area under consideration was shaped, initiated some 1000 million years ago with the formation of the supercontinent Rodinia. A mountain chain of global extent formed along the boundaries, underlain by metamorphic rocks that have since then been exposed due to erosion. Metamorphic rocks of this age formed across South Africa to the south and west of the Kaapvaal Craton, known as the Namaqua-Natal Province. The Namaqua-Natal Province can be divided into five tectonostratigraphic subprovinces and terranes, based on marked changes in the lithostratigraphy across structural discontinuities. The five domains so recognized are the Richtersveld Subprovince, the Bushmanland Terrane, Kakamas Terrane, Areachap Terrane and Kaaien Terrane. The tectonic subdivision as proposed on Figure 2 (Cornell) is reproduced in this document as Figure 3.

The process of landforming can be described as compatible to the modern concept of plate tectonics. In this case the Namaqua plate became buried beneath the Kaapvaal Craton in a subduction zone. Considering the forces involved it can be regarded as a violent process, resulting in the breaking up of the landmass into the five domains as described above, associated with the intrusion of recycled rock material from the subduction zone. What is

important for this report is that in the case of the Kaaien terrane, the formation of metaquartzites, deformed early Namaquan volcano-sedimentary rocks and deformed, but thermally metamorphosed bimodal volcanic rocks resulted, amongst others. These rocks are at present referred to amongst others as the Brulpan Group, on which Groblershoop is located. There is controversy about the age of the Brulpan Group, but is estimated between 1710Ma to 1780Ma, underlying the Wilgenhoutsdrif Group.

The regional geology is indicated on Figure 4 : Regional Geology.

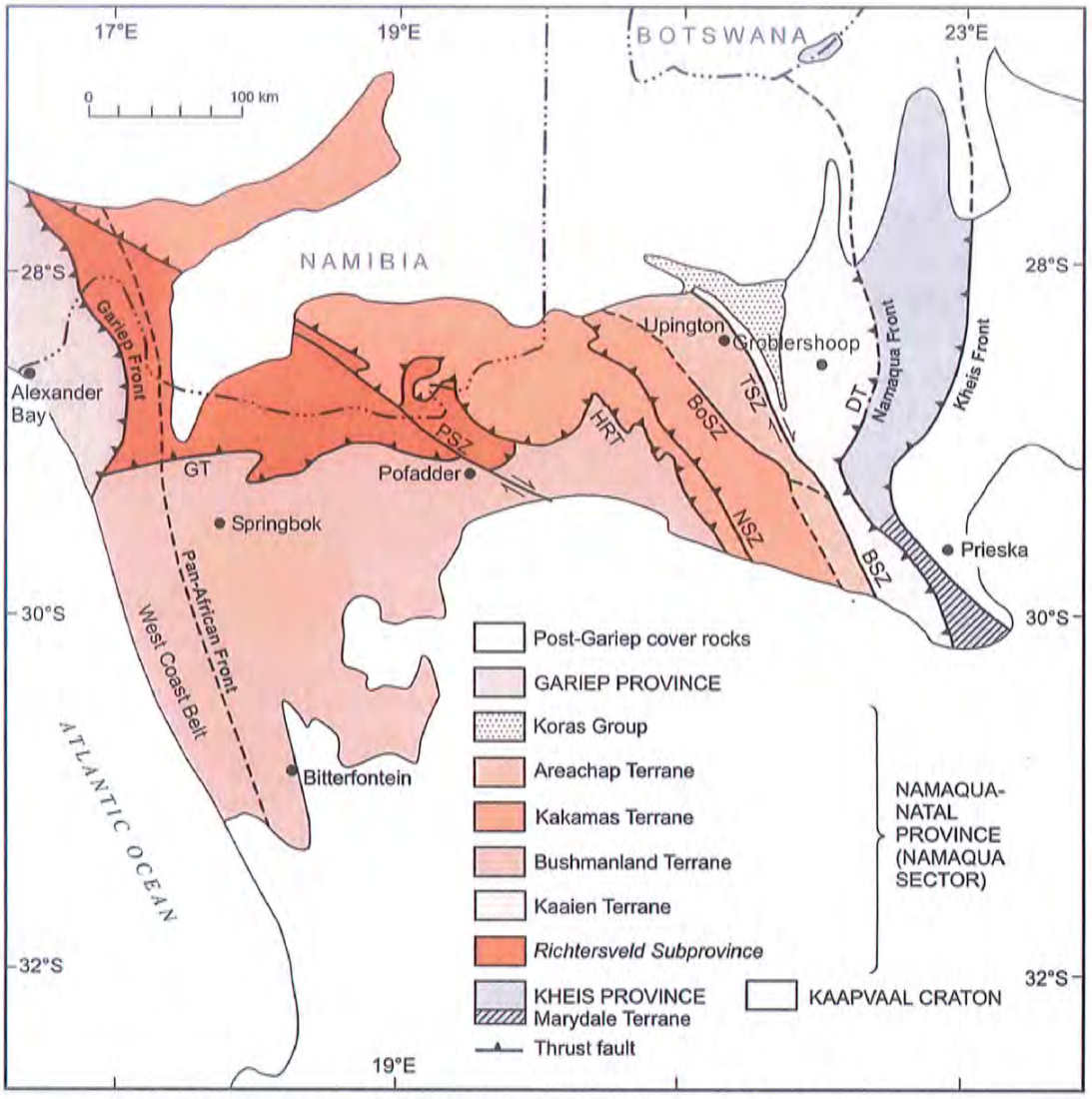
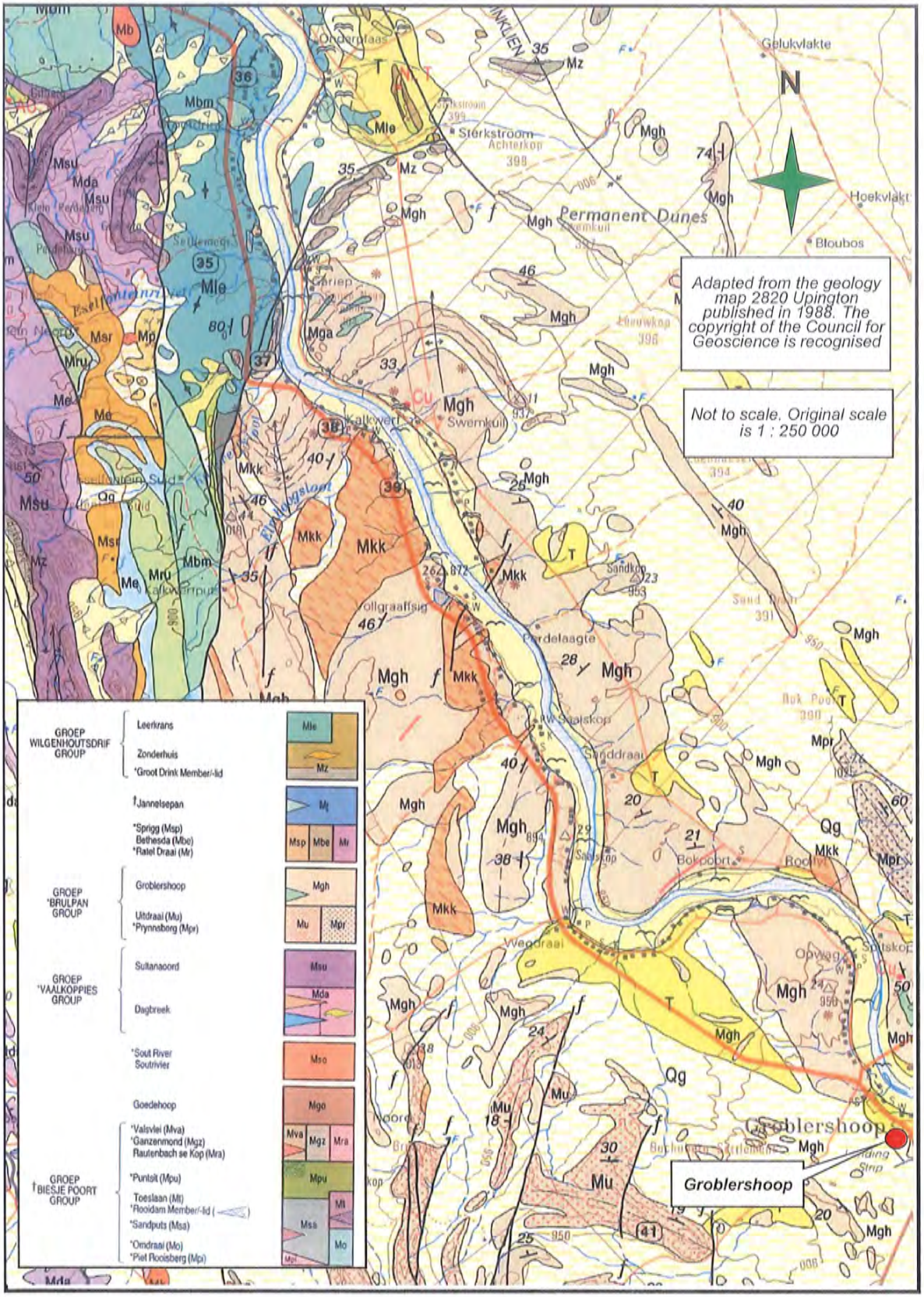


FIGURE 3 : TECTONIC SUBDIVISION OF THE NAMAQUA SECTOR

6.2 Site Geology

The site geology is illustrated on Figure 5. The soil and pedocretes are present as a very dense barrier over bedrock with exposures in areas of thin and less dense pedocrete deposits.



C.G.C.

GROBLERSHOOP : REGIONAL GEOLOGY

FIGURE 4

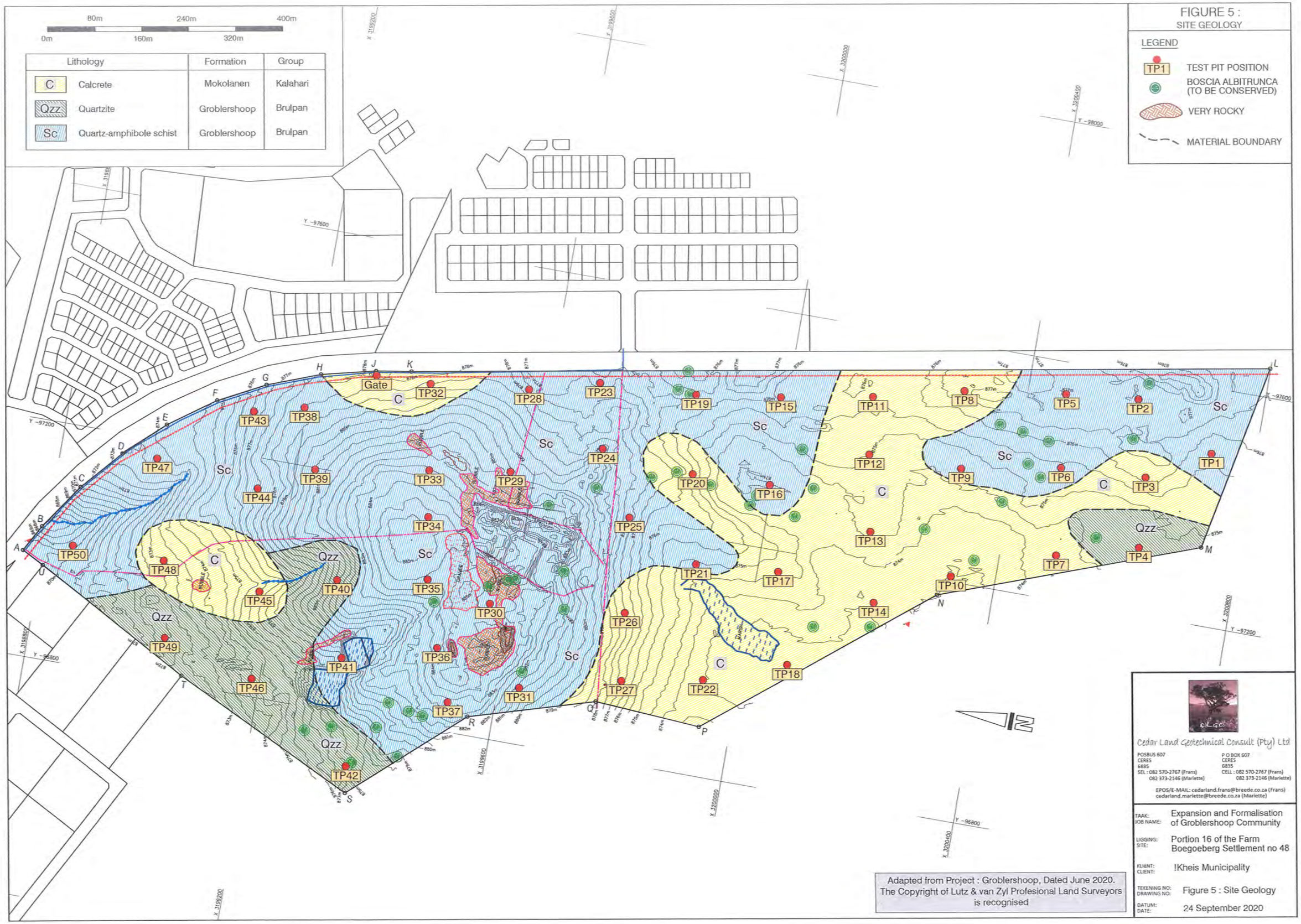
FIGURE 5 :
SITE GEOLOGY

80m 240m 400m
0m 160m 320m

Lithology		Formation	Group
C	Calcrete	Mokolanen	Kalahari
Qzz	Quartzite	Groblershoop	Brulpan
Sc	Quartz-amphibole schist	Groblershoop	Brulpan

LEGEND

- TP1 — TEST PIT POSITION
- BOSCIA ALBITRUNCA (TO BE CONSERVED)
- VERY ROCKY
- MATERIAL BOUNDARY



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TAAK: / JOB NAME:	Expansion and Formalisation of Groblershoop Community
LIGGING: / SITE:	Portion 16 of the Farm Boegoeberg Settlement no 48
KLIENT: / CLIENT:	!Kheis Municipality
TEKENING NO: / DRAWING NO:	Figure 5 : Site Geology
DATUM: / DATE:	24 September 2020

Due to the irregular presence of pedocretes the inferred material boundaries must be accepted as indicative of the actual conditions only. Bedrock of the Groblershoop Formation of the Brulpan Group on site occurs as follows :

6.2.1 Quartzite

Quartzite was encountered in TP's 4, 40, 42, 46 and 49 only. It tends to be present in steeply dipping lineal bands of limited width rather than wide spread occurrences of rock. Due to its resistance to weathering it is present as easily identifiable outcrops of rock. It is generally described as light yellow grey speckled light brown or light grey, very fine grained, slightly weathered to unweathered, medium jointed to widely jointed, hard rock to very hard rock. The joints are smooth, closed and clean. The quartzite is sometimes muscovite rich.

6.2.2 Quartz-amphibole Schist

It was possible to penetrate the very dense calcrete into bedrock of quartz-amphibole schist in TP's 1, 2, 5, 6, 9, 15, 16, 19, 21, 23, 25, 28, 29, 31, 33 to 39, 41, 43, 44, 47 and 50. The quartz-amphibole schist is described as dull light grey green to yellow grey, speckled white or black, very closely jointed, very intensely laminated, unweathered to slightly weathered, hard rock to very hard rock. The joints in the rock matrices are usually open and filled with white calcareous sand, but the laminations are closed smooth and clean. Well-developed, needle like, black crystals of amphibole are present in the rock matrix. The crystals are up to 1mm thick and 2cm in length. The strata of quartz-amphibole schist dip at highly variable angles, estimated at between 30° and 75°.

6.3 Soil Profile

6.3.1 Aeolian Sand

The aeolian sand is described as light red, loose to very loose, intact, fine sand. It can be associated with the Gordonia Formation of the Kalahari Group. The sand consists of rounded quartz grains coloured red by a thin coating of haematite. The general consensus is that the aeolian sand is derived from local sources with some additional material transported over short distances.

Aeolian sand was encountered as surface deposits in TP's 1, 4, 7, 10, 16, 19, 20 and 22 as deposits most probably subjected t0 some previous alluvial rework action. The horizon of alluvial sand extended to depths varying between 300mm and 800mm in these test pits.

The deposits to the north of the imaginary line formed by TP's 23 to 27 can be regarded as true dune deposits. Under these conditions aeolian sand was encountered in TP's 24, 25, 30, 31, 36, 37, 42 and 46 extending to depths varying between 100mm and 1900mm.

6.3.2 Colluvium

On site colluvium was encountered as a surface horizon in test pits TP's 2, 3, 5, 6, 9, 11 to 15, 17, 18, 21,23, 26 to 29, 32 to 35, 38 to 41, 44, 45 and 47 to 48. It was present to depths varying between 100mm minimum to 700mm maximum, at which stage calcrete was usually encountered. The colluvium was also encountered underlying the younger aeolian sand in TP's 1, 7, 24, 30, 36 and 46, occurring from depths between 500mm and 1900mm minimum, extending to 700mm to 2100mm. In the latter case the vertical extent of the colluvium could not be determined reliably as the aeolian sand tended to collapse in the test pits.

The colluvium is a homogenous material, consisting light brown fine sand and clasts of gravels and cobbles of quartz and some calcrete. Isolated occurrences of banded ironstone prove that the colluvium may also be present as transported alluvial terrace gravel. The consistency of the colluvium is loose to medium dense and the soil matrix intact.

6.3.3 Mokalanen Formation

Calcrete of the Mokalanen Formation, Kalahari Group, is present as an ubiquitous surface duricrust on site. In the strictest sense calcrete cannot be regarded as either rock or soil, but as a duricrust with properties and a geological context all of its own. However, for purposes of discussion it is regarded as a soil due to the possibility of retrieving samples thereof for purposes of materials testing.

There is a difference in opinion between Moen (Reference 14.4 page147) and Partridge[Reference 14.5] regarding the origin of the calcrete. Moen regards the calcrete as being of Tertiary age, but some doubt whether the outcrops are of the same age and in some localities it may still be in the process of forming. Partridge describes the age of the calcrete as straddling the boundary between the Pliocene and Quaternary, making it some 2,6 to 2,8 million years old. It was deposited under arid conditions and possibly reflects a climatic interval of global aridification.

The engineering properties of calcrete may differ widely for samples taken from the same locality. It is therefore important to provide some background in this regard to aid in the understanding of these conditions.

Brink[Reference 14.6] states that during pedocrete development, clay and silt become flocculated and cemented into larger silt to gravel-sized complexes of varying strength and porosity. These particles and aggregations may or may not break down during laboratory testing and under compaction. The mineralogy of the cementing material and of the clay fraction is different from those of normal, temperate zone soils on which current specifications for soil testing and classification is based. Calcrete can therefore be expected to exhibit differences in behaviour from those of traditional soil materials.

Whereas in traditional soil mechanics it is assumed that all the water is outside the particles, calcrete aggregates retain moisture and this affects conventional moisture content and Atterberg limit determinations. Palygorskite which is the dominant clay in calcrete has approximately the same plasticity index as some smectites, which can be regarded as highly expansive. However, the palygorskite has a non-expansive lattice and a hollow, needle-like shape instead of the usual flaky particle shape of most other clays. It has the lowest shrinkage limit and dry density and the highest optimum moisture content and shear strength of all clays.

Be it as it may, calcrete was encountered as a widely distributed material on site, continuously covering the Groblershoop Formation, only to be covered in the high-lying parts of the land by aeolian sand of the Gordonia Formation, Kalahari Group. The calcrete was encountered in TP's 2, 3, 7, 8, 10 to 22 in the low-lying land mostly as very dense, boulder calcrete. In the high-lying part of the land it was encountered in TP's 25 to 30, 32 to 34, 37, 39, 40, 45 and 48 mostly as dense to very dense hardpan calcrete. The calcrete is present as outcrops ; or underlies the transported materials, occurring from depths between zero and 800mm minimum, extending to 100mm to 1200mm maximum, at which stage refusal of excavation occurred or bedrock was encountered. Moen reports the calcrete to be up to five meters thick in the area. Minor outcrops of calcrete are present randomly across the site. It is described as dirty white to dirty light yellow white, very fine grained, very dense calcrete. Some fine sand may occasionally be contained in voids in the matrix of the calcrete.

6.3.4 Residual Quartzite

On site residual quartzite was encountered in TP 49 only underlying the colluvium. It consists of cobbles and boulders of quartzite with diameter less than 500mm contained a matrix of dry, light brown sand. The soil matrix is medium dense and weakly calcareous cemented. The horizon of residual quartzite extended to a depth of 700mm in the test pit, prior to encountering bedrock of quartzite.

6.4 Groundwater

6.4.1 Perched Water

Perched groundwater was not encountered in any of the test pits excavated for this investigation. Considering the climate of the area and the nature of in situ materials, it is anticipated that perched water will generally not prove problematic on the site, except in the lesser drainage courses of the site after events of inundation. Even if it did occur, the grading of in-situ materials is such that dispersal will take place fairly rapidly. Furthermore, it is expected that perched water and/or surface seepage may occur shortly after precipitation events and in years of excessive rain only.

6.4.2 Permanent Groundwater

Vegter[Reference 14.7] indicates the probability for drilling successfully for water in the area to be between 40% and 60%, and the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths less than 15 meters in compact, argillaceous strata.

7 GEOTECHNICAL EVALUATION

The engineering properties of the in-situ materials are summarized in Table 3 : Summary of Engineering Properties. The characterizations have been derived based on the Unified materials classifications as reported by literature studies.

7.1 Engineering and Material Characteristics

7.1.1 Properties of Heave

The results of the materials testing as reported in Table 2 indicate the in-situ materials are not expansive. Any future structures will thus not be subject to heave. The content of active clay, that is the material smaller than 0,002mm in diameter, was less than 1,2% for all the samples tested.

7.1.2 Properties of Settlement

7.1.2(i) Aeolian Sand

The aeolian sand is described as light red, loose to very loose, intact, fine sand. The sand is unconsolidated and consists of rounded quartz grains coloured red by a thin coating of

TABLE 3 : SUMMARY OF ENGINEERING PROPERTIES

TEST PIT NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	SOIL CLASS PRA	SOIL CLASS UNIFIED	COHESION[1] (kNm^{-2})	FRICTION ANGLE (°)[1]	COMPRESSIBILITY[2]	EROSION RESISTANCE[2,5]	PERMEABILITY[2] k (cms^{-1})	SPECIFICATIONS FOR UNPAVED ROADS[3] MAXIMUM SIZE	OVERSIZE INDEX (I_o)	GRADING COEFFICIENT(G_c)	SHRINKAGE PRODUCT(S_p)	CBR @ 95% MOD	SUITABILITY FOR ROAD CONSTRUCTION[4] PAVED	UNPAVED
2	U9309	200-600	Hardpan calcrete	Sandy gravel	A-1-a(0)	GW-GC	0 to 20	28° to 40°	Negligible to very low	1 to 3	Highly variable	50,0	8	20,2	45,0			Ravels & corrugates
9	U9310	0-800	Rock fragments	Gravelly sand	A-1-b(0)	SC	5 to 10	30° to 35°	Low	5	$(3\pm2)X10^{-7}$	63,0	8	11,8	50,0	28	Subbase & base	Ravels & corrugates
15	U9307	100-500	Boulder calcrete	Sandy gravel	A-1-a(0)	GW-GC	0 to 20	28° to 40°	Negligible to very low	1 to 3	Highly variable	63,0	4	10,3	19,0			Ravels & corrugates
17	U9308	0-300	Boulder calcrete	Sandy gravel	A-1-b(0)	GM	<5	30° to 40°	Negligible	4	$>3X10^{-7}$	50,0	3	19,5	48,0			Ravels & corrugates
22	U9304	0-700	Boulder calcrete	Gravelly sand	A-1-b(0)	SM	20 to 22	32° to 35°	Low	8	$(7,5\pm4,8)X10^{-6}$	75,0	7	9,9	90,0	28	Subbase & base	Ravels & corrugates
23	U9306	0-400	Colluvium	Gravelly sand	A-2-4(0)	SC	5 to 10	30° to 35°	Low	5	$(3\pm2)X10^{-7}$	50,0	9	10,4	53,0			Ravels & corrugates
25	U9305	0-600	Aeolian sand	Fine sand	A-2-4(0)	SC	5 to 10	30° to 35°	Low	5	$(3\pm2)X10^{-7}$	20,0	0	2,0	44,0			Ravels & corrugates
30	U9303	0-500	Aeolian sand	Fine sand	A-2-4(0)	SM	20 to 22	32° to 35°	Low	8	$(7,5\pm4,8)X10^{-6}$	14,0	0	3,9	178,0			Erodible
33	U9299	300-500	Rock fragments	Sandy gravel	A-1-b(0)	SM	20 to 22	32° to 35°	Low	8	$(7,5\pm4,8)X10^{-6}$	50,0	4	22,1	85,0			Ravels & corrugates
37	U9298	0-600	Aeolian sand	Fine sand	A-2-4(0)	SC	5 to 10	30° to 35°	Low	5	$(3\pm2)X10^{-7}$	20,0	0	2,0	0,0			Ravels & corrugates
38	U9293	300-500	Rock fragments	Sandy gravel	A-1-a(0)	GM-GC	<5	28° to 40°	Negligible to very low	Highly variable	$>3X10^{-7}$	50,0	0	21,4	75,0			Ravels & corrugates
40	U9297	0-300	Colluvium	Sandy gravel	A-1-a(0)	GM	<5	30° to 40°	Negligible	4	$>3X10^{-7}$	50,0	10	12,8	43,5	42	Subbase & base	Ravels & corrugates
44	U9296	0-500	Colluvium	Sandy gravel	A-2-4(0)	SM	20 to 22	32° to 35°	Low	8	$(7,5\pm4,8)X10^{-6}$	28,0	0	21,0	93,0			Ravels & corrugates
46	U9295	0-700	Aeolian sand	Fine sand	A-2-4(0)	SC	5 to 10	30° to 35°	Low	5	$(3\pm2)X10^{-7}$	20,0	0	5,8	0,0			Ravels & corrugates
50	U9294	200-1000	Rock fragments	Sandy gravel	A-1-a(0)	GW-GM	<5	30° to 40°	Negligible	1 to 4	$(2,7\pm1,3)X10^{-2}$	75,0	14,0	11,8	50,0	31	Subbase & base	Ravels & corrugates

1 Obrzud RF and Truty A : The Hardening Soil Model - A Practical Guidebook, 2018 edition, revised 21 October 2018.
2 Brink ABA et al : Soil Survey for Engineering, published in 1982.
3 The Structural Design, Construction and Maintenance of Unpaved Roads (Draft TRH 20), Committee of State Road Authorities 1990.
4 Structural Design of Flexible Pavements for Interurban and Rural Roads (Draft TRH 4), Committee of State Road Authorities 1996.
5 Erosion resistance : 1 is best 10 is poor.

haematite. Aeolian sand was encountered in TP's 1, 4, 7, 10, 16, 19, 20, 22, 24, 25, 30, 31, 36, 37, 42 and 46 extending to depths varying between 100mm and 1900mm. Due to its very loose consistency the aeolian sand can be considered as highly compressible.

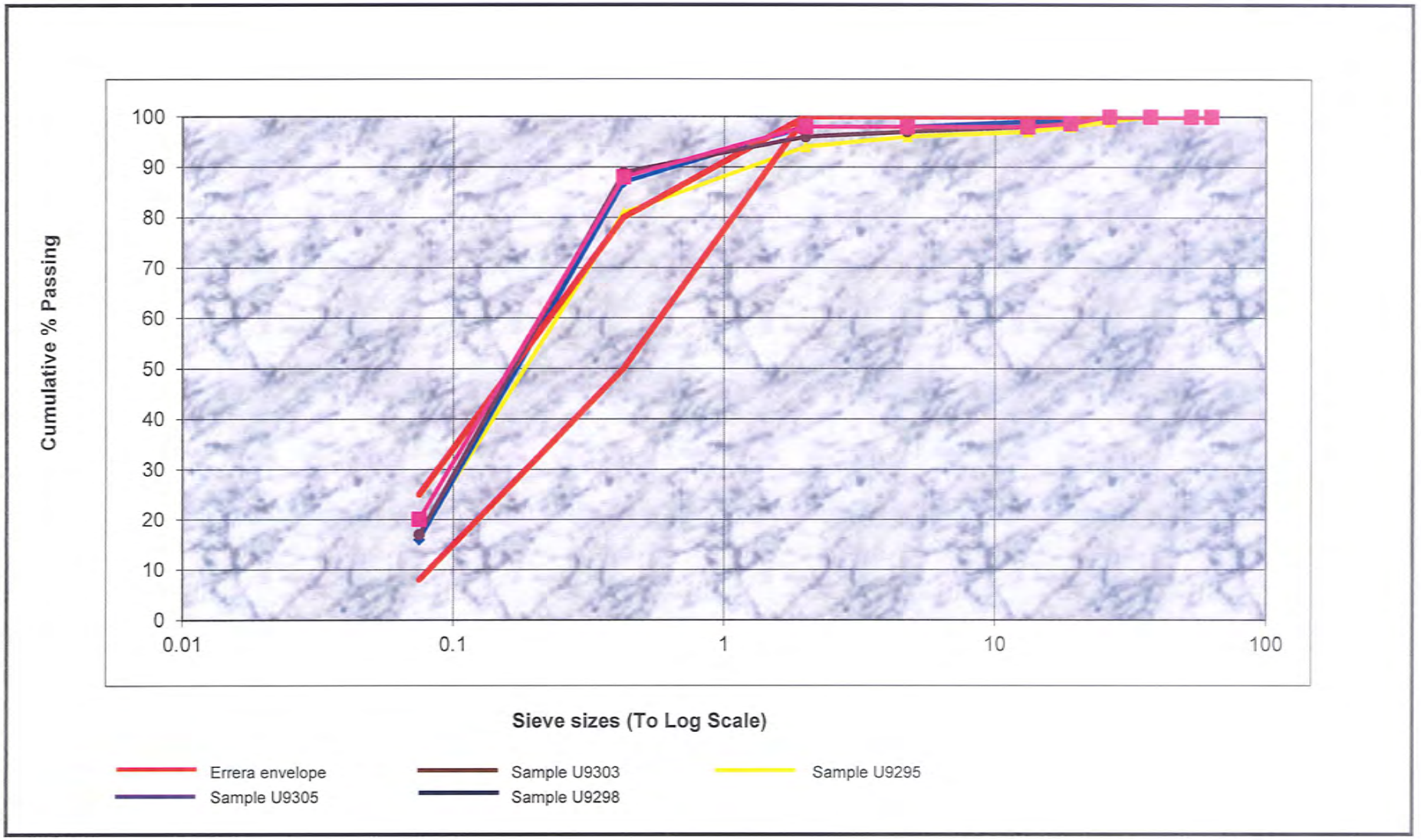
A case is often made for the collapsing properties of aeolian sand originating from the Gordonia Formation. The correct procedure to determine the collapse potential of a soil material is to conduct a collapse potential test on an undisturbed sample in the laboratory. In the case of this investigation it was not possible to retrieve an undisturbed sample from the aeolian sand due to its friable and very loose consistency. However, Errera[Reference 14.8] proved specifically for the aeolian sand that potential properties of collapse can be determined on a parametric basis by plotting the grading curves of the sand. Should the grading curves fit into a so-called Errera envelope, the sand can be regarded as potentially collapsible. Figure 6 shows the grading curves of the various samples of aeolian sand retrieved during this investigation. Of these, only Sample U2995 fit partially into the envelope. The aeolian sand encountered during this investigation is therefore not regarded as collapsible.

7.1.2(ii) Colluvium

Colluvium was encountered as a surface horizon in test pits TP's 2, 3, 5, 6, 9, 11 to 15, 17, 18, 21,23, 26 to 29, 32 to 35, 38 to 41, 44, 45 and 47 to 48. It was present to depths varying between 100mm minimum to 700mm maximum, at which stage calcrete was usually encountered. The colluvium was also encountered underlying the younger aeolian sand in TP's 1, 7, 24, 30, 36 and 46, occurring from depths between 500mm and 1900mm minimum, extending to 700mm to 2100mm. The colluvium is a homogenous material, consisting of light brown fine sand and clasts of gravels and cobbles of quartz and some calcrete. The consistency of the colluvium is loose to medium dense and the soil matrix intact. The properties of the gravelly colluvium are thus such that it does not tend to excessive settlement.

7.1.2(iii) Pedocretes

Calcrete was encountered as a widely distributed material on site in TP's 2, 3, 7, 8, 10 to 22 in the low-lying land mostly as very dense, boulder calcrete. In the high-lying part of the land it was encountered in TP's 25 to 30, 32 to 34, 37, 39, 40, 45 and 48 mostly as dense to very dense hardpan calcrete. The calcrete is present as outcrops ; or underlies the transported materials, occurring from depths between zero and 800mm minimum, extending to 100mm to 1200mm maximum, at which stage refusal of excavation occurred or bedrock was encountered. It can thus accommodate stresses imposed by conventional housing structures without undue settlement. Only limited – if any –settlement can thus be expected for structures such as single storey units of masonry construction.



ERRERA ENVELOPE FOR COLLAPSING SAND

FIGURE 6

7.1.2(iv) Residual Quartzite

Residual quartzite was encountered in TP 49 only underlying the colluvium. It consists of cobbles and boulders of quartzite with diameter less than 500mm contained a matrix of dry, light brown sand. The soil matrix is medium dense and weakly calcareous cemented. The horizon of residual quartzite extended to a depth of 700mm in the test pit, prior to encountering bedrock of quartzite. The properties of the residual quartzite are thus such that it does not tend to excessive settlement.

7.1.3 Corrosivity

When discussing soil corrosivity, it is applicable to consider the guidelines as proposed by Evan[sReference 14.9]. The corrosivity of a soil towards buried, exposed, metallic surfaces is dependent on the following properties of the soil :

- Electrical conductivity.
- Chemical properties of the soil.
- Ability of the soil to support sulphate reducing bacteria.
- Heterogeneity of the soil.

The tests carried out for the compilation of this report must be considered as indicative of the corrosivity of the soils only. The pH of a soil gives an indication of potential acid related problems. Should the soil pH be less than 6,0, corrosion may take place ; and should the pH be less than 4,50, the problem of corrosion may be serious. If the conductivity of the soil is less than $0,01Sm^{-1}$, corrosiveness is generally not a problem. However, the potential for corrosivity of the soil increases with an increase in conductivity. Should the conductivity of the soil exceed $0,05Sm^{-1}$, the soil can be regarded as very corrosive. Should exposed metal pipes pass from argillaceous soils to arenaceous soils or vice versa, electrochemical cells are set up due to the different rates of oxygen diffusion of the soils. Sulphate reducing bacteria is usually present under anaerobic conditions, that is, typically saturated or waterlogged clays.

The results of the chemical testing carried out for this report indicate the following :

- *Acidity* : The pH of the samples of material tested varied between 7,58 and 7,87. The soils are thus regarded as not corrosive due to the acidity there of.
- *Water Soluble Salts Content* : The conductivity of the samples of material tested varied between $0,03Sm^{-1}$ for the fragments of quartz-amphibole schist to $0,18\ Sm^{-1}$ for the aeolian sand. However, for all materials tested a wide scatter of results occur, from non-corrosive to highly corrosive. One therefore has to accept that all residual materials can be regarded as corrosive due to their high soluble salt contents.

Other considerations are :

- *Heterogeneity of the Soil* : Conditions of corrosive soils due to a heterogeneous soil profile do not occur on the property.
- *Water Logged Soils* : Conditions of water logged soils do not naturally occur on site, but may be present as a result of dumping of waste water.

7.1.4 Materials Utilisation

7.1.4(i) Backfilling of Service Trenches

The hardpan calcrete is not suitable to be used for any type of backfill due to its tendency to break into boulder and cobble sized fragments on excavation. Such fragments cannot be compacted properly on backfilling.

The colluvium can be used for normal backfilling of services trenches. However, due to the coarse granular composition thereof, these materials are not suitable for pipe bedding or selected backfill around pipes.

The aeolian sand does not contain any coarse materials nor any significant clay particles. It may thus be used for selected backfill and pipe bedding.

7.1.4(ii) Construction of Paved or Segmental Block Streets

Only provisional indicators for future guidance of development are provided as far as material quality for road construction is concerned, complying with the requirements applicable to the level of investigation.

The results of the compaction testing on soil samples show the fragments of quartz-amphibole schist, calcrete and colluvium to be of G6 quality. These materials are thus suitable for purposes of paved road or segmental block paving construction. This type of construction is applicable to access roads to townships. The soil materials are therefore suitable for the construction of base and subbase course construction of lightly trafficked roads. The aeolian sand was not tested for this purpose, but can be regarded as suitable for an in-situ roadbed only.

7.1.4(iii) Wearing Course for Urban Gravel Roads

The properties to provide guidance for the use of soil materials for the structural design of a wearing course for urban gravel roads are contained in the various sub-columns of the

column "Specifications for Unpaved Roads" in Table 3. The various parameters are colour-coded : Green = suitable ; red = unsuitable. The two sub-columns with a light yellow-brown background contain the parameters on which the physical behaviour of the wearing is course is determined.

From the table it is clear that none of the in-situ materials comply in all aspects to the requirements for a gravel wearing course. In most cases the use of these materials will result in a wearing course subject to raveling and corrugations. This can be attributed the non-cohesive character of most of the materials. In contradiction to the construction of paved roads, calcrete appears to be the material more suitable for gravel wearing course construction, although experience has taught that if a calcrete with a high PI is used for this purpose, the road surface can become slippery in wet conditions.

7.1.5 Other Considerations

The properties discussed in this subsection of the report were obtained from literature reported values based on studies done by the US Army Corps of Engineers as reported by Brink[Reference 14.10] for compacted material. This approach is followed as the arenaceous character of the in-situ materials that did not allow the retrieval of undisturbed sampling. The typical soil properties associated with the Unified classifications of the materials are thus reported.

7.1.5(i) Compressibility

The compressibility of the material can be regarded as a necessary input to pavement design as well as lesser important supporting information for geotechnical classification for site class designation.

- *Colluvium* : The colluvium is regarded as low to negligible compressible with cohesion (c_0) of less than 5,0kNm^{-2} to 22kNm^{-2} and the effective stress envelope approximately 30° to 40°.
- *Calcrete* : The calcrete is regarded as negligible to very low compressible with cohesion (c_0) of less than 5,0kNm^{-2} to 22kNm^{-2} and the effective stress envelope approximately 28° to 40°.
- *Aeolian Sand* : The aeolian sand is regarded as low compressible with cohesion (c_0) of 5,0kNm^{-2} to 22kNm^{-2} and the effective stress envelope approximately 30° to 35°.

7.1.5(ii) Permeability

Permeability is an important parameter in the design of surface drainage and seepage drains.

As such indicators in this regard are provided.

- *Colluvium* : The colluvium is regarded as semi-pervious to impervious. The soil permeability coefficient varies between $2,7X10^{-6}cms^{-1}$ to $>3,0X10^{-7}cms^{-1}$.
- *Hardpan Calcrete* : The permeability of the hardpan calcrete is highly variable depending on the mode of deposition and regarded as pervious to impervious. The soil permeability coefficient varies between more permeable than $1,5X10^{-2}cms^{-1}$ to $>3,0X10^{-7}cms^{-1}$.
- *Aeolian Sand* : The aeolian sand is regarded as impervious. The soil permeability coefficient varies between $2,7X10^{-6}cms^{-1}$ $3X10^{-7}cms^{-1}$.

7.1.5(iii) Erosion Potential

The colluvium and calcrete can be regarded as moderately to slightly erodible. The aeolian sand can be regarded as moderately to highly erodible.

7.2 Properties of Bedrock

The TLB used to excavate the test pits did not penetrate the calcrete or bedrock of quartzite or schist to any significant extent and refusal of excavation occurred within millimeters after encountering these materials. It is not customary to penetrate bedrock in the case of a geotechnical investigation for purposes of a residential development. Refusal of excavation on hard rock is accepted as suitable. One can thus accept bedrock to be hard tending to very hard once refusal of excavation was encountered.

7.2.1 Calcrete

Voided matrices were not encountered in the hardpan calcrete during the investigation. The results of the materials testing on samples of the calcrete approach that of sandy gravel. However, it must be borne in mind that in in-situ conditions the properties of hardpan calcrete approach that of hard rock rather than a gravelly sand. The grading modulus of the samples of calcrete fragments tested as 1,80 to 2,50 ; plasticity index as one to four ; and clay content less than 1,0%. The activity of the calcrete is described as low. The PRA classification of the calcrete is A-1-a(0) to A-1-b(0) ; and the Unified classification is GW to SM. Based on these properties and material classification the calcrete is regarded as non-expansive and no consolidation settlement and no collapse settlement can thus be expected for structures such as single storey units of masonry construction.

The test results of the samples of the calcrete reflect the properties of excavated fragments of material and not the intact mass of calcrete. It is therefore accepted that the properties of the very dense calcrete can be considered as tending towards soft rock to hard rock, limestone.

Brink (Reference 14.6) reports an average UCS of 32MPa for intact samples of hardpan calcrete from the Kalahari region. Using this as input to parametric calculations with Roclab software results for very dense calcrete tending to widely jointed, slightly weathered, medium hard rock, limestone result in the following properties :

- Cohesion : 1,08MPa
- Friction Angle : 24°
- Tensile Strength : 0,018MPa
- Uni-axle Compressive Strength : 550kPa
- Young's Modulus : 2340MPa

All which show a sound pedocrete, not compressible, not permeable nor subject to erosion.

7.2.2 Quartzite

Parametric calculations with Roclab software results for unweathered, jointed, very hard rock result in the following properties :

- Cohesion : 11,0MPa
- Friction Angle : 36,6°
- Tensile Strength : 0,35MPa
- Uni-axle Compressive Strength : 14,1MPa
- Young's Modulus : 21435MPa

All which show a sound, very hard and durable rock.

7.2.3 Quartz-amphibole Schist

Parametric calculations with Roclab software results for slightly weathered, very closely jointed, very intensely laminated, hard rock result in the following properties :

- Cohesion : 3,4MPa
- Friction Angle : 29,0°
- Tensile Strength : 0,07MPa
- Uni-axle Compressive Strength : 2,5MPa
- Young's Modulus : 8082,4MPa

The above calculations are for schists dipping at 90° with the horizontal plane. Should the angle of dip change the tensile strength, UCS and Young's modulus may change accordingly.

7.3 Excavation Classification with Respect to Services

7.3.1 Hand Excavation

7.3.1(i) Aeolian Sand

The aeolian sand can be considered as suitable to be excavated by swing tools. However, due to its very loose consistency the side walls of excavations tend to collapse – even in shallow excavations.

7.3.1(ii) Colluvium

The colluvium can be considered as suitable to be excavated by swing tools.

7.3.1(iii) Pedogenic Deposits

The boulder and hardpan calcrete are of dense to very dense consistency. Such material cannot be considered as suitable to be manually excavated and may as minimum require the use of a 55kW TLB, but preferably a 30 ton excavator to remove it on an economical basis.

7.3.1(iv) Residual Quartzite

The residual quartzite is of dense to very dense consistency containing boulders of quartzite. Such material cannot be considered as suitable to be manually excavated and may as minimum require the use of a 55kW TLB, but preferably a 30 ton excavator to remove it on an economical basis.

7.3.1(v) Bedrock

Bedrock of quartzite or quartz-amphibole schist cannot be excavated manually successfully.

7.3.2 Classification of Material for Machine Excavation

In terms of Table 5 of SANS 634 : 2012 the following is applicable :

7.3.2(i) Restricted Excavation

- *Soft Excavation* : The colluvium, aeolian sand and residual quartzite can be regarded as soft excavation. The thickness of these strata varied between 100mm and 2100mm in the

test pits, averaging 410mm prior to encountering conditions of intermediate or hard rock excavation.

- *Intermediate Excavation* : Refusal of excavation with a TLB occurred in most cases once very dense, hardpan calcrete or slightly weathered to unweathered rock was encountered. However, some penetration into the hardpan calcrete or bedrock was possible and can be regarded as intermediate excavation. It was possible to penetrate between 100mm and 900mm into the hardpan calcrete and bedrock, averaging 330mm thick, prior to encountering hard rock excavation.
- *Boulder Class A Excavation* : Conditions of Boulder Class A excavation may be encountered in the residual quartzite. However in TP 49 the consistency of such material was medium dense only and the presence of cobbles and boulders did not impede the removal of the material with the TLB.
- *Hard Rock Excavation :* Refusal of excavation occurred on conditions of hard rock excavation in all the test pits at depths varying between 100mm and 1500mm, averaging 700mm.

7.3.2(ii) Non-restricted Excavation

The classification as per subparagraph 7.3.2(i) : Restricted Excavation as above is also applicable for non-restricted excavation.

7.4 Seismicity

A 10% probability of an event with magnitude less than 100cms^{-2} to take place once in 50 years is regarded as favourable ; and a natural seismic activity with magnitude exceeding 100cms^{-2} is regarded as unfavourable. Based on a report compiled by Kijko[Reference 14.11] a 10% probability exists that an earthquake with Peak Ground Acceleration exceeding of 0,05g may take place once in 50 years in Groblershoop.

The closest source of seismic measurements to Opwag under control of the Council for Geoscience is Tontelbos at 31° 10' 12"S and 20' 30' 00"E.

- The annual probability for an earthquake with intensity of 4,5 on the Modified Mercalli Scale to occur in the area is less than $10^{-0,7}$; and with an intensity of 8,5 to occur the probability is $10^{-3,8}$.
- The annual probability for an earthquake with an acceleration of $10^{-1,9}$g to occur in the area is less than $10^{-0,7}$; and with an acceleration of $10^{-0,75}$g to occur in the area is less than $10^{-3,8}$.

To put the above information into perspective, Table 4 : Earthquake and Magnitude and Intensity, is attached to this report.

TABLE 4 : EARTHQUAKE MAGNITUDE AND INTENSITY

MODIFIED MERCALLI INTENSITY SCALE	INTENSITY	DESCRIPTION	RICHTER SCALE MAGNITUDE	RADIUS OF PERCEPTIBILITY (km)
I	Instrumental	Detected only by seismography		
II	Feeble	Noted only by sensitive people	3.5 to 4.2	3 to 24
III	Slight	Like the vibrations due to a passing lorry. Felt by people at rest, especially on upper floors		
IV	Moderate	Felt by people while walking. Rocking of loose objects, including vehicles	4.3 to 4.8	24 to 48
V	Rather strong	Felt generally ; most sleepers are awakened and bells ring		
VI	Strong	Trees sway and suspended objects swing ; damage by overturning and filing of loose objects	4.9 to 5.4	48 to 112
VII	Very strong	General public alarm ; walls crack ; plaster falls	5.5 to 6.1	110 to 200
VIII	Destructive	Car drivers seriously disturbed; masonry fissured ; buildings damaged	6.2 to 6.9	200 to 400
IX	Ruinous	Houses collapse ; pipes break		
X	Disasterous	Ground cracks badly ; buildings destroyed ; railway lines bent ; landslides on steep slopes	7.0 to 7.3	400 to 700
XI	Very disasterous	Few buildings remain standing; bridges destroyed ; all services out of action ; great landslides and floods	7.4 to 8.1	400 to 700
XII	Catastrophic	Total destruction ; objects thrown into the air; ground rises and falls in waves	>8.1	400 to 700

7.5 Undermining

The area of investigation is not undermined.

7.6 Dolomite Stability

The area of investigation is not subject to dolomite related instabilities.

8 SITE CLASS DESIGNATIONS

Based on the above discussions the property can be divided into five zones as per the guidelines posted by SANS 10400 : Section H[Reference 14.12] . The zonation is indicated on Figure 7 : Site Class Designation.

8.1 Geotechnical Zone I

The zone can be divided into two parts. The geotechnical conditions are similar in both parts and characterized by the presence of rock and very dense calcrete at depths less than 400mm, but distinction can be made on land slope and previous land use as follows :

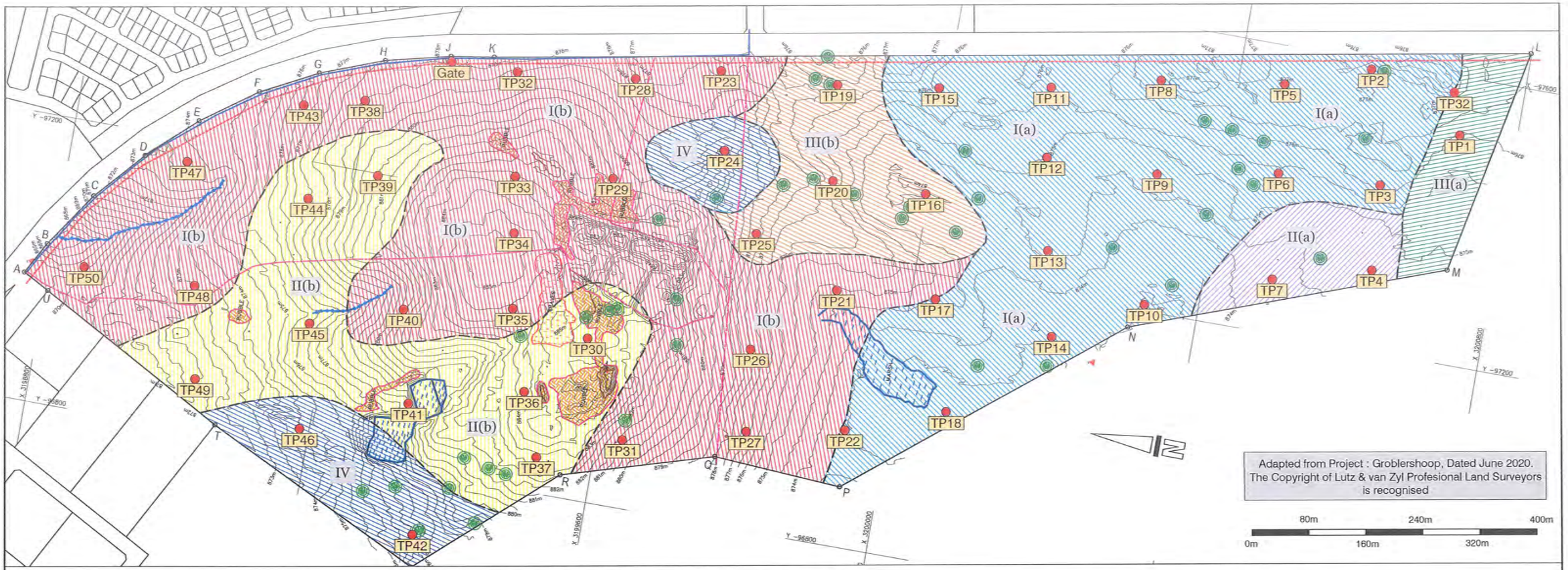
8.1.1 Geotechnical Zone I(a)

This zone comprises 28% of the area investigated. It is characterized by the materials profiles of TP's 2, 3, 5, 6, 8 to 15, 17 and 18. It covers the larger part of the southern low-lying land on a continuous basis. It consists of a superficial horizon less than 400mm thick comprising of colluvium, reworked aeolian sand and very dense calcrete overlying bedrock of quartzite and quartz-amphibole schist. Several outcrops of calcrete, quartzite and schist occur in the area. Slope across the land is less than 2%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in almost negligible settlement if founded directly on the slightly weathered and unweathered hard rock to very hard rock, or on the very dense calcrete. The area is thus zoned as "R" and regarded as stable.

The development potential of the land is detrimentally influenced by the slope of the land being less than 2%, conditions of hard rock excavation and presence of active waste water dumping in the area of TP's 17, 18 and 22.

8.1.2 Geotechnical Zone I(b)

This zone comprises 36% of the area investigated. It is characterized by the materials profiles of TP's 21, 23, 26 to 29, 32 to 35, 38, 40, 43, 47, 48 and 50. It is present along the north eastern boundary of the site extending through centrally to the west and includes the two drainage courses. It consists of a superficial horizon less than 400mm thick comprising of colluvium and reworked aeolian sand less than 400mm thick overlying very dense hardpan



FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

AREA	AREA OF PROPERTY (%)	GEOTECHNICAL CLASS	ESTIMATED SOIL MOVEMENT(mm)	SOIL PROFILE	CONSTRUCTION TYPE	FOUNDATION DESIGN	ASSOCIATED PROBLEMS	DEVELOPMENT POTENTIAL
I(a)	27,54	R	Negligible	Less than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock	Conditions of hard rock excavation. Landslope less than 2% favours slab-on-the-ground foundations	Intermediate
I(b)	36,22	R	Negligible	Less than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock.	Conditions of hard rock excavation. Landslope between 2% and 6%. Presence of stockpiles of waste and obsolete sewerage oxidation ponds	Intermediate
II(a)	3,12	S	0mm to 10mm compression settlement	Surface horizon of colluvial or aeolian sand, 400mm to 700mm thick overlying medium dense residual soil and very dense pedogenic deposits and bedrock	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on medium dense gravelly colluvium or aeolian sand. Foundation bearing pressure not to exceed 50kPa. Good site drainage.	Conditions of hard rock excavation. Landslope less than 2% favours slab-on-the-ground foundations.	Intermediate
II(b)	16,82	S	0mm to 10mm compression settlement	Surface horizon of colluvial or aeolian sand, 400mm to 700mm thick overlying medium dense residual soil and very dense pedogenic deposits and bedrock	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on medium dense gravelly colluvium or aeolian sand. Foundation bearing pressure not to exceed 50kPa. Good site drainage.	Conditions of hard rock excavation. Landslope between 2% and 6%. Presence of stockpiles of waste and existing oxidation ponds from abbatoir	Intermediate
III(a)	2,87	S1	10mm to 20mm compression settlement	Surface horizon of reworked aeolian sand overlying dense calcareous cemented colluvium to depths exceeding 700mm.	Modified Normal	Reinforced strip foundations with articulation joints at some internal doors and all external doors and light reinforcement in masonry. Site drainage and service and plumbing precautions. Foundation bearing pressure not to exceed 50kPa	Landslope less than 2%	Intermediate
					Replacement of in-situ soils below individual footings	Remove in-situ material below fondations to a depth and width of 1,5 times the foundation width or to a suitable soil horizon and replace with material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. Normal construction with lightly reinforced strip foundation and light reinforcement in masonry		
III(b)	7,09	S1	10mm to 20mm compression settlement	Surface horizon of aeolian sand 600mm to 800mm thick overlying boulder calcrete and bedrock at depth.	Modified Normal	Reinforced strip foundations with articulation joints at some internal doors and all external doors and light reinforcement in masonry. Site drainage and service and plumbing precautions. Foundation bearing pressure not to exceed 50kPa	Presence of stockpiles of waste Landslope between 2% and 6%	Intermediate
					Replacement of in-situ soils below individual footings	Remove in-situ material below fondations to a depth and width of 1,5 times the foundation width or to a suitable soil horizon and replace with material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. Normal construction with lightly reinforced strip foundations and light reinforcement in masonry		
IV	6,34	S2	>20mm compression settlement	Surface horizon of very loose aeolian sand, >1000mm thick overlying cemented colluvium and bedrock at depth	Modified Normal	Reinforced strip footings or reinforced concrete raft placed on engineered fill. Foundation system to be designed by engineer. Foundation bearing pressure not to exceed 50kPa. Good site drainage.	Landslope between 2% and 6% Presence of stockpiles of waste and existing oxidation ponds from abbatoir. Collapsing sidewalls in excavations Metastable dunes	Intermediate

FIGURE 7 :
SITE CLASS DESIGNATION

LEGEND

- TP1 — TEST PIT POSITION
- BOSCIA ALBITRUNCA (TO BE CONSERVED)
- VERY ROCKY
- MATERIAL BOUNDARY

Cedar Land Geotechnical Consult (Pty) Ltd

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CERES
6835
SEL : 082 570-2767 (Frans)
082 373-2146 (Mariette)

P O BOX 607
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EPOS/E-MAIL: cedarland.frans@breede.co.za (Frans)
cedarland.mariette@breede.co.za (Mariette)

TAAK: / JOB NAME: Expansion and Formalisation of Groblershoop Community

LIGGING: / SITE: Portion 16 of the Farm Boegoeberg Settlement no 48

KLIENT: / CLIENT: !Kheis Municipality

TEKENING NO: / DRAWING NO: Figure 7 : Site Class Designation

DATUM: / DATE: 24 September 2020

calcrete and bedrock of quartzite and schist. Slope across the land is approximately between 2% and 6%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in almost negligible settlement if founded directly on the slightly weathered and unweathered hard rock to very hard rock, or on the very dense calcrete. The area is thus zoned as "R" and regarded as stable.

The development potential of the land is detrimentally influenced by the conditions of hard rock excavation and presence of active waste water dumping in the area of TP 21 ; obsolete oxidation ponds between TP's 26 and 29 ; cemetery near TP 35 and wide spread occurrences of stockpiles of waste.

8.2 Geotechnical Zone II

The zone can be divided into two parts. The geotechnical conditions are similar in both parts and characterized by the presence of rock and very dense calcrete at depths exceeding 400mm, but usually less than 700mm. Distinction can be made on land slope and previous land use as follows :

8.2.1 Geotechnical Zone II(a)

This zone comprises 3% of the area investigated and is characterized by the materials profiles of TP's 4 and 7. It is present in an area on the southwestern perimeter of the area of investigation. The soil profile consists of a surface horizon of reworked aeolian deposits and colluvium. The combined thickness of the horizon is between 400mm and 700mm in the test pits and it overlies very dense calcrete and bedrock of quartz-amphibole schist at depth. Slope across the land is less than 2%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in limited compression settlement less than 10mm if founded directly on the reworked aeolian sand or medium dense gravelly colluvium. As per the materials profile encountered in the test pits the thickness of the horizon of competent material is sufficient to dissipate the stresses induced by the foundations effectively. The area is thus zoned as "S" and the materials strata can be regarded as compressible to a maximum of 10mm.

The development potential of the land is detrimentally influenced by the slope of the land being less than 2% and conditions of hard rock excavation.

8.2.2 Geotechnical Zone II(b)

This zone comprises 217% of the area investigated and is characterized by the materials profiles of TP's 30, 36, 37, 39, 41, 44, 45 and 49. It is present in an area on the northwestern

perimeter of the area of investigation. The soil profile consists of a surface horizon of aeolian deposits and colluvium. The thickness of the strata is between 400mm and 700mm in the test pits and it overlies very dense calcrete and bedrock of quartzite and quartz-amphibole schist at depth. Slope across the land is between 2% and 6%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in limited compression settlement less than 10mm if founded directly on the aeolian sand or medium dense gravelly colluvium. As per the materials profile encountered in the test pits the thickness of the horizon of competent material is sufficient to dissipate the stresses induced by the foundations effectively. The area is thus zoned as "S" and the materials strata can be regarded as compressible to a maximum of 10mm.

The development potential of the land is detrimentally influenced by the conditions of hard rock excavation ; presence of active waste water dumping in the area of TP 41 and wide spread occurrences of stockpiles of waste.

8.3 Geotechnical Zone III

The zone can be divided into two parts. The geotechnical conditions are similar in both parts and characterized by the presence of competent material exceeding depths of 700mm. Distinction can be made on land slope and previous land use as follows :

8.3.1 Geotechnical Zone III(a)

This zone comprises 3% of the area investigated and is characterized by the materials profiles of TP 1. It is present in an area on the southern perimeter of the area of investigation. The soil profile consists of a surface horizon of aeolian deposits and colluvium. The combined thickness of the horizon exceeds 700mm in the test pit and it overlies bedrock of quartz-amphibole schist at depth. Slope across the land is less than 2%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in compression settlement between 10mm and 20mm if founded directly on the aeolian deposits. The area is thus zoned as "S1" and the materials strata can be regarded as compressible to a maximum of 20mm.

The development potential of the land is detrimentally influenced by the slope of the land being less than 2%.

8.3.2 Geotechnical Zone III(b)

This zone comprises 7% of the area investigated and is characterized by the materials profiles of TP's 16, 19, 20 and 25. It is present in a central area on the eastern perimeter of

the area of investigation. The soil profile consists of a surface horizon of very loose aeolian deposits. The combined thickness of the horizon is between 600mm and 800mmin the test pits and it overlies very dense calcrete and bedrock of quartzite and quartz-amphibole schist at depth. Slope across the land is between 2% and 6%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in compression settlement between 10mm and 20mm if founded directly on the very loose aeolian deposits. The area is thus zoned as "S1" and the materials strata can be regarded as compressible to a maximum of 20mm.

8.4 Geotechnical Zone IV

This zone comprises 6% of the area investigated and is characterized by the materials profiles of TP's 22, 42 and 46. It is present in two areas on site and located on the extreme limit of the regional presence of sand dunes. The soil profile consists of a surface horizon of very loose aeolian deposits. The combined thickness of the horizon exceeds 1000mm and may extend to more than 2000mm deep. It overlies colluvium and bedrock of quartz-amphibole schist or quartzite at depth. Slope across the land is between 2% and 6%. Foundation stresses induced by conventional strip foundations for single and double storey structures will result in compression settlement exceeding 20mm, mainly due to the very loose consistency of the aeolian sand. The area is thus zoned as "S2" and the materials strata can be regarded as compressible to a maximum exceeding 20mm.

The development potential of the land is detrimentally influenced by the conditions of instable sand and presence of active waste water dumping in the area of TP 41. Moen (Reference 14.4 page 149) reports that these dunes are stable by virtue of vegetation cover, but removal of the vegetation soon reveals that the dunes are metastable and may begin to readjust according to current wind patterns.

8.5 Other Considerations

The contents of this subparagraph 8.5 largely fall outside the scope of a geotechnical investigation. However, it is given in good faith in an effort to find a solution to the presence of waste in the area. Three issues need to be addressed, namely :

- *Construction Waste* : The construction waste can be crushed and used as fill material during construction. Such material may also be used as successfully as a gravel wearing course for streets in Groblershoop.
- *Disposal of Waste Water* : It is not known whether the historic and present dumping of waste water on site is legal or not. However, such actions have a detrimental influence on

site development and can greatly reduced the development potential of areas close to the activities.

- *Cemetery* : It appears as if the cemetery is not in use any more. Present guidelines require some safe distance between residential development and cemetery sites, which can can greatly reduced the development potential of areas close to the activities.

9 FOUNDATION RECOMMENDATIONS AND SOLUTIONS

The foundation design alternatives and ancillary issues as discussed in subparagraphs 9.1 and 9.7 below are summarized in Table 5 : Foundation Design, Building Procedures and Precautionary Measures. In some cases more than one foundation solution is offered in the discussion below. Whichever option is used, the design must adhere strictly on the proposals of SANS 10400H, which allows more options than those indicated in this report. As geotechnical conditions favour the use of several alternatives, the decision of which option to use must be based on financial and practical considerations. In all cases service trenches shall not be excavated parallel to buildings within 1500mm of the building perimeter.

9.1 Geotechnical Zone I(a)

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. Considering the limited slope across the land of less than 2% only and the favourable geotechnical site classification as per Section 8 above, two foundation design alternatives are applicable to the zone.

The two options can be discussed as follows :

9.1.1 Strip Foundations

Foundations of 400mm wide placed directly on the very dense hardpan calcrete may be used. Should the areas of the proposed dwellings not exceed 200m^2 foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

9.1.2 Slab-on-the-ground Foundations

This is the preferred method of founding. The solution of slab-on-the-ground foundations may only be used for dwellings less than 200m^2 in area. Edge beams shall be placed directly on the very dense hardpan calcrete. Foundations for internal non-loadbearing walls shall consist of thickened floorslabs. The foundations shall not contain any changes in surface levels with

TABLE 5 : FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

AREA	AREA OF PROPERTY (%)	GEOTECH NICAL CLASS	ESTIMATED SOIL MOVEMENT (mm)	SOIL PROFILE	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES	ASSOCIATED PROBLEMS	DEVELOPMENT POTENTIAL
I(a)	28	R	Negligible	Less than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock	Conditions of hard rock excavation Landslope less than 2% favours slab-on-the-ground foundations.	Intermediate
I(b)	36	R	Negligible	Less than 400mm of colluvium and residual soil overlying bedrock and pedogenic deposits	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on very dense pedocretes or bedrock	Conditions of hard rock excavation. Landslope between 2% and 6% Presence of stockpiles of waste and obsolete sewerage oxidation ponds	Intermediate
II(a)	3	S	0mm to 10mm compression settlement	Surface horizon of colluvial or aeolian sand, 400mm to 700mm thick overlying medium dense residual soil and very dense pedogenic deposits and bedrock	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on medium dense gravelly colluvium or aeolian sand Foundation bearing pressure not to exceed 50kPa Good site drainage	Conditions of hard rock excavation Landslope less than 2% favours slab-on-the-ground foundations.	Intermediate
II(b)	17	S	0mm to 10mm compression settlement	Surface horizon of colluvial or aeolian sand, 400mm to 700mm thick overlying medium dense residual soil and very dense pedogenic deposits and bedrock	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Founding to take place on medium dense gravelly colluvium or aeolian sand Foundation bearing pressure not to exceed 50kPa Good site drainage	Conditions of hard rock excavation. Landslope between 2% and 6% Presence of stockpiles of waste and existing oxidation ponds from abbatoir	Intermediate
III(a)	3	S1	10mm to 20mm compression settlement	Surface horizon of reworked aeolian sand overlying dense calcareous cemented colluvium to depths exceeding 700mm.	Modified normal	Reinforced strip foundations with articulation joints at some internal doors and all external doors and light reinforcement in masonry. Site drainage and service and plumbing precautions. Foundation bearing pressure not to exceed 50kPa	Landslope less than 2%	Intermediate
					Replacement of in-situ soils below individual footings	Remove in-situ material below foundations to a depth and width of 1,5 times the foundation width or to a suitable soil horizon and replace with material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. Normal construction with lightly reinforced strip foundations and light reinforcement in masonry.	
III(b)	7	S1	10mm to 20mm compression settlement	Surface horizon of aeolian sand 600mm to 800mm thick overlying boulder calcrete and bedrock at depth	Modified normal	Reinforced strip foundations with articulation joints at some internal doors and all external doors and light reinforcement in masonry. Site drainage and service and plumbing precautions. Foundation bearing pressure not to exceed 50kPa	Presence of stockpiles of waste Landslope between 2% and 6%	Intermediate
					Replacement of in-situ soils below individual footings	Remove in-situ material below foundations to a depth and width of 1,5 times the foundation width or to a suitable soil horizon and replace with material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. Normal construction with lightly reinforced strip foundations and light reinforcement in masonry.	
IV	6	S2	>20mm compression settlement	Surface horizon of very loose aeolian sand, >1000mm thick overlying cemented colluvium and bedrock at depth	Modified normal	Reinforced strip footings or reinforced concrete raft placed on engineered fill. Foundation system to be designed by engineer. Foundation bearing pressure not to exceed 50kPa Good site drainage	Landslope between 2% and 6% Presence of stockpiles of waste and existing oxidation ponds from abbatoir Collapsing sidewalls in excavations Metastable dunes	Intermediate

steps exceeding 400mm and do not support any chimneys or walls which support concrete roofs.

9.2 Geotechnical Zone I(b)

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The slope across the land varies between approximately 2% and 6%. Two founding alternatives can be considered :

9.2.1 Strip Foundations

The preferable founding alternative is foundations of 400mm wide strip footings placed directly on very dense hardpan calcrete or bedrock. Should the areas of the proposed dwellings not exceed 200m^2 foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

9.2.2 Slab-on-the-ground Foundations

Considering the slope across the land of approximately 2% to 6% the use of slab-on-the-ground foundations may require additional works in the form of the construction of an engineered fill or cutting to establish a level platform for construction, but it still remains a viable alternative. This latter option of additional earthworks may be costly and hence is regarded as less attractive than conventional strip footings.

9.3 Geotechnical Zone II(a)

The zone is classed as S, meaning that the proposed horizon for founding is stable and less than 10mm compression settlement is expected. Considering the limited slope across the land of less than 2% only and the favourable geotechnical site classification as per Section 8 above, two foundation design alternatives are applicable to the zone.

The two options can be discussed as follows :

9.3.1 Strip Foundations

Foundations of 400mm wide placed directly on the very dense hardpan calcrete or medium dense in-situ soil may be used. Should the areas of the proposed dwellings not exceed 200m^2 foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

9.3.2 Slab-on-the-ground Foundations

This is the preferred method of founding. The solution of slab-on-the-ground foundations may only be used for dwellings less than 200m^2 in area. Edge beams shall be placed directly on the very dense hardpan calcrete or medium dense in-situ soils. Foundations for internal non-loadbearing walls shall consist of thickened floorslabs. The foundations shall not contain any changes in surface levels with steps exceeding 400mm and do not support any chimneys or walls which support concrete roofs.

9.4 Geotechnical Zone II(b)

The zone is classed as S, meaning that less than 10mm of compression settlement may occur. Considering the slope across the land of approximately 2% to 6% and the stable geotechnical site classification as per Section 8 above, two foundation design alternatives are applicable to the zone.

9.4.1 Strip Foundations

This is the preferred method of founding. Foundations of 400mm wide placed directly on the medium dense in-situ soil or very dense calcrete or bedrock. Should the areas of the proposed dwellings not exceed 200m^2 foundations for internal non-loadbearing walls may consist of thickened floorslabs. Should this option be adopted the floorslabs shall be reinforced steel mesh.

9.4.2 Slab-on-the-ground Foundations

The solution of slab-on-the-ground foundations may only be used for dwellings less than 200m^2 in area. Edge beams shall be placed directly on the medium dense in-situ soil, very dense calcrete or bedrock. Foundations for internal non-loadbearing walls shall consist of thickened floorslabs. The foundations shall not contain any changes in surface levels with steps exceeding 400mm and do not support any chimneys or walls which support concrete roofs.

9.5 Geotechnical Zone III(a)

The zone is classed as S1, meaning that between 10mm and 20mm compression settlement may occur. The land slopes at less than 2% and the soil profile consists of very loose aeolian sand overlying dense colluvium and bedrock at depth. Two foundation design alternatives are applicable to the zone :

9.5.1 Modified Normal Construction

The implementation of reinforced strip foundations, will require foundations of 400mm wide placed within the aeolian sand. The sand shall be compacted prior to casting of the foundations. The foundations shall be suitably steel reinforced and articulation joints at internal and external doors with light reinforcement in the masonry. Site drainage, wet services and plumbing precautions to prevent leaks shall be provided. Foundation pressures shall be limited to less than 50kPa.

9.5.2 Replacement of In-situ Soils

Remove in-situ soils below foundations to a depth of 1,5 times the foundation width or to a suitable soil horizon and replace with granular material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. Normal construction of the superstructure can take place with lightly reinforced strip foundations and light reinforcement in the masonry.

9.6 Geotechnical Zone III(b)

The zone is classed as S1, meaning that between 10mm and 20mm compression settlement may occur. The land slopes between 2% to 6% and the soil profile consists of very loose aeolian sand overlying dense colluvium and very dense calcrete and bedrock at depth. Two foundation design alternatives are applicable to the zone :

9.6.1 Modified Normal Construction

The implementation of reinforced strip foundations, will require foundations of 400mm wide placed within the aeolian sand. The sand shall be compacted prior to casting of the foundations. The foundations shall be suitably steel reinforced and articulation joints at internal and external doors with light reinforcement in the masonry. Site drainage, wet services and plumbing precautions to prevent leaks shall be provided. Foundation pressures shall be limited to less than 50kPa.

9.6.2 Replacement of In-situ Soils

Remove in-situ soils below foundations to a depth of 1,5 times the foundation width or to a suitable soil horizon and replace with granular material compacted to 93% MOD AASHTO density at -1% to +2% of optimum moisture content. Normal construction of the superstructure can take place with lightly reinforced strip foundations and light reinforcement in the masonry.

9.7 Geotechnical Zone IV

The zone is classed as S2. The slope of the land is between 2% and 6%. The soil profile consists of deeper than 1000mm very loose aeolian sand overlying colluvium and bedrock at depth. Founding in this zone can be a source of some challenges. Due to the very loose consistency of the aeolian deposits, collapse of excavation sidewalls, even less than 1000mm deep will result in conditions difficult to excavate for construction of reinforced strip footings. It thus appears as if a reinforced raft is the better solution. However, due to the slope across the land it will require additional groundworks to provide a level platform for the construction of a reinforced concrete raft. The use of mini piles placed at depth on bedrock is an expensive option and not suitable for the development of low cost housing. The problem of dunes that may remobilize if vegetation is removed must also be considered.

It is thus recommended that the conditions at each individual stand be considered on its own merits and that all foundations be designed by a professional engineer to suit the conditions. Site drainage, wet services and plumbing precautions to prevent leaks shall be provided. Foundation pressures shall be limited to less than 50kPa. Such foundations may consist of the following :

- *Reinforced Strip Foundations* : The foundations shall be suitably steel reinforced and articulation joints at internal and external doors with light reinforcement in the masonry. Site drainage, wet services and plumbing precautions to prevent leaks shall be provided. Foundation pressures shall be limited to less than 50kPa.
- *Reinforced Concrete Raft* : Alternatively structures may be founded by means on a suitably reinforced concrete raft. The raft may be placed on an engineered fill to reduce excavating into the very loose sand.

10 DRAINAGE

The water courses on site are contained in narrow and well-defined gullies of such extent that they do not influence the various geotechnical site class designations. They are therefore not zoned separately. However, the presence of these water courses must be taken into account and infrastructure established only in a safe distance from these features.

The slope of less than 2% in certain areas of the land is regarded as marginal and may result in problems with the design of stormwater and sewerage disposal systems depending on dissipation by gravity.

11 SPECIAL PRECAUTIONARY MEASURES

11.1 Soil and Water Contamination

Some issues need to be resolved prior to residential development may take place on the land. The Cedar Land Geotechnical Consult appointment excludes the investigation of possible soil and groundwater contamination due to the presence of the cemetery, obsolete oxidation dams, existing oxidation dam and sewer dumping area. However, as a matter of due diligence these issues need to be considered in a geotechnical report.

Even though no in-situ testing was conducted to determine whether these items are responsible for, or have historically been responsible for soil or water contamination, it can be stated that such conditions may have occurred. Due to the relative absence of groundwater of any sort close to the surface and an impermeable barrier formed by the calcrete and bedrock it is unlikely that groundwater contamination may have taken place, but contamination of surface water could have occurred. Similarly could bacterial contamination of the surface soils have taken place.

It is thus essential that the developer ensure that the areas surrounding the features concerned be investigated by a suitably qualified professional practitioner to determine the absence/presence of contamination. Should the habit of waste water dumping be terminated, these features may be rehabilitated and the environment declared contamination free, the entire area can be developed as per the guidelines proposed by the investigating professional. Should it be found that contamination exists and that the culture of dumping waste water be continued, the facilities shall be upgraded to comply to modern legal requirements and applicable minimum distances between the facilities and residential developments maintained as per legal requirements and complying to the proposals of the investigating professional.

11.2 Dune Stability

The effects and damage that may occur due to moving dunes are amply illustrated by old mine villages in desert areas. Although the dunes in this area have been stable and not subject to movement over a very long time, it has been found that with the removal of vegetation the effects of wind result in the displacement of the sand. It is therefore important that any development of the dune area be done in conjunction with an environmental specialist who can provide guidance with regard to revegetating the dunes and development of infrastructure in these conditions.

12 CONCLUSIONS

The property is regarded as being of intermediate suitability for residential development. Founding conditions can be defined as R and S, S1 and S2. The factors that reduce the suitability of the land for development are :

- The presence of hard rock and very dense hardpan calcrete close to the surface in areas zoned as S and R. The presence thereof will result in conditions of hard excavation. On the other hand it provides conditions favouring conventional methods of founding.
- The limited slope of less than 2% in Geotechnical Zones I(a), II(a) and III(a) will have a detrimental influence on the design of stormwater disposal systems and sewerage reticulation.
- The presence of waste material need to be addressed.
- The issue of the presence of a cemetery and past and present waste water disposal need to be addressed.
- The possibility that dunes may be mobilized with the removal of vegetation need to be addressed.

The conclusions as based on the site conditions are summarized in Table 6 : Influence of Constraints per Geotechnical Zoning. This classification is based on the proposals of the document *Geotechnical Site Investigations for Housing Developments (Generic Specification GFSH-2)*, issued by the National Department of Housing in September 2002.

12.1 Stratigraphy

The available information shows that the area of investigation is located on a subduction zone dating approximately 1000 million years old. The zone is located between the lithology of the Kaapvaal Craton and the Namaqua-Natal mobile belt. The remains of the original geology in the area are referred to as the Kaaien Terrane and the site is located on the Groblershoop Formation of the Brulpan Group. Bedrock on site occurs as lineal bands of grey, micaceous quartzite associated with a wider distributed quartz-amphibole schist of the Groblershoop Formation, Brulpan Group. Occasionally the quartzite tends to be muscovite-rich.

12.2 Soil Profile

12.2.1 Gordonia Formation

Aeolian sand was encountered in a reworked form in the southern area of the site and in a pure form in the northwestern part thereof. These deposits are light red in colour, very loose, fine sand with an intact matrix. The aeolian sand can be associated with the Gordonia

TABLE 6 : INFLUENCE OF CONSTRAINTS PER GEOTECHNICAL ZONING

CONSTRAINT	KEY TO CLASSIFICATION			CLASSIFICATION PER GEOTECHNICAL ZONE						
	MOST FAVOURABLE (1)	INTERMEDIATE (2)	LEAST FAVOURABLE (3)	I(a)	I(b)	II(a)	II(b)	III(a)	III(b)	IV
Collapsible soil	Any collapsible horizon or consecutive horizons totalling a depth of less than 750mm in thickness	Any collapsible horizon or consecutive horizons with a depth of more than 750mm in thickness	A least favourable situation for this constraint does not occur							
Seepage	Permanent or perched water table more than 1,5m below ground surface	Permanent or perched water table less than 1,5m below ground surface	Swamps and marshes							
Active soil	Low soil heave potential anticipated	Moderate soil heave potential anticipated	High soil heave potential anticipated							
Highly compressible soil	Low soil compressibility anticipated	Moderate soil compressibility anticipated	High soil compressibility anticipated							
Erodibility of Soil	Low	Intermediate	High							
Difficulty of excavation to 1,5m depth	Scattered or occasional boulders less than 10% of the total volume	Rock or hardpan pedocretes between 10% and 40% of the total volume	Rock or hardpan pedocretes more than 40% of the total volume							
Undermined ground	Undermining at a depth greater than 240m below surface, except where total extraction mining has not occurred	Old undermined areas to a depth of 90m to 240m below surface where stope closure has ceased	Mining within less than 90m to 240m of surface or where total extraction mining has taken place							
Dolomite and limestone stability	Possibly stable. Areas of dolomite overlain by Karroo rocks or intruded by sills. Areas of Black Reef rocks. Anticipated Inherent Risk Class 1	Potentially characterised by instability. Anticipated Inherent Risk Classes 2 to 5	Known sinkholes and dolines Anticipated Inherent Risk Classes 6 to 8							
Steep slopes*	Between 2° and 6° in all regions	Slopes between 6° and 18° and less than 2° (Natal and Western Cape) Slopes between 6° and12° and less than 2° (all other regions)	More than 18° (Natal and Western Cape) More than 12° (all other regions)							
Areas of unstable natural slopes*	Low risk	Intermediate risk	High risk (Especially in areas subject to seismic activity)							
Areas subject to seismic activity	10% probability of an event less than $100cms^{-2}$ within 50 years	Mining induced seismic activity more than $100cms^{-2}$	Natural seismic activity more than $100cms^{-2}$							
Areas subject to flooding	A "most favourable" situation for this constraint does not occur	Areas adjacent to a known drainage channel or floodplain with slope less than 1%	Areas with a known drainage channel or floodplain							

Formation of the Kalahari Group. The thickness of the horizon varied between 800mm and 1900mm in the test pits.

12.2.2 Colluvium

Gravelly colluvium as surface deposit was found over the entire site. Being older than the aeolian sand, it underlies the dunes where they were encountered. The colluvium is a homogenous material, consisting light brown fine sand and clasts of gravels and cobbles of quartz and some calcrete. The consistency of the gravelly colluvium is medium dense and the soil matrix intact. The horizon of colluvium was between 600mm and 1400mm thick in the test pits.

12.2.3 Mokalanen Formation

Calcrete was encountered as the dominant lithic material on site, in virtually a continuous cover over the quartzite and schist, with the latter outcropping occasionally. The calcrete is present as very dense hardpan or boulder calcrete. The calcrete is present as outcrops ; or underlies the transported materials, occurring from depths between zero and 800mm minimum, extending to 100mm to 1200mm maximum, at which stage refusal of excavation occurred or bedrock was encountered. It is described as dirty white to dirty light yellow white, very fine grained, very dense calcrete. Some fine sand may occasionally be contained in voids in the matrix of the calcrete.

12.2.4 Residual Quartzite

On site residual quartzite was encountered as surface material or underlying the gravelly colluvium. It consists of cobbles and boulders of quartzite with diameter less than 500mm contained a matrix of dirty white, calcareous cemented sand. The soil matrix is medium dense. The horizon of residual quartzite extended to a depth of 700mm where encountered.

12.3 Groundwater

12.3.1 Perched Water

Perched groundwater was not encountered in any of the test pits excavated for this investigation. It is anticipated that perched water will generally not prove problematic on the site. However, seepage water may be encountered in the vicinity of the waste water disposal areas.

12.3.2 Permanent Groundwater

The probability for drilling successfully for water in the area is between 40% and 60%, and the probability that such a borehole will yield more than 2l/s is between 10% and 20%. Groundwater is expected to occur at depths less than 15 meters in compact, argillaceous strata.

12.4 Conditions of Excavation

12.4.1 Conditions of Hard Rock Excavation

On average over the entire site bedrock or refusal of excavation on very dense hardpan calcrete, bedrock of quartz-amphibole schist or quartzite was encountered at depths between 100mm minimum and 1500mm maximum, averaging 700mm deep. The implication of this is that should trenches require excavated depths to 1000mm, 30% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 53% of the excavation may be classified as hard.

Irrespective of which method of excavation is considered, the most important issue is that across the entire site the depth to bedrock and hardpan calcrete that can be regarded as hard rock excavation is highly variable as follows :

12.4.1(i) Geotechnical Zones I(a) and I(b)

These zones are classified as R. The average depth to bedrock or very dense pedocrete is 185mm. Refusal of excavation occurred at an average depth of 550mm. The implication of this is that should trenches require excavated depths to 1000mm, 45% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 63% of the excavation may be classified as hard.

12.4.1(ii) Geotechnical Zones II(a) and II(b)

These zones are classified as S. The average depth to bedrock or very dense pedocrete is 620mm. Refusal of excavation occurred at an average depth of 850mm. The implication of this is that should trenches require excavated depths to 1000mm, 15% of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 43% of the excavation may be classified as hard.

12.4.1(iii) Geotechnical Zones III(a and b)

These zones are classified as S1. The average depth to bedrock or very dense pedocrete is 780mm. Refusal of excavation occurred at an average depth of 1200mm. The implication of this is that should trenches require excavated depths to 1000mm, zero percent of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 20% of the excavation may be classified as hard.

12.4.1(iv) Geotechnical Zone IV

This zones is classified as S2. The average depth to bedrock or very dense pedocrete is 1370mm. Refusal of excavation occurred at an average depth of 1470mm. The implication of this is that should trenches require excavated depths to 1000mm, zero percent of the excavation may be classified as hard, requiring drilling and blasting. Should the required depth of excavation increase to 1500mm, 2% of the excavation may be classified as hard.

12.4.2 Sidewall Stability

In all cases where aeolian sand or reworked aeolian sand may occur such material may be regarded as potentially unstable and subject to collapse. However, especially in Geotechnical Zone S2 where deep, very loose sand is present, such conditions are dangerous and can prove fatal if collapses occur while workmen are occupied in trenches.

12.5 Site Class Designation

It is concluded that the area is regarded as suitable for residential development as follows :

12.5.1 Geotechnical Zone I(a)

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 28% of the proposed area for development. Slope across the land is less than 2%. Considering the limited slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on bedrock or very dense pedocrete. The latter option is regarded as the better solution of the two alternatives.

Geotechnical conditions related to foundation design can be regarded as favourable, but the conditions of hard rock excavation close to the surface and slope less than 2% detract from

the ease suitability of establishing services and overall the development potential is regarded as intermediate only.

12.5.2 Geotechnical Zone I(b)

The zone is classed as R, meaning that the proposed horizon for founding is stable and negligible soil movement is expected. The distribution thereof encompasses 36% of the proposed area for development. Slope across the land is approximately between 2% and 6%. The use of slab-on-the-ground foundations will require additional works in the form of the construction of an engineered fill or cutting to establish a level platform for construction. The more viable foundation alternative therefore remains founding by conventional strip foundations.

Geotechnical conditions related to foundation design can be regarded as favourable, but the conditions of hard rock excavation close to the surface detracts from the ease suitability of establishing services and overall the development potential is regarded as intermediate only.

12.5.3 Geotechnical Zone II(a)

The zone is classed as S, meaning that the proposed horizon for founding is stable and less than 10mm rapid compression settlement is expected. The distribution thereof encompasses 3% of the proposed area for development. Slope across the land is less than 2%. Considering the limited slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on gravelly colluvium or aeolian sand. The latter option is regarded as the better solution of the two alternatives.

Geotechnical conditions related to foundation design can be regarded as favourable, but the conditions of hard rock excavation close to the surface and slope less than 2% detract from the ease suitability of establishing services and overall the development potential is regarded as intermediate only.

12.5.4 Geotechnical Zone II(b)

The zone is classed as S, meaning that the proposed horizon for founding is slightly compressible and rapid compression settlement less than 10mm is expected. The distribution thereof encompasses 17% of the proposed area for development. Slope across the land is between 2% and 6%. Considering the slope and the favourable geotechnical site classification, two foundation design alternatives are applicable to the zone, namely conventional strip foundations or slab-on-the-ground foundations placed directly on gravelly

colluvium or aeolian sand. The more viable foundation alternative therefore remains founding by conventional strip foundations.

Geotechnical conditions related to foundation design can be regarded as favourable, but the conditions of hard rock excavation close to the surface detracts from the ease suitability of establishing services and overall the development potential is regarded as intermediate only.

12.5.5 Geotechnical Zone III(a)

The zone is classed as S1, meaning that the proposed horizon for founding is fairly compressible and the foundation design need to incorporate measures to counter the effects of the geotechnical conditions. Between 10mm and 20mm rapid compression settlement is expected. The distribution thereof encompasses 3% of the proposed area for development. Slope across the land is less than 2%. Considering the limited slope and the intermediate geotechnical site classification, two foundation design alternatives are applicable to the zone, namely reinforced strip foundations or replacement of the in-situ soils underneath individual footings. From a geotechnical viewpoint both alternatives are regarded as suitable solutions for the founding conditions. The developer must base is choice on financial constraints.

Geotechnical conditions related to foundation design can be regarded as intermediate, and slope less than 2% detract from the ease suitability of establishing services and overall the development potential is regarded as intermediate only.

12.5.6 Geotechnical Zone III(b)

The zone is classed as S1, meaning that the proposed horizon for founding is fairly compressible and the foundation design need to incorporate measures to counter the effects of the geotechnical conditions. Between 10mm and 20mm rapid compression settlement is expected. The distribution thereof encompasses 7% of the proposed area for development. Slope across the land is between 2% and 6%. Considering the intermediate geotechnical site classification, two foundation design alternatives are applicable to the zone, namely reinforced strip foundations or replacement of the in-situ soils underneath individual footings. From a geotechnical viewpoint both alternatives are regarded as suitable solutions for the founding conditions. The developer must base is choice on financial constraints.

Geotechnical conditions related to foundation design can be regarded as intermediate, and overall the development potential is regarded as intermediate only.

12.5.7 Geotechnical Zone IV

The zone is classed as S2, meaning that the proposed horizon for founding is highly compressible and the foundation design need to incorporate measures to counter the effects of the geotechnical conditions. In excess of 20mm rapid compression settlement is expected. The distribution thereof encompasses 6% of the proposed area for development. Slope across the land is between 2% and 6%. Considering the intermediate geotechnical site classification, two foundation design alternatives are applicable to the zone, namely reinforced strip foundations or reinforced concrete rafts. From a geotechnical viewpoint both alternatives are regarded as suitable solutions for the founding conditions. However, the selection of which alternative to use must be made individually for each stand. All foundations to be designed by a suitably experienced professional engineer.

Geotechnical conditions related to foundation design can be regarded as intermediate, and overall the development potential is regarded as intermediate only.

12.6 Land Slope

The average slope across 66% of the land is between 2% and 6% and over 34% it is less than 2%.

The slope of less than 2% has a detrimental influence on especially the design of a stormwater disposal system depending on gravity to dissipate of the surface water due to downpours. The land slope also affects the design of the sewerage disposal but to a lesser extent as the gradient of the pipes can be adjusted according to design requirements.

12.7 Areas Subject to Flooding

The non-perennial water courses on site are contained in well-defined, narrow gullies and may be regarded as being of lesser importance, requiring no additional precautionary measures to ensure the safety of the population against flooding.

12.8 Materials Utilization

- *Trench Backfilling* : Only the aeolian sand can be regarded as suitable for selected fill or pipe bedding. With exception of the hardpan calcrete all materials can be used for normal backfill.
- *Layerworks for Paved or Segmental Block Paving* : The hardpan calcrete and colluvium are of G6 quality and hence suitable for the construction of layerworks up to subbase and base course level for lightly trafficked roads.

- *Wearing Course for Gravel Roads in Urban Areas* : None of the soil materials are 100% suitable for this purpose. The use of these materials will generally result in a road surface subject to raveling and corrugations.

12.9 Other Considerations

- *Undermining* : The area is not subject to undermining.
- *Seismic Activity* : The Peak Ground Acceleration expected in 50 years is 0,05g. A low risk for the development of earth tremors therefore exist.
- *Soil Corrosivity* : The in-situ soils and pedocretes are not corrosive due to acidic properties. All soil materials can be regarded as corrosive due to high soluble salt contents.
- *Dolomite* : The area of investigation is not subject to any restrictions due to the presence of dolomite. Bedrock of dolomite does not occur in the area of investigation.

13 RECOMMENDATIONS

13.1 Foundation and Structural Design

Section 9 of this document provides guidelines for foundation and structural design. These guidelines are based strictly on the contents of SANS 10400H and the NHBRC Home Owners Manual published in 2015. It is recommended that development take place strictly according to these guidelines. More than one founding solution is applicable on the site, and the property developer can base his choice on financial constraints.

13.2 Materials Utilization

- *Trench Backfill* : With exception of the hardpan calcrete, the in-situ materials may be used for normal backfill of trenches. The hardpan calcrete shall be spoilt and not used at all for this purpose. Material for pipe bedding and selected backfill may be obtained from the aeolian sand or commercial sources.
- *Layerworks for Paved or Segmental Block Paving* : The hardpan calcrete and colluvium are of G6 quality and hence suitable for the construction of layerworks up to subbase and base course level for lightly trafficked roads. It is recommended that a centerline investigation consisting of test pitting and soil sampling be conducted to allow the consulting engineer to produce suitable pavement designs for the project.
- *Wearing Course for Gravel Roads in Urban Areas* : Material for the construction of a gravel wearing course shall be obtained from stockpiled or calcrete from a licensed borrow pit.

13.4 Conditions of Excavation

Although manual excavation is possible through the colluvium, aeolian sand and residual soil and to some extent through the calcrete, it is considered as not an economic proposition, mostly due to the consistency and composition of the soil. Excavation through these soils shall require the use of a TLB rated at 55kW minimum, or preferably a 30 ton excavator of the very dense pedocretes need to be removed. It is recommended that adequate provision be made for hard rock excavation.

The sidewalls of excavations through the aeolian sand may be subject to collapse. It is recommended that precautionary measures be provided to protect workmen in these excavations. Such precautionary measures can consist of either shoring the excavations or sloping the sides to flatter than 1(V) : 2(H).

13.5 Land Slope

The average slope across 66% of the land is between 2% and 6%, which is regarded as favourable for residential development. Over 34% it is less than 2%, which will require careful consideration of the design of wet services due to possible reduced flow rates of liquids.

13.6 Presence of the Cemetery Site and Waste Water Facilities

It is recommended that the effects of these facilities on the proposed development be investigated. The future development must comply to legal requirements to mitigate any negative effects that these facilities may have on the development of the site.

13.7 Dune Stability

As yet there is no definite indicators that the dunes in Geotechnical Zone S2 are unstable. However, residential development in such conditions will be difficult due to the very loose consistency of the sand. Careful consideration must thus be given to placement of houses in such area and the natural environment disturbed as little as possible. Vegetation must be re-established to ensure that the dunes stay stable as far as possible.

14 SOURCES OF REFERENCE

14.1 Mucina L et al : *The Vegetation of South Africa, Lesotho and Swaziland*, pages 335 and 336, published in 2006 by SANBI.

14.2 McCarthey T and Rubidge B : *The Story of Earth and Life*, pages 156 to 161, funded by Exxaro and published in 2006 by Struik Nature.

14.3 Cornell DH et al : *Section 16 The Namaqua-Natal Province, pages 325 to 380, as contained in the Geology of South Africa*, under editorship of MR Johnson, published by the Council for Geoscience in 2006.

14.4 Moen HFG : *The Geology of the Upington Area*, pages 72 to 87, published by the Council for Geoscience in 2007.

14.5 Partridge TC et al : *Section 29 Cenozoic Deposits of the Interior, pages 585 to 593, as contained in the Geology of South Africa*, under editorship of MR Johnson, published by the Council for Geoscience in 2006.

14.6 Brink ABA : Engineering Geology of Southern Africa, Volume 4, pages 294 to 295, published in 1985 by Building Publications, Pretoria.

14.7 Vegter JR : *An Explanation of a Set of National Ground Water Maps*, published by the Water Research Commission, in August 1995.

14.8 Errera LA : *Stress Paths and Collapsing Soils*, M Sc Thesis, Department of Civil Engineering, University of Cape Town, 1977.

14.9 Evans UR : *The Corrosion and Oxidation of Metals*, published by Edward Arnold in 1971.

14.10 Brink ABA et al : *Soil Survey for Engineering*, pages 38 to 39, published by Clarendon Press in 1982.

14.11 Kijko A et al : *Probabilistic Peak Ground Acceleration and Spectral Seismic Hazard Maps for South Africa*, Report 2003-0053 by the Council for Geoscience.

14.12 SANS 10400 : Section H Edition 3 pages 14 to 28.

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For Cedar Land Geotechnical Consult (Pty) Ltd

23 September 2020

GEOTECHNICAL CONDITIONS ON PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT 48: A REPORT FOR THE EXPANSION AND FORMALISATION OF GROBLERSHOOP COMMUNITY

2020/J09/MCP_01

ADDENDUM A: TEST PIT PROFILES

TRIAL HOLE: 1

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°55'09,3" S 21°57'10,1" E*

Cedar Land Geotechnical Consult (Pty) Ltd
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Ceres
6835
Cell: 082 570 2767
Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Dry, light red, very loose, intact, fine *SAND* and matrix supported, fine, rounded gravels of quartz. Reworked aeolian deposits.				
0.80		Abundant, clast supported, fine to medium coarse, rounded *GRAVELS* of quartz in a matrix of dry, light brown, fine sand. Soil matrix is partially calcareous and cemented. Overall consistency is dense. Colluvium.				
1.40		Dull light grey green speckled white, intensely laminated, very closely jointed, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST*. Discontinuities are open and filled with white, calcareous fine sand. Discontinuities dip at 30°.				
1.80						

NOTES:

1 Refual of excavation at 1500 mm on medium hard rock, quartz-amphibole schist.

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 1

FIGURE: A1

TRIAL HOLE: 2

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°55'05,8" S 22°00'02,2" E*

Cedar Land Geotechnical Consult (Pty) Ltd
P O Box 607
Ceres
6835
Cell: 082 570 2767
Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				**NOTES:** 1 Refual of excavation at 600 mm on medium hard rock, quartz-amphibole schist.
0.20		Lenses (± 20 mm thick) of dirty white discoloured light brown, very fine grained, very dense hardpan *CALCRETE.* Discontinuities are open and filled with light brown sand. Pedogenic deposits.				
0.40		Dull light grey green speckled white, intensely laminated, very closely jointed, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST.* Discontinuities are open and filled with white, calcareous fine sand. Discontinuities dip at 15º.	U9309	0,2-0,6	●	
0.60						
0.80						▽ Water encountered ▼ Water level ▽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 2

FIGURE: A2

TRIAL HOLE: 3

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°55'05,8" S 21°59'56,8" E*

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cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 300 mm on very dense hardpan calcrete.
0.20		Lenses of dirty white discoloured light brown, very fine grained, very dense hardpan *CALCRETE.* Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⊽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 3

FIGURE: A3

TRIAL HOLE: 4

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°55'06,2" S 21°59'52,4" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light brown, loose, intact, fine *SAND.* Reworked aeolian deposits.				1 Refual of excavation at 700 mm on hard rock, quartzite.
0.20						
0.40						
0.60		Light green brown, closely jointed, very fine grained, unweathered, hard rock, micaceous *QUARTZITE.* Discontinuities are closed, smooth and clean. Discontinuities dip at 75°.				
0.80						▽ Water encountered ▼ Water level ⊽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 4

FIGURE: A4

TRIAL HOLE: 5

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°55'01,0" S 22°00'01,4" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 600 mm on hard rock, quartz-amphibole schist.
0.20		Light green brown, closely jointed, very intensely laminated, very fine grained, unweathered, hard rock, *quartz-amphibole SCHIST.* Discontinuities are open and filled with white, calcareous sand. Discontinuities dip at 75°.				
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 5

FIGURE: A5

TRIAL HOLE: 6

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°55'01,1" S 21°59'56,4" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 600 mm on hard rock, quartz-amphibole schist.
0.20		Light grey green, closely jointed, very intensely laminated, very fine grained, unweathered, hard rock, *quartz-amphibole SCHIST.* Discontinuities are open and filled with white, calcareous sand. Discontinuities dip at 75°.				
0.40						
0.60						
0.80						
1.00						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 6

FIGURE: A6

TRIAL HOLE: 7

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°55'01,7" S 21°59'51,0" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light brown, loose, intact, fine *SAND*. Reworked aeolian sand.				1 Refual of excavation at 900 mm on very dense boulder calcrete.
0.20						
0.40						
0.60		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				
0.80		White, very fine grained, very dense, boulder *CALCRETE* with pockets of dry, light grey brown, fine sand. Pedogenic deposits.				
1.00						

Water encountered
Water level
Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 7

FIGURE: A7

TRIAL HOLE: 8

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'55,1" S 22°00'00,0" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dirty white discoloured light brown, very fine grained, very dense, hardpan *CALCRETE.* Pedogenic deposits.				1 Refual of excavation at 100 mm on very dense hardpan calcrete.
0.20						
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 8

FIGURE: A8

TRIAL HOLE: 9

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'55,7" S 21°59'55,2" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				**NOTES:** 1 Refual of excavation at 800 mm on hard rock, quartz-amphibole schist.
0.20			U9310	0-0,8	●	
		Light green grey, closely jointed, very intensely laminated, very fine grained, unweathered, hard rock, *quartz-amphibole SCHIST*. Discontinuities are open and filled with white, calcareous sand. Discontinuities dip at 45º.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ▽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 9

FIGURE: A9

TRIAL HOLE: 10

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'56,2" S 21°59'48,5" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose becoming dense with depth, intact, fine *SAND*. Reworked aeolian sand.				1 Refual of excavation at 700 mm on very dense boulder calcrete.
0.40		White, very fine grained, very dense, boulder *CALCRETE* with pockets of dry, light grey brown, fine sand. Pedogenic deposits.				
0.60						
0.80						▽ Water encountered ▼ Water level ⏚ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 10

FIGURE: A10

TRIAL HOLE: 11

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'50,2" S 21°59'58,6" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 600 mm on very dense boulder calcrete.
0.20		White, very fine grained, very dense, boulder *CALCRETE* with pockets of dry, light grey brown, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⊽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 11

FIGURE: A11

TRIAL HOLE: 12

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'50,6" S 21°59'55,0" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 500 mm on very dense boulder calcrete.
0.20						
		White, very fine grained, very dense, boulder *CALCRETE* with pockets of dry, light grey brown, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ▽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 12

FIGURE: A12

TRIAL HOLE: 13

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'51,4" S 21°59'50,3" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 400 mm on very dense boulder calcrete.
0.20						
		White, very fine grained, very dense, boulder *CALCRETE*. Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⊽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 13

FIGURE: A13

TRIAL HOLE: 14

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'50,2" S 21°59'58,6" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 200 mm on very dense boulder calcrete.
0.20		White, very fine grained, very dense, boulder *CALCRETE* with pockets of dry, light grey brown, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 14

FIGURE: A14

TRIAL HOLE: 15

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'45,2" S 21°59'57,5" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 500 mm on medium hard rock, quartz-amphibole schist.
		White, very fine grained, very dense, boulder *CALCRETE*. Pedogenic deposits.				
0.20			U9307	0,1-0,5	●	
		Dull light grey brown speckled white, intensely laminated, very closely jointed, very fine grained, slighlty weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST*. Discontinuities are open and filled with white, calcareous fine sand. Discontinuites dip at 15º.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⊽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 15

FIGURE: A15

TRIAL HOLE: 16

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'45,5" S 21°59'52,0" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Dry, light red, very loose becoming dense with depth, fine *SAND.* Aeolian sand.				**NOTES:** 1 Refual of excavation at 1200 mm on medium hard rock, quartz-amphibole schist.
0.20						
0.40						
0.60						
0.80		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				
1.00		Dull light grey green speckled white, intensely laminated, very closely jointed, very fine grained, slighlty weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST.* Discontinuities are open and filled with white, calcareous fine sand. Discontinuites dip at 15º.				
1.20						
1.40						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 16

FIGURE: A16

TRIAL HOLE: 17

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'52,3" S 21°59'46,0" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.	U9308	0-0,3	●	1 Refual of excavation at 300 mm on very dense boulder calcrete.
0.20		White, very fine grained, very dense, boulder *CALCRETE* with pockets of dry, light grey brown, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						

▽ Water encountered
▼ Water level
⏚ Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 17

FIGURE: A17

TRIAL HOLE: 18

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'48,2" S 21°59'41,2" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 600 mm on very dense boulder calcrete.
0.20						
		White, very fine grained, very dense, boulder *CALCRETE* with pockets of dry, light grey brown, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 18

FIGURE: A18

TRIAL HOLE: 19

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'40,6" S 21°59'56,7" E*

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Email:
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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose, intact, fine *SAND.* Aeolian deposits. Roots are present in the horizon.				1 Refual of excavation at 1000 mm on very hard rock, quartz-amphibole schist.
0.20						
0.40						
0.60		White, very fine grained, very dense, boulder *CALCRETE*. Pedogenic deposits.				
0.80		Dull light yellow grey speckled dark grey, very closely jointed, very intensely laminated, fine grained, slightly weathered, hard rock, quartz-amphibole SCHIST. Joints are open, smooth and filled with light red sand. Laminations are closed, smooth and clean. Well developed, black, needle-like amphibole crystals are contained in the rock matrix. Discontinuities dip at 60°.				
1.00						
1.20						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 19

FIGURE: A19

TRIAL HOLE: 20

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'41,2" S 21°59'51,8" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose, intact, fine *SAND.* Aeolian deposits.				1 Refual of excavation at 1200 mm on very dense boulder calcrete.
0.20						2 Test pit collapses from surface.
0.40						
		White, very fine grained, very dense, boulder *CALCRETE* with pockets of dry, light grey brown, fine sand. Pedogenic deposits.				
0.60						
0.80						
1.00						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.20						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 20

FIGURE: A20

TRIAL HOLE: 21

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'42,3" S 21°59'46,3" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 1100 mm on medium hard rock, quartz-amphibole schist.
0.20		White, very fine grained, very dense, boulder *CALCRETE* with pockets of dry, light grey brown, fine sand. Pedogenic deposits.				
0.40						
0.60						
0.80		Dull light grey green speckled white, intensely laminated, very closely jointed, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST*. Discontinuities are open and filled with white calcareous fine sand. Discontinuites dip at 30°.				
1.00						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.20						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 21

FIGURE: A21

TRIAL HOLE: 22

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'43,8" S 21°59'39,3" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose, intact, fine *SAND.* Aeolian depostis. Roots are present in the horizon.				1 Refual of excavation at 900 mm on very dense hardpan calcrete.
0.20			U9304	0-0,7	●	
		White, very fine grained, very dense, boulder *CALCRETE.* Pedogenic deposits.				
0.40						
0.60						
		Dirty white, very fine grained, very dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.80						
1.00						▽ Water encountered ▼ Water level ▽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.20						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 22

FIGURE: A22

TRIAL HOLE: 23

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'35,3" S 21°59'56,3" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				**NOTES:** 1 Refual of excavation at 400 mm on very hard rock, quartz-amphibole schist.
0.20			U9306	0-0,4	●	
		Dull light yellow grey green speckled dark grey, very intensely laminated, very closely jointed, fine grained, slightly weathered, hard rock, *quartz-amphibole SCHIST*. Joints are open and filled with light red sand. Laminations are closed, smooth and clean. Well developed, black, needle-like amphibole crystals are contained in the rock matrix. Discontinuities dip at 30°.				
0.40						
0.60						
0.80						
1.00						
1.20						

Water encountered
Water level
Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 23

FIGURE: A23

TRIAL HOLE: 24

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'36,1" S 21°59'52,3" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose, intact, fine *SAND.* Aeolian depostis. Roots are present in the horizon.				1 Test pit abandoned. Dangerous and collapses from surface.
2.00		Abundant, clast supported, coarse, angular *GRAVELS* and *COBBLES* of quartz. Colluvium.				
2.40						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 24

FIGURE: A24

TRIAL HOLE: 25

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'38,2" S 21°59'48,4" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose, intact, fine *SAND.* Aeolian deposits. Roots are present in the horizon.				1 Refual of excavation at 1100 mm on very hard rock, quartz-amphibole schist.
0.20			U9305	0-0,6	●	
0.40						
0.60		White, very fine grained, very dense, boulder *CALCRETE.* Pedogenic deposits.				
0.80						
1.00		Dull light yellow grey speckled dark grey, very intensely laminated, very closely jointed, fine grained, slightly weathered, hard rock, *quartz-amphibole SCHIST*. Joints are open, smooth and filled with light red sand. Laminations are closed, smooth and clean. Well developed, black, needle-like amphibole crystals are contained in the rock matrix. Discontinuites dip at 60º.				
1.20						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.40						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 25

FIGURE: A25

TRIAL HOLE: 26

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'38,9" S 21°59'42,5" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 600 mm on very dense, hardpan calcrete.
0.20		Dirty white, very fine grained, very dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.20						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 26

FIGURE: A26

TRIAL HOLE: 27

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'39,4" S 21°59'38,3" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refual of excavation at 400 mm on very dense, hardpan calcrete.
0.20		Dirty white, very fine grained, very dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.40						
0.60						
0.80						
1.00						
1.20						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 27

FIGURE: A27

TRIAL HOLE: 28

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'31,5" S 21°59'55,1" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				
0.20		Lenses of dirty white discoloured light brown, very fine grained, dense, hardpan *CALCRETE*. Pedogenic deposits.				
0.40		Light grey brown, very closely jointed, very intensely laminated, very fine grained, unweathered, hard rock, *quartz-amphibole SCHIST*. Joints are closed, smooth and clean. Discontinuities dip at 30°.				**NOTES:** 1 Refual of excavation at 800 mm on hard rock, quartz-amphibole schist.
0.60						
0.80						
1.00						
1.20						
1.40						
1.60						
1.80						

Water encountered
Water level
Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 28

FIGURE: A28

TRIAL HOLE: 29

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'31,3" S 21°59'49,8" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and angular *GRAVELS* of quartz in a matrix of dry, light brown, sand. Overall consistency is medium dense. Colluvium.				
0.20		Lenses of dirty white discoloured light brown, very fine grained, dense, hardpan *CALCRETE*. Pedogenic deposits.				
0.40		Light grey brown, very closely jointed, very intensely laminated, very fine grained, unweathered, hard rock, *quartz-amphibole SCHIST*. Joints are closed, smooth and clean. Discontinuities dip at 30°.				
0.60						
0.80						
1.00						
1.20						
1.40						
1.60						
1.80						

NOTES:

1 Refual of excavation at 600 mm on hard rock, quartz-amphibole schist.

- Water encountered
- Water level
- Bottom of hole
- Approximate material change
- Disturbed sample
- Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 29

FIGURE: A29

TRIAL HOLE: 30

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'31,5" S 21°59'41,5" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose, intact, fine *SAND.* Aeolian deposits. Roots are present in the horizon.				1 Refusal of excavation at 800 mm on very dense boulder calcrete.
0.20			U9303	0-0,5	●	
0.40						
0.60		Abundant, clast supported, rounded and subrounded, medium coarse, *GRAVELS* of quartz in a matrix of light red, fine sand. Overall consistency is medium dense. Colluvium.				
		White, very fine grained, very dense, boulder *CALCRETE.* Pedogenic deposits.				
0.80						▽ Water encountered ▼ Water level ▽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 30

FIGURE: A30

TRIAL HOLE: 31

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *10/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'33,9" S 21°59'36,7" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose, intact, fine *SAND.* Aeolian deposits.				1 Refusal of excavation at 400 mm on hard rock, quartz-amphibole schist.
0.20		Dull light yellow grey speckled dark grey, very closely jointed, very intensely laminated, fine grained, slightly weathered, hard rock, *quartz-amphibole SCHIST*. Joints are open, smooth and filled with light red sand. Laminations are closed, smooth and clean. Well developed, black, needle-like amphibole crystals are contained in the rock matrix. Discontinuities dip at 45°.				
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 10/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 31

FIGURE: A31

TRIAL HOLE: 32

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'26,1" S 21°59'54,3" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refusal of excavation at 300 mm on very dense hardpan calcrete.
0.20		Dirty white mottled light brown, very fine grained, very dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 32

FIGURE: A32

TRIAL HOLE: 33

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'26,9" S 21°59'49,0" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				**NOTES:** 1 Refusal of excavation at 500 mm on hard rock, quartz-amphibole schist.
0.20		Lenses of dirty white discoloured light brown, very fine grained, dense, hardpan *CALCRETE.* Pedogenic deposits.				
		Light grey brown, very closely jointed, very intensely laminated, very fine grained, unweathered, hard rock, *quartz-amphibole SCHIST.* Joints are closed, smooth and clean. Discontinuities dip at 60°.	U9299	0,3-0,5	●	
0.40						
0.60						
0.80						Water encountered; Water level; Bottom of hole; Approximate material change; Disturbed sample; Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 33

FIGURE: A33

TRIAL HOLE: 34

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'27,3" S 21°59'46,1" E*

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cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refusal of excavation at 600 mm on hard rock, quartz-amphibole schist.
0.20		Lenses of dirty white discoloured light brown, very fine grained, dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.40		Light grey brown, very closely jointed, very intensely laminated, very fine grained, unweathered, hard rock, *quartz-amphibole SCHIST.* Joints are closed, smooth and clean. Discontinuities dip at 30°.				
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 34

FIGURE: A34

TRIAL HOLE: 35

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'27,9" S 21°59'42,3" E*

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cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refusal of excavation at 600 mm on hard rock, quartz-amphibole schist.
0.20		Light grey brown, very closely jointed, very intensely laminated, very fine grained, unweathered, hard rock, *quartz-amphibole SCHIST*. Joints are closed, smooth and clean. Discontinuities dip at 45°.				
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 35

FIGURE: A35

TRIAL HOLE: 36

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'29,1" S 21°59'38,2" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose, intact, fine *SAND.* Aeolian deposits. Roots are present in the horizon.				1 Refusal of excavation at 1000 mm on very hard rock, quartz-amphibole schist.
0.20						
0.40						
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				
0.60						
0.80						
		Light grey, very closely jointed, very intensely laminated, fine grained, unweathered, very hard rock, *quartz-amphibole SCHIST.* Joints are closed, smooth and clean. Discontinuities dip at 15°.				
1.00						
1.20						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 36

FIGURE: A36

TRIAL HOLE: 37

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'30,2" S 21°59'35,0" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Dry, light red, very loose, intact, fine *SAND.* Aeolian deposits.				**NOTES:** 1 Test pit abandoned - dangerous collapse from the surface.
0.20			U9298	0-0,6	●	
0.40						
0.60		Lenses (± 20 mm thick) of dirty white, very fine grained, dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.80		Dirty white, very closely jointed, very intensely laminated, very fine grained, slightly weathered, medium hard rock, *quartz-amphibole SCHIST.* Joints are closed, smooth and clean. Discontinuities dip at 30°.				
1.00						
1.20						

▽ Water encountered
▼ Water level
▽ Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 37

FIGURE: A37

TRIAL HOLE: 38

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28º54'19,5" S 21º59'51,4" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				**NOTES:** 1 Refusal of excavation at 500 mm on medium hard rock, quartz-amphibole schist.
0.20						
		Dull light grey green speckled white, very closely jointed, very intensely laminated, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST.* Joints are open and filled with white, calcareous fine sand. Discontinuities dip at 15º.	U9293	0,3-0,5	●	
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⏚ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 38

FIGURE: A38

TRIAL HOLE: 39

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'20,7" S 21°59'47,7" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red brown, medium dense, intact, fine *SAND* and matrix supported, subrounded, medium coarse gravels of quartz and banded ironstone. Colluvium.				1 Refusal of excavation at 800 mm on medium hard rock, quartz-amphibole schist.
0.20						
		Lenses of dirty white discoloured light brown, very fine grained, dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.40						
		Dull light grey green speckled white, very closely jointed, intensely laminated, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST.* Joints are open and filled with white, calcareous fine sand. Discontinuities orientated horizontally.				
0.60						
0.80						
1.00						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.20						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 39

FIGURE: A39

TRIAL HOLE: 40

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'23,0" S 21°59'41,2" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red brown, medium dense, intact, fine *SAND* and matrix supported, subrounded, medium coarse gravels of quartz and banded ironstone. Colluvium				1 Refusal of excavation at 400 mm on very hard rock, quartzite.
0.20		Lenses of dirty white discoloured light brown, very fine grained, very dense, hardpan *CALCRETE.* Pedogenic deposits.	U9297	0-0,3	●	
		Dark grey speckled white, widely jointed, fine grained, slightly weathered, very hard rock, *QUARTZITE.* Joints are closed, smooth and clean.				
0.40						
0.60						
0.80						
1.00						
1.20						

▽ Water encountered
▼ Water level
⊽ Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 40

FIGURE: A40

TRIAL HOLE: 41

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'24,0" S 21°59'36,5" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refusal of excavation at 800 mm on medium hard rock, quartz-amphibole schist.
0.20						
0.40						
0.60						
0.80		Dull light grey green speckled white, very closely jointed, intensely laminated, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST*. Joints are open and filled with white, calcareous fine sand. Discontinuities dip at 15°.				
1.00						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 41

FIGURE: A41

TRIAL HOLE: 42

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'25,3" S 21°59'29,9" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light red, very loose, intact, fine *SAND.* Aeolian deposits.				1 Refusal of excavation at 1200 mm on very hard rock, quartzite.
0.20						2 Test pit collapses from the surface.
0.40						
0.60						
0.80						
1.00						
1.20		Light grey discoloured light yellow brown, widely jointed, fine grained, slightly weathered, very hard rock, *QUARTZITE.* Discontinuities are closed, smooth and clean.				
1.40						

Water encountered
Water level
Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 42

FIGURE: A42

TRIAL HOLE: 43

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'16,8" S 21°59'50,6" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refusal of excavation at 800 mm on medium hard rock, quartz-amphibole schist.
0.20		Dull light grey green speckled white, very closely jointed, intensely laminated, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST.* Joints are open and filled with white, calcareous fine sand. Discontinuities dip at 15°.				
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 43

FIGURE: A43

TRIAL HOLE: 44

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'17,7" S 21°59'45,9" E*

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6835
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Email:
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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				**NOTES:** 1 Refusal of excavation at 800 mm on medium hard rock, quartz-amphibole schist.
0.20			U9296	0-0,5	●	
0.40						
		Dull light grey green speckled white, very closely jointed, intensely laminated, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST.* Joints are open and filled with white, calcareous fine sand. Discontinuities dip at 15°.				
0.60						
0.80						
1.00						

▽ Water encountered
▼ Water level
▽ Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 44

FIGURE: A44

TRIAL HOLE: 45

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'18,9" S 21°59'39,6" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				**NOTES:** 1 Refusal of excavation at 800 mm on very dense hardpan calcrete.
0.20						
0.40						
0.60		Dirty white, very fine grained, very dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.80						Water encountered; Water level; Bottom of hole; Approximate material change; Disturbed sample; Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 45

FIGURE: A45

TRIAL HOLE: 46

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'19,3" S 21°59'34,2" E*

Cedar Land Geotechnical Consult (Pty) Ltd
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6835
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Email:
cedarland.frans@breede.co.za

Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Dry, light red, very loose, intact, fine *SAND.* Aeolian deposits.				
0.20						
			U9295	0-0,7	●	
0.40						
0.60						
		Dry, light brown, loose, intact, fine SAND and matrix supported, fine, rounded gravels of quartz. Colluvium.				
0.80						
		Pale light yellow grey speckled light grey, medium jointed, very fine grained, slightly weathered, hard rock, *QUARTZITE.* Joints are closed, smooth and clean.				
1.00						
1.20						
1.40						

NOTES:

1 Refusal of excavation at 1000 mm on hard rock, quartzite.

2 Test pit collapses from the surface.

- Water encountered
- Water level
- Bottom of hole
- --- Approximate material change
- • Disturbed sample
- ▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 46

FIGURE: A46

TRIAL HOLE: 47

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28º54'12,0" S 21º59'46,6" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refusal of excavation at 500 mm on medium hard rock, quartz-amphibole schist.
0.20		Lenses of dirty white discoloured light brown, very fine grained, dense, hardpan *CALCRETE.* Pedogenic deposits.				
		Dull light grey green speckled white, very closely jointed, intensely laminated, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST.* Joints are open and filled with white calcareous fine sand. Discontinuities dip at 15º.				
0.40						
0.60						
0.80						Water encountered Water level Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 47

FIGURE: A47

TRIAL HOLE: 48

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'13,4" S 21°59'40,4" E*

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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Abundant, clast supported, medium coarse, subangular and angular, *GRAVELS* of quartz in a matrix of dry, light brown sand. Overall consistency is medium dense. Colluvium.				1 Refusal of excavation at 300 mm on very dense hardpan calcrete.
0.20		Pale light brown and pink mottled dark grey, very fine grained, very dense, hardpan *CALCRETE.* Pedogenic deposits.				
0.40						
0.60						
0.80						▽ Water encountered ▼ Water level ⊽ Bottom of hole --- Approximate material change • Disturbed sample ▪ Undisturbed sample
1.00						

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 48

FIGURE: A48

TRIAL HOLE: 49

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'14,2" S 21°59'35,7" E*

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6835
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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				**NOTES:**
		Dry, light brown, very loose, intact, fine *SAND* and matrix supported, fine, rounded gravels of quartz. Colluvium. Tree roots are present in the horizon.				1 Refusal of excavation at 800 mm on hard rock, quartzite.
0.20						
0.40		Abundant, clast supported, *COBBLES* and *BOULDERS* (< 500 mm in diameter) of quartzite and subrounded *GRAVELS* of calcrete in a matrix of dry, light brown, fine sand. Overall consistency is medium dense. Weakly calcareous and cemented residual quartzite.				
0.60						
0.80		Pale light yellow grey speckled light grey, medium jointed, very fine grained, slightly weathered, hard rock, *QUARTZITE.* Joints are closed, smooth and clean.				
1.00						
1.20						
1.40						

Water encountered
Water level
Bottom of hole
Approximate material change
Disturbed sample
Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 49

FIGURE: A49

TRIAL HOLE: 50

PROJECT: *EXPANSION AND FORMALISATION OF THE GROBLERSHOOP COMMUNITY*

LOGGED BY: *FJB*

SITE: *PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT NO 48*

DATE LOGGED: *9/7/2020*

CLIENT: *!KHEIS MUNICIPALITY*

LOCATION: *28°54'08,3" S 21°59'40,3" E*

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Email:
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Depth (m)	Legend	PROFILE	SAMPLE Number	SAMPLE Type	SAMPLE Symbol	Remarks
0.00		Ground Surface				
		Dry, light brown, loose, intact, fine *SAND.* Colluvium.				**NOTES:** 1 Refusal of excavation at 1000 mm on medium hard rock, quartz-amphibole schist.
0.20		Dull light grey green speckled white, very closely jointed, intensely laminated, very fine grained, slightly weathered, soft rock to medium hard rock at depth, *quartz-amphibole SCHIST.* Joints are open and filled with white calcareous fine sand. Discontinuities dip at 75°.				
0.40						
0.60			U9294	0,2-1,0	●	
0.80						
1.00						

Water encountered
Water level
Bottom of hole
--- Approximate material change
• Disturbed sample
▪ Undisturbed sample

Contractor: ALS Plant Hire
Date Drilled: 9/7/2020
Machine: Bell 315SK

Hole Diameter: 600 mm
Water Depth:
Sheet: 1 of 1

SOIL PROFILE: TEST PIT 50

FIGURE: A50

GEOTECHNICAL CONDITIONS ON PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT 48: A REPORT FOR THE EXPANSION AND FORMALISATION OF GROBLERSHOOP COMMUNITYUNITY

2020/J09/MCP_01

ADDENDUM B: RESULTS OF MATERIALS TESTING

ROADLAB

Roadlab Germiston
207 Rietfontein Road Germiston
1401
Tel: 011 828 0279 Fax: 011 828 0279
Email: info@roadlab.co.za
Web: www.roadlab.co.za

Date Reported : 2020-08-24

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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6835
Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

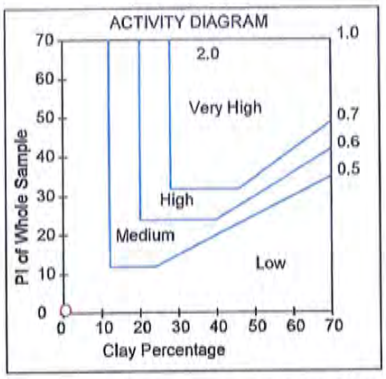
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

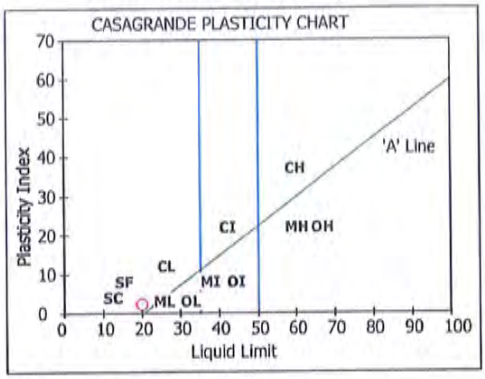
Sample No.	: U9309
Position	: TP 2
Layer Type	: 200-600mm
Sample Colour	: Light Brown Gravel
Sample Type	: Mix Calcrete

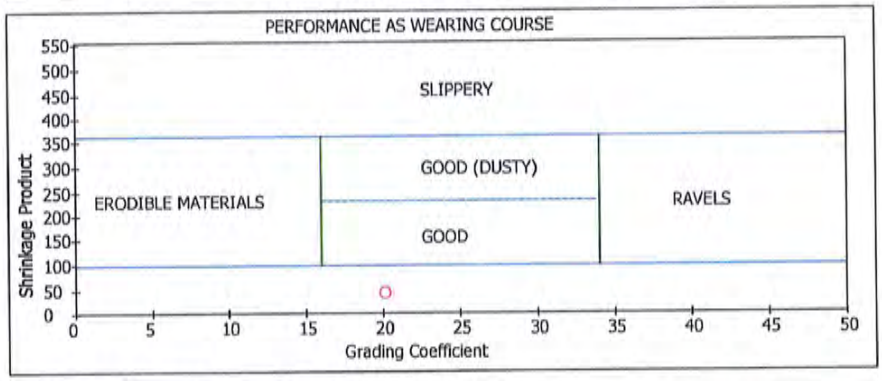
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	97
37.50	89
28.00	81
20.00	74
14.00	68
5.000	48
2.000	39
0.425	30
0.250	24
0.150	17
0.075	8,9
0.060	3,3
0.050	2,9
0.020	1,7
0.005	0,9
0.002	0,4

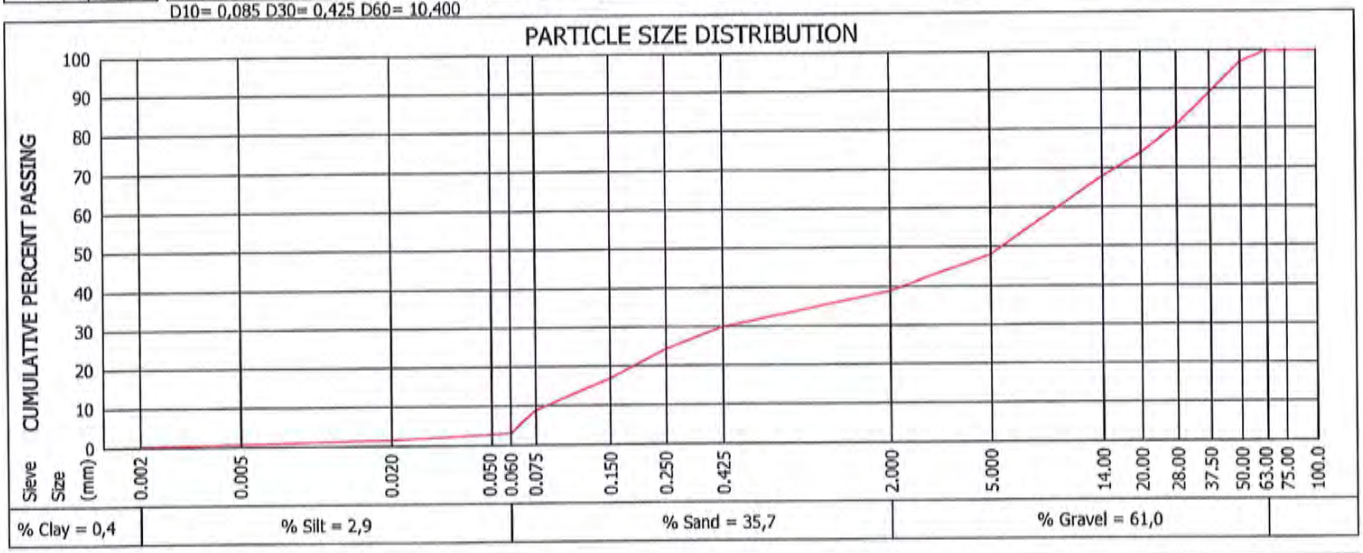
Soil Mortar	2.000 - 0.425	22
	0.425 - 0.250	15
	0.250 - 0.150	19
	0.150 - 0.075	21
	< 0.075	23
Effective Size		0,085
Uniformity Coefficient		122,4
Curvature Coefficient		0,2
Oversize Index		8,0
Shrinkage Product		45,0
Grading Coefficient		20,2
Grading Modulus		2,20
Atterberg Limits	Liquid Limit	20
	Plasticity Index	2.0
	Linear Shrinkage	1.5
	PI < 0.075	
Unified Soil Classification		GW-GC
US Highway Classification		A-1-a(0)

D10= 0,085 D30= 0,425 D60= 10,400









% Clay = 0,4	% Silt = 2,9	% Sand = 35,7	% Gravel = 61,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.76 [SANS 5854] & Conductivity = 0.16 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

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Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

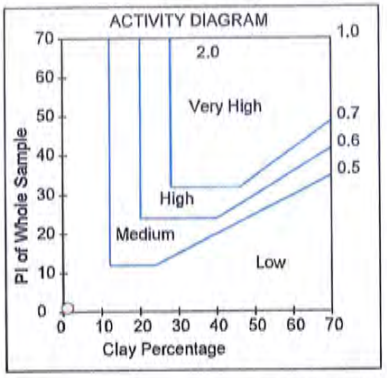
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

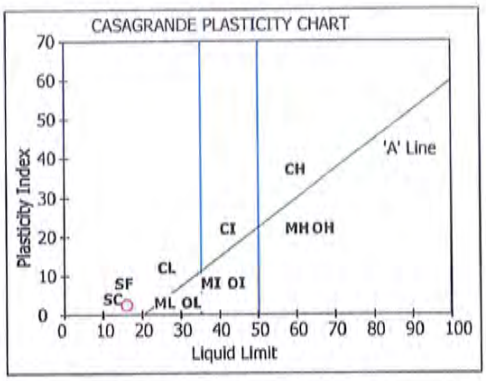
Sample No.	: U9310
Position	: TP 9
Layer Type	: 0-800mm
Sample Colour	: Orange Brown Gravel
Sample Type	: Mix Quartz

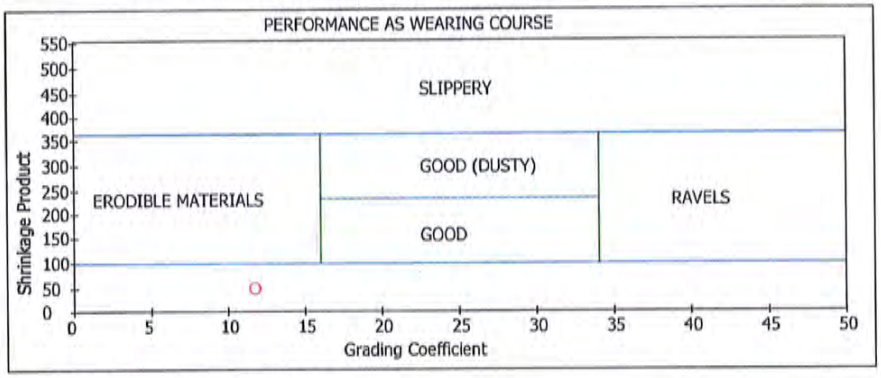
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	97
50.00	95
37.50	87
28.00	78
20.00	72
14.00	70
5.000	62
2.000	59
0.425	50
0.250	38
0.150	27
0.075	18
0.060	6,3
0.050	5,6
0.020	3,6
0.005	2,3
0.002	0,8

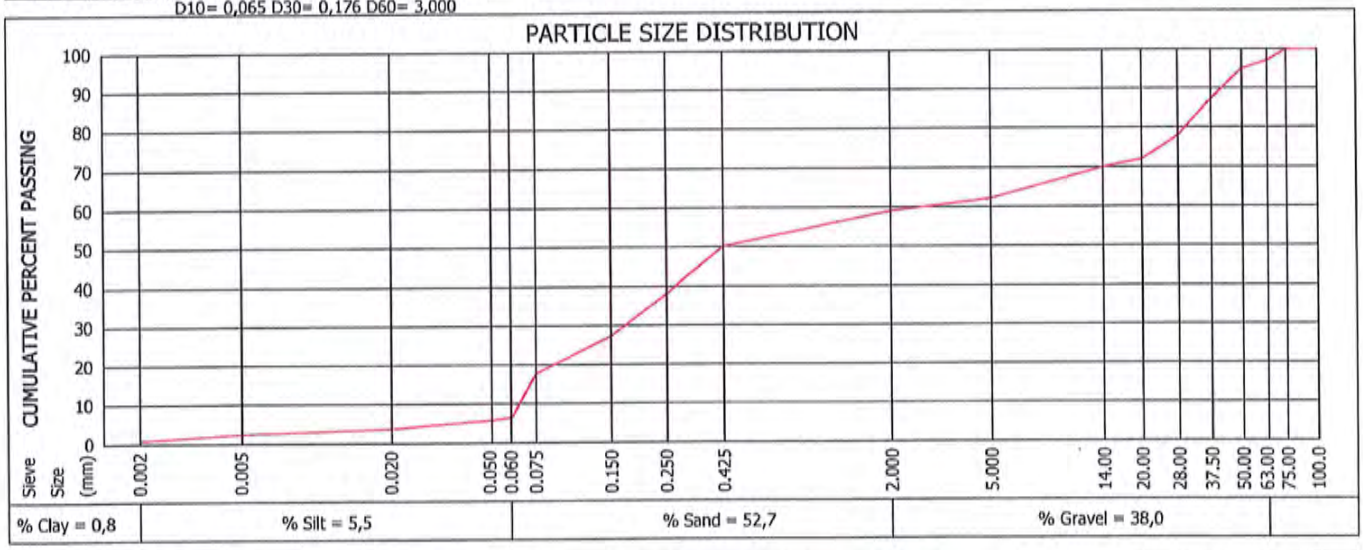
Soil Mortar	2.000 - 0.425	16
	0.425 - 0.250	20
	0.250 - 0.150	18
	0.150 - 0.075	16
	< 0.075	31
Effective Size		0,065
Uniformity Coefficient		46,2
Curvature Coefficient		0,2
Oversize Index		8,0
Shrinkage Product		50,0
Grading Coefficient		11,8
Grading Modulus		1,70
Atterberg Limits	Liquid Limit	16
	Plasticity Index	2.0
	Linear Shrinkage	1.0
	PI < 0.075	
Unified Soil Classification		SC
US Highway Classification		A-1-b(0)

D10= 0,065 D30= 0,176 D60= 3,000









% Clay = 0,8	% Silt = 5,5	% Sand = 52,7	% Gravel = 38,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.90 [SANS 5854] & Conductivity = 0.03 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)
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Job Request No.: RU3525

Date Reported : 2020-08-06

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Project : Groblershoop

Attention : Frans Breytenbach

Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.		U9310			
HOLE NO./ Km / CHAINAGE		TP9			
ROAD NO./ NAME Line 1 ROAD NO./ NAME Line 2		S28° 54' 55,7" E21° 59' 55,2"			
LAYER TESTED/SAMPLED		0-800mm			
SAMPLE DEPTH		0-800mm			
DATE SAMPLED		2020-07-13			
COLOUR OF SAMPLE		Orange Brown			
TYPE OF SAMPLE		Mix Quartz			

SIEVE ANALYSIS - % PASSING SIEVES *(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm				
	75.0 mm	100			
	63.0 mm	97			
	50.0 mm	95			
	37.5 mm	87			
	28.0 mm	78			
	20.0 mm	72			
	14.0 mm	70			
	5.0 mm	62			
	2.0 mm	59			
	0.425 mm	50			
	0.075 mm	18			
GM %		1,7			

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	16			
COARSE FINE SAND	0.425 - 0.250	20			
MEDIUM FINE SAND	0.250 - 0.150	18			
FINE FINE SAND	0.150 - 0.075	16			
SILT CLAY	0.075	31			

ATTERBERG LIMITS ANALYSIS - *(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	16			
	PLASTICITY INDEX	2.4			
	LINEAR SHRINKAGE	1.0			
CLASSIFICATION	H.R.B.	A-1-b(0)			
	COLTO	G6			
	TRH 14	G6			

CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	6,5			
	MDD (kg/m³)	2179			
	COMP MC %	6,6			
SWELL % @	MOD | NRB | PRO	0,00 | 0,01 | 0,02			
C.B.R. SANS GR40	100 %	35			
	98 %	32			
	97 %	31			
	95 %	28			
	93 %	26			
	90 %	23			

STABILISER IN LAB		Not Applicable			
TEST TYPE		CBR			
SAMPLING METHOD		TMH 5			
WEATHER WHEN SAMPLED		Cold			

Deviation from Test Method :
Remarks and Notes :

Report compiled by : Juraine Okkies

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Project : Groblershoop

Attention : Frans Breytonbach

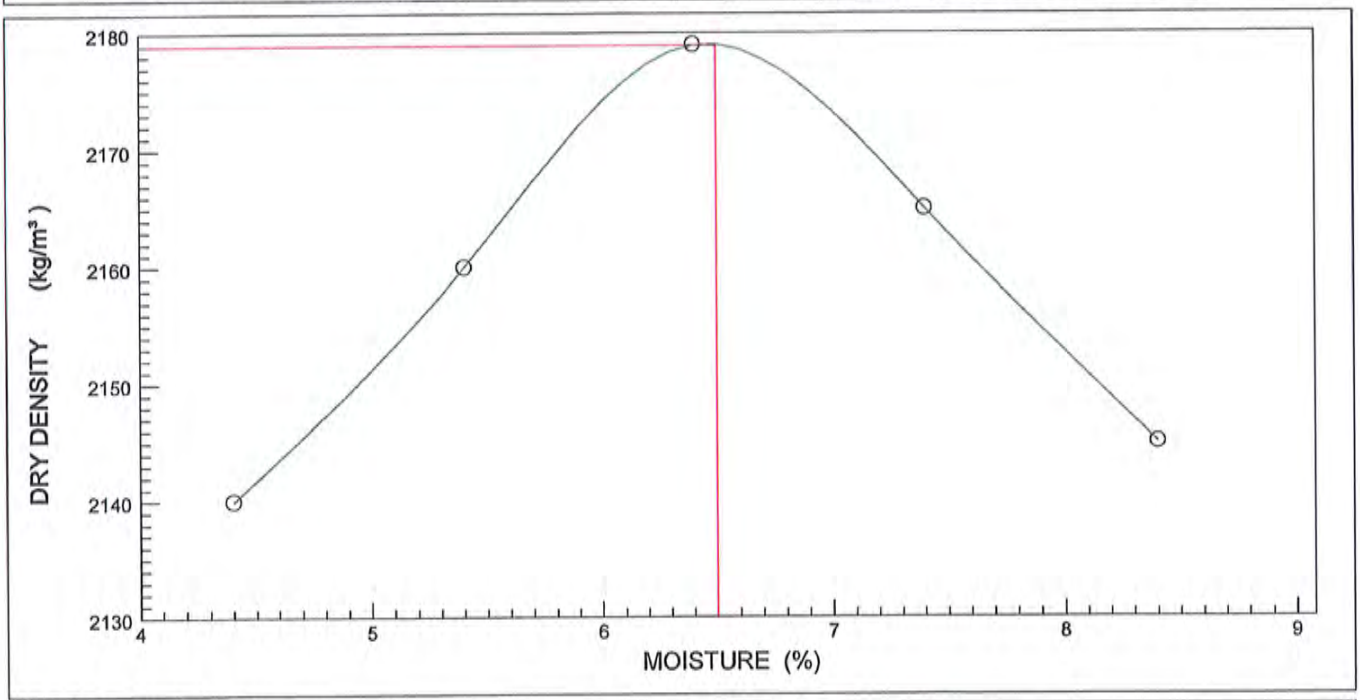
Determination Maximum Dry Density & Optimum Moisture Content Test Report

SANS 3001 - GR20/GR30

SAMPLE NO.	U9310
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	100kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	0-800mm
MATERIAL DESCRIPTION	Mix Quartz
HOLE NO./ km / CHAINAGE	TP9
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-14
DATE SAMPLED	2020-07-13
CLIENT MARKING	U9310
COLOUR AND TYPE	Orange Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m³)	2140	2160	2179	2165	2145			
MOISTURE (%)	4,4	5,4	6,4	7,4	8,4			

MAXIMUM DRY DENSITY (kg/m³) : 2179	OPTIMUM MOISTURE CONTENT (%) : 6,5



Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
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Date Reported : 2020-08-24

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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6835
Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

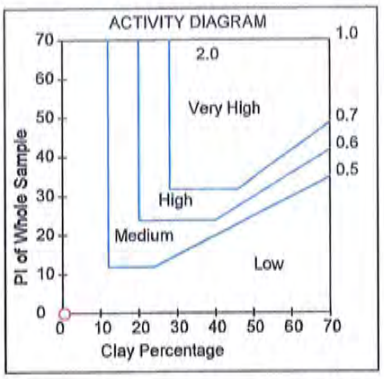
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

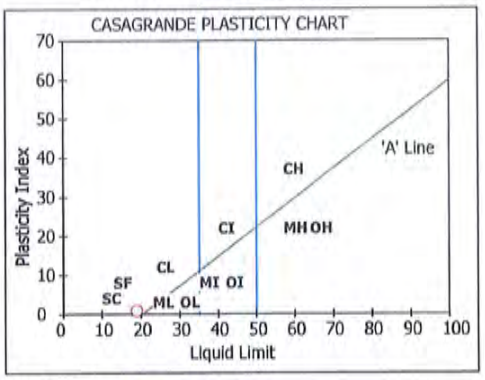
Sample No.	: U9307
Position	: TP 15
Layer Type	: 100-500mm
Sample Colour	: Brown Gravel
Sample Type	: Mix Calcrete Quartz

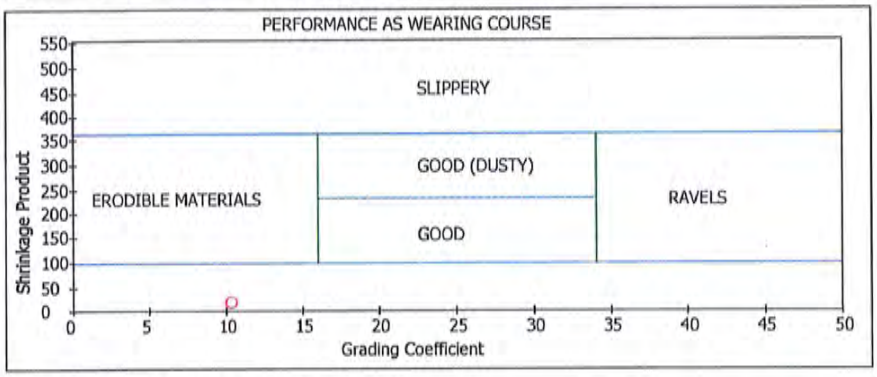
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	84
50.00	77
37.50	73
28.00	64
20.00	46
14.00	37
5.000	24
2.000	21
0.425	19
0.250	15
0.150	11
0.075	6,4
0.060	1,7
0.050	1,5
0.020	1,0
0.005	0,8
0.002	0,3

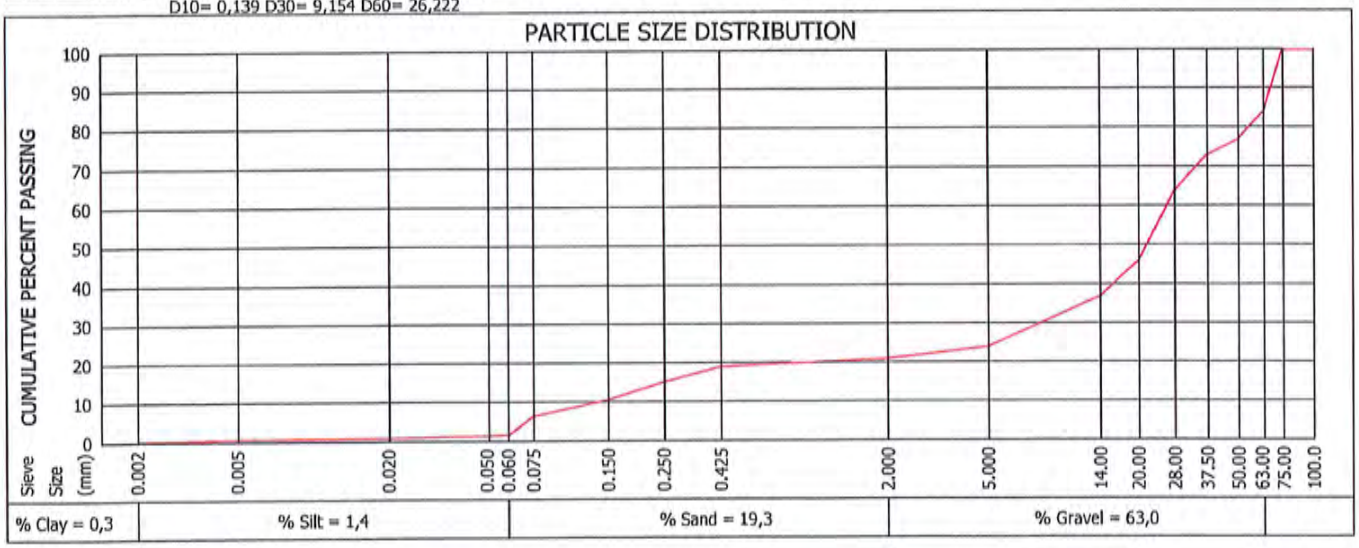
Soil Mortar	2.000 - 0.425	10
	0.425 - 0.250	19
	0.250 - 0.150	21
	0.150 - 0.075	22
	< 0.075	28
Effective Size		0,139
Uniformity Coefficient		188,6
Curvature Coefficient		23,0
Oversize Index		4,0
Shrinkage Product		19,0
Grading Coefficient		10,3
Grading Modulus		2,50
Atterberg Limits	Liquid Limit	19
	Plasticity Index	1.0
	Linear Shrinkage	1.0
	PI < 0.075	
Unified Soil Classification		GW-GC
US Highway Classification		A-1-a(0)

D10= 0,139 D30= 9,154 D60= 26,222









% Clay = 0,3	% Silt = 1,4	% Sand = 19,3	% Gravel = 63,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.77 [SANS 5854] & Conductivity = 0.12 S/m [SANS 6240]

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Date Reported : 2020-08-24

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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

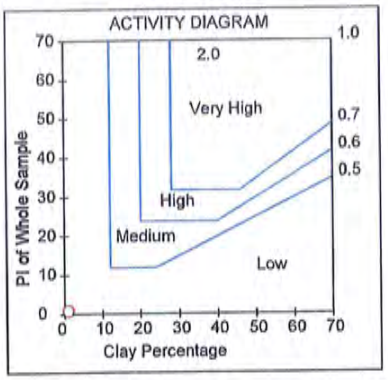
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

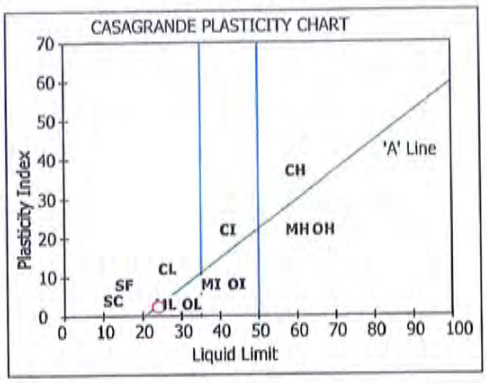
Sample No.	: U9308
Position	: TP 17
Layer Type	: 0-300mm
Sample Colour	: Dark Brown Gravel
Sample Type	: Mix Quartz+Cal+OCC I

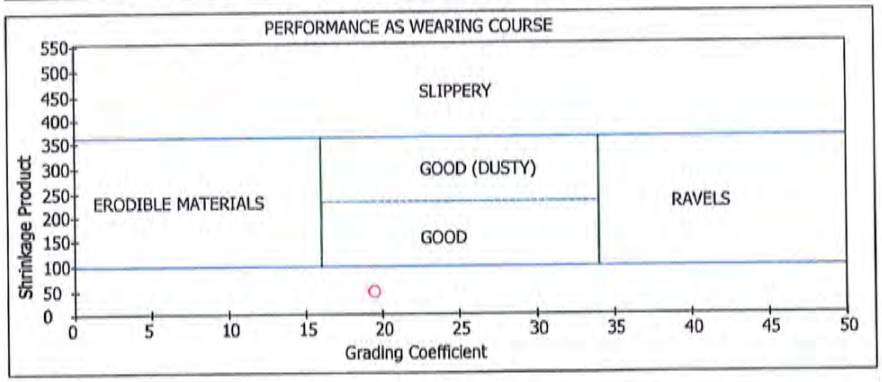
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	90
37.50	87
28.00	85
20.00	71
14.00	62
5.000	39
2.000	35
0.425	32
0.250	28
0.150	22
0.075	14
0.060	4,4
0.050	3,8
0.020	2,1
0.005	1,8
0.002	0,8

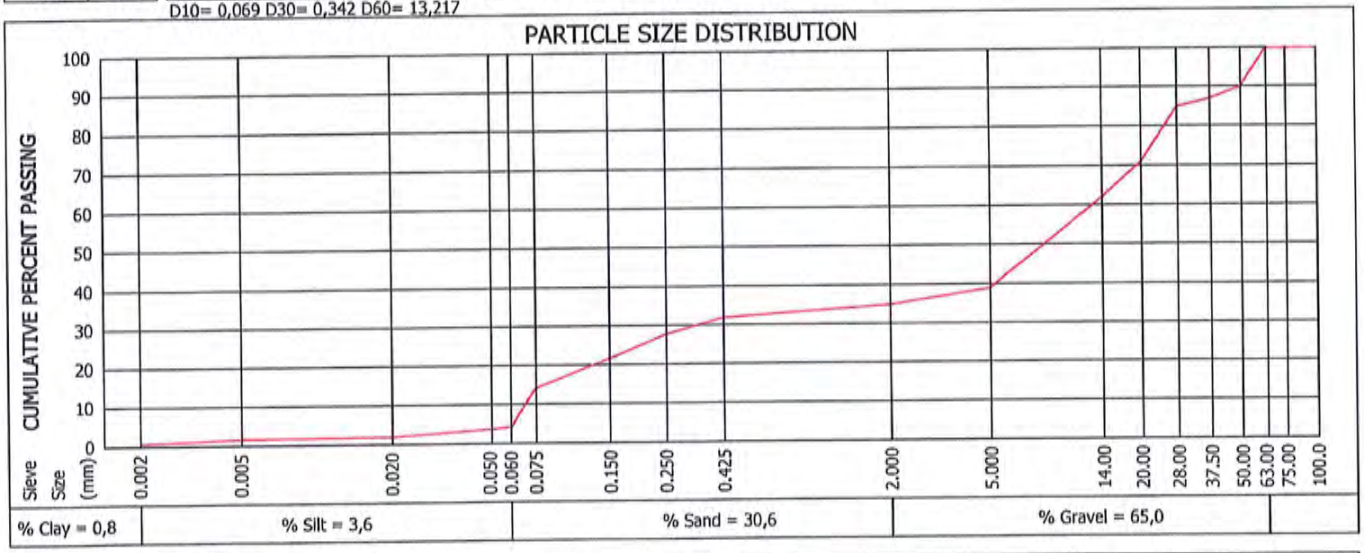
Soil Mortar	2.000 - 0.425	10
	0.425 - 0.250	12
	0.250 - 0.150	17
	0.150 - 0.075	22
	< 0.075	40
Effective Size		0,069
Uniformity Coefficient		191,6
Curvature Coefficient		0,1
Oversize Index		3,0
Shrinkage Product		48,0
Grading Coefficient		19,5
Grading Modulus		2,20
Atterberg Limits	Liquid Limit	24
	Plasticity Index	2.0
	Linear Shrinkage	1.5
	PI < 0.075	
Unified Soil Classification		GM
US Highway Classification		A-1-b(0)

D10= 0,069 D30= 0,342 D60= 13,217









% Clay = 0,8	% Silt = 3,6	% Sand = 30,6	% Gravel = 65,0

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
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Date Reported : 2020-08-05

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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

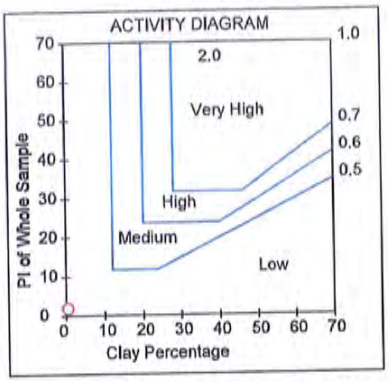
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

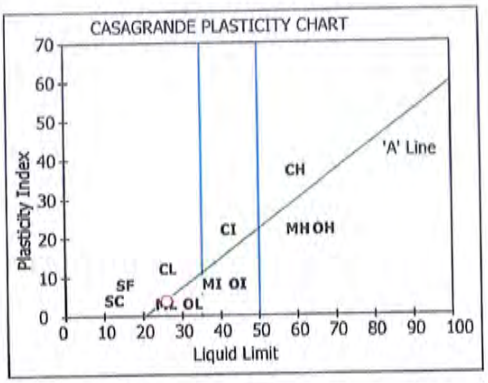
Sample No.	: U9304
Position	: TP 22
Layer Type	: 0-700mm
Sample Colour	: Orange Brown Gravel
Sample Type	: Mix Calcerete+Quartz

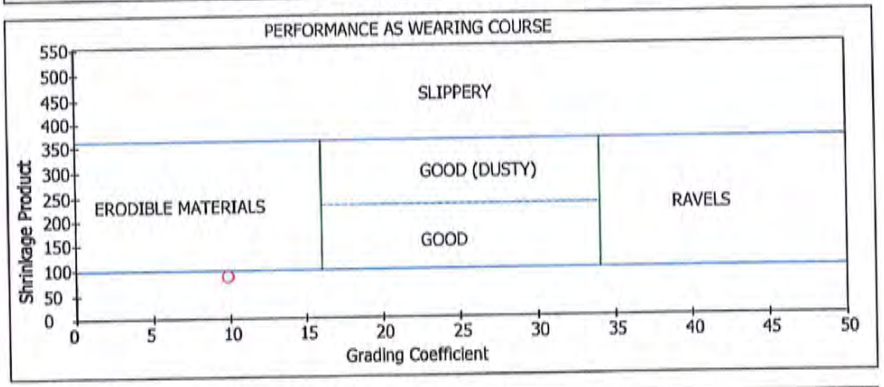
Sieve Size(mm)	% Passing
100.0	100
75.00	93
63.00	88
50.00	84
37.50	77
28.00	71
20.00	69
14.00	67
5.000	58
2.000	54
0.425	45
0.250	38
0.150	30
0.075	19
0.060	6,2
0.050	5,2
0.020	2,2
0.005	1,7
0.002	0,4

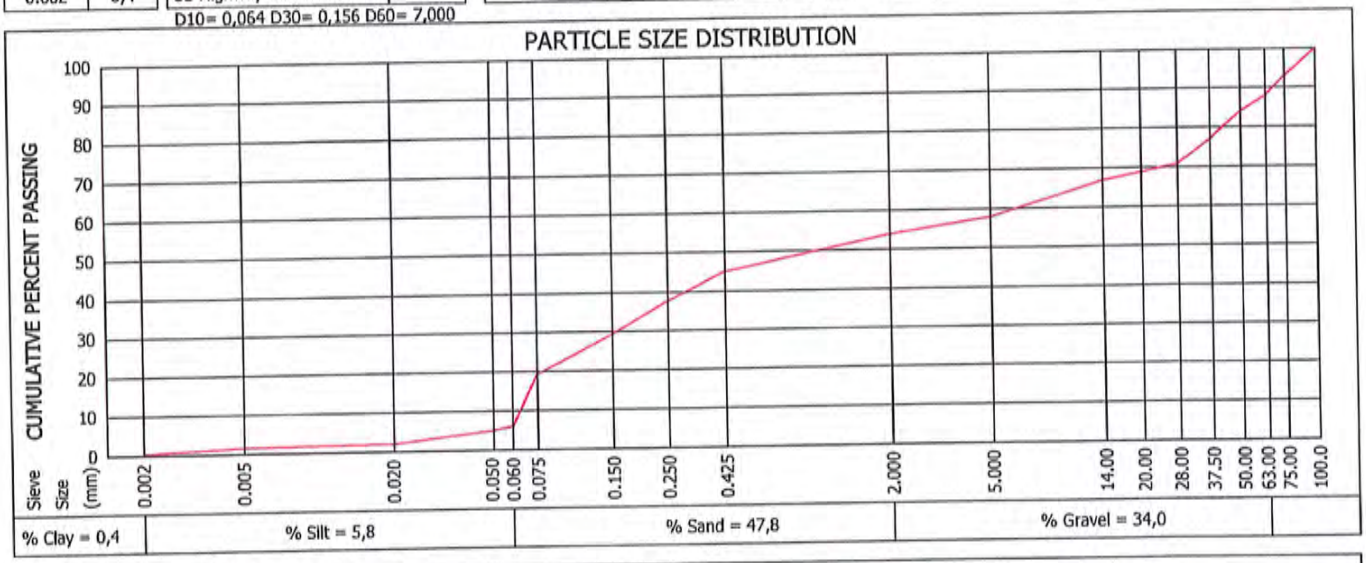
Soil Mortar	2.000 - 0.425	17
	0.425 - 0.250	13
	0.250 - 0.150	15
	0.150 - 0.075	19
	< 0.075	35
Effective Size		0,064
Uniformity Coefficient		109,4
Curvature Coefficient		0,1
Oversize Index		7,0
Shrinkage Product		90,0
Grading Coefficient		9,9
Grading Modulus		1,80
Atterberg Limits	Liquid Limit	26
	Plasticity Index	4
	Linear Shrinkage	2,0
	PI < 0.075	
Unified Soil Classification		SM
US Highway Classification		A-1-b(0)

D10= 0,064 D30= 0,156 D60= 7,000









% Clay = 0,4	% Silt = 5,8	% Sand = 47,8	% Gravel = 34,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.52 [SANS 5854] & Conductivity = 0.11 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)
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Date Reported : 2020-08-05

Job Request No.: RU3525

Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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6835

Project : Groblershoop Infrastructure Upgrade

Attention : Frans Breytenbach

Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.	U9304				
HOLE NO./ Km / CHAINAGE	TP22				
ROAD NO./ NAME Line 1 ROAD NO./ NAME Line 2	S28° 54' 43,8" E21° 59' 39,3"				
LAYER TESTED/SAMPLED	0-700mm				
SAMPLE DEPTH	0-700mm				
DATE SAMPLED	2020-07-13				
COLOUR OF SAMPLE	Orange Brown				
TYPE OF SAMPLE	Mix Calcrete+Quartz				

SIEVE ANALYSIS - % PASSING SIEVES *(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm	100				
	75.0 mm	93				
	63.0 mm	88				
	50.0 mm	84				
	37.5 mm	77				
	28.0 mm	71				
	20.0 mm	69				
	14.0 mm	67				
	5.0 mm	58				
	2.0 mm	54				
	0.425 mm	45				
	0.075 mm	19				
GM %		1,8				

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	17				
COARSE FINE SAND	0.425 - 0.250	13				
MEDIUM FINE SAND	0.250 - 0.150	15				
FINE FINE SAND	0.150 - 0.075	19				
SILT CLAY	0.075	35				

ATTERBERG LIMITS ANALYSIS - *(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	26				
	PLASTICITY INDEX	4				
	LINEAR SHRINKAGE	2.0				
CLASSIFICATION	H.R.B.	A-1-b(0)				
	COLTO	G6				
	TRH 14	G7				

CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	7,7				
	MDD (kg/m³)	2146				
	COMP MC %	7,5				
SWELL % @	MOD | NRB | PRO	0,01 | 0,04 | 0,06				
C.B.R. SANS GR40	100 %	82				
	98 %	54				
	97 %	43				
	95 %	28				
	93 %	18				
	90 %	10				

STABILISER IN LAB	Not Applicable			
TEST TYPE	CBR			
SAMPLING METHOD	TMH 5			
WEATHER WHEN SAMPLED	Cold			

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

sanas Testing Laboratory
Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

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Date Reported : 2020-07-29

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
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Project : Groblershoop Infrastructure Upgrade

Attention : Frans Breytenbach

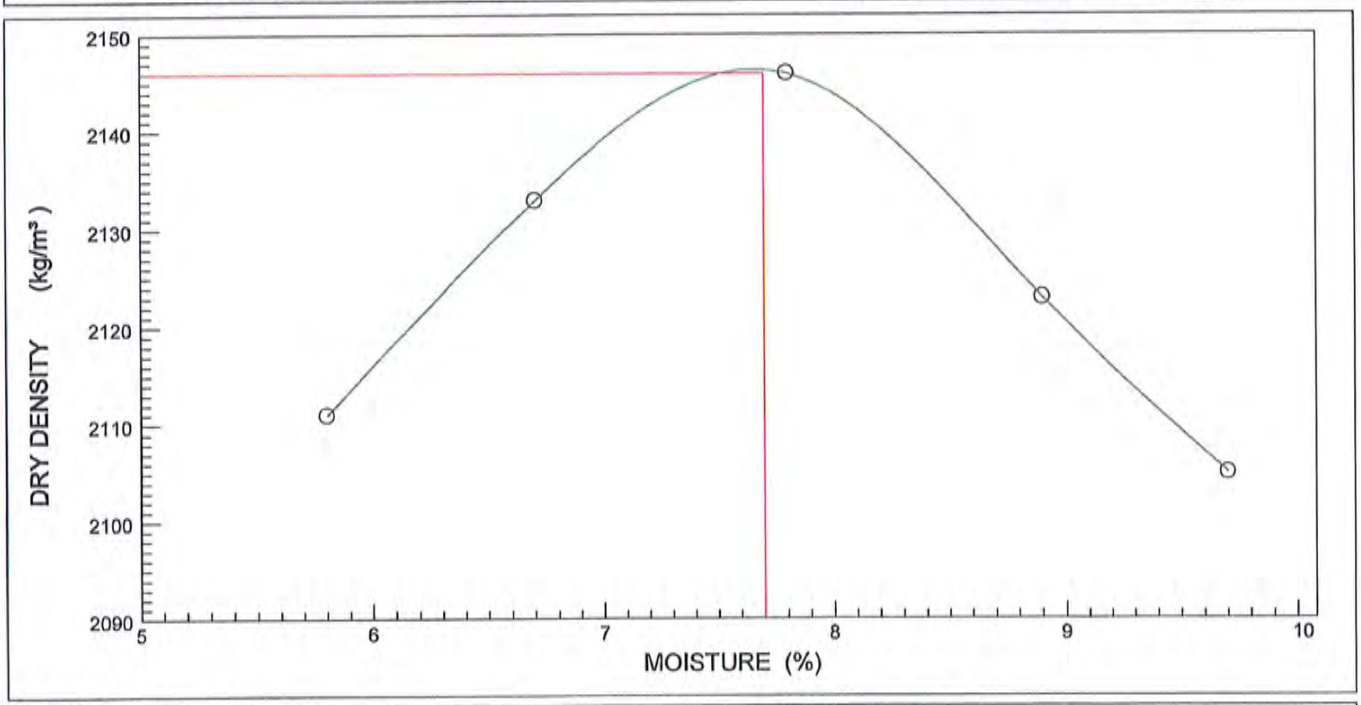
Determination Maximum Dry Density & Optimum Moisture Content Test Report

SANS 3001 - GR20/GR30

SAMPLE NO.	U9304
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	99kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	0-700mm
MATERIAL DESCRIPTION	Mix Calcrete+Quartz
HOLE NO./ km / CHAINAGE	TP22
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-14
DATE SAMPLED	2020-07-13
CLIENT MARKING	S28° 54' 43,8"; E21° 59' 39,3"
COLOUR AND TYPE	Orange Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m³)	2111	2133	2146	2123	2105			
MOISTURE (%)	5,8	6,7	7,8	8,9	9,7			

MAXIMUM DRY DENSITY (kg/m³) : 2146	OPTIMUM MOISTURE CONTENT (%) : 7,7



Deviation from Test Method :
Remarks and Notes :

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Date Reported : 2020-08-24

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

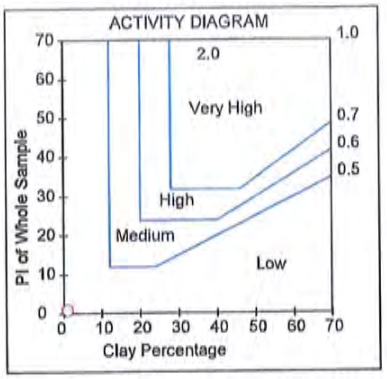
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

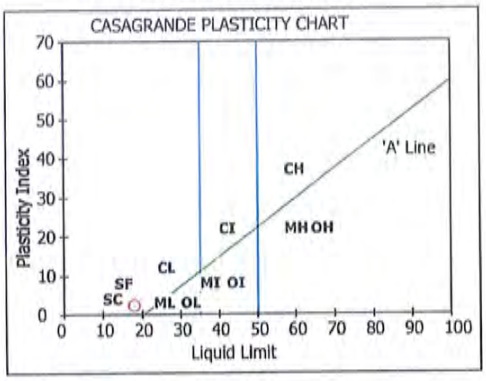
Sample No.	: U9306
Position	: TP 23
Layer Type	: 0-400mm
Sample Colour	: Orange Brown Gravel
Sample Type	: Mix Quartz

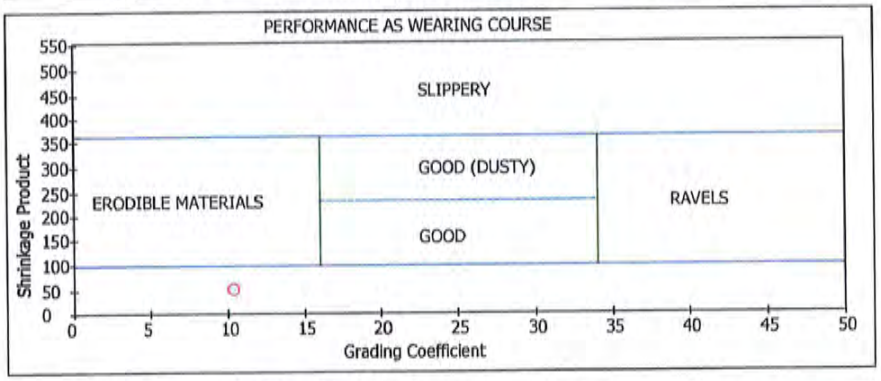
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	92
37.50	83
28.00	76
20.00	73
14.00	69
5.000	61
2.000	59
0.425	53
0.250	39
0.150	26
0.075	17
0.060	5,6
0.050	5,1
0.020	3,2
0.005	2,4
0.002	1,2

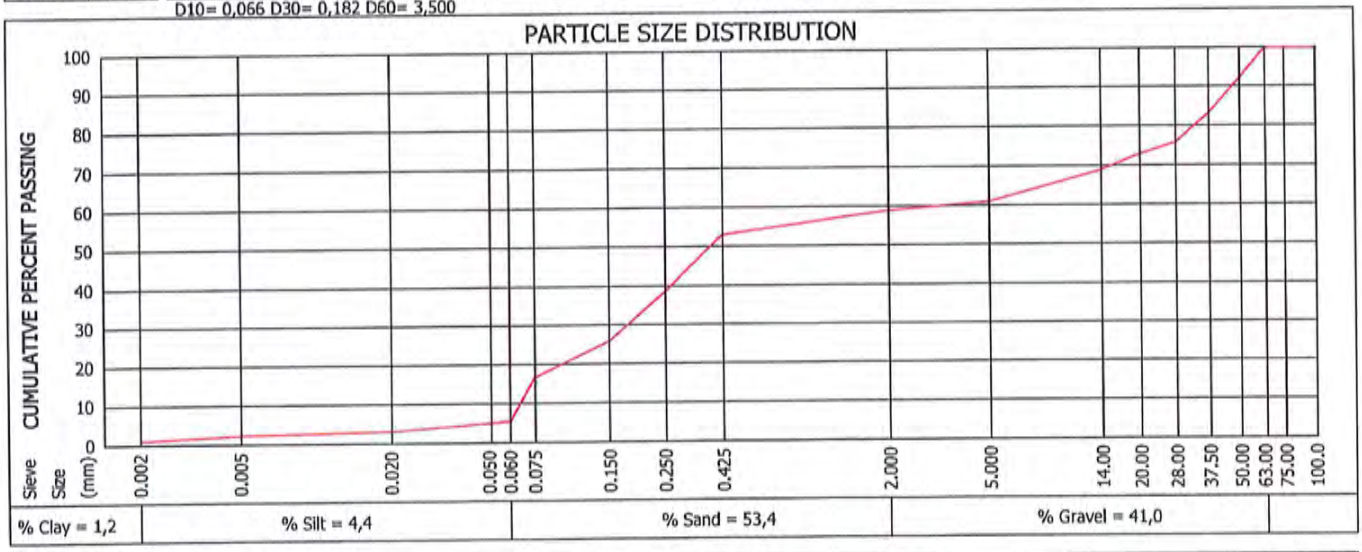
Soil Mortar	2.000 - 0.425	11
	0.425 - 0.250	24
	0.250 - 0.150	21
	0.150 - 0.075	15
	< 0.075	29
Effective Size		0,066
Uniformity Coefficient		53,0
Curvature Coefficient		0,1
Oversize Index		9,0
Shrinkage Product		53,0
Grading Coefficient		10,4
Grading Modulus		1,70
Atterberg Limits	Liquid Limit	18
	Plasticity Index	2.0
	Linear Shrinkage	1.0
	PI < 0.075	
Unified Soil Classification		SC
US Highway Classification		A-2-4(0)

D10= 0,066 D30= 0,182 D60= 3,500









% Clay = 1,2	% Silt = 4,4	% Sand = 53,4	% Gravel = 41,0

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
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Date Reported : 2020-08-24

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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

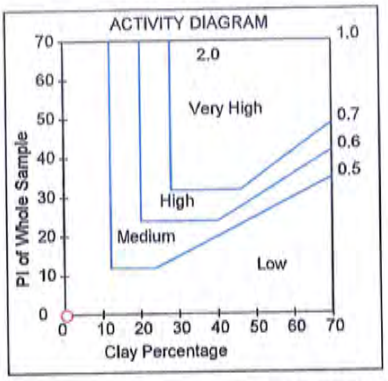
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

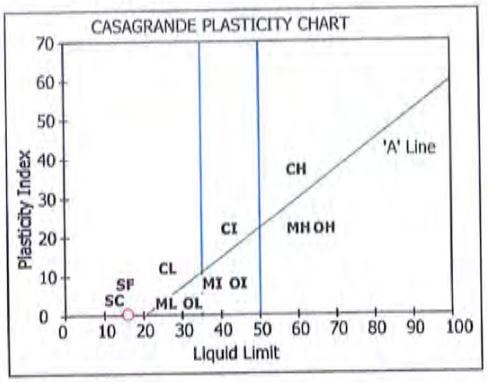
Sample No.	: U9305
Position	: TP 25
Layer Type	: 0-600mm
Sample Colour	: Orange Brown Gravel
Sample Type	: Mix Quartzstone

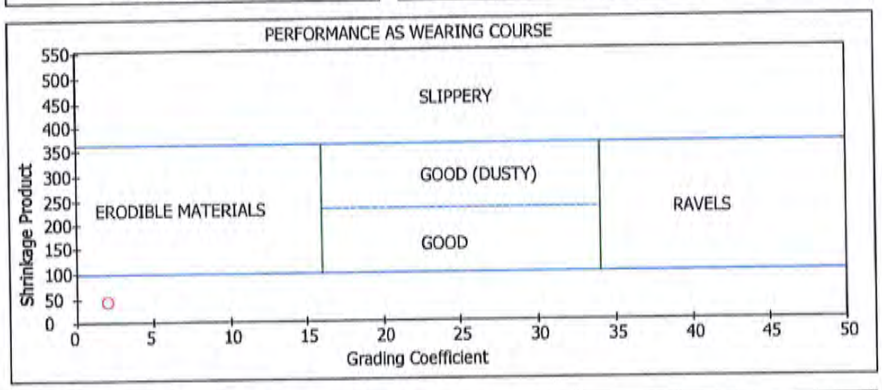
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	100
20.00	99
14.00	98
5.000	98
2.000	98
0.425	88
0.250	63
0.150	39
0.075	20
0.060	3,7
0.050	3,0
0.020	1,6
0.005	1,0
0.002	0,3

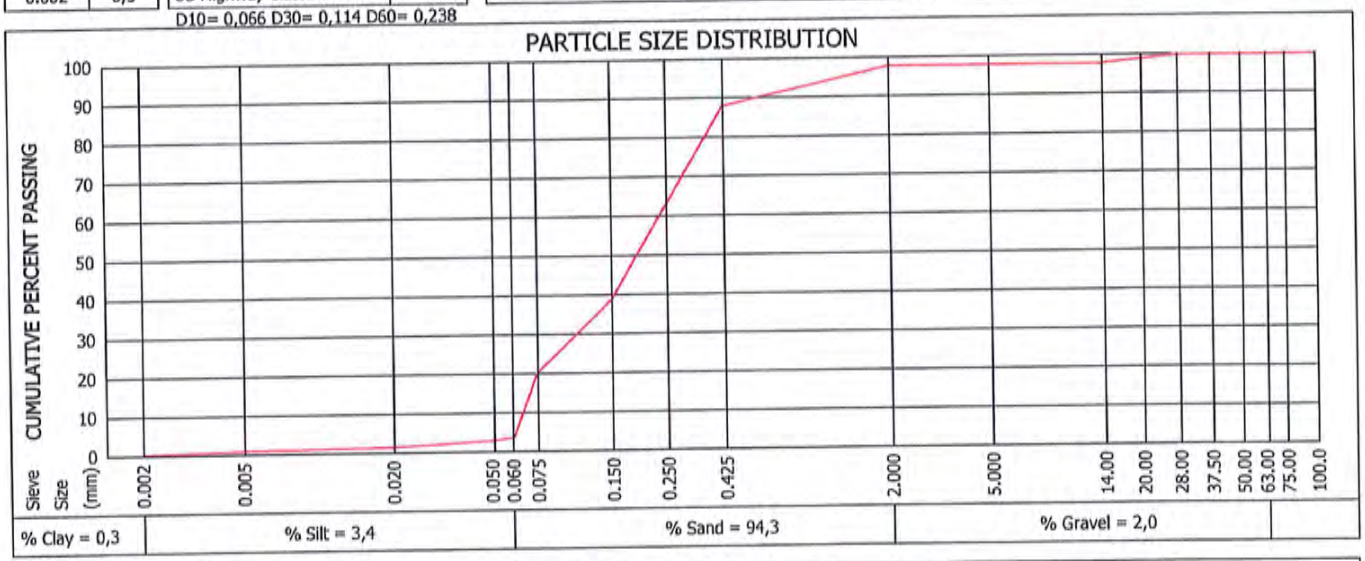
Soil Mortar	2.000 - 0.425	9
	0.425 - 0.250	26
	0.250 - 0.150	25
	0.150 - 0.075	19
	< 0.075	21
Effective Size		0,066
Uniformity Coefficient		3,6
Curvature Coefficient		0,8
Oversize Index		0,0
Shrinkage Product		44,0
Grading Coefficient		2,0
Grading Modulus		0,90
Atterberg Limits	Liquid Limit	16
	Plasticity Index	0,0
	Linear Shrinkage	0,5
	PI < 0.075	
Unified Soil Classification		SC
US Highway Classification		A-2-4(0)

D10= 0,066 D30= 0,114 D60= 0,238









Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.63 [SANS 5854] & Conductivity = 0.13 S/m [SANS 6240]

Report compiled by : Juraine Okkies

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Date Reported : 2020-08-21

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

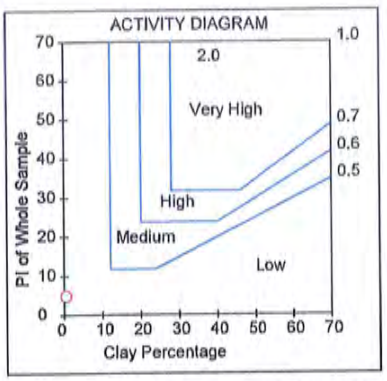
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

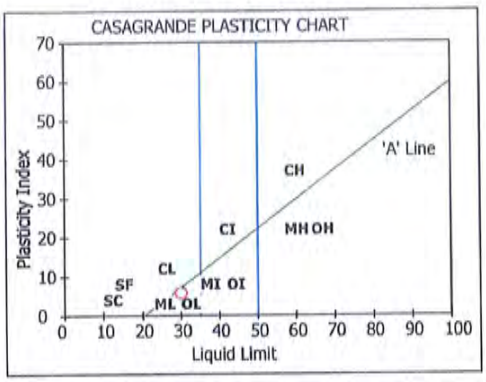
Sample No.	: U9303
Position	: TP 30
Layer Type	: 0-500mm
Sample Colour	: Orange Brown Gravel
Sample Type	: Mix Quartzstone

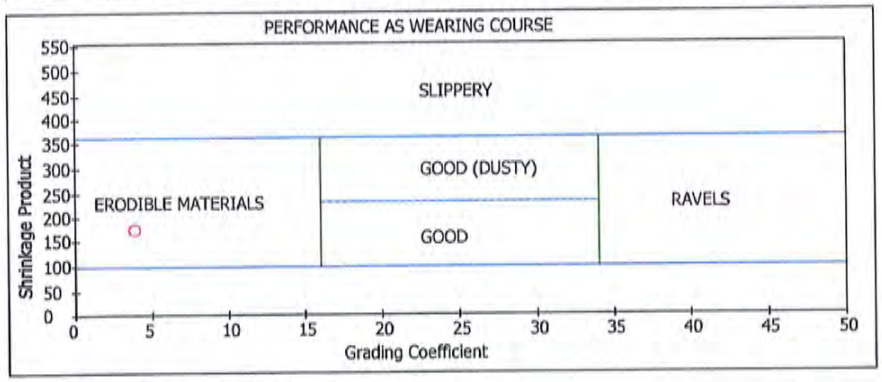
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	100
20.00	100
14.00	98
5.000	97
2.000	96
0.425	89
0.250	62
0.150	36
0.075	17
0.060	3,0
0.050	2,7
0.020	1,6
0.005	1,6
0.002	0,3

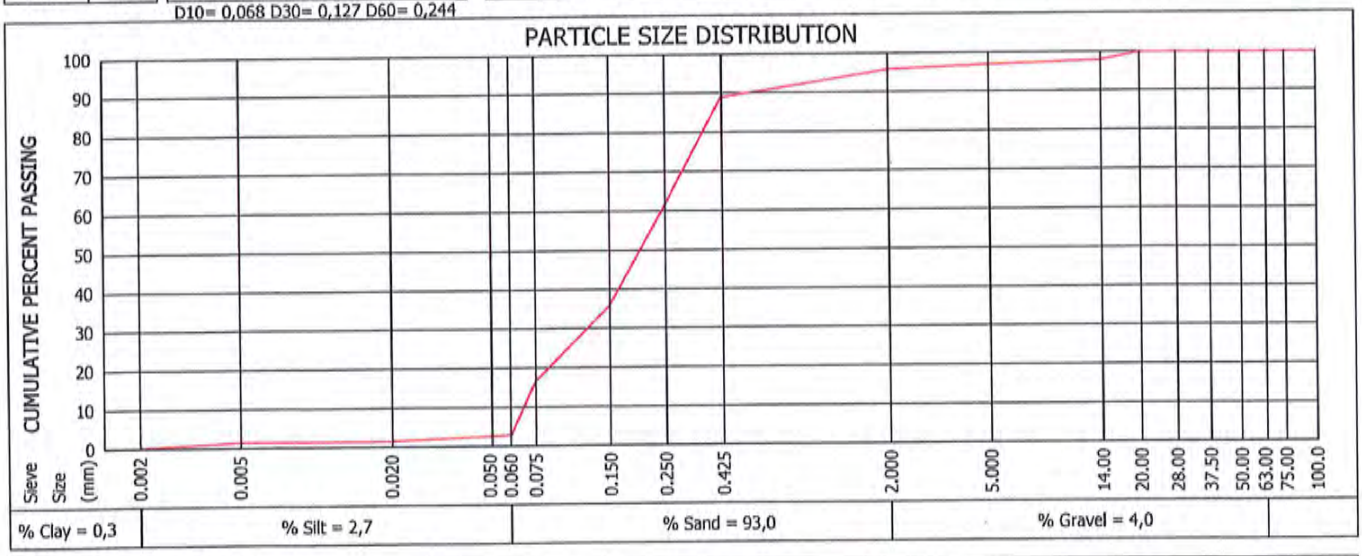
Soil Mortar	2.000 - 0.425	8
	0.425 - 0.250	29
	0.250 - 0.150	27
	0.150 - 0.075	20
	< 0.075	18
Effective Size		0,068
Uniformity Coefficient		3,6
Curvature Coefficient		1,0
Oversize Index		0,0
Shrinkage Product		178,0
Grading Coefficient		3,9
Grading Modulus		1,00
Atterberg Limits	Liquid Limit	30
	Plasticity Index	6
	Linear Shrinkage	2.0
	PI < 0.075	
Unified Soil Classification		SM
US Highway Classification		A-2-4(0)

D10= 0,068 D30= 0,127 D60= 0,244









% Clay = 0,3	% Silt = 2,7	% Sand = 93,0	% Gravel = 4,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.56 [SANS 5854] & Conductivity = 0.15 S/m [SANS 6240]

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Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

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Date Reported : 2020-08-12

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

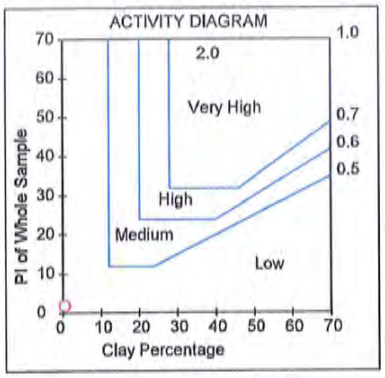
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

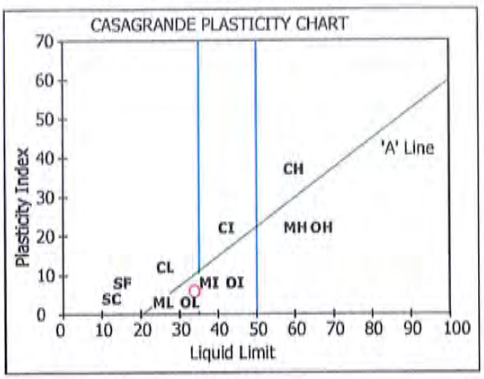
Sample No.	: U9299
Position	: TP 33
Layer Type	: 300-500mm
Sample Colour	: Brown Gravel
Sample Type	: Weathered Calcrete+Q

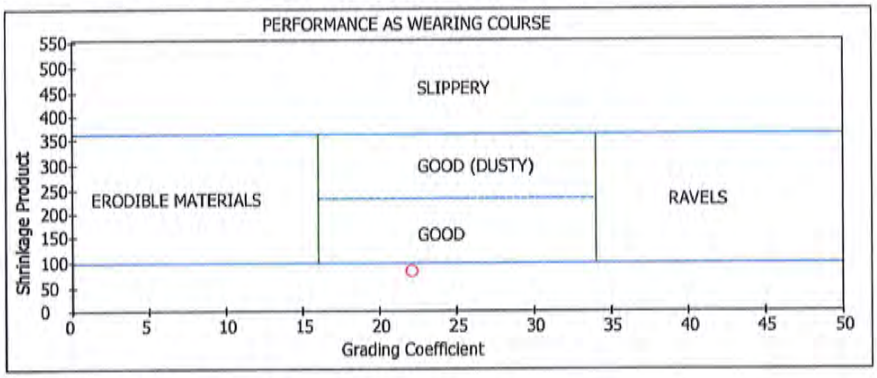
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	91
37.50	87
28.00	85
20.00	81
14.00	76
5.000	54
2.000	44
0.425	34
0.250	29
0.150	21
0.075	13
0.060	3,5
0.050	3,3
0.020	2,3
0.005	1,1
0.002	0,5

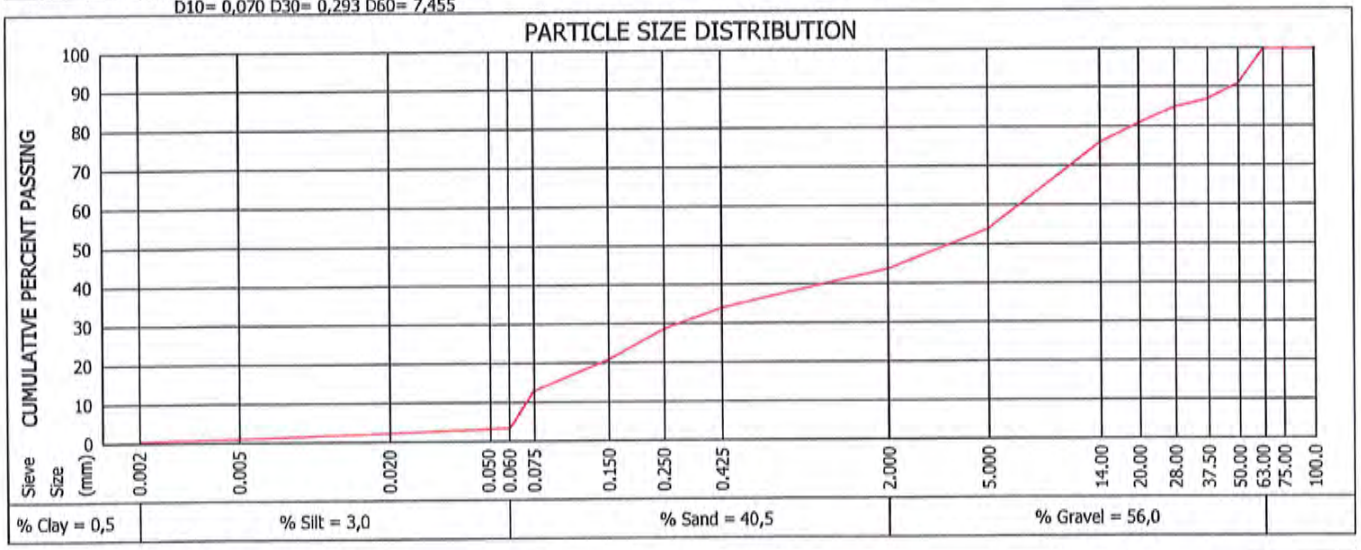
Soil Mortar	2.000 - 0.425	23
	0.425 - 0.250	12
	0.250 - 0.150	18
	0.150 - 0.075	18
	< 0.075	30
Effective Size		0,070
Uniformity Coefficient		106,5
Curvature Coefficient		0,2
Oversize Index		4,0
Shrinkage Product		85,0
Grading Coefficient		22,1
Grading Modulus		2,10
Atterberg Limits	Liquid Limit	34
	Plasticity Index	6
	Linear Shrinkage	2.5
	PI < 0.075	
Unified Soil Classification		SM
US Highway Classification		A-1-b(0)

D10= 0,070 D30= 0,293 D60= 7,455









% Clay = 0,5	% Silt = 3,0	% Sand = 40,5	% Gravel = 56,0

Deviation from Test Method :
Remarks and Notes :

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Date Reported : 2020-08-06

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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

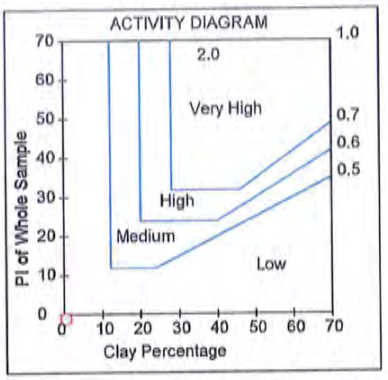
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

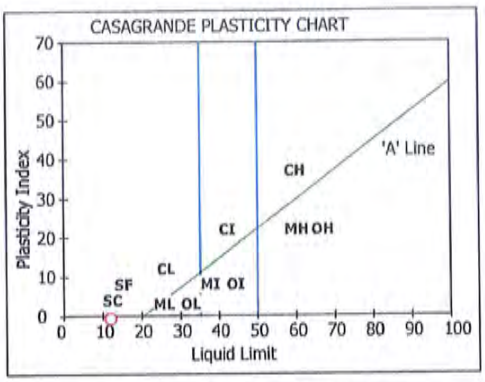
Sample No.	: U9298
Position	: TP 37
Layer Type	: 0-600mm
Sample Colour	: Kalahari Sand
Sample Type	: Kalahari Sand

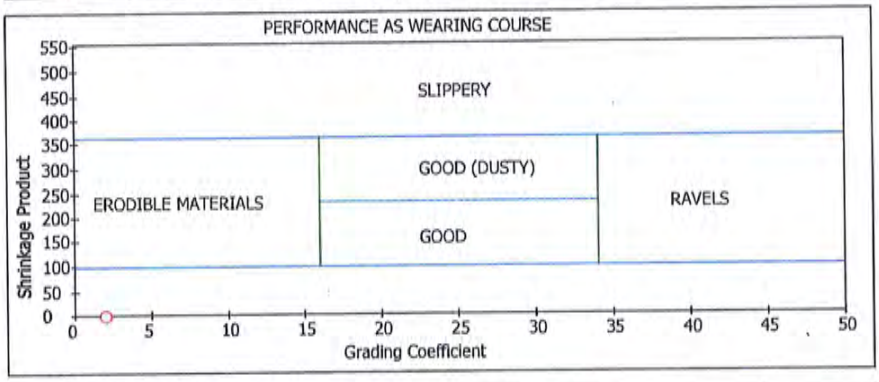
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	100
20.00	99
14.00	99
5.000	98
2.000	98
0.425	87
0.250	59
0.150	33
0.075	16
0.060	2,8
0.050	2,6
0.020	2,1
0.005	1,6
0.002	0,5

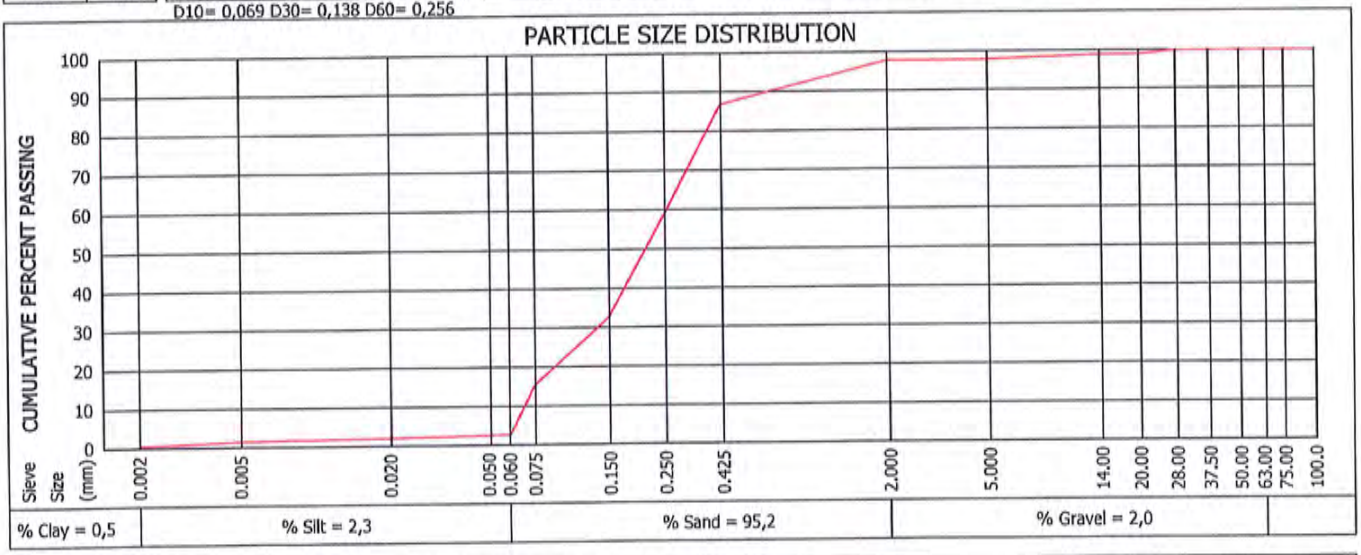
Soil Mortar	2.000 - 0.425	11
	0.425 - 0.250	29
	0.250 - 0.150	27
	0.150 - 0.075	17
	< 0.075	16
Effective Size		0,069
Uniformity Coefficient		3,7
Curvature Coefficient		1,1
Oversize Index		0,0
Shrinkage Product		0,0
Grading Coefficient		2,0
Grading Modulus		1,00
Atterberg Limits	Liquid Limit	12
	Plasticity Index	-1.0
	Linear Shrinkage	0.0
	PI < 0.075	
Unified Soil Classification		SC
US Highway Classification		A-2-4(0)

D10= 0,069 D30= 0,138 D60= 0,256









% Clay = 0,5	% Silt = 2,3	% Sand = 95,2	% Gravel = 2,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.50 [SANS 5854] & Conductivity = 0.18 S/m [SANS 6240]

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Date Reported : 2020-08-12

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
Ceres
6835
Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

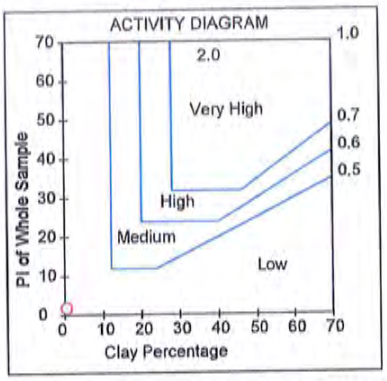
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

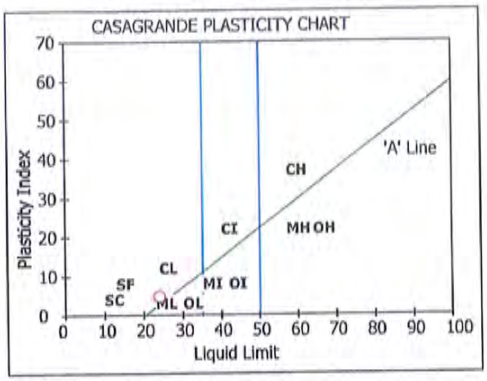
Sample No.	: U9293
Position	: TP 38
Layer Type	: 300-500mm
Sample Colour	: Dark Brown Gravel
Sample Type	: Mix Calcrete + Quart

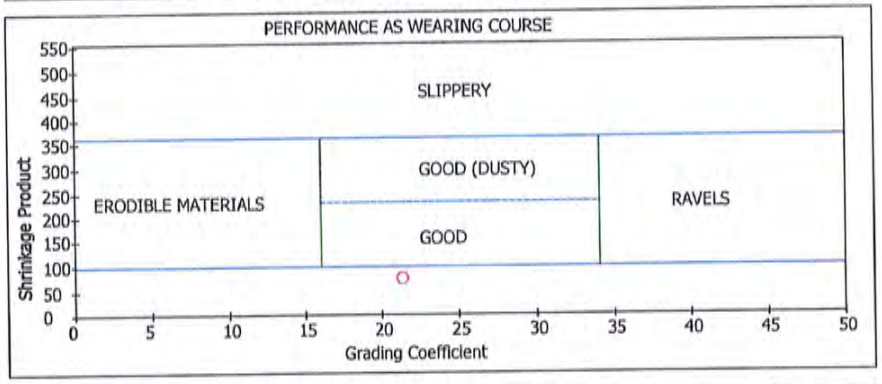
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	95
37.50	95
28.00	86
20.00	74
14.00	65
5.000	42
2.000	35
0.425	30
0.250	25
0.150	19
0.075	12
0.060	3,8
0.050	3,6
0.020	2,7
0.005	1,6
0.002	0,3

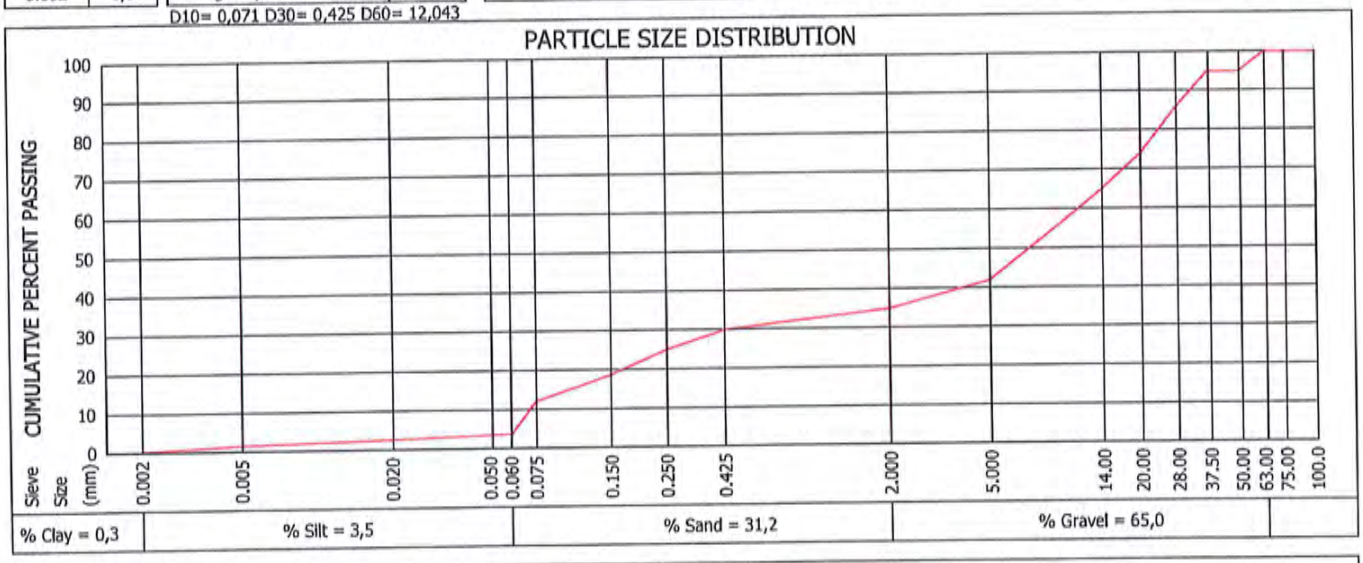
Soil Mortar	2.000 - 0.425	15
	0.425 - 0.250	13
	0.250 - 0.150	18
	0.150 - 0.075	19
	< 0.075	34
Effective Size		0,071
Uniformity Coefficient		169,6
Curvature Coefficient		0,2
Oversize Index		0,0
Shrinkage Product		75,0
Grading Coefficient		21,4
Grading Modulus		2,20
Atterberg Limits	Liquid Limit	24
	Plasticity Index	5
	Linear Shrinkage	2.5
	PI < 0.075	
Unified Soil Classification		GM-GC
US Highway Classification		A-1-a(0)

D10= 0,071 D30= 0,425 D60= 12,043









% Clay = 0,3	% Silt = 3,5	% Sand = 31,2	% Gravel = 65,0

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

sanas Testing Laboratory
Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

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Date Reported : 2020-08-06

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

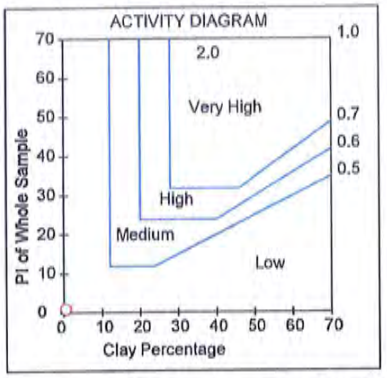
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

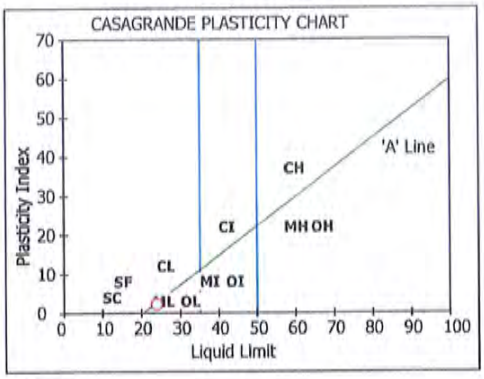
Sample No.	: U9297
Position	: TP 40
Layer Type	: 0-300mm
Sample Colour	: Dark Brown Gravel
Sample Type	: Mix Calcrete+Quartz

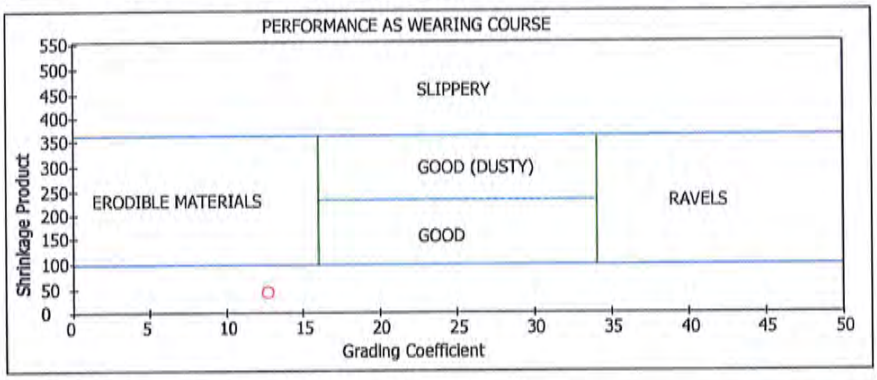
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	97
37.50	87
28.00	70
20.00	57
14.00	47
5.000	32
2.000	30
0.425	29
0.250	26
0.150	21
0.075	14
0.060	3,5
0.050	3,1
0.020	1,7
0.005	1,1
0.002	0,5

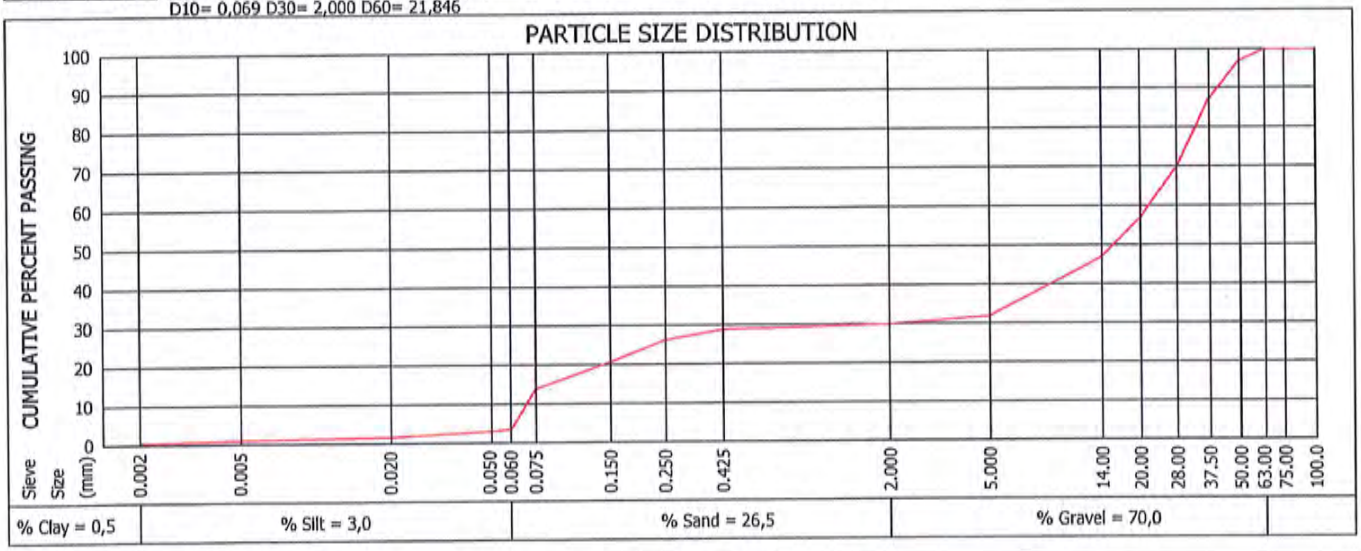
Soil Mortar	2.000 - 0.425	4
	0.425 - 0.250	10
	0.250 - 0.150	19
	0.150 - 0.075	22
	< 0.075	46
Effective Size		0,069
Uniformity Coefficient		316,6
Curvature Coefficient		2,7
Oversize Index		10,0
Shrinkage Product		43,5
Grading Coefficient		12,8
Grading Modulus		2,30
Atterberg Limits	Liquid Limit	24
	Plasticity Index	2,0
	Linear Shrinkage	1,5
	PI < 0.075	
Unified Soil Classification		GM
US Highway Classification		A-1-a(0)

D10= 0,069 D30= 2,000 D60= 21,846









% Clay = 0,5	% Silt = 3,0	% Sand = 26,5	% Gravel = 70,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.73 [SANS 5854] & Conductivity = 0.05 S/m [SANS 6240]

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
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Report compiled by : Juraine Okkies

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Project : Groblershoop Infrastructure Upgrade

Attention : Frans Breytenbach

Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.	U9297				
HOLE NO./ Km / CHAINAGE	TP40				
ROAD NO./ NAME Line 1 ROAD NO./ NAME Line 2	S28° 54' 23,0" E21° 59' 41,2"				
LAYER TESTED/SAMPLED	0-300mm				
SAMPLE DEPTH	0-300mm				
DATE SAMPLED	2020-07-09				
COLOUR OF SAMPLE	Dark Brown				
TYPE OF SAMPLE	Mix Quartz+Calcrete				

SIEVE ANALYSIS - % PASSING SIEVES *(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm				
	75.0 mm				
	63.0 mm	100			
	50.0 mm	97			
	37.5 mm	87			
	28.0 mm	70			
	20.0 mm	57			
	14.0 mm	47			
	5.0 mm	32			
	2.0 mm	30			
	0.425 mm	29			
	0.075 mm	14			
GM %		2,3			

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	4			
COARSE FINE SAND	0.425 - 0.250	10			
MEDIUM FINE SAND	0.250 - 0.150	19			
FINE FINE SAND	0.150 - 0.075	22			
SILT CLAY	0.075	46			

ATTERBERG LIMITS ANALYSIS - *(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	24			
	PLASTICITY INDEX	2,4			
	LINEAR SHRINKAGE	1,5			
CLASSIFICATION	H.R.B.	A-1-a(0)			
	COLTO	G6			
	TRH 14	G6			

CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	5,7			
	MDD (kg/m³)	2096			
	COMP MC %	5,5			
SWELL % @	MOD | NRB | PRO	0,01 | 0,02 | 0,05			
C.B.R. SANS GR40	100 %	55			
	98 %	49			
	97 %	47			
	95 %	42			
	93 %	37			
	90 %	31			

STABILISER IN LAB	Not Applicable				
TEST TYPE	CBR				
SAMPLING METHOD	TMH 5				
WEATHER WHEN SAMPLED	Cold				

Deviation from Test Method :
Remarks and Notes :

Report compiled by : Juraine Okkies

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Accreditation No. T0296
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Project : Groblershoop Infrastructure Upgrade

Attention : Frans Breytenbach

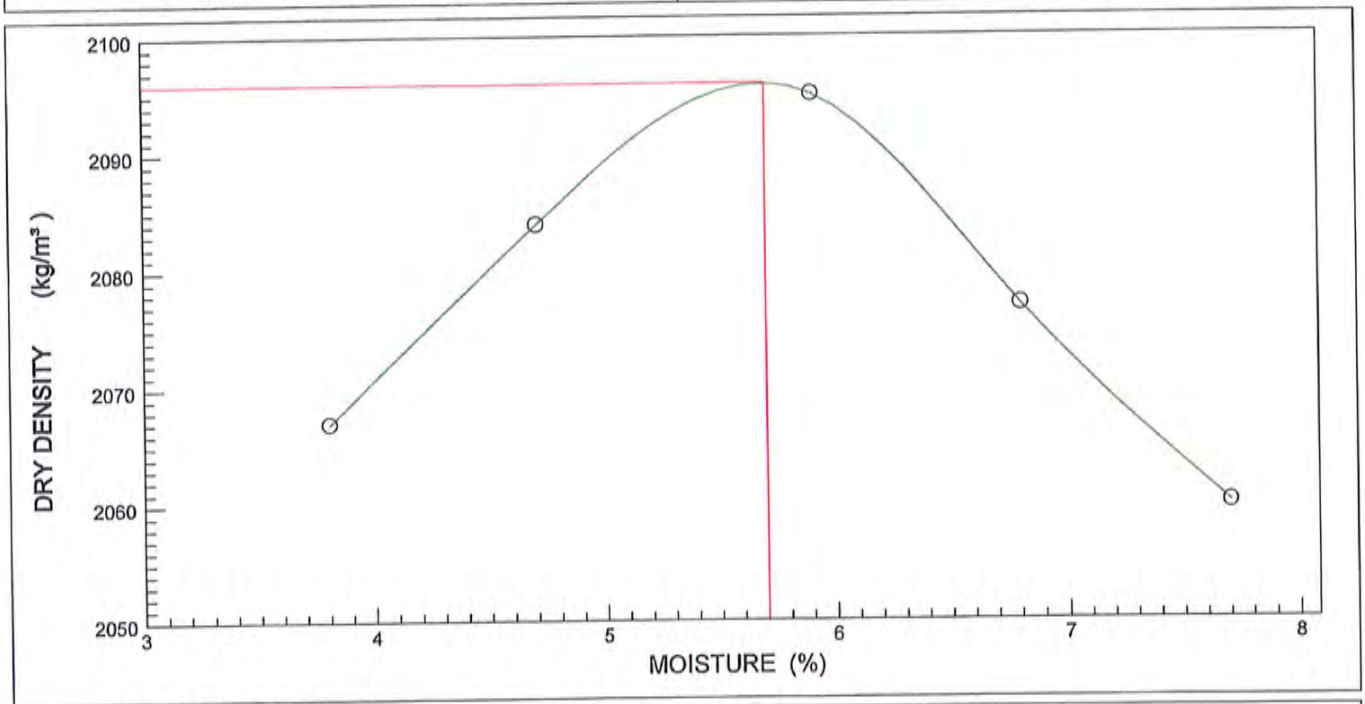
Determination Maximum Dry Density & Optimum Moisture Content Test Report

SANS 3001 - GR20/GR30

SAMPLE NO.	U9297
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	95kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	0-300mm
MATERIAL DESCRIPTION	Mix Calcrete + Quartzstone
HOLE NO./ km / CHAINAGE	TP40
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-10
DATE SAMPLED	2020-07-09
CLIENT MARKING	S28° 54' 23,0"; E21° 59' 41,2"
COLOUR AND TYPE	Dark Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m³)	2067	2084	2095	2077	2060			
MOISTURE (%)	3,8	4,7	5,9	6,8	7,7			

MAXIMUM DRY DENSITY (kg/m³) : 2096	OPTIMUM MOISTURE CONTENT (%) : 5,7



Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Date Reported : 2020-08-12

Job Request No.: RU3525
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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

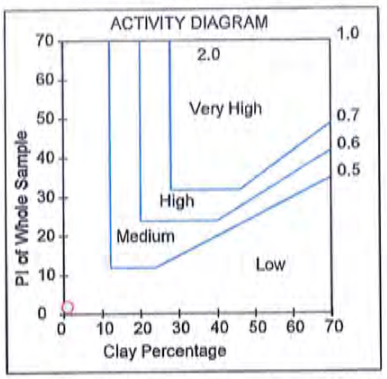
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

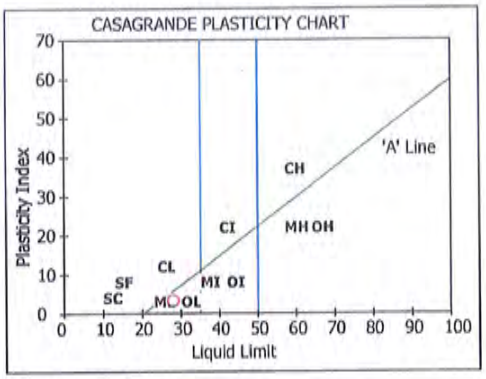
Sample No.	: U9296
Position	: TP 44
Layer Type	: 0-500mm
Sample Colour	: Orange Brown Gravel
Sample Type	: Mix Quartzstone

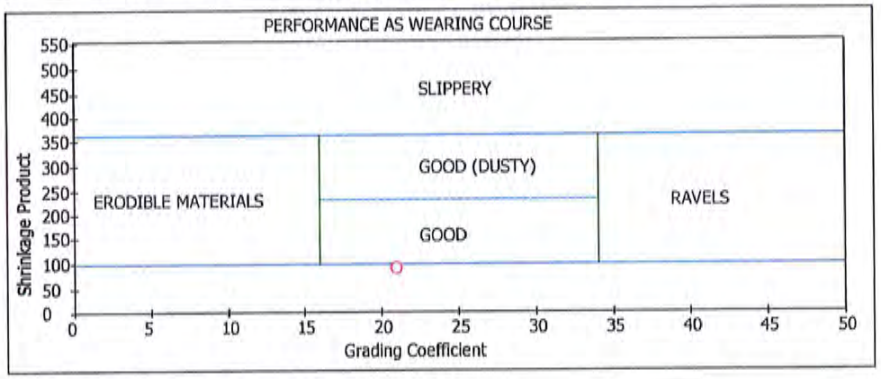
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	98
20.00	92
14.00	85
5.000	70
2.000	68
0.425	62
0.250	51
0.150	35
0.075	22
0.060	6,6
0.050	5,8
0.020	3,5
0.005	2,4
0.002	0,9

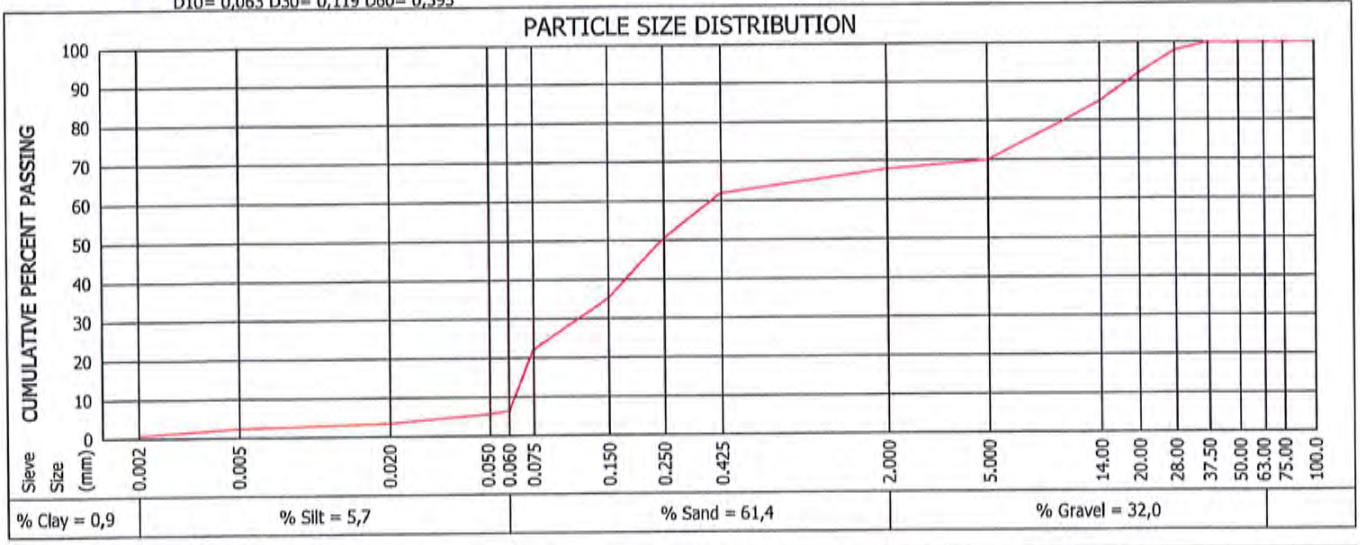
Soil Mortar	2.000 - 0.425	8
	0.425 - 0.250	18
	0.250 - 0.150	22
	0.150 - 0.075	20
	< 0.075	33
Effective Size		0,063
Uniformity Coefficient		6,3
Curvature Coefficient		0,6
Oversize Index		0,0
Shrinkage Product		93,0
Grading Coefficient		21,0
Grading Modulus		1,50
Atterberg Limits	Liquid Limit	28
	Plasticity Index	3.0
	Linear Shrinkage	1.5
	PI < 0.075	
Unified Soil Classification		SM
US Highway Classification		A-2-4(0)

D10= 0,063 D30= 0,119 D60= 0,395









% Clay = 0,9	% Silt = 5,7	% Sand = 61,4	% Gravel = 32,0

Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
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Report compiled by : Juraine Okkies

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Date Reported : 2020-08-21

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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

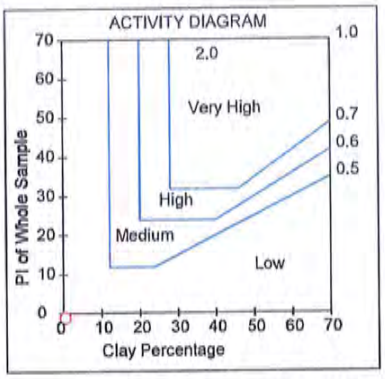
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

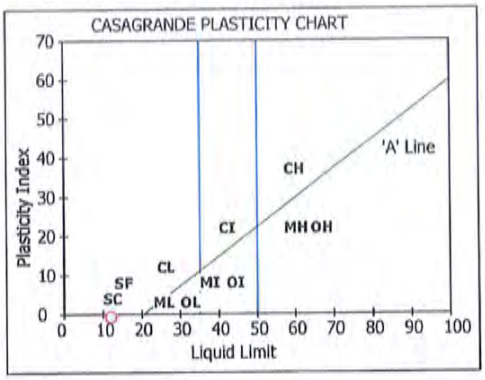
Sample No.	: U9295
Position	: TP 46
Layer Type	: 0-700mm
Sample Colour	: Kalahari Sand
Sample Type	: Kalahari Sand

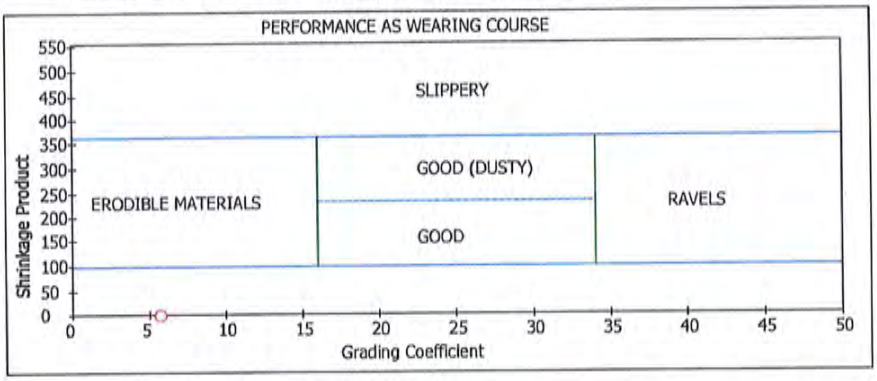
Sieve Size(mm)	% Passing
100.0	100
75.00	100
63.00	100
50.00	100
37.50	100
28.00	100
20.00	98
14.00	97
5.000	96
2.000	94
0.425	81
0.250	56
0.150	34
0.075	17
0.060	3,1
0.050	2,8
0.020	1,8
0.005	1,5
0.002	0,4

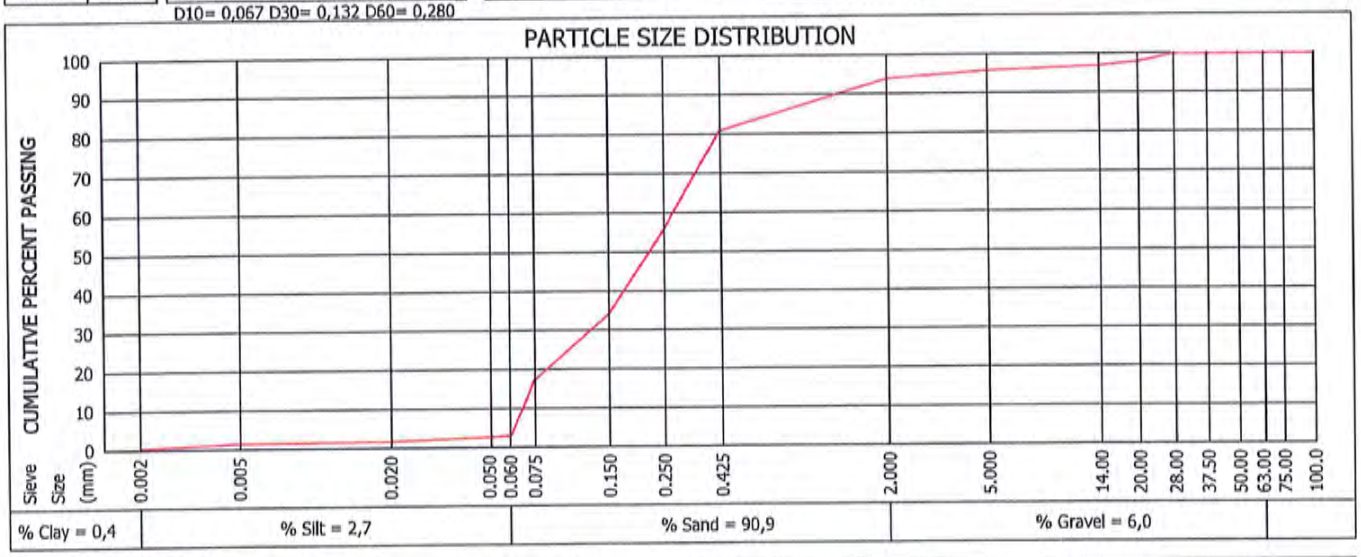
Soil Mortar	2.000 - 0.425	15
	0.425 - 0.250	27
	0.250 - 0.150	23
	0.150 - 0.075	18
	< 0.075	18
Effective Size		0,067
Uniformity Coefficient		4,2
Curvature Coefficient		0,9
Oversize Index		0,0
Shrinkage Product		0,0
Grading Coefficient		5,8
Grading Modulus		1,10
Atterberg Limits	Liquid Limit	12
	Plasticity Index	-1.0
	Linear Shrinkage	0.0
	PI < 0.075	
Unified Soil Classification		SC
US Highway Classification		A-2-4(0)

D10= 0,067 D30= 0,132 D60= 0,280









% Clay = 0,4	% Silt = 2,7	% Sand = 90,9	% Gravel = 6,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.70 [SANS 5854] & Conductivity = 0.09 S/m [SANS 6240]

Report compiled by : Juraine Okkies

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Prog.ver 10.7 (2019/11/07)

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Date Reported : 2020-08-06

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Attention : Frans Breytenbach

Project : Groblershoop Infrastructure Upgrade

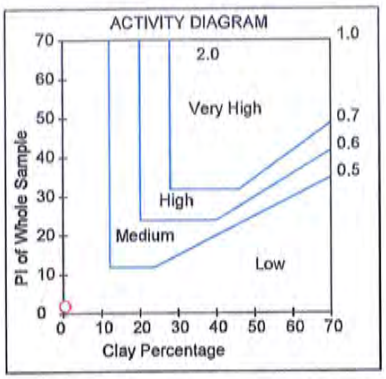
Foundation Indicator Test Report SANS 3001 - GR1 / GR3 / GR10

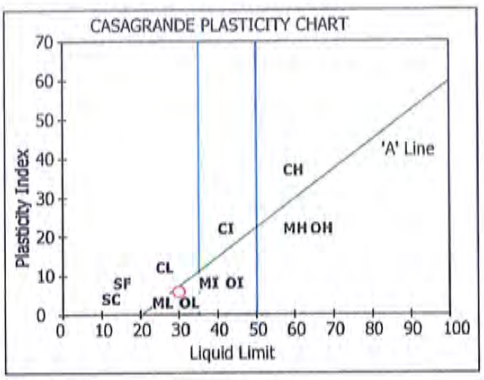
Sample No.	: U9294
Position	: TP 50
Layer Type	: 200-1000mm
Sample Colour	: Light Brown Gravel
Sample Type	: Mix Calcrete+Quartz

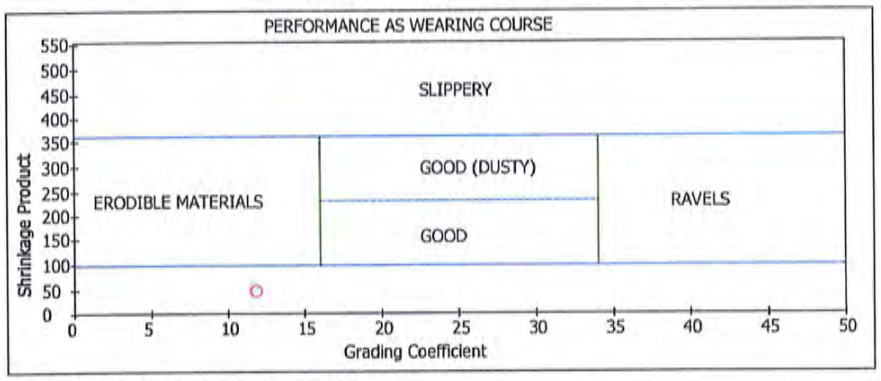
Sieve Size(mm)	% Passing
100.0	100
75.00	96
63.00	89
50.00	84
37.50	70
28.00	63
20.00	56
14.00	52
5.000	37
2.000	31
0.425	25
0.250	21
0.150	16
0.075	9,3
0.060	3,1
0.050	2,8
0.020	1,7
0.005	1,3
0.002	0,4

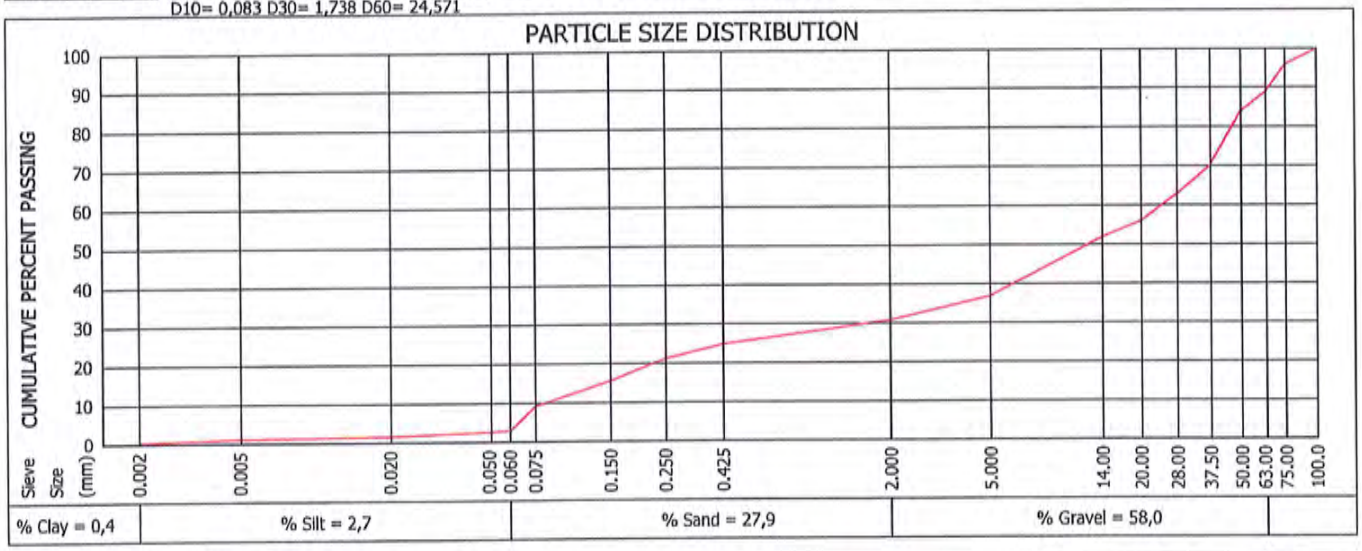
Soil Mortar	2.000 - 0.425	19
	0.425 - 0.250	13
	0.250 - 0.150	18
	0.150 - 0.075	22
	< 0.075	29
Effective Size		0,083
Uniformity Coefficient		296,0
Curvature Coefficient		1,5
Oversize Index		14,0
Shrinkage Product		50,0
Grading Coefficient		11,8
Grading Modulus		2,30
Atterberg Limits	Liquid Limit	30
	Plasticity Index	6
	Linear Shrinkage	2.0
	PI < 0.075	
Unified Soil Classification		GW-GM
US Highway Classification		A-1-a(0)

D10= 0,083 D30= 1,738 D60= 24,571









% Clay = 0,4	% Silt = 2,7	% Sand = 27,9	% Gravel = 58,0

Deviation from Test Method :
Remarks and Notes : Chemistry: pH = 7.78 [SANS 5854] & Conductivity = 0.06 S/m [SANS 6240]

Report compiled by : Juraine Okkies

sanas Testing Laboratory
Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

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Tel: 011 828 0279 Fax: 011 828 0279
Email: info@roadlab.co.za
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Job Request No.: RU3525

Date Reported : 2020-08-06

Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
Ceres
6835

Project : Groblershoop Infrastructure Upgrade

Attention : Frans Breytenbach

Determination of the California Bearing Ratio Test Report SANS 3001 - GR1 / GR2 / GR10 / GR20 / GR30 / GR40 / PR5

SAMPLE INFORMATION AND PROPERTIES

SAMPLE NO.		U9294			
HOLE NO./ Km / CHAINAGE		TP50			
ROAD NO./ NAME Line 1 ROAD NO./ NAME Line 2		S28° 54' 08,3" E21° 59' 40,3"			
LAYER TESTED/SAMPLED		200-1000mm			
SAMPLE DEPTH		200-1000mm			
DATE SAMPLED		2020-07-09			
COLOUR OF SAMPLE		Light Brown			
TYPE OF SAMPLE		Mix Calcrete+Quartz			

SIEVE ANALYSIS - % PASSING SIEVES *(SANS 3001-GR1:2010, SANS 3001-GR2:2010)

SIEVE ANALYSIS (GR 1) % PASSING	100.0 mm	100				
	75.0 mm	96				
	63.0 mm	89				
	50.0 mm	84				
	37.5 mm	70				
	28.0 mm	63				
	20.0 mm	56				
	14.0 mm	52				
	5.0 mm	37				
	2.0 mm	31				
	0.425 mm	25				
	0.075 mm	9				
GM %		2,3				

SOIL MORTAR ANALYSIS (SANS 3001-PR5:2011)

COARSE SAND	2.000 - 0.425	19				
COARSE FINE SAND	0.425 - 0.250	13				
MEDIUM FINE SAND	0.250 - 0.150	18				
FINE FINE SAND	0.150 - 0.075	22				
SILT CLAY	0.075	29				

ATTERBERG LIMITS ANALYSIS - *(SANS 3001-GR10:2010)

ATTERBERG LIMITS (%) SANS GR10,GR11	LIQUID LIMIT	30				
	PLASTICITY INDEX	6				
	LINEAR SHRINKAGE	2.0				
CLASSIFICATION	H.R.B.	A-1-a(0)				
	COLTO	G6				
	TRH 14	G7				

CALIFORNIA BEARING RATIO - *(SANS 3001-GR30:2010, SANS 3001-GR40:2010)

SANS GR30 MAX. DRY DENSITY	OMC %	11,3				
	MDD (kg/m³)	1957				
	COMP MC %	11,1				
SWELL % @	MOD | NRB | PRO	0,01 | 0,03 | 0,05				
C.B.R. SANS GR40	100 %	81				
	98 %	56				
	97 %	46				
	95 %	31				
	93 %	21				
	90 %	12				

STABILISER IN LAB	Not Applicable				
TEST TYPE	CBR				
SAMPLING METHOD	TMH 5				
WEATHER WHEN SAMPLED	Cold				

Deviation from Test Method :
Remarks and Notes :

Report compiled by : Juraine Okkies

sanas Testing Laboratory
Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

D Juckers
Technical Signatory

Roadlab Germiston
207 Rietfontein Road Germiston
1401
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Email: info@roadlab.co.za
Web: www.roadlab.co.za

Date Reported : 2020-07-29

Job Request No.: RU3525
Ceder Land Geotechnical Consult (Pty) Ltd
PO Box 607
Ceres
6835

Project : Groblershoop Infrastructure Upgrade

Attention : Frans Breytenbach

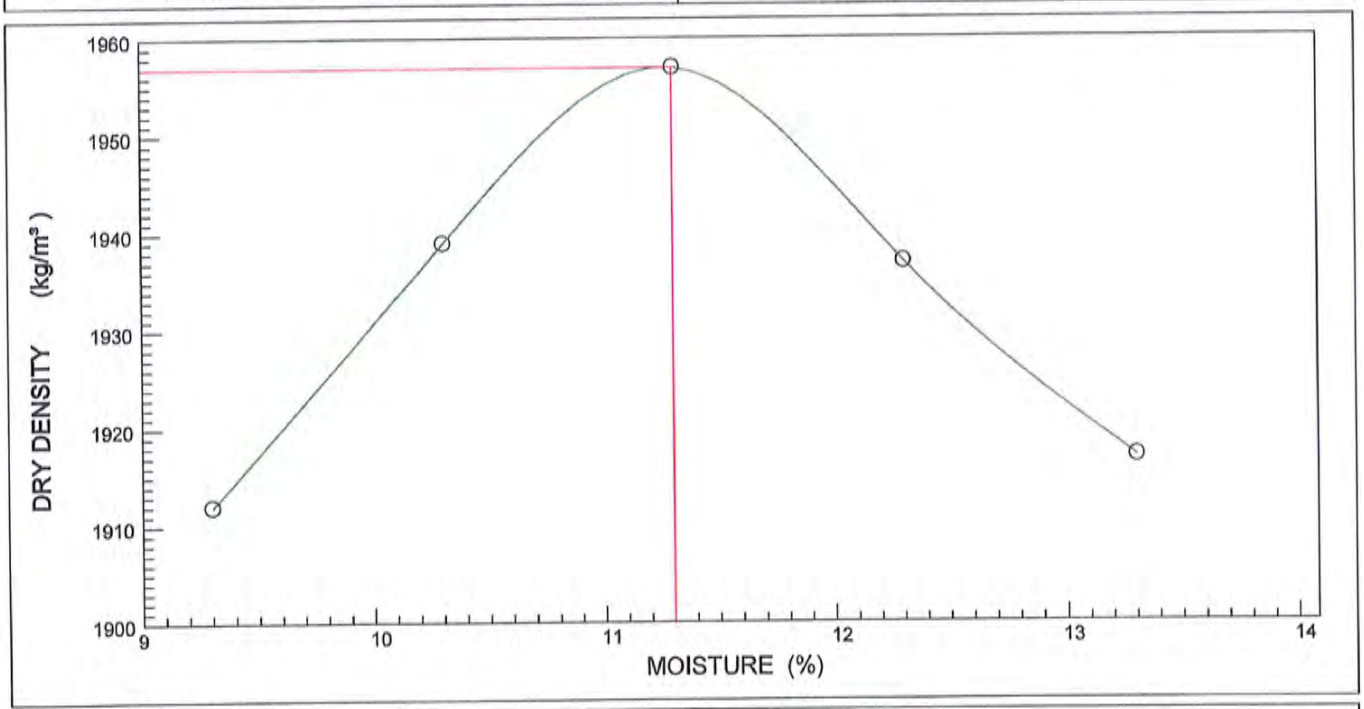
Determination Maximum Dry Density & Optimum Moisture Content Test Report

SANS 3001 - GR20/GR30

SAMPLE NO.	U9294
CONTAINER FOR SAMPLING	Black Bags
SIZE / APPROX. MASS OF SAMPLE	100kg
MOISTURE CONDITION OF SAMPLE	Moist
LAYER TESTED / SAMPLED FROM	200-1000mm
MATERIAL DESCRIPTION	Mix Quartz
HOLE NO./ km / CHAINAGE	TP50
ROAD NO.	Not Specified
DATE RECEIVED	2020-07-10
DATE SAMPLED	2020-07-09
CLIENT MARKING	S28° 54' 08,3"; E21° 59' 40,3"
COLOUR AND TYPE	Light Brown Gravel

POINT NO.	1	2	3	4	5			
DRY DENSITY (kg/m³)	1912	1939	1957	1937	1917			
MOISTURE (%)	9,3	10,3	11,3	12,3	13,3			

MAXIMUM DRY DENSITY (kg/m³) : 1957	OPTIMUM MOISTURE CONTENT (%) : 11,3



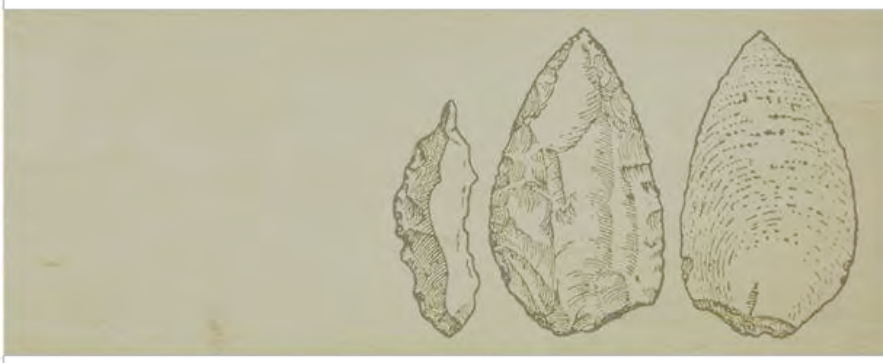
Deviation from Test Method :
Remarks and Notes :

Opinions and interpretations are not included in our scope of works. (T0296)
The samples were subjected to analysis according to (SANS)(TMH5)(DOT)(ASTM).
The test results reported relate to the samples tested.
Further use of the above information is not the responsibility or liability of Roadlab.
Documents may only be reproduced or published in their full context.
Report compiled by : Juraine Okkies

sanas Testing Laboratory
Accreditation No. T0296
Prog.ver 10.7 (2019/11/07)

D Juckers
Technical Signatory

ANNEXURE H: HERITAGE ASSESSMENT



PHASE 1 HIA REPORT !KHEIS TOWNSHIP EXPANSION GROBLERSHOOP NORTHERN CAPE

PROPOSED TOWNSHIP EXPANSION ON PORTION 16 FARM BOEGOEBERGNEDERSETTING RE/48, GROBLERSHOOP, !KHEIS LOCAL MUNICIPALITY, ZF MGCAWU DISTRICT MUNICIPALITY, NORTHERN CAPE.

Reference: NC/21/2018/PP (Groblershoop 1500)/BH0066

PREPARED FOR:

ENVIROAFRICA

PREPARED BY:

HEIDI FIVAZ & JAN ENGELBRECHT

UBIQUE HERITAGE CONSULTANTS

29 JUNE 2020

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Fax: 086 512 0154 / Tel: 021 8511616 /
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Contact Person: Bernard de Witt
Email: bernard@enviroafrica.co.za

Heritage Consultant: UBIQUE Heritage Consultants

Contact Person: Jan Engelbrecht (archaeologist and lead CRM specialist)
Member of the Association of Southern African Professional Archaeologists: Member number: 297
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Heidi Fivaz (archaeologist)
Member of the Association of Southern African Professional Archaeologists: Member number: 433
Cell: (+27) 0721418860
Email: heidi@ubiquecrm.com

For this project, Mr Engelbrecht was responsible for the field survey of the development footprint, identification of heritage resources, and recommendations. Ms Fivaz was responsible for research and report compilation. The desktop study was conducted by Sky-Lee Fairhurst and the PIA was completed by Elize Butler.

Declaration of independence:

We, Jan Engelbrecht and Heidi Fivaz, partners of UBIQUE Heritage Consultants, hereby confirm our independence as heritage specialists and declare that:

- we are suitably qualified and accredited to act as independent specialists in this application;
- we do not have any vested interests (either business, financial, personal or other) in the proposed development project other than remuneration for the heritage assessment and heritage management services performed;
- the work was conducted in an objective and ethical manner, in accordance with a professional code of conduct and within the framework of South African heritage legislation.

Signed: **Date:** 2020-06-29

J.A.C. Engelbrecht & H. Fivaz
UBIQUE Heritage Consultants

JAN ENGELBRECHT

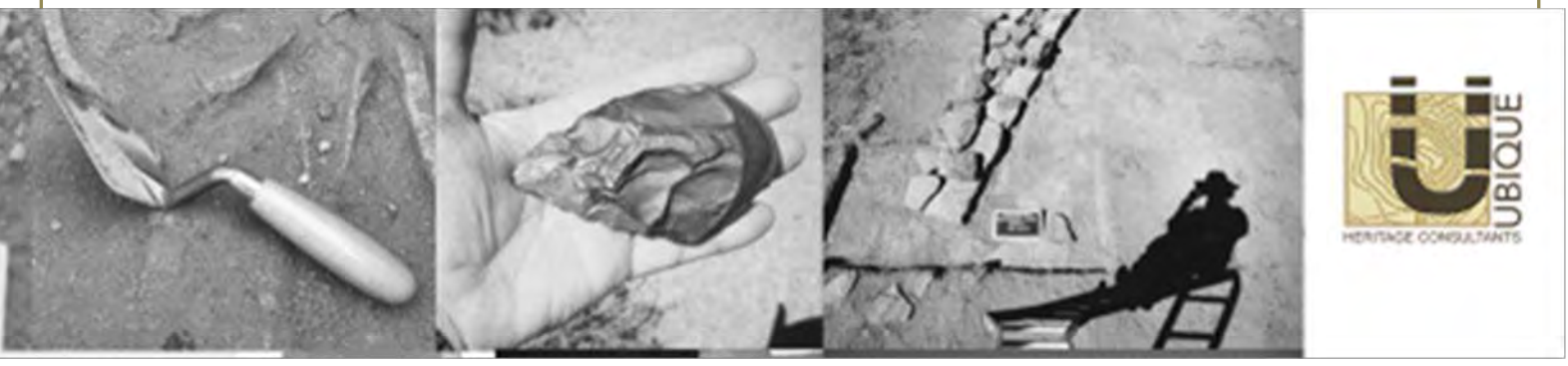
CRM ARCHAEOLOGIST

Jan Engelbrecht is accredited by the Cultural Resources Management section of the Association of Southern African Professional Archaeologists (ASAPA) to undertake Phase1 AIAs and HIAs in South Africa. He is also a member of the Association for Professional Archaeologists (ASAPA). Mr Engelbrecht holds an honours degree in archaeology (specialising in the history of early farmers in southern Africa (Iron Age) and Colonial period) from the University of South Africa. He has 12 years' experience in heritage management. He has worked on projects as diverse as the Zulti South HIA project of Richards Bay Minerals, research on the David Bruce heritage site at Ubombo in Kwa-Zulu Natal, and various archaeological excavations and historical projects. He has worked with many rural communities to establish integrated heritage and land use plans and speaks Zulu fluently. Mr Engelbrecht established Ubique Heritage Consultants during 2012. The company moved from KZN to the Northern Cape and is currently based at Askham in the Northern Cape within the Dawid Kruiper Local Municipality in the Kgalagadi region. He had a significant military career as an officer, whereafter he qualified as an Animal Health Technician at Technikon RSA and UNISA. He is currently studying for his MA Degree in Archaeology.

HEIDI FIVAZ

ARCHAEOLOGIST & OBJECT CONSERVATOR

Heidi Fivaz has been a part of UBIQUE Heritage Consultants since 2016 and is responsible for research and report compilation. She holds a B.Tech. Fine Arts degree (2000) from Tshwane University of Technology, a BA Culture and Arts Historical Studies degree (2012) from UNISA and received her BA (Hons) Archaeology in 2015 (UNISA). She has received extensive training in object conservation from the South African Institute of Object Conservation and specialises in glass and ceramics conservation. She is also a skilled artefact and archaeological illustrator. Ms Fivaz is currently completing her MA Archaeology at the University of South Africa (UNISA), with a focus on historical and industrial archaeology. She is a professional member of the Association of South African Archaeologists and has worked on numerous archaeological excavation and surveying projects over the past ten years.



EXECUTIVE SUMMARY

Project description

UBIQUE Heritage Consultants were appointed by EnviroAfrica cc as independent heritage specialists in accordance with Section 38 of the NHRA and the National Environmental Management Act 107 of 1998 (NEMA), to conduct a cultural heritage assessment to determine the impact of the proposed township expansion on Portion 16 Farm Boegoebergnedersetting RE/48, Groblershoop, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape, on any sites, features, or objects of cultural heritage significance.

Findings and Impact on Heritage Resources

Ten incidences of ESA/MSA/LSA lithic material and low-fired indigenous ceramics were recorded across the development footprint. The lithic assemblage predominantly consists of informal tools and knapping debris, with some scrapers, blades, and cores. The majority of the lithics are banded ironstone formation (BIF), an abundant raw material within the area. Some cryptocrystalline silicates (CCS) and quartzite pieces are present. Undecorated, low fired, thin-walled, mineral-tempered ceramics were also recorded. The material was documented as widely dispersed surface scatters, with no archaeological context. The resources will be affected negatively by the proposed development, but due to the low significance of the material, the impact is negligible.

The Groblershoop development footprint is underlain by Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group) as well as underlying Precambrian rocks of the Transvaal Supergroup. According to the SAHRIS PalaeoMap, the Palaeontological Sensitivity of the Kalahari Group is low. The underlying Precambrian Transvaal Supergroup that is of moderate significance are too deep to affect the proposed development (Butler 2020).

Recommendations

Based on the assessment of the potential impact of the development on the identified heritage, the following recommendations are made, taking into consideration any existing or potential sustainable social and economic benefits:

1. No significant heritage sites or features were identified within the surveyed sections of the new Groblershoop township, Portion 16 of the Farm Boegoebergnedersetting RE/48. The Early/Middle/Late Stone Age cultural material identified is not conservation worthy. No further mitigation is recommended with regards to these resources. Therefore, from a heritage point of view, we recommend that the proposed development can continue.

2. The Groblershoop cemetery is situated well outside the development footprint. This site is graded as IIIB and is of High Local Significance. No further mitigation is recommended with regards to these resources. No other graves were identified on the development footprint.

3. Due to the low palaeontological significance of the area, no further palaeontological heritage studies, ground-truthing and/or specialist mitigation are required. It is considered that the development of the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area (Butler 2020). If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol (Appendix A/11) must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected, and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carried out by a palaeontologist (Butler 2020).

4. Although all possible care has been taken to identify sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the assessment. If during construction, any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources are found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine 021 462 5402) must be alerted as per section 35(3) of the NHRA. If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Thingahangwi Tshivhase/Mimi Seetelo 012 320 8490), must be alerted immediately as per section 36(6) of the NHRA. A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contacted as soon as possible to inspect the findings. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance, a Phase 2 rescue operation may be required subject to permits issued by SAHRA. UBIQUE Heritage Consultants and its personnel will not be held liable for such oversights or costs incurred as a result of such oversights.

TABLE OF CONTENTS

TABLE OF FIGURES

ABBREVIATIONS

AIA:	Archaeological Impact Assessment
ASAPA:	Association of South African Professional Archaeologists
BIA:	Basic Impact Assessment
CRM:	Cultural Resource Management
ECO:	Environmental Control Officer
EIA:	Environmental Impact Assessment*
EIA:	Early Iron Age*
EMP:	Environmental Management Plan
ESA:	Earlier Stone Age
GPS:	Global Positioning System
HIA:	Heritage Impact Assessment
LIA:	Late Iron Age
LSA:	Later Stone Age
MEC:	Member of the Executive Council
MIA:	Middle Iron Age
MPRDA:	Mineral and Petroleum Resources Development Act
MSA:	Middle Stone Age
NEMA:	National Environmental Management Act
NHRA:	National Heritage Resources Act
OWC:	Orange River Wine Cellars
PRHA:	Provincial Heritage Resource Agency
SADC:	Southern African Development Community
SAHRA:	South African Heritage Resources Agency
SAHRIS:	South African Heritage Resources Information System

**Although EIA refers to both Environmental Impact Assessment and the Early Iron Age both are internationally accepted abbreviations it must be read and interpreted in the context it is used.*

GLOSSARY

Archaeological: material remains resulting from human activity which are in a state of disuse and are in or on land and are older than 100 years, including artefacts, human and hominid remains and artificial features and structures;

- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and is older than 100 years (as defined and protected by the National Heritage Resources Act (NHRA) (Act No. 25 of 1999) including any area within 10 m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which were wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures and artefacts associated with military history, which are older than 75 years and the sites on which they are found.

Stone Age:	The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.
Earlier Stone Age:	>2 000 000 - >200 000 years ago
Middle Stone Age:	<300 000 - >20 000 years ago
Later Stone Age:	<40 000 - until the historical period
Iron Age:	(Early Farming Communities). Period covering the last 1800 years, when immigrant African farmer groups brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and herded cattle as well as sheep and goats. As they produced their own iron tools, archaeologists call this the Iron Age.
Early Iron Age:	AD 200 - AD 900
Middle Iron Age:	AD 900 - AD 1300
Later Iron Age:	AD 1300 - AD 1850
Historic:	Period of arrival of white settlers and colonial contact. AD 1500 to 1950
Historic building:	Structures 60 years and older.
Fossil:	Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.
Heritage:	That which is inherited and forms part of the National Estate (historic places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).
Heritage resources:	These mean any place or object of cultural significance, tangible or intangible.
Holocene:	The most recent geological period that commenced 10 000 years ago.
Palaeontology:	Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site that contains such fossilised remains or traces
Cumulative impacts:	"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity that may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.
Mitigation:	Anticipating and preventing negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.
A 'place':	a site, area or region;

- a building or other structure which may include equipment, furniture, fittings and articles associated with or connected with such building or other structure;
- a group of buildings or other structures which may include equipment, furniture, fittings and articles associated with or connected with such group of buildings or other structures;
- an open space, including a public square, street or park; and
- in relation to the management of a place, includes the immediate surroundings of a place.

'Public monuments and memorials': mean all monuments and memorials—

- erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government; or
- which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual;

'Structures': any building, works, device or other facility made by people and which are fixed to land, and include any fixtures, fittings and equipment associated therewith.

1. INTRODUCTION

1.1 Scope of study

The project involves the expansion of the Groblershoop community on Portion 16 of the Farm Boegoebergnedersetting RE/48 in the !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape. UBIQUE Heritage Consultants were appointed by EnviroAfrica cc as independent heritage specialists in accordance with the National Environmental Management Act 107 of 1998 (NEMA), and in compliance with Section 38 of the National Heritage Resources Act 25 of 1999 (NHRA), to conduct a cultural heritage assessment (AIA/HIA) of the development area.

The assessment aims to identify and report any heritage resources that may fall within the development footprint; to determine the impact of the proposed development on any sites, features, or objects of cultural heritage significance; to assess the significance of any identified resources; and to assist the developer in managing the documented heritage resources in an accountable manner, within the framework provided by the National Heritage Resources Act (Act 25 of 1999) (NHRA).

South Africa's heritage resources are both rich and widely diverse, encompassing sites from all periods of human history. Resources may be tangible, such as buildings and archaeological artefacts, or intangible, such as landscapes and living heritage. Their significance is based upon their aesthetic, architectural, historical, scientific, social, spiritual, linguistic, economic or technological values; their representation of a time or group; their rarity; and their sphere of influence.

The integrity and significance of heritage resources can be jeopardised by natural (e.g. erosion) and human (e.g. development) activities. In the case of human activities, a range of legislation exists to ensure the timeous and accurate identification and effective management of heritage resources for present and future generations.

The result of this investigation is presented within this heritage impact assessment report. It comprises the recording of heritage resources present/ absent and offers recommendations for the management of these resources within the context of the proposed development.

Depending on SAHRA's acceptance of this report, the developer will receive permission to proceed with the proposed development, taking into account any proposed mitigation measures.

1.2 Assumptions and limitations

It is assumed that the description of the proposed project, as provided by the client, is accurate. Furthermore, it is assumed that the public consultation process undertaken as part of the Environmental Impact Assessment (EIA) is comprehensive and does not have to be repeated as part of the heritage impact assessment.

The significance of the sites, structures and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. The various aspects are not mutually exclusive, and the evaluation of any site is done with reference to any number of these aspects. Cultural significance is site-specific and relates to the content and context of the site.

All possible care has been taken during the comprehensive field survey and intensive desktop study to identify sites of cultural importance within the development areas. However, it is essential to note that some heritage sites may have been missed due to their subterranean nature, or due to dense vegetation cover. No subsurface investigation (i.e. excavations or sampling) were undertaken since a permit from SAHRA is required for such activities. Therefore, should any heritage features and/or objects such as architectural features, stone tool scatters, artefacts, human remains, or fossils be uncovered or observed during construction, operations must be stopped, and a qualified archaeologist contacted for an assessment of the find. Observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to assess the significance of the site (or material) in question.

2. TERMS OF REFERENCE

An HIA/ AIA must address the following key aspects:

- the identification and mapping of all heritage resources in the area affected;
- an assessment of the significance of such resources in terms of heritage assessment criteria set out in regulations;
- an assessment of the impact of the development on heritage resources;
- an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
- if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
- plans for mitigation of any adverse effects during and after completion of the proposed development.

In addition, the HIA/AIA should comply with the requirements of NEMA, including providing the assumptions and limitations associated with the study; the details, qualifications and expertise of the person who prepared the report; and a statement of competency.

2.1. Statutory Requirements

2.1.1 General

The Constitution of the Republic of South Africa Act 108 of 1996 is the source of all legislation. Within the Constitution the Bill of Rights is fundamental, with the principle that the environment should be protected for present and future generations by preventing pollution, promoting conservation and practising ecologically sustainable development. With regard to spatial planning and related legislation at national and provincial levels the following legislation may be relevant:

- Physical Planning Act 125 of 1991
- Municipal Structures Act 117 of 1998
- Municipal Systems Act 32 of 2000
- Development Facilitation Act 67 of 1995 (DFA)

The identification, evaluation and management of heritage resources in South Africa are required and governed by the following legislation:

- National Environmental Management Act 107 of 1998 (NEMA)
- KwaZulu-Natal Heritage Act 4 of 2008 (KZNHA)
- National Heritage Resources Act 25 of 1999 (NHRA)
- Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA)

2.1.2 National Heritage Resources Act 25 of 1999

The NHRA established the South African Heritage Resources Agency (SAHRA) together with its Council to fulfil the following functions:

- coordinate and promote the management of heritage resources at national level;

- set norms and maintain essential national standards for the management of heritage resources in the Republic and to protect heritage resources of national significance;
- control the export of nationally significant heritage objects and the import into the Republic of cultural property illegally exported from foreign countries;
- enable the provinces to establish heritage authorities which must adopt powers to protect and manage certain categories of heritage resources; and
- provide for the protection and management of conservation-worthy places and areas by local authorities.

2.1.3 Heritage Impact Assessments/Archaeological Impact Assessments

Section 38(1) of the NHRA of 1999 requires **the responsible heritage resources authority to notify the person who intends to undertake a development that fulfils the following criteria to submit an impact assessment report if there is reason to believe that heritage resources will be affected by such event**:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- the construction of a bridge or similar structure exceeding 50m in length;
- any development or other activity that will change the character of a site—
    - exceeding 5000m² in extent; or
    - involving three or more existing erven or subdivisions thereof; or
    - involving three or more erven or divisions thereof which have been consolidated within the past five years; or
    - the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
- the rezoning of a site exceeding 10 000m² in extent; or
- any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority.

2.1.4 Definitions of heritage resources

The NHRA defines a heritage resource as any place or object of cultural significance, i.e. of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. These include, but are not limited to, the following wide range of places and objects:

- living heritage as defined in the National Heritage Council Act No 11 of 1999 (cultural tradition; oral history; performance; ritual; popular memory; skills and techniques; indigenous knowledge systems; and the holistic approach to nature, society and social relationships);
- Ecofacts (non-artefactual organic or environmental remains that may reveal aspects of past human activity; definition used in KwaZulu-Natal Heritage Act 2008);
- places, buildings, structures and equipment;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features;
- geological sites of scientific or cultural importance;

- archaeological and palaeontological sites;
- graves and burial grounds;
- public monuments and memorials;
- sites of significance relating to the history of slavery in South Africa;
- movable objects, but excluding any object made by a living person; and
- battlefields.

Furthermore, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of—

- its importance in the community, or pattern of South Africa's history;
- its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons; and
- its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.

2.1.5 Management of Graves and Burial Grounds

- **Graves younger than 60 years** are protected in terms of Section 2(1) of the Removal of Graves and Dead Bodies Ordinance 7 of 1925 as well as the Human Tissues Act 65 of 1983.

- **Graves older than 60 years, situated outside a formal cemetery administered by a local Authority are** protected in terms of Section 36 of the NHRA as well as the Human Tissues Act of 1983. Accordingly, such graves are the jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of NHRA) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

The **protocol for the management of graves older than 60 years situated outside a formal cemetery administered by a local authority** is detailed in Section 36 of the NHRA:

> (3) *(a)* No person may, without a permit issued by SAHRA or a provincial heritage resources authority—

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;
(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
(c) bring onto or use at a burial ground or grave referred to in paragraph *(a)* or *(b)* any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)*(a)* unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.

(5) SAHRA or a provincial heritage resources authority may not issue a permit for any activity under subsection (3)*(b)* unless it is satisfied that the applicant has, in accordance with regulations made by the responsible heritage resources authority—

(a) made a concerted effort to contact and consult communities and individuals who by tradition have an interest in such grave or burial ground; and
(b) reached agreements with such communities and individuals regarding the future of such grave or burial ground.

(6) Subject to the provision of any other law, any person who in the course of development or any other activity discovers the location of a grave, the existence of which was previously unknown, must immediately cease such activity and report the discovery to the responsible heritage resources authority which must, in cooperation with the South African Police Service and in accordance with regulations of the responsible heritage resources authority—

(a) carry out an investigation for the purpose of obtaining information on whether or not such grave is protected in terms of this Act or is of significance to any community; and
(b) if such grave is protected or is of significance, assist any person who or community which is a direct descendant to make arrangements for the exhumation and re-interment of the contents of such grave or, in the absence of such person or community, make any such arrangements as it deems fit.

3. STUDY APPROACH AND METHODOLOGY

3.1 Desktop study

The first step in the methodology was to conduct a desktop study of the heritage background of the area and the site of the proposed development. This entailed the scoping and scanning of historical texts/records as well as previous heritage studies and research around the study area.

By incorporating data from previous CRM reports done in the area and an archival search, the study area is contextualised. The objective of this is to extract data and information on the area in question, looking at archaeological sites, historical sites and graves in the area.

No archaeological site data was available for the project area. A concise account of the archaeology and history of the broader study area was compiled (sources listed in the bibliography).

3.1.1 Literature review

A survey of the literature was undertaken to obtain background information regarding the area. Through researching the SAHRA APM Report Mapping Project records and the SAHRIS online database (http://www.sahra.org.za/sahris), it was determined that several other archaeological or historical studies had been performed within the broader vicinity of the study area. Sources consulted in this regard are indicated in the bibliography.

3.2 Field study

Phase 1 (AIA/HIA) requires the completion of a field study to establish and ensure the following:

3.2.1 Systematic survey

A systematic survey of the proposed project area to locate, identify, record, photograph and describe sites of archaeological, historical or cultural interest, was completed.

UBIQUE Heritage Consultants inspected the proposed development and surrounding areas on 23 and 24 May 2020 and completed a controlled-exclusive, pre-planned, pedestrian survey. We conducted an inspection of the surface of the ground, wherever the surface was visible. This was done with no substantial attempt to clear brush, sand, deadfall, leaves or other material that may cover the surface and with no effort to look beneath the surface beyond the inspection of rodent burrows, cut banks and other exposures fortuitously observed.

The survey was tracked with a handheld Garmin global positioning unit (Garmin eTrex 10).

3.2.2 Recording significant areas

GPS points of identified significant areas were recorded with a handheld Garmin global positioning unit (Garmin eTrex 10). Photographs were taken with a Canon IXUS 185 20-megapixel camera. Detailed field notes were taken to describe observations. The layout of the area and plotted GPS points, tracks and coordinates, were transferred to Google Earth and QGIS and maps were created.

3.2.3 Determining significance

Levels of significance of the various types of heritage resources observed and recorded in the project area will be determined to the following criteria:

Cultural significance:

- Low	A cultural object being found out of context, not being part of a site or without any related feature/structure in its surroundings.
- Medium	Any site, structure or feature being regarded less important due to several factors, such as date and frequency. Likewise, any important object found out of context.
- High	Any site, structure or feature regarded as important because of its age or uniqueness. Graves are always categorised as of a high importance. Likewise, any important object found within a specific context.

Heritage significance:

- Grade I	Heritage resources with exceptional qualities to the extent that they are of national significance
- Grade II	Heritage resources with qualities giving it provincial or regional importance although it may form part of the national estate
- Grade III	Other heritage resources of local importance and therefore worthy of Conservation

Field ratings:

i.	National Grade I	significance should be managed as part of the national estate
ii.	Provincial Grade II	significance should be managed as part of the provincial estate
iii.	Local Grade IIIA	should be included in the heritage register and not be mitigated (high significance)
iv.	Local Grade IIIB	should be included in the heritage register and may be mitigated (high/ medium significance)

v. General protection A (IV A) site should be mitigated before destruction (high/ medium significance)

vi. General protection B (IV B) site should be recorded before destruction (medium significance)

vii. General protection C (IV C) phase 1 is seen as sufficient recording and it may be demolished (low significance)

Heritage value, statement of significance:

a. its importance in the community, or pattern of South Africa's history;

b. its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;

c. its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

d. its importance in demonstrating the principal characteristics of a particular class of south Africa's natural or cultural places or objects;

e. its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;

f. its importance in demonstrating a high degree of creative or technical achievement at a particular period;

g. its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;

h. its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and

i. sites of significance relating to the history of slavery in South Africa.

3.2.4 Assessment of development impacts

A heritage resource impact may be defined broadly as the net change, either beneficial or adverse, between the integrity of a heritage site with and without the proposed development. Beneficial impacts occur wherever a proposed development actively protects, preserves or enhances a heritage resource, by minimising natural site erosion or facilitating non-destructive public use, for example. More commonly, development impacts are of an adverse nature and can include:

- destruction or alteration of all or part of a heritage site;
- isolation of a site from its natural setting; and / or
- introduction of physical, chemical or visual elements that are out of character with the heritage resource and its setting.

Beneficial and adverse impacts can be direct or indirect, as well as cumulative, as implied by the examples. Although indirect impacts may be more difficult to foresee, assess and quantify, they must form part of the assessment process. The following assessment criteria have been used to assess the impacts of the proposed development on possible identified heritage resources:

Criteria	Rating Scales	Notes
Nature	Positive	An evaluation of the type of effect the construction, operation and management of the proposed development would have on the heritage resource.
	Negative	
	Neutral	
Extent	Low	Site-specific affects only the development footprint.
	Medium	Local (limited to the site and its immediate surroundings, including the surrounding towns and settlements within a 10 km radius);
	High	Regional (beyond a 10 km radius) to national.
Duration	Low	0-4 years (i.e. duration of construction phase).
	Medium	5-10 years.
	High	More than 10 years to permanent.
Intensity	Low	Where the impact affects the heritage resource in such a way that its significance and value are minimally affected.
	Medium	Where the heritage resource is altered, and its significance and value are measurably reduced.
	High	Where the heritage resource is altered or destroyed to the extent that its significance and value cease to exist.
Potential for impact on irreplaceable resources	Low	No irreplaceable resources will be impacted.
	Medium	Resources that will be impacted can be replaced, with effort.
	High	There is no potential for replacing a particular vulnerable resource that will be impacted.
Consequence, (a combination of extent, duration, intensity, and the potential for impact on irreplaceable resources).	Low	A combination of any of the following: - Intensity, duration, extent and impact on irreplaceable resources are all rated low. - Intensity is low and up to two of the other criteria are rated medium. - Intensity is medium and all three other criteria are rated low.
	Medium	Intensity is medium and at least two of the other criteria are rated medium.

Criteria	Rating Scales	Notes
	High	Intensity and impact on irreplaceable resources are rated high, with any combination of extent and duration. Intensity is rated high, with all the other criteria being rated medium or higher.
Probability (the likelihood of the impact occurring)	Low	It is highly unlikely or less than 50 % likely that an impact will occur.
	Medium	It is between 50 and 70 % certain that the impact will occur.
	High	It is more than 75 % certain that the impact will occur, or it is definite that the impact will occur.
Significance (all impacts including potential cumulative impacts)	Low	Low consequence and low probability. Low consequence and medium probability. Low consequence and high probability.
	Medium	Medium consequence and low probability. Medium consequence and medium probability. Medium consequence and high probability. High consequence and low probability.
	High	High consequence and medium probability. High consequence and high probability.

3.3 Oral history

Where possible, people from local communities would be interviewed to obtain information relating to the surveyed area.

3.4 Report

The results of the desktop research and field survey are compiled in this report. The identified heritage resources and anticipated direct, indirect, and cumulative impacts that the development of the proposed project may have on the identified heritage resources will be presented objectively. Alternatives, should any significant sites be impacted adversely by the proposed project, are offered. All effort will be made to ensure that all studies, assessments and results comply with the relevant legislation and the code of ethics and guidelines of the Association of South African Professional Archaeologists (ASAPA). The report aims to assist the developer in managing the documented heritage resources in a responsible manner, and to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999).

4. PROJECT OVERVIEW

UBIQUE Heritage Consultants were appointed by EnviroAfrica cc as independent heritage specialists in accordance with Section 38 of the NHRA and the National Environmental Management Act 107 of 1998 (NEMA), to conduct a cultural heritage assessment to determine the impact of the proposed development of Groblershoop township, Portion 16 of the Farm Boegoebergnedersetting RE/48 in the !Kheis Local Municipality, on any sites, features, or objects of cultural heritage significance.

The project entails the expansion and formalisation of the Groblershoop Community. A total of 1500 new erven will be created in an area positioned between the western and eastern segments of the town, perfect for integrated and infill planning. The size of the study area is 95 ha. Groblershoop is located 120 km southeast of Upington.

4.1 Technical information

Project description	
Project name	!KHEIS LOCAL MUNICIPALITY TOWNSHIP EXPANSION: GROBLERSHOOP
Description	The expansion and upgrade of housing and infrastructure at Groblershoop township in the !Kheis Local Municipality and within the ZF Mgcawu District Municipality in the Northern Cape Province. Reference: NC/21/2018/PP
Developer	
!Kheis Local Municipality in cooperation with the Barzani group and Macroplan Regional and Town Planners	
Contact information	Groblershoop Community, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.
Development type	Housing (Township expansion)
Landowner	
!Kheis Local Municipality	
Contact information	054-332 3642 or 054- 833 9500
Consultants	
Environmental	EnviroAfrica cc.
Heritage and archaeological	UBIQUE Heritage Consultants
Paleontological	Banzai Environmental
Property details	
Province	Northern Cape
District municipality	ZF Mgcawu
Local municipality	!Kheis
Topo-cadastral map	1:50 000 2821DD
Farm name	Portion 16 of the Farm Boegoeberg Settlement, No. 48
Closest town	Groblershoop
GPS Co-ordinates	28°54'32.64"S; 21°59'47.71"E
Property size	
Development footprint size	95 ha

Land use	
Previous	Agriculture
Current	Agriculture, on-site landfill and sewage dams used by Groblesrhoop, and an abattoir.
Rezoning required	Yes
Sub-division of land	Yes (1500 erven)

Development criteria in terms of Section 38(1) NHRA	Yes/No
Construction of a road, wall, power line, pipeline, canal or other linear forms of development or barrier exceeding 300m in length.	Yes
Construction of bridge or similar structure exceeding 50m in length.	No
Construction exceeding 5000m ².	Yes
Development involving three or more existing erven or subdivisions.	Yes
Development involving three or more erven or divisions that have been consolidated within the past five years.	Yes
Rezoning of site exceeding 10 000m ².	Yes
Any other development category, public open space, squares, parks, recreation grounds.	No

Figure 1 *Proposed township expansion at Groblershoop, !Kheis Local Municipality. Image provided by Macroplan.*

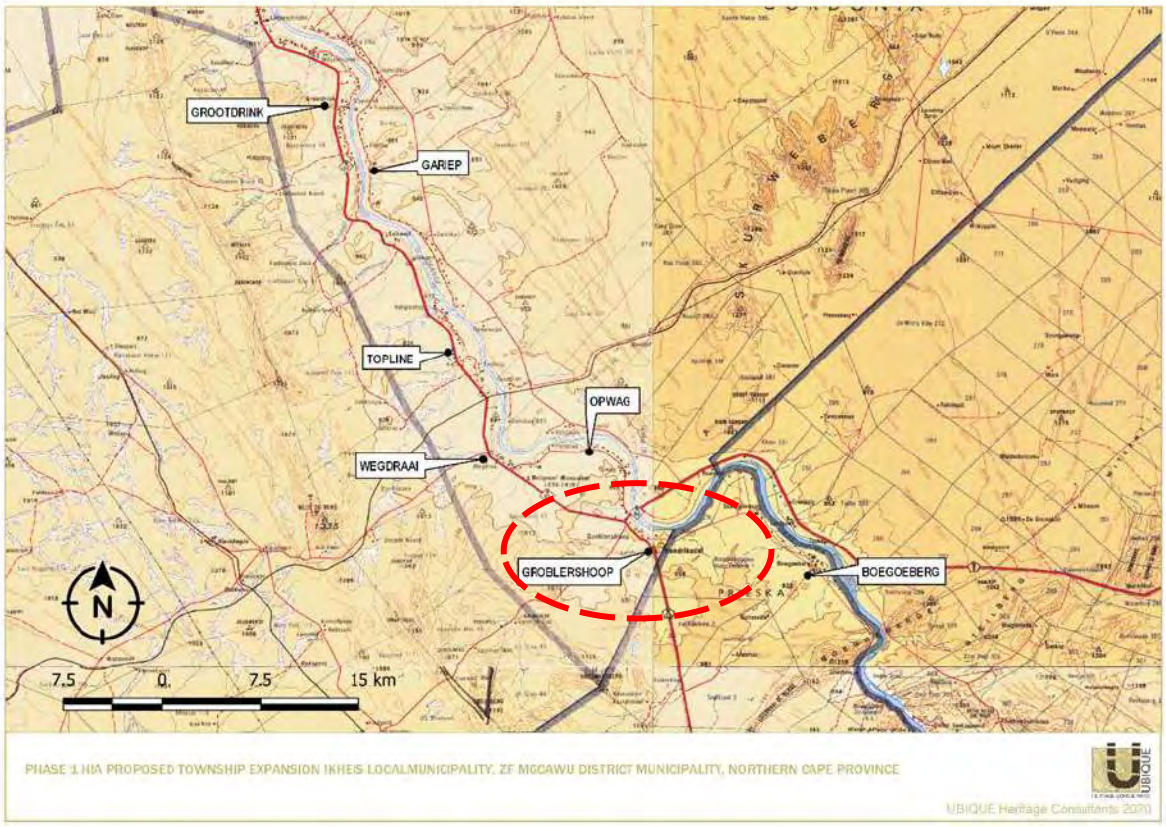


Figure 2 *Regional locality of the development footprint, Groblershoop, !Kheis Local Municipality indicated on 1: 250 000 WGS2820-2920.*

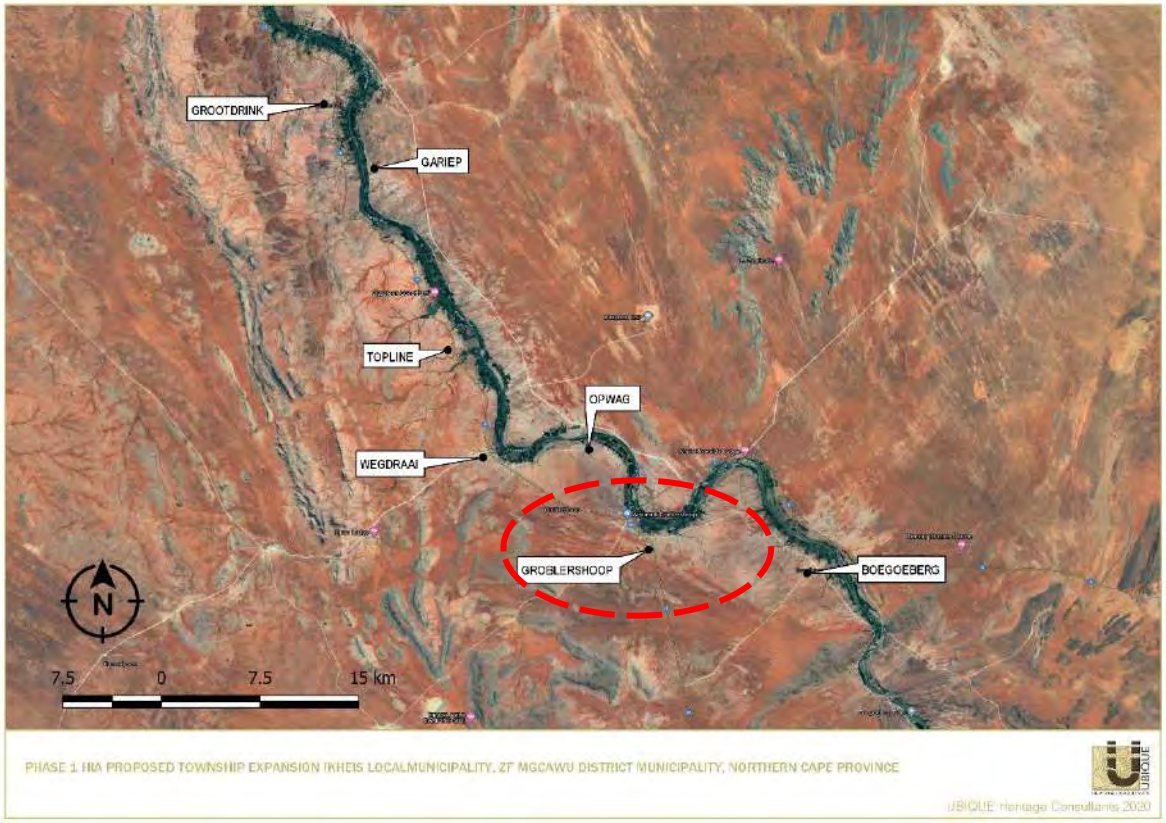


Figure 3 *Regional locality of the development footprint, Groblershoop, !Kheis Local Municipality indicated on Google Earth Satellite imagery.*

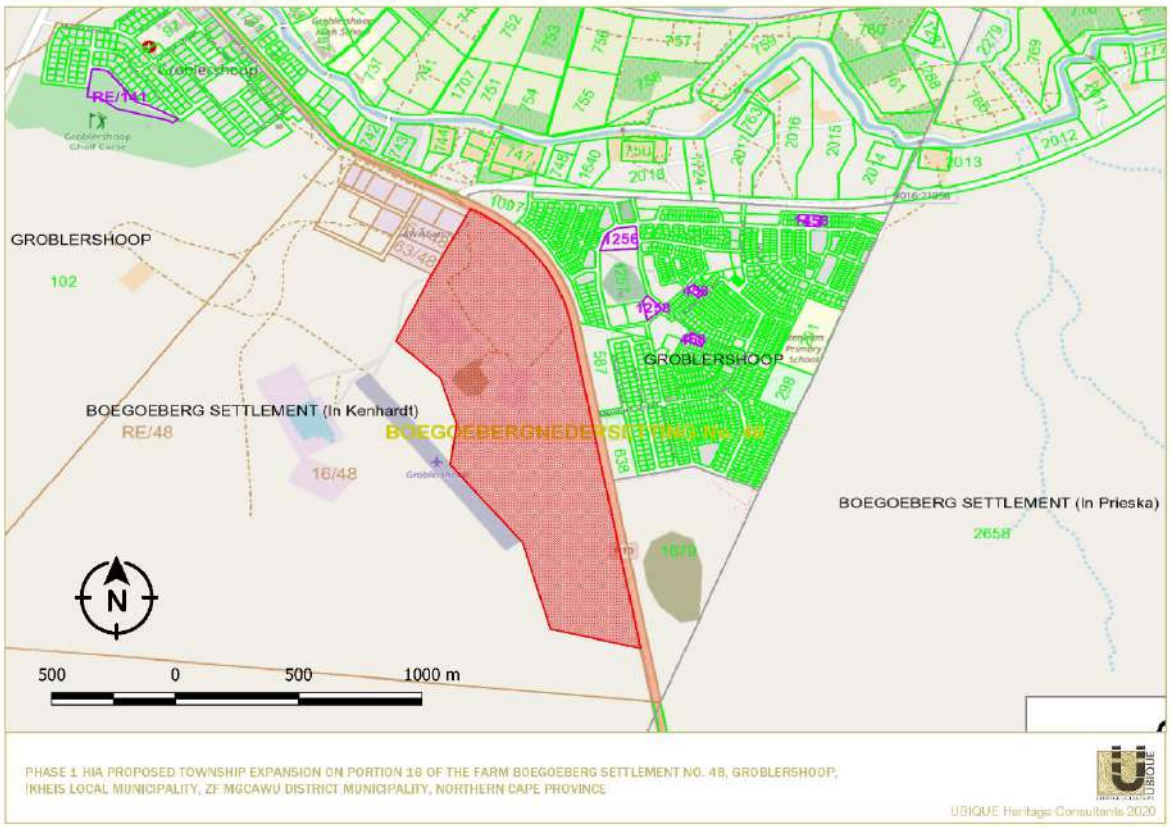


Figure 4 *Locality of the development footprint, Groblershoop, !Kheis Local Municipality indicated on Chief Surveyor-General ArcGIS Web Map (source https://csg.esri-southafrica.com/)*

Figure 5 *Locality of the development footprint Groblershoop, !Kheis Local Municipality indicated on Google Earth Satellite imagery.*

4.2 Description of the affected environment

The development area falls within Bushmanland Arid Grassland. It is characterised by extensive to irregular plains on a slightly sloping plateau. The white grass (*Stipagrostis* species) dominated grassland gives this vegetation type the character of semidesert 'steppe'. In places, low shrubs of *Salsola* change the vegetation structure. Vegetation identified in the development footprint includes camel thorn trees *(Acacia erioloba*), blackthorn trees (*Acacia mellifera*), silky bushman grass (*Stipagrostis uniplumis*), three thorn/driedoring (*Rhigozum trichotomum*), skaapbossie (*Aizoon schellenbergii*), shepherd tree (*Boscia albitrunca*), suurgras (*Enneapogon desvauxii*), tall bushman grass (*Stipagrostis hirtigluma*), silky bushman grass (*Stipagrostis uniplumis*), kortbeen boesmangras (*Stipagrostis obtuse*), pencil milkbush (*Euphorbia lignose*), *Aloe (Aloe argenticuada), and* Prosopis (*Prosopis glandulosa)*. The soils of the area are mostly red-yellow freely drained apedal soils (Mucina & Rutherford 2006). There are deposits of banded ironstone formation (BIF), calcrete, quartz, quartzite, and shale on the surface.

The study area consists of flat open vacant fields with a few trees scattered throughout the footprint. The terrain is predominantly level, with a slight slope towards the west and south in the southern section of the study area. The development footprint is bounded in the north by a gravel road, the Groblershoop abattoir and townscape, in the south by vacant land, in the west by an airstrip and open veldt, and in the east by the N10 national road. Anthropogenic disturbances are present throughout the development footprint. Effluent from the abattoir wastewater dams in the northwestern to the southwestern section of the footprint has created "wetlands" in this area. Abandoned dried-up wastewater dams, as well as rubbish dumps, are situated in the central northern area of the development footprint. Animal kraals and holding pens are located in at least two instances on the site footprint. The southern half of the site footprint is mostly undisturbed. The site was accessed from the N10 in the northeast.

Figure 6 *Views of the affected development area.*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5. HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

5.1 Region

The Northern Cape is rich in archaeological sites and landscapes that reflect the complex South African heritage from the Stone Age to Colonial history.

5.1.1 Stone Age

The Stone Age is the period in human history when lithic material was mainly used to produce tools (Coertze & Coertze 1996). In South Africa, the Stone Age can be divided into three periods. It is, however, important to note that dates are relative and only provide a broad framework for interpretation. The division of the Stone Age, according to Lombard et al. (2012) is as follows:

Earlier Stone Age: >2 000 000 - >200 000 years ago
Middle Stone Age: <300 000 - >20 000 years ago
Later Stone Age: <40 000 - until the historical period.

In short, the Stone Age refers to humans that mainly utilised stone as their technological marker. Each of the sub-divisions represents a group of industries where the assemblages share attributes or common traditions (Lombard et al. 2012). The ESA is characterised by flakes produced from pebbles, cobbles and percussive tools, as well as objects created later during this period such as large hand axes, cleavers and other bifacial tools (Klein 2000). The MSA is associated with small flakes, blades and points. The aforementioned are commonly inferred to have been made and utilised for hunting activities and had numerous functions (Wurz 2013). Lastly, the LSA is characterised by microlithic stone tools, scrapers and flakes (Binneman 1995; Lombard et al. 2012). The LSA is also associated with rock art. Numerous LSA rock art sites, mainly in the form of rock engravings and paintings have been identified in the Northern Cape (Beaumont 2008; Kruger 2018; Morris 1988). These sites are commonly found on slopes, hilltops, rocky outcrops and occasionally in river beds (Kruger 2018). Banded ironstone occurs on several sites throughout the Northern Cape and appears to have been a favoured raw material for making stone tools due to its superior flaking qualities (Morris 2012). Prominent sites that exemplify these periods in the Nama-Karoo Biome are Rooidam and Bundu Farm (Earlier Stone Age and Middle Stone Age), and Biesje Poort 2, Bokvasmaak 3, Melkboom 1, Vlermuisgat, and Jagtpan 7 (Later Stone Age) (Lombard et al. 2012).

Within the region, Stone Age sites and complexes have been, and are still being investigated in some detail. For instance, in the Kathu landscape, the longest preserved lithostratigraphic and archaeological sequence of human occupation has been documented and excavated. Evidence of 500 000-year-old hafted stone points, ancient specularite working (and mining), and associated Ceramic Later Stone Age material have been recorded on the eastern side of Postmasburg and Doornfontein. Older transitional ESA/MSA Fauresmith sites at Lyly Feld, Demaneng, Mashwening, King, Rust & Vrede, Paling, Gloucester and Mount Huxley have been recorded (Beaumont 2004; Beaumont 2013; Beaumont & Morris 1990; Beaumont & Vogel 2006; Morris 2005; Morris & Beaumont 2004; Porat et al. 2010; Thackeray et al. 1983; Walker et al. 2014; Wilkins et al. 2012).

Beaumont et al. (1995) commented that thousands of square kilometres of Bushmanland are covered by low-density lithic scatters. It is therefore not surprising that Stone Age sites and lithic scatters were identified by CRM practitioners between the Garona substation and the Gariep/Orange River in numerous surveys conducted during the recent years. Scatters of MSA material have been recorded close to Griekwastad, Hotazel. Postmasburg and Kenhardt, Pofadder, Marydale, and in the Upington district (Dreyer 2006, 2012, 2014; Pelser & Lombard 2013; PGS Heritage 2009, 2010; Webley 2013). MSA and LSA tools, as well as rock engravings, were also found at Putsonderwater, Beeshoek and Bruce (Morris 2005; Snyman 2000; Van Vollenhoven 2012b; Van Vollenhoven 2014).

Archaeological surveys have shown that rocky outcrops, hills, drainage lines, riverbanks and confluences, are prime localities for archaeological finds (Lombard 2011). Sites can likewise be found close to local sources of highly-prized raw materials such as previously mentioned banded iron formations (BIF), as well as jaspilite and specularite (Morris 2012; Kruger 2015; 2018). If any such features occur in the study area, Stone Age manifestations can be anticipated.

5.1.2 Iron Age

The Iron Age (IA) is characterised by the use of metal (Coertze & Coertze 1996: 346). There is some controversy about the periods within the IA. Van der Ryst & Meyer (1999) have suggested that there are two phases within the IA, namely:

- Early Iron Age (EIA) 200 – 1000 AD
- Late Iron Age (LIA) 1000 – 1850 AD

However, Huffman (2007) suggests instead that there are three periods within the Iron Age; these periods are:

- Early Iron Age (EIA) 250 – 900 AD
- Middle Iron Age (MIA) 900 – 1300 AD
- Late Iron Age (LIA) 1300 – 1840 A.D

Thomas Huffman believes that a Middle Iron Age should be included within this period. His dates have been widely accepted in the IA field of archaeology.

The South African Iron Age consists of farming communities who had domesticated animals, cultivated plants, manufactured, and made use of ceramics and beads, smelted iron for weapons and manufactured tools (Hall 1987). Iron Age people were often mixed farmers/agropastoralists. These agropastoralists generally chose to live in areas with sufficient water for domestic use along with arable soil that could be cultivated with an iron hoe. Most Iron Age (IA) settlements were permanent settlements, consisting of features such as houses, raised grain bins, storage pits and animal kraals/byres this is in contrast to the temporary camps of pastoralists and hunter-gatherers (Huffman 2007). It is evident in the archaeological record that IA groups had migrated with their material culture (Huffman 2002).

The majority of the IA groups in southern Africa preferred to occupy the central and eastern parts of southern African from about 200 AD. The San and Khoi remained in the western and southern parts (Huffman 2007; Van Vollenhoven 2014). IA sites are scarce, but not unheard-of in the Northern Cape. IA sites have predominantly been recorded in the northeastern part of the province. Kruger (2018) suggested that environmental factors delegated the spread of IA farming westwards during the 17th century. Settlement in the Northern Cape was constrained mainly to the areas east of the Langeberg Mountains. The Later Iron Age (LIA) was accompanied by extensive stone walled settlements, such as the Thlaping capital Dithakong, approximately 40 km north of Kuruman (De Jong 2010). The Sotho-Tswana and Nguni speaking societies, who are the descendants of the LIA mixed farming communities, moved into a region already sparsely inhabited by LSA Khoisan groups. De Jong (2010) commented that LIA communities eventually assimilated many LSA Khoisan groups, and only a few had managed to survive independently. Some of the surviving groups included the Koranna and the Griqua. This period of contact has often been referred to as the Ceramic LSA. It is represented by sites such as the earlier mentioned Blinkklipkop specularite mine near Postmasburg and Kathu Pan (De Jong 2010). LIA people briefly utilised the area close to the Orange River in the Northern Cape, mining copper, and there is even evidence of an IA presence as far as the Upington area in the 18th century (Kruger 2018; Van Vollenhoven 2014).

5.1.3 Historical period

The historical period within the region coincides with the incursion of white traders, hunters, explorers, and missionaries into the interior of South Africa. Buildings and structures associated with the early missionaries, travellers, and traders such as PJ Truter's and William Somerville (arriving in 1801), Donovan, Burchell and Campbell, James Read (arriving around 1870) William Sanderson, John Ryan and John Ludwig's (De Jong 2010; Snyman 2000) arrival during the 19th century, and the settlement of the first white farmers and towns, are still evident in the Northern Cape. Numerous heritage reports that provide a synthesis of the incursions of travellers, missionaries and the early European settlers have been captured on the SAHRIS database.

San hunter-gatherer groups utilised the landscape for thousands of years, and Khoi herders moved into South Africa with their cattle and sheep approximately 2000 years ago. With the arrival of the Dutch settlers in the Cape in the mid-17th century, clashes between the Europeans and Khoi tribes in the Cape Peninsula resulted in the Goringhaiqua and Goraxouqua migrating north towards the Gariep/Orange River in 1680. These tribes became collectively known as the Korannas, living as small tribal entities in separate areas (Penn 2005).

Because of its distance from the Cape Colony, this arid part of South Africa's interior was generally not colonised until relatively recent. According to history, the remote northern reaches of the Cape Colony were home to cattle rushers, gunrunners, river pirates and various manner of outlaws. Distribution of land to colonial farmers only occurred from the 1880s onwards when Government-owned land was surveyed, divided into farms, and transferred to farmers. More permanent large-scale settlement however only started in the late 1920s, and the first farmsteads were possibly built during this period. The region remained sparsely populated until the advent of the 20th century (De Jong 2010, Penn 2005).

The region has been the backdrop to various incidents of conflict. Numerous factors such as population growth, increasing pressure on natural resources, the emergence of power blocs, attempts to control trade, and the emergence of the Griquas, and penetration of the Koranna and early white communities from the south-west resulted in a period of instability in the Northern Cape. With the introduction of loan farms, in the second half of the 18th century, an influx of newcomers such as trekboers, European game hunters and livestock thieves contributed to the volatility and sociocultural stress and transformation in the region (Mlilo 2019).

The *Difaqane/Mfecane*, which began in the late-18th century, affected the Northern Cape Province around 1820, which was much later than the rest of southern Africa (De Jong 2010; Mlilo 2019). During this time, there was an incursion of displaced refugees associated with the Fokeng, Tlokwa, Hlakwana and Phuting groups into the northeast (De Jong 2010). The arrival of large numbers of Great Trek Boers from the Cape Colony to the borders of Bechuanaland and Griqualand West in 1836 caused friction with many Tswana groups and the missionaries of the London Mission Society. The conflict between Boer and Tswana communities escalated in the 1860s and 1870s when the Koranna and Griqua communities and the British government became involved. The Koranna wars took place during 1879-1880.

According to Breutz (1953, 1954), and Van Warmelo (1935), several Batswana tribes, including the different Thlaping and Thlaro sections as well as other smaller groups, take their 18th and 19th-century roots back to the area around Groblershoop, Olifantshoek, the Langeberg (Majeng) and Korannaberg ranges in the western part of the region. After Britain annexed Bechuanaland in 1885, the land of the indigenous inhabitants was limited to a few reserves. After the failed Tswana revolt in 1895, the British continued to divide the Tswana land up, and grant it to settling colonial farmers.

The Northern Cape was critical in the Anglo-Boer War (1899-1902), and significant battles took place within 120 km of Kimberley, including the battle of Magersfontein. Boer guerrilla forces roamed the entire Northern Cape region and skirmishes between Boer and Brits were regular occurrences. Furthermore, many graves in the region tell the story of battles fought during the 1914 Rebellion (Hopkins 1978).

5.2 Local

During 1778, Swedish-born traveller and explorer Hendrik Wikar reached the middle and lower reaches of the Orange River after a long land journey that started in Cape Town. As a deserter from the service of the Dutch East India Company, Wikar spent several years within the area and compiled a report of his experiences in exchange for a pardon (Ross 1975). He documented his encounters with Khoisan communities who called themselves the *Einiqua*, or *River People*. The *Einiqua* were divided into three “kraals”: the *Namnykoa* near the Augrabies Falls, the *Kaukoa* on islands west of Keimoes, and the *Aukokoa* of Kanoneiland and other islands to the east. Their kraals consisted of a considerable amount of sheep and cattle, and they collected plants, hunted game, and cultivated dagga but no other crops, according to Wikar (Ross 1975). Amongst the

pastoralist communities living on the islands were the *Anoe eis* people whom Wikar characterised as “Bushmen”. They possessed no domesticated stock, subsisted by fishing, game-trapping, hunting and the gathering of plant foods (Morris & Beaumont 1991). Colonel Robert Jacob Gordon who visited the area in 1779, however, remarked that they were actually *Einiqua* (i.e. Khoi) who had "lost their cattle as a result of an argument with the *Namneiqua* village (Morris & Beaumont 1991). The San and Khoekhoe hunter-gatherers in the region had reached a form of stability by the early 18th century (Mlilo 2019). The area west of the Langeberg and east of Upington was occupied by IA groups such as the BaTlaping. Their influence had reached as far down the river as Upington (Morris 1992).

By the 18th century, the *Basters* had focused on the Orange River (and Namaqualand) as destinations of sanctuary from colonial rule and social oppression present in the Cape Colony (Mlilo 2019; Van der Walt 2015). The term "*Baster*" characterises a group of people of mixed percentage (white and Khoekhoe or slave and Khoekhoe) who possessed property and who was culturally European. In 1882, the first 81 farms north of the Gariep/Orange River between Groblershoop and the Augrabies Falls were allocated almost exclusively to *Basters* (Morris 1992). During the late 19th century, more white people started moving to the Gordonia area, and by the turn of the century, some 13 Afrikaner families had settled at Keimoes (De Beer 1992; Van der Walt 2015). The aftermath of the scorched earth policy of the South African War (Anglo-Boer War), resulted in many farmers moving to new areas, in search of greener pastures, and settlement next to the Gariep/Orange River provided ample irrigation for one‘s crops.

Since the 1880s, the irrigation of the Orange River played a central role in the economic advancement of the area around Upington (Legassick 1996). The development of the canal systems was integral in irrigating extensive vineyards and orchards and the expansion of substantial agricultural enterprises within the area (Engelbrecht & Fivaz 2018). Dutch Reformed Church missionary Reverend C.H.W. Schröder and Special Magistrate for the Northern Border John H. Scott, are credited with formalising and extending the irrigation system. However, when Schröder first came to Upington in July 1883, there were already people in the area of Keimoes that used irrigation and planted fields. Moolman (1946) and Legassick (1996) mentions how the *Baster* farmers diverted river water to their gardens, albeit crudely. The *Basters*’ irrigation scheme has been attributed to the ingenuity of Abraham September. Legassick (1996) commented that "the small, white-painted, stone house where Abraham September lived when he undertook this work survives to this day, though the house and the land upon which it stands have long passed from the hands of the September family".

The early Portuguese sailors referred to the Gariep/Orange River as the St Anthonio, and Simon van der Stel marked it as the Vigiti Magna on maps from 1685. The elephant hunter Jacobus Coetzee called it the “*de Groote Rivier*” (the Great River) in 1760 and land-surveyor Carel Brink noted in 1761 that the river is known to the local island inhabitants as the Tyen Gariep (*Our River*). The missionary Campell also spoke of the Gariep, Gareeb, and Garib, as the name the Korannas used. On the evening of 17 August 1779, Robert Gordon took his rowboat out to the middle of the river, raised and toasted the Netherland’s flag, and proclaimed the river in the name of the Prince van Oranje. Maps from this date forward name the river as the Orange River (Oranjeriver), but colloquially it is still known as the Gariep or Grootrivier. !Kheis Municipality is named in recognition

of the first permanent residents of the area. !Kheis is a Khoi name meaning "a place where you live", or "a home".

De Jong (2010) classifies the cultural landscape along the Gariep/Orange River as predominantly historic farmland. In the Lower Orange River environment, farms display heritage features that typically occur in the district, such as their large size, irrigation furrows and pipelines, fences, tracks, farmsteads, and irrigated fields. Farmsteads are clustered close to rivers and primary roads (De Jong 2010). According to De Jong (2010), this class of landscape is of relatively low heritage sensitivity because it can absorb adverse effects of new development through some mitigation.

5.3 Topline (Saalskop), Wegdraai, Opwag, Groblershoop, Boegoeberg (Brandboom)

Various HIA and AIA reports have been conducted in and around the vicinity of Groblershoop, Boegoeberg, Opwag, Topline and Wegdraai study areas. These include, but are not limited to, the farms situated around the study areas. These farms include Buchuberg 263, Farm 292, Farm 387 Sanddraai 391, Bokpoort 390 and Kleinbegin 115.

5.3.1 Stone Age

The distribution of archaeological sites in the area has been characterised by Morris (2012) as stone artefacts along the Orange River; stone artefacts situated on the calcrete plain east of the Orange River; stone artefact scatters between dunes. Scatters of stone artefacts in and around the Groblershoop- Boegoeberg area have been reported by Beaumont (2008), Engelbrecht & Fivaz (2019) Dreyer (2006, 2012, 2013, 2015), Morris (2006, 2007, 2012, 2014), Orton & Webley (2013), Van der Walt (2012); Van Ryneveld (2007), Van Schalkwyk (2011, 2020), Van Vollenhoven (2014), and Webley (2013). The lithics that have in the area have been attributed to the ESA, MSA, and the LSA. Raw materials include chalcedony, jaspilite, quartzite and banded ironstone formation (BIF), as well as meta-quartzite. These scatters of lithics generally have little to no context. Predominantly heritage reports describe the recorded stone artefacts in the area to be of poor preservation and with limited heritage significance.

During his survey on the Farms Sanddraai and Bokpoort, situated in the vicinity of Saalskop (Topline) and Wegdraai, Morris (2012) reported MSA materials scattered amongst the calcrete surface deposits at the edges of borrow pits along the Loop 16 on the Sishen-Saldanha railway line. Dreyer's (2012) survey documents a single scatter of worked chalcedony, BIF, quartz and meta-quartz artefacts near a calcrete outcrop, with a substantial collection of flakes on the slopes along the River at Sanddraai.

Engelbrecht & Fivaz (2019) documented several MSA and LSA scatters on Farm 387, Portion 18, Groblershoop. Apart from low-density MSA and LSA artefact scatters, they documented moderate to high densities of MSA/LSA open lithic scatters with flakes, scrapers, cores, microliths and

incidences of local ceramics. Two sites recorded next to the Orange/Gariep River are probable hunter/herder sites, while five sites located on the dunes are believed to be knapping sites (Engelbrecht & Fivaz 2019). On the Farm 292 located near Groblershoop, Beaumont (2008) found low densities of Stone Age artefacts. On a section of Farm 387 Webley (2013) recorded background scatters of MSA artefacts of quartzite and BIF cobbles throughout the study area.

The majority of the artefacts across the landscape are randomly scattered. Nevertheless, it has been found that dense scatters of artefacts appear on and around small koppies. Several MSA and LSA stone artefact scatters have been identified on the eastern margins of the Orange River, Groblershoop (Webley 2013). The informally flaked hornfels cobbles and quartz flakes recorded along the shore may indicate the presence of LSA occupations (Webley 2013). The LSA scatters on the eastern shore, are believed to be of medium significance as they can potentially inform us “on hunter-gatherer and pastoralist settlement patterns along the River" (Webley 2013).

In Orton & Webley's (2013) report for the proposed Boegoeberg Hydropower station approximately 14.6 - 24 km south/southeast from the Brandboom/Boegoeberg study area, they mention several exciting finds. They found a small ephemeral archaeological Later Stone Age site on the sandy floodplain just downstream of the Boegoeberg Dam/Weir. This site consisted of a scatter of rocks that may likely have been used to anchor a hut, in association with two artefacts and one fragment of OES (Orton & Webley 2013). Orton & Webley (2013) recorded a cluster of stone walls on the south side of the river and the mountain slope close to the power line crossing point. The presence of pre-colonial stonewalling in the Groblershoop and Boegoeberg study areas is rare. This archaeological site is approximately 17 km from the Brandboom/Boegoeberg study area. The features included straight walls, semi-circles, L-shapes and small mounds of rocks. Very little associated archaeological material was discovered on the surface. They note in the report that these stone walls are typical of pre-colonial walling from the Karoo and some may have been hunting blinds. They also documented scatters of MSA stone artefacts above the cliff at Boegoeberg Weir/Dam, and a few LSA grindstones and other isolated artefacts in the area.

5.3.2 Historical period

It was around 1870 that the first Colonial farmers had settled in the Groblershoop area (Orton & Webley 2013). The town of Groblershoop originally developed on the farm Uitdraai (Engelbrecht & Fivaz 2019). Military topographic maps from 1908 and 1913 show a sparsely populated area, with numerous tracks across the sandy plains. There were halts situated at Zaalskop, Wegdraai, Uitdraai, Winstead and a hotel at Dabep. Access to water at Wegdraai was via a steep and narrow approach, at Uitdraai, there were a large well and tank situated underneath the house and a store where a supply of forage could be obtained. A weir was constructed across the Orange River at Buchuberg, with a turbine historic water turbine driven by solid-oak gears in the Orange River on the Farm Winstead. This historic water turbine was built in 1913 (Engelbrecht & Fivaz 2019). All along the eastern shore of the Orange River, locations of “native huts and kraals” are indicated.

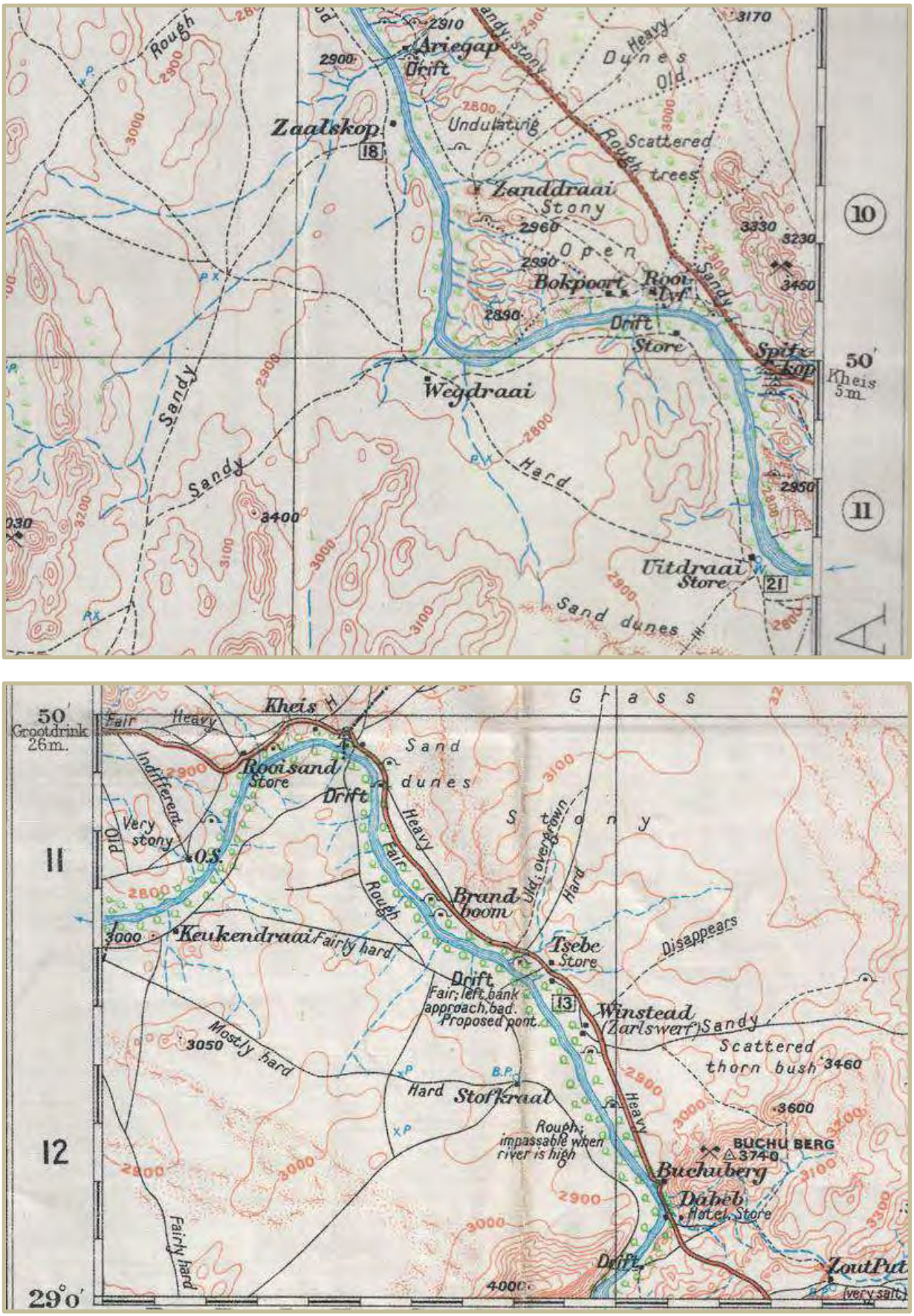

Figure 7 Detail of 1913 Topographical map of Upington, and detail of 1914 topographical map of Langeberg, available at https://digitalcollections.lib.uct.ac.za/

Groblershoop developed as a result of the development of the Boegoeberg Dam and water channels in 1929 (Van Schalkwyk 2019; 2020). The town was initially known as Sternham, with the first house dating to 1912. In 1935, the town was renamed to Groblershoop, after a former Minister of Agriculture: Mr PGW Grobler. Mr Grobler assisted in the development of the Boegoeberg Dam and the irrigation project in 1929. He had played a substantial role in this development and creating employment for the poor-white community and boosting progress in the region (Engelbrecht & Fivaz 2019). The idea for the construction of the weir and irrigation canal was first considered in 1872. Proposals for the project was rejected in 1896, and again in 1907, for being too expensive (Orton & Webley 2013). After about 20 years of preparatory work, the construction of the Boegoeberg Dam began in May 1929. The dam was completed in 1932, and the canal in 1934. Even children as young as nine years old were employed to work on the construction of the dam and irrigation canals. It is believed that about 50 people (39 being children) died during the construction of the project (Orton & Webley 2013). The Boegoeberg Dam itself is a significant heritage structure (Orton & Webley 2013).

Minimal artefacts and structures dating to the historical/colonial period have been recorded on sites in the vicinity of the Groblershoop and Brandboom/Boegoeberg study areas or on the farms surrounding Topline (Saalskop), Wegdraai, and Opwag. Nevertheless, AIA and HIA reports state that it is not uncommon to find colonial-era builds/artefacts in the area. Morris (2012) noted colonial-era traces such as the agricultural modification of the riverbank, a railway bridge, and a stone structure, close to the Orange River, on the farms of Sanddraai 391 and Bokpoort 390. During Webley's (2013) survey for the proposed construction of the Eskom Groblershoop Substation and the Garona-Groblershoop 132 kV powerline, she found a stone reservoir (25m x 25m) lined with plaster, with a gutter made of stone running around the margins to collect water. She notes that there were various rusted farm implements nearby (Webley 2013). Orton & Webley (2013) have noted that there are a few farm buildings in the area, such as a house dating to the late-19th or early-20th century, considered to be of high heritage significance. Another structure, built with traditional materials like sun-dried bricks, mud and mortar, plastered in modern cement in 1956 (date inscribed by the entrance steps) was documented.

5.2.3 Graves and Burials

During the construction of the Boegoeberg Dam, severe gastroenteritis and malaria resulted in the deaths of many children. Most of the headstones in the cemetery at the dam mark children's graves (https://graves-at-eggsa.org). Orton & Webley (2013) recorded an informal graveyard alongside the access road to Zeekoebaart. An isolated grave about one metre off the edge of the road, as well as two isolated graves in the sandy floodplain just downstream of the weir was also documented (Orton & Webley 2013). Several graves dating to the Second Anglo Boer War (1899-1902), belonging to the Dragoon mounted infantry unit, are present in the area (Van Vollenhoven 2014). Seven graves dating to the 1914 Rebellion have been recorded about 25 km from Groblershoop on the road to Griquastad (Webley 2013).

In 1956 Senator A. S. Brink of Keimoes donated archaeological objects to the South African Museum in Cape Town. Rudner (1971) wrote that the majority of the objects were found in 1934

on the former farm Grootdrink, between Upington and Prieska, during the construction of an irrigation canal from the Boegoeberg Dam. On the southern bank of the river, the flooding of the canal exposed old burials. The human remains were buried in a squatting (crouching) position with their arms folded in front of the legs. Along with the graves, several ostrich eggshell (OES) flasks, one filled with powdered specularite iron, OES beads and bored stone (one of them heart-shaped), several pots and other objects were discovered (Rudner 1971).

5.2.4 Oral history

No interviews with locals were conducted regarding the history of the area.

6. IDENTIFIED RESOURCES AND HERITAGE ASSESSMENT

6.1 Surveyed area

The area surveyed for the impact assessment was dictated by the Google Earth map of the development footprints provided by the client.

The pedestrian survey was conducted in predominantly 40-50 m transects. Areas that have been severely disturbed were surveyed in wider transects or only scoped. The survey extended beyond the development footprints to take into consideration the full impact of the development by investigating probable areas on the landscape adjacent to the development footprints that may contain heritage.

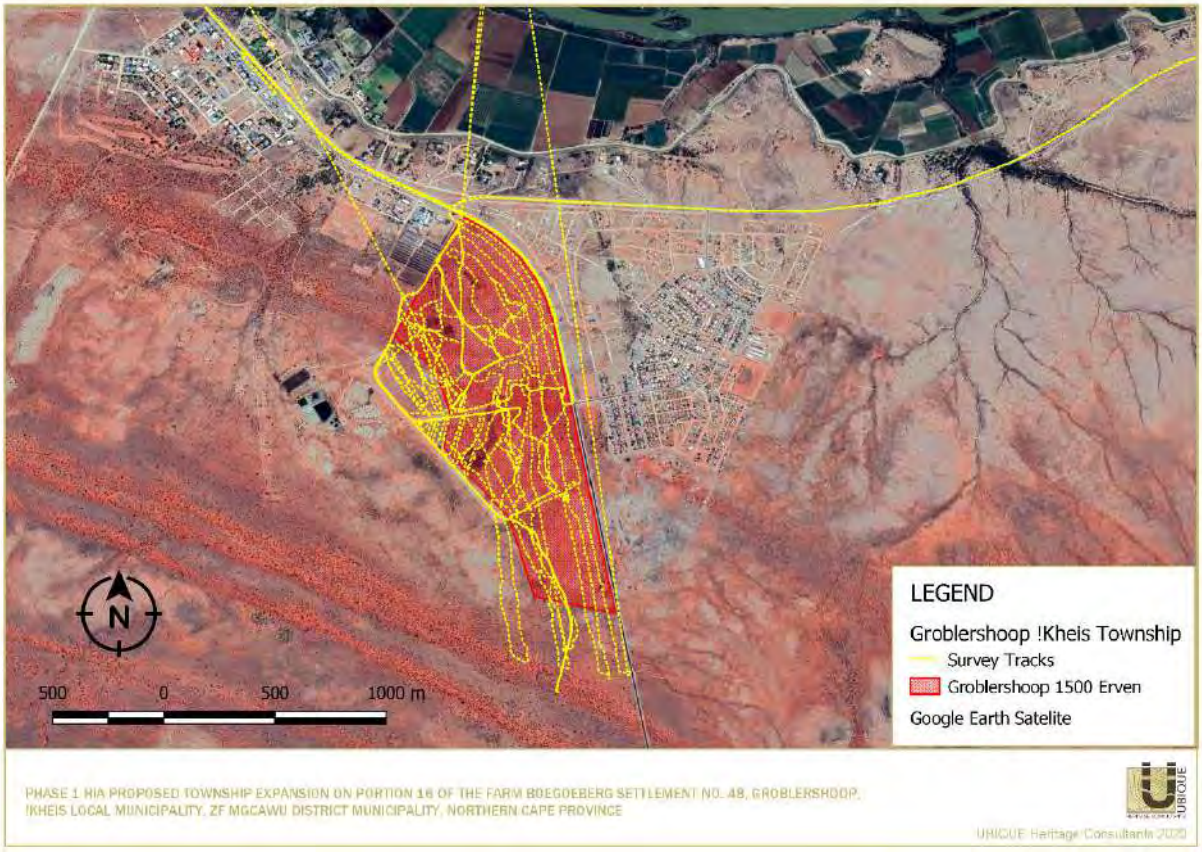

Figure 8 *Survey tracks across the development footprint.*

6.2 Identified heritage resources

HERITAGE RESOURCES RECORDING

Stone Age Resources Identified

Point ID & Site Name	Description		Period	Location	Field rating/ Significance/ Recommended Mitigation
WP 057 GBH001 Boegoeberg Settlement RE/48/16	Type of feature	Chunks and scraper	ESA/ MSA	**28° 54' 52.2" S 21° 59' 56.5" E**	Field Rating IV C Low significance No Mitigation Required
	Material	BIF			
	N in m².	3/200m²			
	Context	Scatter. No context			
	Additional				
WP 060 GBH002 Boegoeberg Settlement RE/48/16	Type of feature	Core, chunks and flake	ESA/ MSA	**28° 54' 44.4" S 21° 59' 46.3" E**	Field Rating IV C Low significance No mitigation
	Material	BIF			
	N in m².	3/100m²			
	Context	Scatter. No context			
	Additional				
WP 061 GBH003 Boegoeberg Settlement RE/48/16	Type of feature	Flakes, chunks and scraper	ESA/ MSA	**28° 54' 46.4" S 21° 59' 48.9" E**	Field Rating IV C Low significance No mitigation
	Material	BIF			
	N in m².	5/500m²			
	Context	Scatter. No context			
	Additional				
WP 062 GBH004 Boegoeberg Settlement RE/48/16	Type of feature	Flakes, scraper and chunks	ESA/ MSA	**28° 54' 37.6" S 21° 59' 46.6" E**	Field Rating IV C Low significance No mitigation
	Material	BIF			
	N in m².	6/100m²			
	Context	Scatter. No context			
	Additional				
WP 063 GBH005 Boegoeberg Settlement RE/48/16	Type of feature	Flakes, chunks and core	MSA/ LSA	**28° 54' 33.3" S 21° 59' 45.8" E**	Field Rating IV C Low significance No mitigation
	Material	BIF and quarzite			
	N in m².	14/50m²			
	Context	Scatter. No context			
	Additional	A total of 13 sherds of fine-grained, low-fired, thin-walled pottery recorded in association.			
WP 065 GBH006 Boegoeberg Settlement RE/48/16	Type of feature	Flakes, scraper and chunks	ESA/ MSA	**28° 54' 48.9" S 21° 59' 53.8" E**	Field Rating IV C Low significance No mitigation
	Material	BIF			
	N in m².	6/500m²			
	Context	Scatter. No context			
	Additional				
WP 066 GBH007 Boegoeberg Settlement RE/48/16	Type of feature	Chunks and flakes	ESA/ MSA	**28° 54' 39.2" S 21° 59' 37.0" E**	Field Rating IV C Low significance No mitigation
	Material	BIF			
	N in m².	6/500m²			
	Context	Scatter. No context			
	Additional				
WP 068 GBH008 Boegoeberg Settlement RE/48/16	Type of feature	Flakes, unfinished handaxe, chunks and blade	ESA/ MSA	**28° 54' 25.6" S 21° 59' 46.7" E**	Field Rating IV C Low significance No mitigation
	Material	BIF and quarzite			
	N in m².	5/500m²			
	Context	Scatter. No context			
	Additional				

WP 069 GBH009 Boegoeberg Settlement RE/48/16	Type of feature	Scraper, flakes and chunks	ESA/ MSA	**28° 54' 20.5" S 21° 59' 49.7" E**	Field Rating IV C Low significance No mitigation
	Material	BIF			
	N in m².	8/500m²			
	Context	Scatter. No context			
	Additional				
WP 070 GBH010 Boegoeberg Settlement RE/48/16	Type of feature	Flakes and chunk	ESA/ MSA	**28° 54' 22.1" S 21° 59' 47.6" E**	Field Rating IV C Low significance No mitigation
	Material	BIF			
	N in m².	6/100m²			
	Context	Scatter. No context			
	Additional				

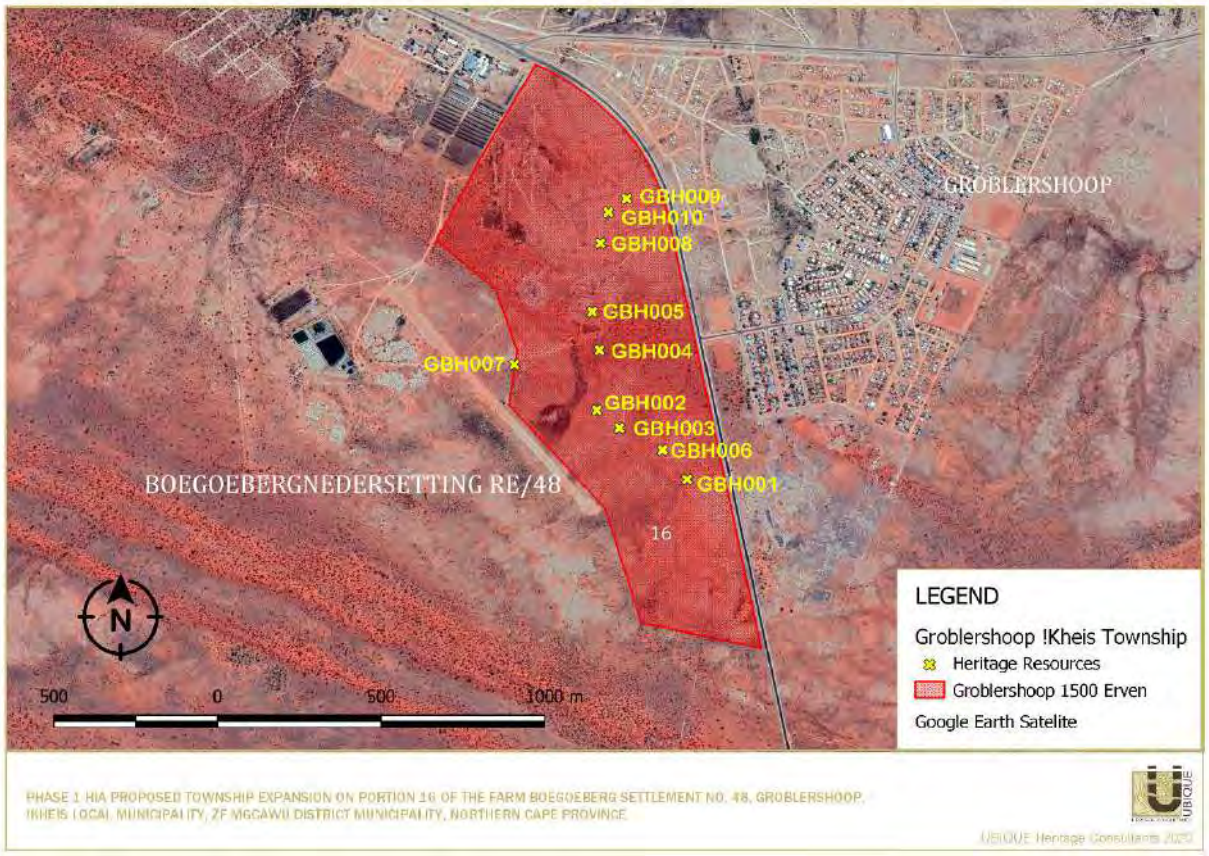

Figure 9 *Distribution of identified heritage resources across Groblershoop township footprint, Farm Boegoebergnedersetting No. 48.*

6.3 Discussion

6.3.1 Archaeological features

A total of ten occurrences of background scatter lithic material was found across the surveyed area of Portion 16 of Farm Boegoebergnedersetting RE/48. The lithic assemblages consist of very few formal tools, mostly large untrimmed flakes, geometrically shaped segments, and knapping debitage like chunks, chips. However, some cores, a few scrapers, blades, and an unfinished hand axe, was recorded as well. Raw materials include banded ironstone formation (BIF), cryptocrystalline silicates (CCS) and quartzite. At GBH005, a higher-density surface scatter with lithics and indigenous ceramics was documented at the site where a dune has been razed to make way for wastewater dams. The ceramics are undecorated, low fired, thin-walled, mineral tempered

and attributed to hunters-with-livestock/herders (Lombard & Parsons 2008; Mitchell 2002). Some LSA microliths were also found in association with the ceramics. The process of levelling the dune destroyed all heritage evidence and context/matrix the cultural material could have had. The cultural material documented across the development footprint represents a mixture of ESA, MSA, and LSA artefacts. Surface sites often exhibit a palimpsest of prehistoric utilisation and may, therefore, contain lithics from different periods in the Stone Age succession. The found lithic material shows various degrees of weathering and are without substantial archaeological context or matrix, and are therefore deemed of minor scientific importance, and not conservation worthy (NCW).

These sites are given a 'General' Protection C (Field Rating IV C). This means these sites have been sufficiently recorded (in Phase 1). It requires no further action.

6.3.2 Graves

No graves were found within the study area. The formal Groblershoop cemetery is situated far from the development footprint, east of the N10.

Figure 10 *Photographic selection of archaeological material recorded.*

6.3.3 Palaeontological resources

The Groblershoop study area is underlain by Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group) as well underlying Precambrian rocks of the Transvaal Supergroup. According to the SAHRIS PalaeoMap, the Palaeontological Sensitivity of the Kalahari Group is low, and that of the underlying Precambrian Transvaal Supergroup is moderate. However, the underlying Precambrian Transvaal Supergroup cherts, dolomites and iron formations are too deep to be affected by the proposed development (Butler 2020). Elize Butler from Banzai Environmental conducted a full paleontological desktop study for this project (see Appendix 1).

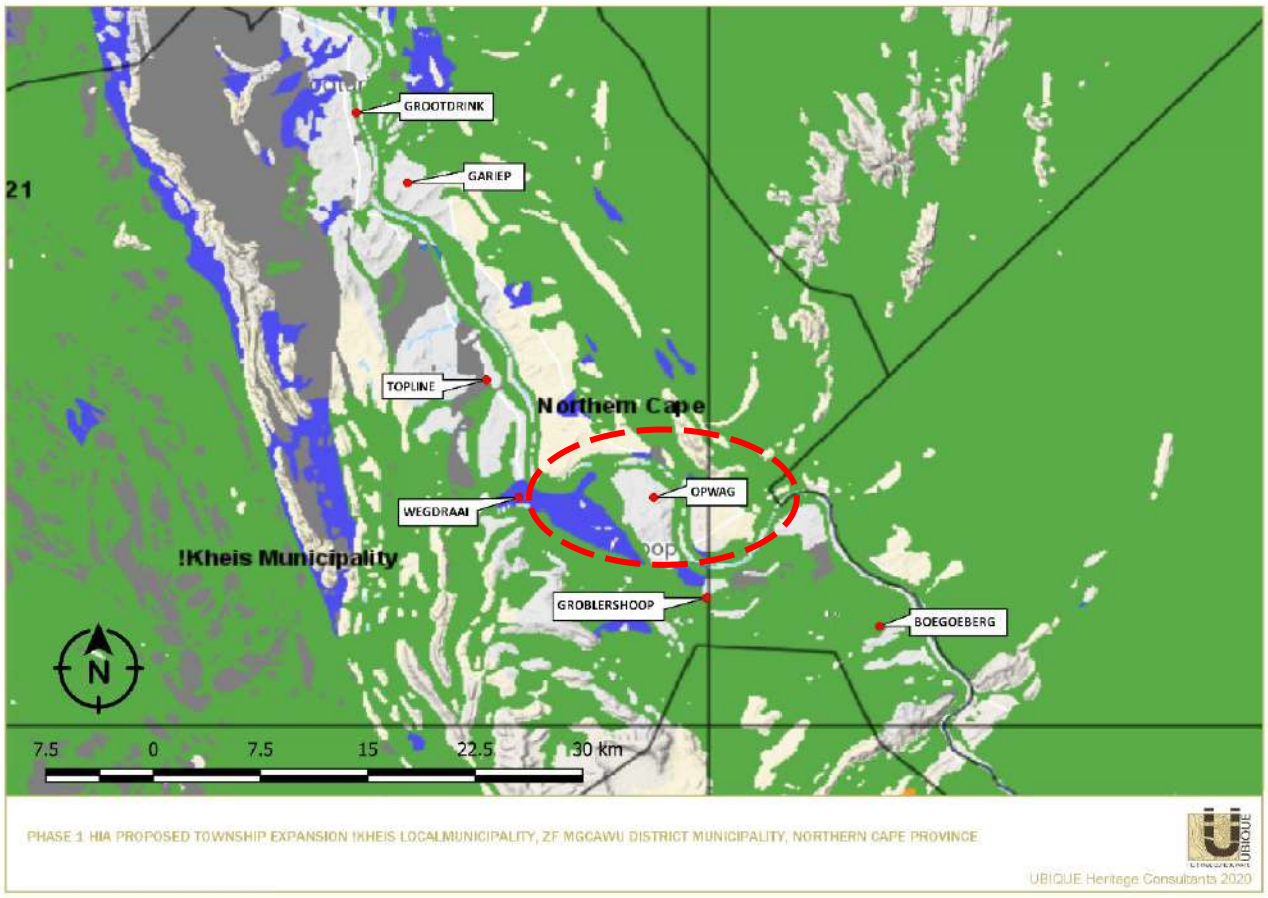

Figure 11 *SAHRIS PalaeoSensitivity Map, indicating Moderate (green), Low (blue), Insignificant/Zero (grey), and Unknown (clear) palaeontological significance in the study area (https://sahris.sahra.org.za/map/palaeo).*

7. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

Description	Development Impact		Mitigation	Field rating/ Significance
Archaeological				
1. The ten occurrences of ESA/MSA/LSA surface scatters across the development footprint.	Nature	Negative	No mitigation required.	Field Rating IV C Low significance
	Extent	Low		
	Duration	High		
	Intensity	High		
	Potential of impact on irreplaceable resource	High		
	Consequence	High		
	Probability of impact	High		
	Significance	High		
Graves				
2. No graves were identified in proximity to the development footprint.	Nature	N/A	No mitigation required.	N/A
	Extent	N/A		
	Duration	N/A		
	Intensity	N/A		
	Potential of impact on irreplaceable resource	N/A		
	Consequence	N/A		
	Probability of impact	N/A		
	Significance	N/A		
Paleontological				
3. The Palaeontological Sensitivity of the Kalahari Group is low, and that of the underlying Precambrian Transvaal Supergroup is moderate	Nature	Neutral	No mitigation required. Chance Finds Protocol provided.	N/A
	Extent	Low		
	Duration	High		
	Intensity	Low		
	Potential of impact on irreplaceable resource	Low		
	Consequence	Low		
	Probability of impact	Low		
	Significance	Low		

The impact of the development will have a negative impact on the identified heritage resources on Portion 16 of the Farm Boegoebergnedersetting RE/48. The cultural material is without any substantial archaeological context and deemed not conservation worthy. The negative impact is, therefore, negligible. The probability of the development impacting on palaeontological heritage during the construction phase is regarded as minimal, and the significance of the impact occurring, low.

8. RECOMMENDATIONS

Based on the assessment of the potential impact of the development on the identified heritage, the following recommendations are made, taking into consideration any existing or potential sustainable social and economic benefits:

1. No significant heritage sites or features were identified within the surveyed sections of the new Groblershoop township, Portion 16 of the Farm Boegoebergnedersetting RE/48. The Early/Middle/Late Stone Age cultural material identified is not conservation worthy. No further mitigation is recommended with regards to these resources. Therefore, from a heritage point of view, we recommend that the proposed development can continue.

2. The Groblershoop cemetery is situated well outside the development footprint. This site is graded as IIIB and is of High Local Significance. No further mitigation is recommended with regards to these resources. No other graves were identified on the development footprint.

3. Due to the low palaeontological significance of the area, no further palaeontological heritage studies, ground-truthing and/or specialist mitigation are required. It is considered that the development of the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area (Butler 2020). If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol (Appendix A/11) must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected, and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carried out by a palaeontologist (Butler 2020).

4. Although all possible care has been taken to identify sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the assessment. If during construction, any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources are found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine 021 462 5402) must be alerted as per section 35(3) of the NHRA. If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Thingahangwi Tshivhase/Mimi Seetelo 012 320 8490), must be alerted immediately as per section 36(6) of the NHRA. A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contacted as soon as possible to inspect the findings. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance, a Phase 2 rescue operation may be required subject to

permits issued by SAHRA. UBIQUE Heritage Consultants and its personnel will not be held liable for such oversights or costs incurred as a result of such oversights.

9. CONCLUSION

This HIA has identified no significant heritage resources that will be impacted negatively by the proposed development. The proposed expansion of the Groblershoop township, on Portion 16 of the Farm Boegoebergnedersetting RE/48 in the !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape, may continue, provided the recommendations stipulated within this report, and the subsequent decision by SAHRA, are followed.

10. BIBLIOGRAPHY

ACRM 2016b. Archaeological Impact Assessment Proposed cultivation of vineyards on the Farm Bethesda 238/38 & 335/38 Louisevale, Upington Northern Cape. Unpublished report: Rondebosch.

ACRM. 2016a. Archaeological Impact Assessment Proposed industrial development on Erf 755 Olyvenhoutsdrift, near Upington Northern Cape. Unpublished report. Rondebosch.

Almond, J.E. & Pether, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc: Cape Town.

Beaumont, P. 2004. Kathu Pan and Kathu Townlands/ Uitkoms. In Morris, D. and Beaumont, P. *Archaeology in the Northern Cape: some key sites:* 50-53. McGregor Museum: Kimberley.

Beaumont, P. 2006. *Phase 1 Heritage Impact Assessment report on a Planned Extension of the Karos Township, Siyanda District Municipality, Northern Cape Province.* Unpublished report. McGregor Museum: Kimberley.

Beaumont, P. 2007. *Phase 1 Heritage Impact Assessment Report on the Farm Eureka 200 near Kimberley, Frances Baard District Municipality, Northern Cape Province.* Unpublished report. McGregor Museum: Kimberley.

Beaumont, P.B. & Morris, D. 1990. *Guide to archaeological sites in the Northern Cape*. McGregor Museum: Kimberley.

Beaumont, P.B. & Vogel, J.C. 2006. On a timescale for the past million years of human history in central South Africa. *South African Journal of Science* 102: 217-228.

Beaumont, P.B. 2006a. Phase 1 Heritage Impact Assessment Report on a Planned Residential Development Flanking Dakota Drive in Upington, //Khara Hais Municipality, Northern Cape Province. McGregor Museum: Kimberley.

Beaumont, P.B. 2006b. Phase 1 Heritage Impact Assessment Report on a Planned Extension of the Louisvaleweg Township, //Khara Hais Municipality, Northern Cape Province. McGregor Museum: Kimberley

Beaumont, P.B. 2006c. Phase 1 Heritage Impact Assessment Report on a Planned Extension Flanking Rondomstraat, //Khara Hais Municipality, Northern Cape Province. An unpublished report. McGregor Museum: Kimberley.

Beaumont, P.B. 2008. *Phase I Archaeological Impact Assessment Report on a Portion of the Farm 292 near Groblershoop, Karoo district Municipality, Northern Cape.* Unpublished report. Upington.

Beaumont, P.B. 2013. Phase 2 Archaeological Permit Mitigation Report on a 0.7ha Portion of the farm Bestwood 549, situated on the eastern outskirts of Kathu, John Taolo Gaetsewe District Municipality, Northern Cape Province. Unpublished report. Dennesig.

Beaumont, P.B., Smith, A.B. & Vogel, J.C. 1995. Before the Einiqua: the archaeology of the frontier zone. In Smith, A.B. (Ed.). *Einiqualand: Studies of the Orange River frontier*. University of Cape Town Press: Cape Town.

Binneman, J. F. 1995. *Symbolic construction of communities during the Holocene Later Stone Age in the South–Eastern Cape.* Unpublished PhD thesis. Johannesburg: University of the Witwatersrand.

Breutz, P.L. 1953. The tribes of the Rustenburg and Pilanesberg districts. Department of Native Affairs, *Ethnological Publications* No.28. Government Printer: Pretoria.

Breutz, P.L. 1954. The tribes of Marico District. Department of Native Affairs, *Ethnological Publications* No. 30. Government Printer: Pretoria.

Breutz, P.L. 1963. The tribes of the districts of Kuruman and Postmasburg. Department of Native Affairs, *Ethnological Publications* No. 49. Government Printer: Pretoria.

Butler, E. 2020. Palaeontological Desktop Assessment For The Proposed Groblershoop Township Expansion, !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Unpublished report. Banzai Environmental: Bloemfontein.

Coertze, P.J. & Coertze, R.D. 1996. *Verklarende vak woordeboek vir Antropologie en Argeologie*. R.D. Coertze: *Pretoria*.

De Bruyn, C. 2019. *Heritage Impact Assessment for the proposed mining rights on the farm Waterkloof 95 located between Griekwastad and Groblershoop in The Pixley Ka Seme District Municipality within the Northern Cape Province*. Unpublished report. NGT. Johannesburg, Northcliff.

De Jong, R.C. & Van Schalkwyk, J. 2010. Archaeological Impact Survey Report For The Land Use Change On Sections Of The Farm Vaalkoppies 40, Gordonia District, Northern Cape Province. Unpublished report. Cultmatrix: Pretoria.

De Jong, R.C. 2010. *Heritage impact assessment report: proposed manganese and iron ore mining right application in respect of the remainder of the farm Paling 434, Hay registration division, Northern Cape.* Unpublished report. Cultmatrix: Pretoria.

Deacon, H.J. & Deacon, J. 1999. *Human Beginnings in South Africa: Uncovering the secrets of the Stone Age.* David *Phillips* Publishers: Cape Town.

Deacon, H.J. & Deacon, J. 1999. *Human Beginnings in South Africa: Uncovering the secrets of the Stone Age.* David Phillips Publishers: Cape Town.

Dreyer, C. 2015. *First Phase Archaeological & Heritage Assessment Of The Proposed Bokpoort Ii 300mw Combined 2 X 75 Pv & 150 Mw Csp Tower Solar Development On The Remainder Of The Farm Bokpoort 390, Groblershoop, Northern Cape Province*. Unpublished report.

Dreyer, J. *2006*. First phase archaeological and cultural heritage assessment of the proposed Concentrated Solar Thermal Plant (CSP) at the farms Olyvenhouts Drift, Upington, Bokpoort 390 and Tampansrus 294/295, Groblershoop, Northern Cape. Unpublished EIA report. Bohlweki Consultants: Johannesburg.

Dreyer, J. 2006. *First phase archaeological and cultural heritage assessment of the proposed Concentrated Solar Thermal Plant (CSP) at the farms Olyvenhouts Drift, Upington, Bokpoort 390 and Tampansrus 294/295, Groblershoop, Northern Cape.* Unpublished EIA report. Bohlweki Consultants: Johannesburg.

Dreyer, J. 2006. *First phase archaeological and cultural heritage assessment of the proposed Concentrated Solar Thermal Plant (CSP) at the farms Olyvenhouts Drift, Upington, Bokpoort 390 and Tampansrus 294/295, Groblershoop, Northern Cape.* Unpublished EIA report. Bohlweki Consultants: Johannesburg.

Dreyer, J. 2008. *First phase archaeological and cultural heritage assessment of the proposed residential developments at a portion of the remainder of the farm Bestwood 459RD, Kathu, Northern Cape.* Unpublished report. EIA Report for Cultmatrix cc (Heritage Consultants) Pretoria and Rock Environmental Consulting, Pretoria.

Dreyer, J. 2008. *First phase archaeological and cultural heritage assessment of the proposed Bourke Project, ballast site and crushing plant at Bruce Mine, Dingleton, near Kathu, Northern Cape.* Unpublished report. EIA Report for MILNEX 189 cc, Schweizer Reneke.

Dreyer, J. 2012. *First phase archaeological and cultural heritage assessment of the proposed water pipeline from Sanddraai 391 to Bokpoort 390, Groblershoop, Northern Cape*. Unpublished EIA Report. SSI Engineers & Environmental 14 Consultants: Sandhurst.

Dreyer, J. 2012. *First phase archaeological and cultural heritage assessment of the proposed water pipeline from Sanddraai 391 to Bokpoort 390, Groblershoop, Northern Cape.* Unpublished EIA Report. SSI Engineers & Environmental 14 Consultants: Sandhurst.

Dreyer, J. 2013 (Revised). *First phase archaeological & heritage assessment of the proposed Garona – Ferrum transmission line, Northern Cape.* Unpublished report. EIA Report for Envirolution Consultants, Johannesburg.

Dreyer, J. 2013. 2013. First Phase Archaeological and Heritage Assessment of the housing developments at Melkstroom 563, Upington, Northern Cape. Report prepared for MDA Environmental Consultants: Bloemfontein.

Dreyer, J. 2014. *First phase archaeological & heritage assessment of the proposed Ferrum (Kathu) – Nieuwehoop (Kenhardt) 400kV transmission line, Northern Cape.* Unpublished report. EIA Report for Envirolution Consulting, Mondeor, Johannesburg.

Dreyer, J. 2014. *First phase archaeological & heritage investigation of the proposed mine prospecting at the remaining extent of the farm Inglesby 580 near Olifantshoek*, Unpublished report.

Dreyer, J. 2014. *First phase archaeological & heritage investigation of the proposed PV energy developments at the farm Sanddraai 391 near Groblershoop, Northern Cape Province.* Unpublished report. EIA Report for Royal Haskoning DHV, Woodmead, Gallo Manor.

Eldredge, E.A. 1987. Drought, famine and disease in nineteenth-century Lesotho. *African Economic History*, (16): 61-93.

Engelbrecht, J. & Fivaz, H. 2019. *Phase 1 HIA report Farm 387 portion 18 Groblershoop Northern Cape. Version 2.* Unpublished report. UBIQUE Heritage Consultants. Roodepoort.

Gaigher, S. 2012. *Heritage Impact Assessment Report, EIA Phase, Proposed establishment of the Karoshoek Valley Solar Park components on Sites 1.1, 1.3, 1.4, 2, 3, 4 & 5 on sites located south and east of Upington, Northern Cape Province*. Unpublished report. G&A Heritage. Limpopo.

Hall, M. 1987. *The changing past: farmers, kings and traders in southern Africa. 200-1860*. Cape Town: David Philip.

Huffman, T. 2002. Regionality in the Iron Age: the case of the Sotho-Tswana. *Southern African Humanities,* 14: 1–22.

Huffman, T. 2007. *Handbook to the Iron Age*. Pietermaritzburg: University of Kwazulu-Natal Press

Kaplan, J. 2008. *Phase 1 Archaeological Impact Assessment proposed construction of a Water Treatment Plant and Supply Pipeline from Keimoes to Kenhardt, Northern Cape Province.* Unpublished report. Agency for Cultural Resource Management: Riebeek West.

Kaplan, J. 2012. *Archaeological Impact Assessment, the proposed Keren Energy Keimoes Solar Farm on Erf 666 Keimoes, Northern Cape Province.* Unpublished report. Agency for Cultural Resource Management: Rondebosch.

Kaplan, J. 2013. *Archaeological Impact Assessment, the proposed upgrading of the Louisvale Road Waste Water Treatment Works in Louisvale, Upington*, Northern Cape Province. Unpublished report. Agency for Cultural Resource Management: Rondebosch.

Kaplan, J. 2013a. Archaeological Impact Assessment the proposed upgrading of the KWV Upington Effluent Management Facility, Northern Cape Province. Report prepared for EnviroAfrica cc. ACRM: Cape Town.

Kaplan, J. 2013b. Archaeological Impact Assessment proposed upgrading of the Louisevale Road Waste Water Treatment Facility in Upington, Northern Cape Province. Report prepared for EnviroAfrica. ACRM: Rondebosch.

Kaplan, J. 2015. Heritage Impact Assessment, proposed high-speed test track on Portion 6 of No. 419 Steenkampspan near Upington. Report prepared for Mercedes Benz South Africa. ACRM: Cape Town.

Kaplan, J. 2016. Archaeological Impact Assessment proposed cultivation of pecan nut trees including associated infrastructure on the Farm Bethesda 238.38 and 335/38 Louisvale, near Upington, Northern Cape Province. Report prepared for Pieter Badenhorst Professional Services. ACRM: Cape Town.

Klein, R. G. 2000. The Earlier Stone Age of Southern Africa. *The South African Archaeological Bulletin*, 27(172): 107-122.

Korsman, S.A. & Meyer, A. 1999. Die Steentydperk en rotskuns. In: Bergh, J.S. (red.). *Geskiedenisatlas van Suid*-Afrika*. Die vier noordelike provinsie*s. J.L. van Schaik: Pretoria.

Kruger, N. 2015. *Archaeological Impact Assessment (AIA) of a Demarcated surface portion on the Farm Avondale 410 for the proposed Avondale 1 Photovoltaic Power Plant & 132kV Power Lines development, //Khara Hais Local Municipality, ZF Mgcawu district Municipality, Northern Cape Province.* Unpublished report. Pretoria.

Kruger, N. 2016. Archaeological Impact Assessment (Aia) Of Areas Demaracted For The Nceda Special Economic Zone (Sez) Development Project, Upington, Northern Cape Province. Faerie Glen: Pretoria.

Kruger, N. 2018. *Archaeological Impact Assessment (AIA) for the Biesieputs Prospecting Project on a portion of the farm Biesieputs 67 in the ZF Mgcawu District Municipality, Northern Cape Province.* Unpublished report. Pretoria.

Legassick, M. 1996. The Will of Abraham and Elizabeth September: The Struggle for Land in Gordonia, 1898-1995. *The Journal of African History,* 37 (3): 371-418.

Lombard, M. & Parsons, I. 2008. Blade and bladelet function and variability in risk management during the last 2000 Years in the Northern Cape. *South African Archaeological Bulletin* 63: 18-27.

Lombard, M. 2011. Howieson's *Poort. McGraw Hill Year Book of Science & Technology*. Article ID: YB120253; Sequence Number 14.

Lombard, M., Wadley, L., Deacon, J., Wurz, S., Parsons, I., Mohapi, M. Swart, J. & Mitchell, P. 2012. South African and Lesotho Stone Age sequence updated. *South African Archaeological Bulletin* 67: 123-144.

Lombard, M., Wadley, L., Deacon, J., Wurz, S., Parsons, I., Mohapi, M. Swart, J. & Mitchell, P. 2012. South African and Lesotho Stone Age sequence updated. *South African Archaeological Bulletin* 67: 123-144.

Lotter, M.G., Gibbon, R.J., Kuman, K., Leader, G.M., Forssman, T., & Granger, D.E. 2016. A Geoarchaeological Study of the Middle and Upper Pleistocene Levels at Canteen Kopje, Northern Cape Province, South Africa. *Geoarchaeology: An International Journal* 00 (2016) 1–20.

Mitchell, P. 2002. *The archaeology of Southern Africa*. Cambridge: Cambridge University Press.

Mitchell, P. 2002. *The archaeology of Southern Africa*. Cambridge: Cambridge University Press.

Mlilo, T. 2019. *Phase 1 Archaeological Impact Assessment Report for Prospecting right application for various minerals (NC12177PR and NC12215PR) in ZF Mgcawu Magisterial District in Kai.! Garib Local Municipality Northern Cape Province.* Unpublished report. Integrated Specialists Services (PTY) LTD: Midrand.

Morris, A. 1995. The Einiqua: an analysis of the Kakamas skeletons. In: Smith A.B. (ed.) *Einiqualand: studies* of *the Orange River frontier*: 110-164.

Morris, D. & Beaumont, P. 2004. *Archaeology in the Northern Cape: Some key sites*. SA3 Post-Conference Excursion, 8-10 April 2004. McGregor Museum: Kimberley.

Morris, D. & Beaumont, P. 2004. *Archaeology in the Northern Cape: Some key sites. SA3 Post-Conference Excursion, 8-10 April 2004.* McGregor Museum: Kimberley.

Morris, D. & Beaumont, P.B. 1991. !Nawabdanas: archaeological sites at Renosterkop, Kakamas District, Northern Cape. *South African Archaeological Bulletin* 46:115124.

Morris, D. 1988. Engraved in Place and Time: A Review of Variability in the Rock Art of the Northern Cape and Karoo. *The South African Archaeological Bulletin*, 43(148): 109-120.

Morris, D. 2005. Report on a Phase 1 Archaeological Impact Assessment of proposed mining areas on the farms Ploegfontein, Klipbankfontein, Welgevonden, Leeuwfontein, Wolhaarkop and Kapstevel, west of Postmasburg, Northern Cape. Unpublished report. McGregor Museum: Kimberley.

Morris, D. 2010. Upington Solar Thermal Plant: Archaeology: Specialist input for the Environmental Impact Assessment Phase and Environmental Management Plan for the proposed Upington Solar Thermal Plant, Northern Cape Province. Report prepared for Savannah Environmental. McGregor Museum: Kimberley.

Morris, D. 2012. *Archaeological Impact Assessment, Phase I: 15km Water Pipeline across farms Sanddraai 391 and Bokpoort 390 near Groblershoop, Northern Cape.* Unpublished Report. McGregor Museum: Kimberley.

Morris, D. 2013. Proposed development of the Upington Solar Thermal Plants Two and Three within Portion 3 of the Farm McTaggarts Camp 435, west of Upington, Northern Cape: Scoping phase heritage input. Report prepared for Savannah Environmental. McGregor Museum: Kimberley.

Morris, D. 2013. *RE Capital 3 Solar Development on the property Dyason's Klip west of Upington, Northern Cape: Scoping phase Heritage Input.* Unpublished report. McGregor Museum: Kimberley.

Morris, D. 2013. *RE Capital 3 Solar Development on the property Dyason's Klip west of Upington, Northern Cape: Archaeological Impact Assessment – proposed 'central' development footprint.* Unpublished report. McGregor Museum: Kimberley

Morris, D. 2014. Proposed development of the Upington Solar Thermal Plant Three within Portion 3 of the Farm McTaggarts Camp 435 west of Upington, Northern Cape. Archaeological Impact Assessment. Savannah Environmental. McGregor Museum: Kimberley.

Morris, D. 2014. *Proposed Kheis Solar Park Phases 1-3 on Portions 7 and 9 of the Farm Namakwari 656, east of Grootdrink in Northern Cape: Heritage Impact Assessment.* Unpublished report. McGregor Museum: Kimberley.

Morris, D. 2014. *Proposed Kheis Solar Park Phase 1-3 on Portions 7 and 9 of the Farm Namakwari 656, east of Grootdrink in Northern Cape: Heritage Impact Assessment.* Unpublished report. McGregor Museum: Kimberley.

Morris, D. 2018. *Heritage Impact Assessment at the site of proposed irrigation development on the farm Openwater near Upington, Northern Cape.* Unpublished report. McGregor Museum, Kimberley.

Morris, D. 2018. Heritage Impact Assessment of proposed sand mining in the bed of a spruit on Olywenhoutsdrift-Suid, near Louisvale, Northern Cape. McGregor Museum: Kimberley.

Morris, D. 2018. *Heritage Impact Assessment of proposed sand mining in the bed of the Donkerhoekspruit on Jannelsepan, near Louisvale, Northern Cape.* Unpublished report. McGregor Museum: Kimberley.

Mucina, L. & Rutherford, M.C. (eds) 2006. *The vegetation of South Africa,* Lesotho *and Swaziland.* Strelitzia 19. SANBI: Pretoria.

Nilssen, P. 2012. Phase 1a Archaeological Impact Assessment, the proposed building and operation of a bulk water supply line near Upington on Remaining Extent of the Farm Vaalkoppies No. 40 //Khara Hais Municipality. Report prepared for Irme Van Zyl Environmental Consultants. Klein Brak River.

Orton, J. & Webley, L. 2013. Heritage Impact Assessment for a proposed Hydro-Electric facility near Riemvasmaak, Northern Cape. Unpublished report. ACO Associates cc: St James.

Orton, J. & Webley, L. 2013. *Heritage Impact Assessment for the Proposed Namies Wind Energy Facility near Aggeneys, Northern Cape.* Unpublished report. ACO Associates cc: Cape Town.

Orton, J. 2015. *Final Archaeological Survey for the proposed Aggeneys Solar Energy facility, Namakwaland Magisterial District, Northern Cape.* Unpublished Report. ASHA Consulting: Cape Town.

Orton, J. 2015. Heritage Impact Assessment For The Proposed Cultivation Of New Lands At Upington, Gordonia Magisterial District, Northern Cape. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2015. *Heritage Impact Assessment for the Proposed Cultivation of New Lands at Klein Pella, Namakwaland Magisterial District, Western Cape.* Unpublished report. ASHA Consulting: Cape Town.

Orton, J. & Webley, L. 2013. *Heritage Impact Assessment for the Proposed Boegoeberg Hydropower Station near Groblershoop, Northern Cape.* Unpublished report. ACO Associates cc: Cape Town.

Pelser, A.J. & Lombard, M. 2013. A report on the archaeological investigation of Stone Age finds on the Paling 434, Hay Magisterial District, near Postmasburg in the Northern Cape Province. Unpublished EIA Report. Kia Batla Holdings: Craighall.

Pelser, A.J. 2012. *A report on a Heritage Impact Assessment (HIA) for the Proposed Photo-Voltaic Solar Power Generation Plant on Konkoonsies 91, Pofadder District, Northern Cape.* Unpublished report. Archaetnos, Groonkloof.

Penn, N. 2005. *The Forgotten Frontier: Colonist and Khoisan on the Cape's Northern Frontier in the 18th Century*. Athens. Ohio University Press and Double Storey Books: Ohio and Cape Town.

PGS Heritage. 2010b. Heritage Impact Assessment for the Proposed Lehating Mining (Pty) Ltd underground manganese mine on Portions of the Farm Lehating 714, approximately 20km northwest of Hotazel, Northern Cape Province. Pretoria.

Porat, N., Chazan, M., Grun, Aubert, R., Eisenmann, V. & Horwitz, L. 2010. New radiometric ages for the Fauresmith industry from Kathu Pan, southern Africa: Implications for the Earlier to Middle Stone Age transition. *Journal of Archaeological Science* 37: 269-283.

Ross, R. 1975. The!Kora Wars on the Orange River, 1830-1880. *The Journal of African History*, 16 (4): 561-576.

Rossouw, L. 2013. *Phase 1 Heritage Impact Assessment of a proposed new road at Blaauwskop near Uppington, NC Province*. Unpublished report. Langenhovenpark.

Rudner, J. 1971. Ostrich Egg-Shell Flasks and Soapstone Objects from the Gordonia District, North-Western Cape. *The South African Archaeological Bulletin,* 26 (103/104): 139-142.

Snyman, P.H.R. 2000. *Changing tides. The story of ASSMANG*. The Associated Manganese Mines of South Africa Limited: Johannesburg.

Thackeray, A.I., Thackeray, J.F. & Beaumont, P.B. 1983. Excavations at the Blinkklipkop specularite mine near Postmasburg, Northern Cape, *South African Archaeological Bulletin* 38:17-25.

Underhill, D. 2011. The Study of the Fauresmith: A Review. *South African Archaeological Bulletin* 66 (193): 15–26.

Van der Ryst, M.M. & Meyer, A. 1999. *Die Ystertydperk. Bergh, J.S. (red.). Geskiedenisatlas van Suid-Afrika. Die vier noordelike provinsies.* Pretoria: J.L. van Schaik.

Van der Walt, J. & Lombard, M. 2018. Kite-like structures in the Nama Karoo of South Africa. *Antiquity* (92) 363,e3: 1–6

Van der Walt, J. 2015. *Heritage Scoping Report for the Additional CSP facilities associated with Authorise CSP sites (1.3, 1.4, 4 & 5), Northern Cape Province*. Unpublished report. Modimolle.

Van der Walt, J. 2016 revised. *Archaeological Scoping Report for the Ilanga CSP 9 Facility and associated infrastructure within the Karoshoek Solar Valley Development near Upington Northern Cape Province*. Unpublished report. Modimolle.

Van der Walt, J. 2016. *Archaeological Impact Assessment report for Proposed establishment of the Ilanga CSP 9 facility, near Upington, Northern Cape Province.* Unpublished report. Modimolle.

Van Ryneveld, K. 2007. *Archaeological Impact Assessment Phase 1: Portion of the farm Boksputs 118, Groblershoop district, Northern Cape South Africa.* Unpublished report.

Van Ryneveld, K. 2017. *Phase 1 Archaeological & Cultural Heritage Impact Assessment Koa Valley Prospecting Right Application (without Bulk Sampling), Portions of the Farms Haramoep 53, Oonab-Noord 609, Amam 46 and Nooisabes 51, near Springbok / Aggeneys, Namakwa District Municipality, Northern Cape.* Unpublished report. ArchaeoMaps: Eastern Cape.

Van Ryneveld, K. 2017. *Phase 1 Archaeological & Cultural Heritage Impact Assessment Prospecting Right Application (without Bulk Sampling), farm Aroams 57 Portion 1, near Aggeneys, Namakwa District Municipality, Northern Cape.* Unpublished report. ArchaeoMaps: Eastern Cape.

Van Schalkwyk, J. 2013. *Cultural Heritage Impact Assessment for the proposed township development on a section of the farm Neilers Draft 34, Lennertsville, Kai !Gaib Municipality, Northern Cape Province.* Unpublished report. Pretoria.

Van Schalkwyk, J. 2014b. Cultural Heritage Impact Assessment for the proposed township development, Louisevaleweg, Upington, //Khara Hais Municipality, Northern Cape. Report prepared for MEG Environmental Consultants. J Van Schalkwyk Heritage Consultant. Pretoria.

Van Schalkwyk, J. 2014c. Cultural heritage impact assessment for the Proposed Township Development, Dakotaweg, Upington, //Khara Hais Municipality, Northern Cape Province

Van Schalkwyk, J. A. 2019. *Phase 1 Cultural Heritage Impact Assessment: Prospecting right application with bulk sampling on various portions of the Farms Zonderhuis 402, Onder Plaats 401 and Namakwari 656, Siyanda District Municipality, Northern Cape Province.* Unpublished report. Pretoria.

Van Schalkwyk, J. A. 2020. *Phase 1 Cultural Heritage Impact Assessment: The Proposed Bokpoort II PV Solar Power Facilities on the farm Bokpoort 390 near Groblershoop, !Kheis Local Municipality, Northern Cape Province.* Unpublished report. Pretoria.

Van Schalkwyk, J.A. 2010a. Archaeological impact survey report for the land-use change on sections of the farm Vaalkoppies 40, Gordonia district, Northern Cape Province. Unpublished report 2010/JvS/069.

Van Schalkwyk. J. 2014a. Cultural Heritage Impact Assessment for the proposed Township Development, Paballelo, Upington, //Khara Hais Municipality, Northern Cape. Report prepared for MEG Environmental Consultants. J Van Schalkwyk Heritage Consultant. Pretoria

Van Vollenhoven 2012a. A report on a cultural heritage baseline study for the proposed exploration activities at the Jacomynspan Project, Northern Cape Province. Unpublished report. Archaetnos: Groenkloof.

Van Vollenhoven, A.C. 2012b. A report on a heritage impact assessment for the proposed SASOL CSP and CPV Project near Upington in the Northern Cape Province. Unpublished report. Archaetnos: Groenkloof.

Van Vollenhoven, A.C. 2014a. A report on a cultural heritage impact assessment for the proposed exploration activities at the Jacomynspan Project, Northern Cape Province. Unpublished report. Archaetnos: Groenkloof.

Van Vollenhoven, AC 2014. *A report on a basic heritage assessment for the proposed Eskom Fibre-Groblershoop 132 Kv power line, Northern Cape Province.* Unpublished report. Archaetnos: Groenkloof.

Van Warmelo, N.J. 1935. A Preliminary Survey of the Bantu Tribes of South Africa. Department of Native Affairs, *Ethnological Publications* Vol. V. Government Printer: Pretoria.

Walker, S.J.H., Chazan, M. & Morris, D. 2013. *Kathu Pan: Location and Significance* – A report requested by SAHRA, Cape Town.

Webley, L & Halkett, D. 2012. Heritage Impact Assessment: Proposed Kenhardt Photo-Voltaic Solar Power Plant On Remainder Of The Farm Klein Zwart Bast 188, Northern Cape Province. Unpublished report.

Webley, L. & Halkett, D. 2014. *Archaeological Impact Assessment: Proposed construction of RE Capital 11 Solar Development on the remainder of the farm Dyason's Klip 454, Northern Cape.* Unpublished report. ACO Associates cc: Cape Town.

Webley, L. 2013. *Heritage impact assessment for proposed construction of the ESKOM Groblershoop Substation and the Garona-Groblershoop 132 kV powerline, Groblershoop, Northern Cape.* Unpublished report. ACO Associates cc: St James.

Wilkins, J. 2010. Style, symbolling, and interaction in Middle Stone Age societies. *Explorations in Anthropology* 10(1):102–125.

Wurz, S., 2013. Technological trends in the Middle Stone Age of South Africa between MIS 7 and MIS 3. *Current Anthropology*, 54(S8): S305-S319.

ACTS

National Environmental Management Act, 1998 (Act 107 of 1998).

National Heritage Resources Act, 1999 (Act 25 of 1999).

SAHRA. 1999. *Government Gazette 1999*. National Heritage Resources Act No. 25 of 1999.

SAHRA. 2007. *SG 2.2 SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports.*

SAHRA. 2008. *Site Management Plans: Guidelines for the Development of Plans for the Management of Heritage Sites or Places*. (see specifically Section 7). (www.sahra.org.za).

WEB

http://www.sahra.org.za/sahris

https://www.sahistory.org.za/article/kora

https://csg.esri-southafrica.com/portal/apps/webappviewer

APPENDIX A

PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED GROBLERSHOOP TOWNSHIP EXPANSION, !KHEIS LOCAL MUNICIPALITY, ZF MGCAWU DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED GROBLERSHOOP TOWNSHIP EXPANSION, !KHEIS LOCAL MUNICIPALITY, ZF MGCAWU DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

Reference: NC/21/2018/PP
(Groblershoop 1500/BH0066)

Issue Date: **13 June 2020**
Client: **UBIQUE Heritage Consultants**

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: elizebutler002@gmail.com

SIGNATURE:

This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1 *- NEMA Table*

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 9	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Desktop Study	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 10	
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Section 11	
(l) Any conditions for inclusion in the environmental authorisation		None required
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 10	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by UBIQUE Heritage Consultants to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed Groblershoop Township Expansion on Portion 16 of the Farm Boegoeberg Settlement No 48, Groblershoop in !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), states that a Palaeontological Impact Assessment (PIA) is necessary to determine the presence of fossil material within the planned development. This PDA is thus necessary to evaluate the effect of the construction on the palaeontological resources.

The development footprint is underlain by Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group) as well underlying Precambrian rocks of the Transvaal Supergroup. According to the PalaeoMap of South African Heritage Resources Information System, the Palaeontological Sensitivity of the Kalahari Group is low, and that of the underlying Precambrian Transvaal Supergroup is moderate. If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected, and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carried out by a palaeontologist.

It is consequently recommended that no further palaeontological heritage studies, ground-truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

- **INTRODUCTION**

The Barzani Group appointed Macroplan Town and Regional Planners to proceed with the completion of the Town Planning process for the Groblershoop Township Expansion (Figure 1-2). UBIQUE Heritage Consultants was appointed to conduct the Heritage Impact Assessment while Banzai Environmental was in turn appointed to conduct the Palaeontological Desktop Study.

The proposed Groblershoop Township Expansion comprises of the creation of new erven, as well as the formalisation of the existing informal houses that are located around the town. The Groblershoop Township expansion will accommodate 1500 erven on 95 ha. This project will fill an urgent need for residential erven in the sub-economic market.

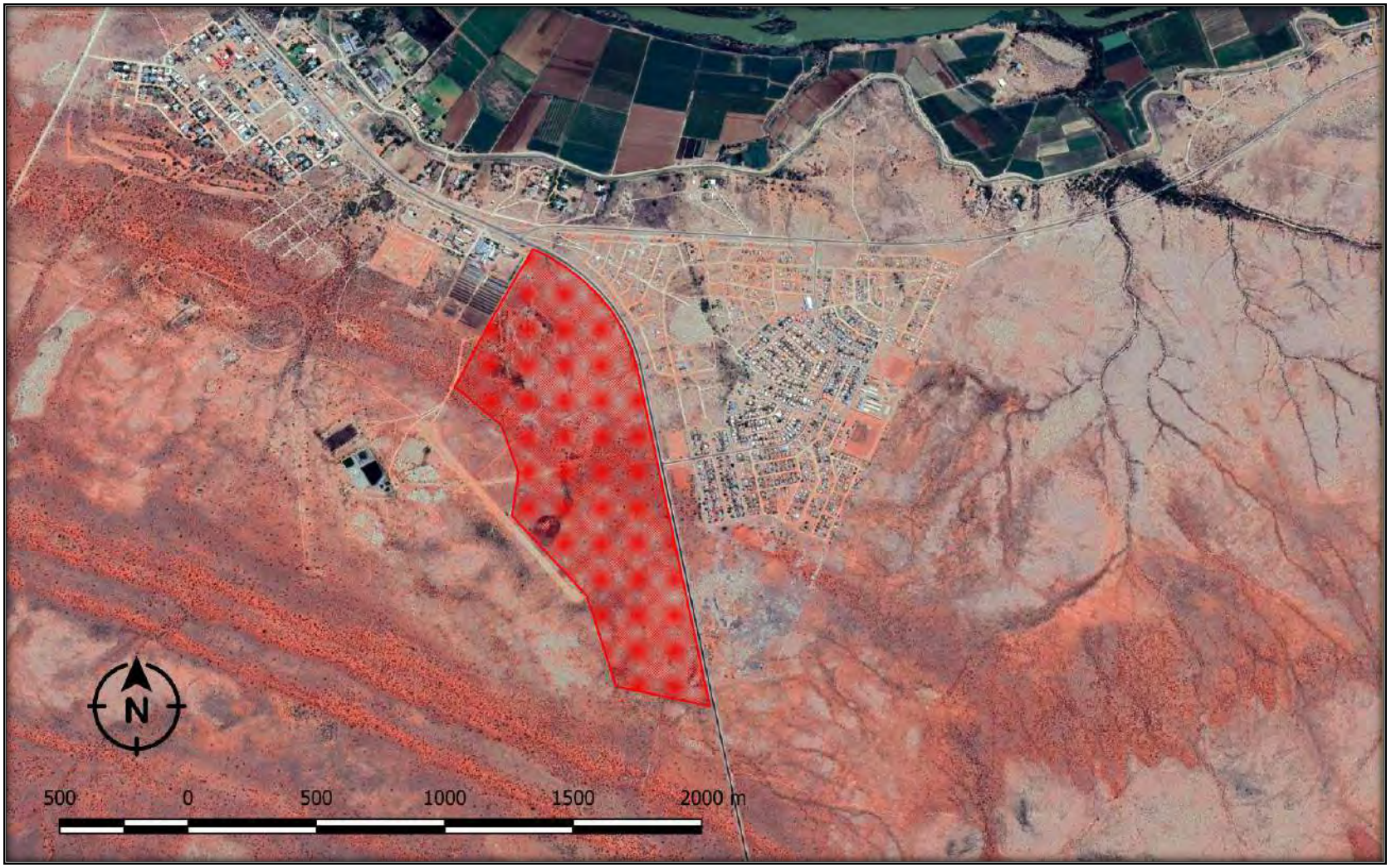

Figure 12: *Google Earth Image indicating the locality of Groblershoop Township Expansion on Portion 16 of the Farm Boegoeberg Settlement No 48, Groblershoop !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Map modified from Ubique Consultants.*

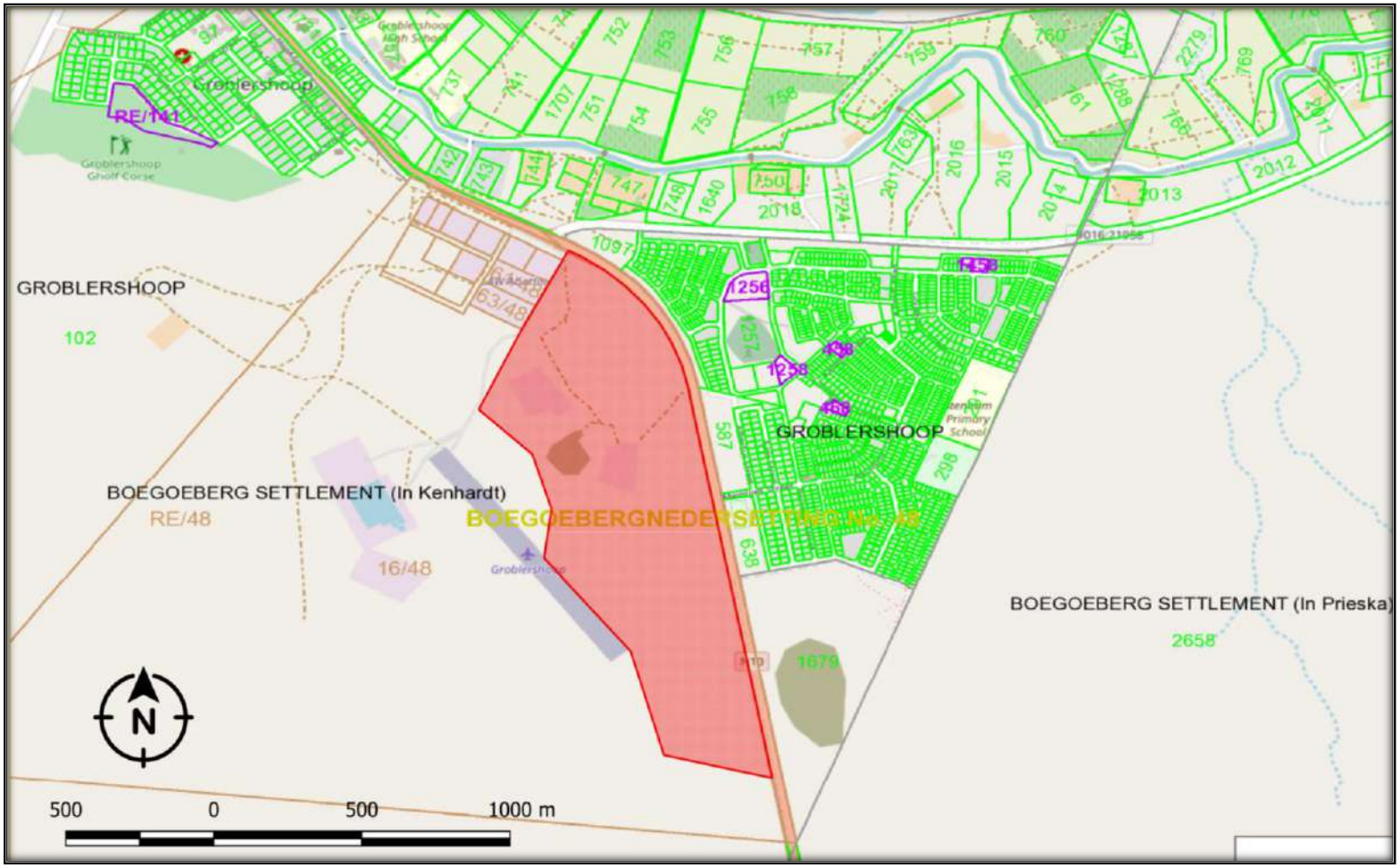

Figure 13: *Topographical map indicating the locality of the Groblershoop Township Expansion on Portion 16 of the Farm Boegoeberg Settlement No 48, Groblershoop !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province. Map modified from Ubique Consultants.*

- **QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR**

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-four years. She has extensive experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 14 years. She has been conducting PIAs since 2014.

- **LEGISLATION**

  - **National Heritage Resources Act (25 of 1999)**

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA. Palaeontological resources may not be unearthed, moved, broken or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Desktop Assessment forms part of the Heritage Impact Assessment (HIA) and adheres to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;

the construction of a bridge or similar structure exceeding 50 m in length;

any development or other activity which will change the character of a site—

(exceeding 5 000 m^2 in extent; or

involving three or more existing erven or subdivisions thereof; or

involving three or more erven or divisions thereof which have been consolidated within the past five years; or

the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority

the re-zoning of a site exceeding 10 000 m^2 in extent;

or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

- **OBJECTIVE**

The objective of a Palaeontological Impact Assessment (PIA) is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the PIA are: 1) to **identify** the palaeontological status of the exposed as well as rock formations just below the surface in the development footprint 2) to estimate the **palaeontological importance** of the formations 3) to determine the **impact** on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

The terms of reference of a PIA are as follows:

General Requirements:

Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;

Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;

Submit a comprehensive overview of all appropriate legislation, guidelines;

Description of the proposed project and provide information regarding the developer and consultant who commissioned the study;

Description and location of the proposed development and provide geological and topographical maps;

Provide Palaeontological and geological history of the affected area;

Identification sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;

Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:

a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
c. **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.

Fair assessment of alternatives (infrastructure alternatives have been provided);

Recommend mitigation measures to minimise the impact of the proposed development; and

Implications of specialist findings for the proposed development (such as permits, licenses etc).

- **GEOLOGICAL AND PALAEONTOLOGICAL HISTORY**

The proposed Groblershoop Township Expansion on Portion 16 of the Farm Boegoeberg Settlement No 48, Groblershoop !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province is depicted on the 1:250 000 2820 Upington Geological Map (Council of Geosciences, Pretoria). The proposed development is underlain by the Cenozoic Kalahari Group as well underlying rocks of the Precambrian Transvaal Supergroup. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Kalahari Group is low and that of the Precambrian rocks of the Transvaal Supergroup is moderate. The cherts, dolomites and iron formations of the underlying Precambrian Transvaal Supergroup are too deep to affect the proposed development and will not be discussed further in this report.

The Cenozoic Kalahari Group is the most widespread body of terrestrial sediments in southern Africa. The Cenozoic sands and calcretes of the Kalahari Group range in thickness from a few metres to more than 180m (Partridge et al., 2006). The youngest formation of the Kalahari group is the Gordonia Formation which is generally termed Kalahari sand and comprises of red aeolian sands that covers most of the Kalahari Group sediments. The pan sediments of the area originated from the Gordonia Formation and contains white to brown fine-grained silts, sands, and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters. Quaternary alluvium, aolian sands, surface limestone, silcrete, and terrace gravels are also included in the Kalahari Group (Kent 1980). Partridge *et al*., (2006) describes numerous types of superficial deposits of Late Caenozoic (Miocene to Pliocene to Recent) age throughout the Karoo Basin.

The fossil assemblages of the Kalahari are generally low in diversity and occur over a wide range. These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods, and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile remains have been uncovered where the depositional settings in the past were wetter.

***Table 2**: Fossil heritage of rocks represented in the proposed Groblershoop Township Development (Almond and Pether, 2008)*

GEOLOGICAL UNIT	ROCK TYPES & AGE	FOSSIL HERITAGE	PALAEONT-OLOGICAL SENSITIVITY	RECOMMENDED MITIGATION
OTHER LATE CAENOZOIC TERRESTRIAL DEPOSITS OF THE INTERIOR (Most too small to be indicated on 1: 250 000 geological maps)	Fluvial, pan, lake and terrestrial sediments, including diatomite (diatom deposits), pedocretes, spring tufa / travertine, cave deposits, peats, colluvium, soils, surface gravels including downwasted rubble MOSTLY QUATERNARY TO HOLOCENE (Possible peak formation 2.6-2.5 Ma)	Bones and teeth of wide range of mammals (*e.g.* mastodont proboscideans, rhinos, bovids, horses, micromammals), reptiles (crocodiles, tortoises), ostrich egg shells, fish, freshwater and terrestrial molluscs (unionid bivalves, gastropods), crabs, trace fossils (*e.g.* termitaria, horizontal invertebrate burrows, stone artefacts), petrified wood, leaves, rhizoliths, diatom floras, peats and palynomorphs. calcareous tufas at edge of Ghaap Escarpment might be highly fossiliferous (*cf* Taung in NW Province – abundant Makapanian Mammal Age vertebrate remains, including australopithecines)	LOW Scattered records, many poorly studied and of uncertain age	Any substantial fossil finds to be reported by ECO to SAHRA
Gordonia Formation (Qs) KALAHARI GROUP *plus* SURFACE CALCRETES (Tl / Qc)	Mainly aeolian sands *plus* minor fluvial gravels, freshwater pan deposits, calcretes PLEISTOCENE to RECENT	Calcretised rhizoliths & termitaria, ostrich egg shells, land snail shells, rare mammalian and reptile (*e.g.* tortoise) bones, teeth (e.g. doline infills) freshwater units associated with diatoms, molluscs, stromatolites *etc.*	LOW	Any substantial fossil finds to be reported by ECO to SAHRA

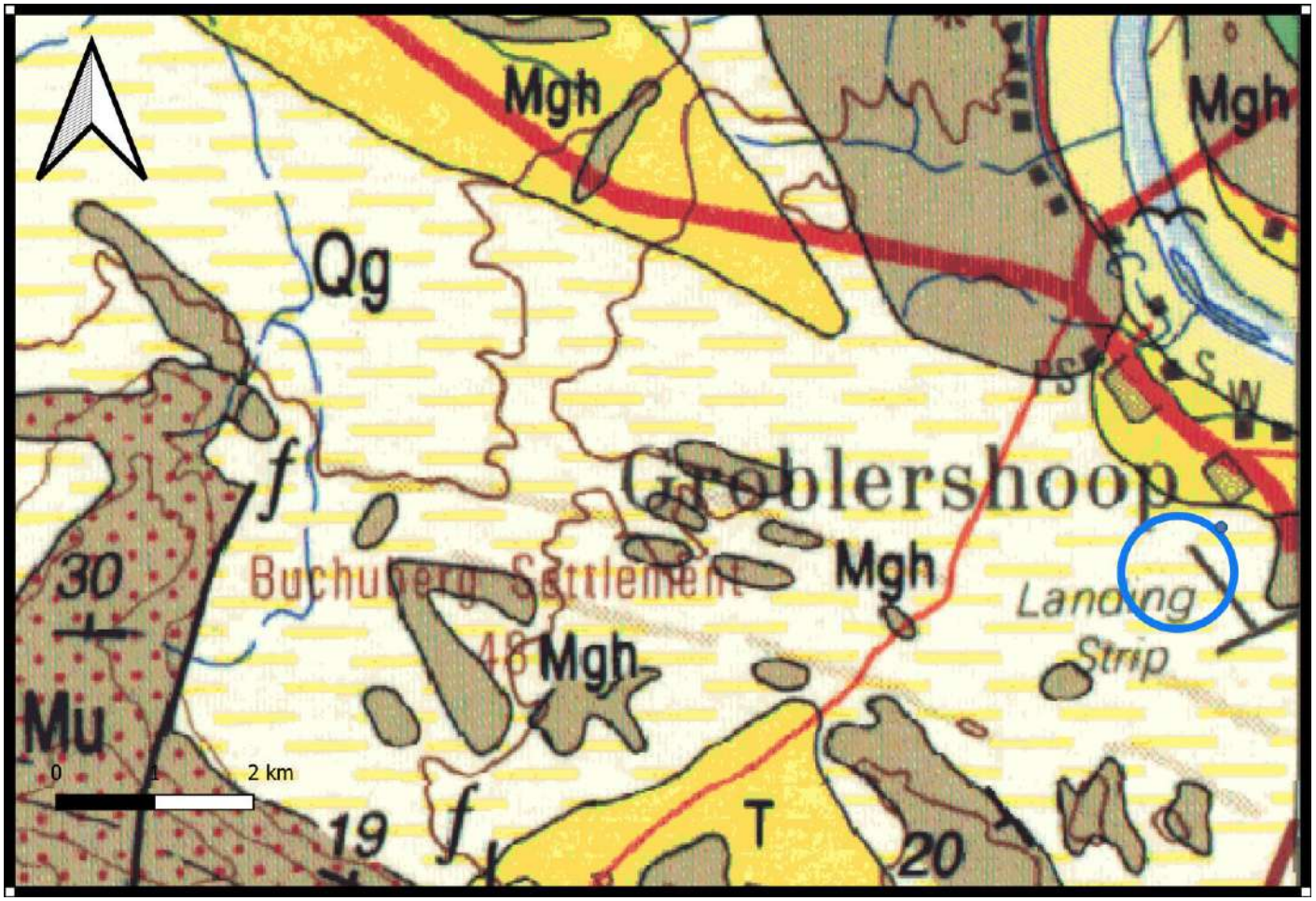

***Figure 14**: Extract of the 1:250 000 2820 Upington geological map (Council for Geoscience, Pretoria) indicating the position of the* proposed Groblershoop Township development (indicated in blue)*, in !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.*

Legend to Map and short explanation.

Qg – Gordonia Formation, Kalahari Group, Quaternary - Red-brown, wind-blown sand and dunes.
Mgh- Groblershoop Formation, Brulpan Group, Areachap Sequence
Mu- Blue grey quartzite, cross-bedded in places
T- Tertiary

- **GEOGRAPHICAL LOCATION OF THE SITE**

The Groblershoop Township Expansion is located about 120 km south-east of Upington within the !Kheis Local Municipal area which forms part of the ZF Mgcawu District Municipality.

***Table 3**: Geographical location of Groblershoop Township Expansion.*

No.	Town	Total Size of the study area	Total Erven	Property Descriptions	Title Deed Numbers	Coordinates	Ownership
3	Groblershoop	95ha	1500	Portion 16 of the Farm Boegoeberg Settlement, No. 48	T2574/1978	28°54'32.64"S; 21°59'47.71"E	!Kheis Local Municipality

- **METHODS**

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This include all trace fossils and fossils. All available information is consulted to compile a desktop study and includes: Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

- **Assumptions and Limitations**

The focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is sourced to provide information on the existence of fossils in an area which was not documented in the past. When using similar Assemblage Zones and geological formations for Desktop studies it is generally **assumed** that exposed fossil heritage is present within the footprint. **A field-assessment will thus improve the accuracy of the desktop assessment.**

- **ADDITIONAL INFORMATION CONSULTED**

In compiling this report the following sources were consulted:

Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984);

1: 250 000 2822 Postmasburg geological map (Council for Geoscience, Pretoria);

A Google Earth map with polygons of the proposed development was obtained from Ubique Heritage Consultants.

- **IMPACT ASSESSMENT METHODOLOGY**

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the following project phases:

- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

Table 4:The rating system

NATURE		
The Nature of the Impact is the possible destruction of fossil heritage		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).

3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently

		ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (**Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive

- **Summary of Impact Tables**

The development footprint is completely underlain by the Kalahari Formation. The Palaeontological Sensitivity of this formation is rated as Low. The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur but are regarded as having a low probability. The significance of the impact occurring will be low.

- **FINDINGS AND RECOMMENDATIONS**

The proposed Groblershoop Township Expansion on Portion 16 of the Farm Boegoeberg Settlement No 48, Groblershoop in !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province is underlain by Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group). According to the PalaeoMap of South African Heritage Resources

Information System, the Palaeontological Sensitivity of the Kalahari Group is low. The underlying Precambrian Transvaal Supergroup cherts, dolomites and iron formations are too deep to affect the proposed development. If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected, and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carried out by a palaeontologist.

If fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected, and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation can be carried out by a palaeontologist.

It is consequently recommended that no further palaeontological heritage studies, ground-truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

- **CHANCE FINDS PROTOCOL**

The following procedure will only be followed if fossils are uncovered during excavation.

- **Legislation**

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA).** According to Section 3 of the Act, all Heritage resources include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

- **Background**

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

- **Introduction**

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

- **Chance Find Procedure**

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

- **REFERENCES**

ALMOND, J.E. and PETHER, J. 2009. SAHRA Palaeotechnical Report: Palaeontological Heritage of the Northern Cape Province. South African Heritage Resources Agency, Pp 1-143.

ALMOND, J.E. 2010. Prospecting application for iron ore and manganese between Sishen and Postmasburg, Northern Cape Province: farms Jenkins 562, Marokwa 672, Thaakwaneng 675, Driehoekspan 435, Doringpan 445 and Macarthy 559: desktop palaeontological assessment, 20 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2012a. Proposed westerly extension of Sishen Iron Ore Mine near Kathu, Kalagadi District Municipality, Northern Cape. Palaeontological specialist study" desktop study, 18 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2012b. Proposed 16 Mtpa expansion of Transnet's existing manganese ore export railway line & associated infrastructure between Hotazel and the port of Ngqura, Northern & Eastern Cape. Part 1: Hotazel to Kimberley, Northern Cape. Palaeontological assessment desktop study, 28 pp.

ALMOND, J.E. 2013a. Proposed 16 Mtpa expansion of Transnet's existing manganese ore export railway line & associated infrastructure between Hotazel and the Port of Ngqura, Northern & Eastern Cape. Part 1: Hotazel to Kimberley, Northern Cape. Palaeontological specialist assessment: combined desktop and field-based study, 85 pp. Natura Viva cc, Cape Town.

ALMOND, 2013b. Proposed new railway compilation yard at Mamathwane near Hotazel, John Taolo Gaetsewe District Municipality, Northern Cape. Palaeontological specialist assessment: combined desktop and field-based study, 29 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016. Proposed Hotazel Solar Park on the Farm Hotazel Annex Langdon (f278/0), Joe Morolong Local Municipality, Northern Cape. Recommended exemption from further palaeontological studies, 12 pp. Natura Viva cc, Cape Town.

ALMOND, J., PETHER, J, and GROENEWALD, G. 2013. South African National Fossil Sensitivity Map. SAHRA and Council for Geosciences. Schweitzer *et al*. (1995) pp p288.

BAMFORD, M. 2017. Palaeontological Impact Assessment for the proposed new underground Khwara Manganese mine near Hotazel, Northern Cape Province

BANZAI ENVIRONMENTAL. 2017. Palaeontological Desktop Assessment for the Proposed Changes to Operations at the UMK Mine near Hotazel, in the John Toala Gaetsewe Distrcit Municipality in the Northern Cape Province.

Cornell, D.H., Thomas, R.J., Moen, H.F.G., Reid, D.L., Moore, J.M., Gibson, R.L., 2006. The Namaqua-Natal Province. . In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 325-379.

DU TOIT, A. 1954. The geology of South Africa. xii + 611pp, 41 pls. Oliver & Boyd, Edinburg.

FOURIE. H.C. 2018. East Manganese: Phase 1 Palaeontological Impact Assessment on the farm East 270 near Hotazel Gamagara Local Municipalities, John Taolo Gaetsewe District Municipality, Northern Cape Province.

GROENEWALD, G. 2013. Palaeontological desktop assessment of the Farm Gloria 266, near Hotazel town in the John Toalo Gaetsewe District Municipality in the Northern Cape Province, 9 pp. PGS Heritage & Grave Relocation Consultants.

GROENEWALD, G., 2014. Palaeontological Impact Assessment for a Manganese mine. Kudumane Manganese Resources (Pty) Ltd.

GROENEWALD, G. and GROENEWALD, D. 2014. SAHRA Palaeotechnical Report: Palaeontological Heritage of the North West Province. South African Heritage Resources Agency, Pp 1-20.

KENT, L. E., 1980. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei, and Venda. SACS, Council for Geosciences, Pp 535-574.

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological Society of South Africa, Johannesburg.

MOEN, H.F.G. 1979. Geological Map 2722 of Kuruman 1:250 000. South African Committee for Stratigraphy, Council for Geoscience, Pretoria.

SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15.

VAN DER MERWE, S.J. 1997. Basin Analysis of the Kalahari Manganese Basin. Unpublished MSc Thesis, UOFS.

VISSER, D.J.L. (ed) 1984. Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy, Council for Geoscience, Pretoria.

VISSER, D.J.L. (ed) 1989. *Toeligting: Geologiese kaart (1:100 000). Die Geologie van die Republieke van Suid Afrika, Transkei, Bophuthatswana, Venda, Ciskei en die Koningkryke van Lesotho en Swaziland*. South African Committee for Stratigraphy. Council for Geoscience, Pretoria, Pp 494.

CURRICULUM VITAE

ELIZE BUTLER

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YEARS' EXPERIENCE:	26 years in Palaeontology

EDUCATION:

B.Sc Botany and Zoology, 1988
University of the Orange Free State

B.Sc (Hons) Zoology, 1991
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Management Course, 1991
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M. Sc. *Cum laude* (Zoology), 2009
University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

Part time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

TECHNICAL REPORTS

1. **Butler, E. 2014.** Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.
2. **Butler, E. 2014.** Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoort, Northern Cape Province. 2014. Bloemfontein.
3. **Butler, E. 2015.** Palaeontological impact assessment of the proposed consolidation, re-division and development of 250 serviced erven in Nieu-Bethesda, Camdeboo local municipality, Eastern Cape. Bloemfontein.
4. **Butler, E. 2015.** Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.
5. **Butler, E. 2015.** Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.
6. **Butler, E. 2015.** Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.
7. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.
8. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.
9. **Butler, E. 2015.** Palaeontological Heritage Impact Assessment report on the establishment of the 65 mw Majuba Solar Photovoltaic facility and associated infrastructure on portion 1, 2 and 6 of the farm Witkoppies 81 HS, Mpumalanga Province. Bloemfontein.
10. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed township establishment on the remainder of portion 6 and 7 of the farm Sunnyside 2620, Bloemfontein, Mangaung metropolitan municipality, Free State, Bloemfontein.
11. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse729, near Vryburg, North West Province. Bloemfontein.
12. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
13. **Butler, E. 2015.**Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.
14. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.

15. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.
16. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 1 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
17. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
18. **Butler, E. 2016.** Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.
19. **Butler, E. 2016.** Palaeontological Impact Assessment of of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.
20. **Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City Of Johannesburg, Gauteng Province. Bloemfontein.
21. **Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.
22. **Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.
23. **Butler, E. 2016.** Recommended Exemption from further Palaeontological studies: Proposed Construction of the Gunstfontein Switching Station, 132kv Overhead Power Line (Single Or Double Circuit) and ancillary infrastructure for the Gunstfontein Wind Farm Near Sutherland, Northern Cape Province. Savannaha South Africa. Bloemfontein.
24. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.
25. **Butler, E. 2016.** Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.
26. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Savannaha South Africa. Bloemfontein.
27. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from the Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's river valley Local Municipality, Eastern Cape Province. Bloemfontein.

28. **Butler, E. 2016.** Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannaha South Africa. Bloemfontein.
29. **Butler, E. 2016.** Palaeontological Impact Assessment for the proposed construction of up to a 132kv power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces. PGS Heritage. Bloemfontein.
30. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed development of two burrow pits (DR02625 and DR02614) in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.
31. **Butler, E. 2016.** Ezibeleni waste Buy-Back Centre (near Queenstown), Enoch Mgijima Local Municipality, Eastern Cape. Bloemfontein.
32. **Butler, E. 2016.** Palaeontological Impact Assessment for the proposed construction of two 5 Mw Solar Photovoltaic Power Plants on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.
33. **Butler, E. 2016.** Palaeontological Impact Assessment for the proposed development of four Leeuwberg Wind farms and basic assessments for the associated grid connection near Loeriesfontein, Northern Cape Province. Bloemfontein.
34. **Butler, E. 2016.** Palaeontological impact assessment for the proposed Aggeneys south prospecting right project, Northern Cape Province. Bloemfontein.
35. **Butler, E. 2016.** Palaeontological impact assessment of the proposed Motuoane Ladysmith Exploration right application, Kwazulu Natal. Bloemfontein.
36. **Butler, E. 2016.** Palaeontological impact assessment for the proposed construction of two 5 MW solar photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.
37. **Butler, E. 2016**: Palaeontological desktop assessment of the establishment of the proposed residential and mixed use development on the remainder of portion 7 and portion 898 of the farm Knopjeslaagte 385 Ir, located near Centurion within the Tshwane Metropolitan Municipality of Gauteng Province. Bloemfontein.
38. **Butler, E. 2017.** Palaeontological impact assessment for the proposed development of a new cemetery, near Kathu, Gamagara local municipality and John Taolo Gaetsewe district municipality, Northern Cape. Bloemfontein.
39. **Butler, E. 2017.** Palaeontological Impact Assessment Of The Proposed Development Of The New Open Cast Mining Operations On The Remaining Portions Of 6, 7, 8 And 10 Of The Farm Kwaggafontein 8 In The Carolina Magisterial District, Mpumalanga Province. Bloemfontein.
40. **Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Development of a Wastewater Treatment Works at Lanseria, Gauteng Province. Bloemfontein.

41. **Butler, E. 2017.** Palaeontological Scoping Report for the Proposed Construction of a Warehouse and Associated Infrastructure at Perseverance in Port Elizabeth, Eastern Cape Province.
42. **Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Establishment of a Diesel Farm and a Haul Road for the Tshipi Borwa mine Near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.
43. **Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Changes to Operations at the UMK Mine near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.
44. **Butler, E. 2017.** Palaeontological Impact Assessment for the Development of the Proposed Ventersburg Project-An Underground Mining Operation near Ventersburg and Henneman, Free State Province. Bloemfontein.
45. **Butler, E. 2017.** Palaeontological desktop assessment of the proposed development of a 3000 MW combined cycle gas turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.
46. **Butler, E. 2017.** Palaeontological Impact Assessment for the Development of the Proposed Revalidation of the lapsed General Plans for Elliotdale, Mbhashe Local Municipality. Bloemfontein.
47. **Butler, E. 2017.** Palaeontological assessment of the proposed development of a 3000 MW Combined Cycle Gas Turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.
48. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed development of the new open cast mining operations on the remaining portions of 6, 7, 8 and 10 of the farm Kwaggafontein 8 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
49. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed mining of the farm Zandvoort 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
50. **Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed Lanseria outfall sewer pipeline in Johannesburg, Gauteng Province. Bloemfontein.
51. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of open pit mining at Pit 36W (New Pit) and 62E (Dishaba) Amandelbult Mine Complex, Thabazimbi, Limpopo Province. Bloemfontein.
52. **Butler, E. 2017.** Palaeontological impact assessment of the proposed development of the sport precinct and associated infrastructure at Merrifield Preparatory school and college, Amathole Municipality, East London. PGS Heritage. Bloemfontein.
53. **Butler, E. 2017.** Palaeontological impact assessment of the proposed construction of the Lehae training and fire station, Lenasia, Gauteng Province. Bloemfontein.
54. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the new open cast mining operations of the Impunzi mine in the Mpumalanga Province. Bloemfontein.

55. **Butler, E. 2017.** Palaeontological Desktop Assessment of the construction of the proposed Viljoenskroon Munic 132 KV line, Vierfontein substation and related projects. Bloemfontein.
56. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed rehabilitation of 5 ownerless asbestos mines. Bloemfontein.
57. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the Lephalale coal and power project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.
58. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of a 132KV powerline from the Tweespruit distribution substation (in the Mantsopa local municipality) to the Driedorp rural substation (within the Naledi local municipality), Free State province. Bloemfontein.
59. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the new coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.
60. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of a Photovoltaic Solar Power station near Collett substation, Middelburg, Eastern Cape. Bloemfontein.
61. **Butler, E. 2017.** Palaeontological Impact Assessment for the proposed township establishment of 2000 residential sites with supporting amenities on a portion of farm 826 in Botshabelo West, Mangaung Metro, Free State Province. Bloemfontein.
62. **Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed prospecting right project without bulk sampling, in the Koa Valley, Northern Cape Province. Bloemfontein.
63. **Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed Aroams prospecting right project, without bulk sampling, near Aggeneys, Northern Cape Province. Bloemfontein.
64. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed Belvior aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.
65. **Butler, E. 2017.** PIA site visit and report of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.
66. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of Tina Falls Hydropower and associated power lines near Cumbu, Mthlontlo Local Municipality, Eastern Cape. Bloemfontein.
67. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed construction of the Mangaung Gariep Water Augmentation Project. Bloemfontein.
68. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed Belvoir aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

69. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of the Melkspruit-Rouxville 132KV Power line. Bloemfontein.
70. **Butler, E. 2017** Palaeontological Desktop Assessment of the proposed development of a railway siding on a portion of portion 41 of the farm Rustfontein 109 is, Govan Mbeki local municipality, Gert Sibande district municipality, Mpumalanga Province. Bloemfontein.
71. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
72. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed extension of the Kareerand Tailings Storage Facility, associated borrow pits as well as a storm water drainage channel in the Vaal River near Stilfontein, North West Province. Bloemfontein.
73. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.
74. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed of the Lephalale Coal and Power Project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.
75. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed Overvaal Trust PV Facility, Buffelspoort, North West Province. Bloemfontein.
76. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed development of the H2 Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.
77. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.
78. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.
79. Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.
80. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HO, North West Province. Bloemfontein.
81. **Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Hartebeesfontein, near Panbult, Mpumalanga. Bloemfontein.
82. **Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Rustplaas near Piet Retief, Mpumalanga. Bloemfontein.

83. **Butler, E. 2018.** Palaeontological Impact Assessment for the Proposed Landfill Site in Luckhoff, Letsemeng Local Municipality, Xhariep District, Free State. Bloemfontein.
84. **Butler, E. 2018.** Palaeontological Impact Assessment of the proposed development of the new Mutsho coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.
85. **Butler, E. 2018.** Palaeontological Impact Assessment of the authorisation and amendment processes for Manangu mine near Delmas, Victor Khanye local municipality, Mpumalanga. Bloemfontein.
86. **Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed Mashishing township establishment in Mashishing (Lydenburg), Mpumalanga Province. Bloemfontein.
87. **Butler, E. 2018.** Palaeontological Desktop Assessment for the Proposed Mlonzi Estate Development near Lusikisiki, Ngquza Hill Local Municipality, Eastern Cape. Bloemfontein.
88. **Butler, E. 2018.** Palaeontological Phase 1 Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.
89. **Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed electricity expansion project and Sekgame Switching Station at the Sishen Mine, Northern Cape Province. Bloemfontein.
90. **Butler, E. 2018.** Palaeontological field assessment of the proposed construction of the Zonnebloem Switching Station (132/22kV) and two loop-in loop-out power lines (132kV) in the Mpumalanga Province. Bloemfontein.
91. **Butler, E. 2018.** Palaeontological Field Assessment for the proposed re-alignment and de-commisioning of the Firham-Platrand 88kv Powerline, near Standerton, Lekwa Local Municipality, Mpumalanga province. Bloemfontein.
92. **Butler, E. 2018.** Palaeontological Desktop Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.
93. **Butler, E. 2018.** Palaeontological field Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.
94. **Butler, E. 2018.** Palaeontological desktop assessment of the proposed Mookodi – Mahikeng 400kV line, North West Province. Bloemfontein.
95. **Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed Thornhill Housing Project, Ndlambe Municipality, Port Alfred, Eastern Cape Province. Bloemfontein.
96. **Butler, E. 2018.** Palaeontological desktop assessment of the proposed housing development on portion 237 of farm Hartebeestpoort 328. Bloemfontein.
97. **Butler, E. 2018.** Palaeontological desktop assessment of the proposed New Age Chicken layer facility located on holding 75 Endicott near Springs in Gauteng. Bloemfontein.
98. **Butler, E. 2018** Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.
99. **Butler, E. 2018.** Palaeontological field assessment of the proposed development of the Wildealskloof mixed use development near Bloemfontein, Free State Province. Bloemfontein.

100. **Butler, E. 2018.** Palaeontological Field Assessment of the proposed Megamor Extension, East London. Bloemfontein
101. **Butler, E. 2018.** Palaeontological Impact Assessment of the proposed diamonds Alluvial & Diamonds General Prospecting Right Application near Christiana on the Remaining Extent of Portion 1 of the Farm Kaffraria 314, Registration Division HO, North West Province. Bloemfontein.
102. **Butler, E. 2018**. Palaeontological Impact Assessment of the proposed construction of a new 11kV (1.3km) Power Line to supply electricity to a cell tower on farm 215 near Delportshoop in the Northern Cape. Bloemfontein.
103. **Butler, E. 2018.** Palaeontological Field Assessment of the proposed construction of a new 22 kV single wood pole structure power line to the proposed MTN tower, near Britstown, Northern Cape Province. Bloemfontein.
104. **Butler, E. 2018.** Palaeontological Exemption Letter for the proposed reclamation and reprocessing of the City Deep Dumps in Johannesburg, Gauteng Province. Bloemfontein.
105. **Butler, E.** 2018. Palaeontological Exemption letter for the proposed reclamation and reprocessing of the City Deep Dumps and Rooikraal Tailings Facility in Johannesburg, Gauteng Province. Bloemfontein.
106. **Butler, E.** 2018. Proposed Kalabasfontein Mine Extension project, near Bethal, Govan Mbeki District Municipality, Mpumalanga. Bloemfontein.
107. **Butler, E.** 2018. Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.
108. **Butler, E.** 2018. Palaeontological Desktop Assessment of the proposed Mookodi – Mahikeng 400kV Line, North West Province. Bloemfontein.
109. **Butler, E.** 2018. Environmental Impact Assessment (EIA) for the Proposed 325mw Rondekop Wind Energy Facility between Matjiesfontein And Sutherland In The Northern Cape Province.
110. **Butler, E.** 2018. Palaeontological Impact Assessment of the proposed construction of the Tooverberg Wind Energy Facility, and associated grid connection near Touws River in the Western Cape Province. Bloemfontein.
111. **Butler, E.** 2018. Palaeontological impact assessment of the proposed Kalabasfontein Mining Right Application, near Bethal, Mpumalanga.
112. **E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed Westrand Strengthening Project Phase II.
113. **E. Butler**. 2019. Palaeontological Field Assessment for the proposed Sirius 3 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province
114. **E. Butler.** 2019. Palaeontological Field Assessment for the proposed Sirius 4 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province
115. **E. Butler**. 2019. Palaeontological Field Assessement for Heuningspruit PV 1 Solar Energy Facility near Koppies, Ngwathe Local Municipality, Free State Province.

116. **E. Butler**. 2019. Palaeontological Field Assessment for the Moeding Solar Grid Connection, North West Province.
117. **E. Butler.** 2019. Recommended Exemption from further Palaeontological studies for the Proposed Agricultural Development on Farms 1763, 2372 And 2363, Kakamas South Settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.
118. **E. Butler. 2019.** Recommended Exemption from further Palaeontological studies: of Proposed Agricultural Development, Plot 1178, Kakamas South Settlement, Kai! Garib Municipality
119. E. Butler. 2019. Palaeontological Desktop Assessment for the Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province:
120. **E. Butler. 2019**. Palaeontological Exemption Letter for the proposed DMS Upgrade Project at the Sishen Mine, Gamagara Local Municipality, Northern Cape Province
121. **E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Integrated Environmental Authorisation process for the proposed Der Brochen Amendment project, near Groblershoop, Limpopo
122. E. **Butler. 2019.** Palaeontological Desktop Assessment of the proposed updated Environmental Management Programme (EMPr) for the Assmang (Pty) Ltd Black Rock Mining Operations, Hotazel, Northern Cape
123. **E. Butler. 2019**. Palaeontological Desktop Assessment of the proposed Kriel Power Station Lime Plant Upgrade, Mpumalanga Province
124. **E. Butler.** 2019. Palaeontological Impact Assessment for the proposed Kangala Extension Project Near Delmas, Mpumalanga Province.
125. **E. Butler. 2019**. Palaeontological Desktop Assessment for the proposed construction of an iron/steel smelter at the Botshabelo Industrial area within the Mangaung Metropolitan Municipality, Free State Province.
126. **E. Butler. 2019**. Recommended Exemption from further Palaeontological studies for the proposed agricultural development on farms 1763, 2372 and 2363, Kakamas South settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.
127. **E. Butler. 2019.** Recommended Exemption from further Palaeontological Studies for Proposed formalisation of Gamakor and Noodkamp low cost Housing Development, Keimoes, Gordonia Rd, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.
128. **E. Butler. 2019**. Recommended Exemption from further Palaeontological Studies for proposed formalisation of Blaauwskop Low Cost Housing Development, Kenhardt Road, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.
129. **E. Butler. 2019**. Palaeontological Desktop Assessment of the proposed mining permit application for the removal of diamonds alluvial and diamonds kimberlite near Windsorton on a certain portion of Farm Zoelen's Laagte 158, Registration Division: Barkly Wes, Northern Cape Province.

130. **E. Butler. 2019**. Palaeontological Desktop Assessment of the proposed Vedanta Housing Development, Pella Mission 39, Khâi-Ma Local Municipality, Namakwa District Municipality, Northern Cape.
131. **E. Butler. 2019**. Palaeontological Desktop Assessment for The Proposed 920 Kwp Groenheuwel Solar Plant Near Augrabies, Northern Cape Province
132. **E. Butler. 2019.** Palaeontological Desktop Assessment for the establishment of a Super Fines Storage Facility at Amandelbult Mine, Near Thabazimbi, Limpopo Province
133. **E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Sace Lifex Project, Near Emalahleni, Mpumalanga Province
134. E. Butler. 2019. Palaeontological Desktop Assessment for the proposed Rehau Fort Jackson Warehouse Extension, East London
135. E. Butler. 2019. Palaeontological Desktop Assessment for the proposed Environmental Authorisation Amendment for moving 3 Km Of the Merensky-Kameni 132KV Powerline
136. E. Butler. 2019. Palaeontological Impact Assessment for the proposed Umsobomvu Solar PV Energy Facilities, Northern and Eastern Cape
137. E. Butler. 2019. Palaeontological Desktop Assessment for six proposed Black Mountain Mining Prospecting Right Applications, without Bulk Sampling, in the Northern Cape.
138. E. Butler. 2019. Palaeontological field Assessment of the Filling Station (Rietvlei Extension 6) on the Remaininng Portion of Portion 1 of the Farm Witkoppies 393JR east of the Rietvleidam Nature Reserve, City of Tshwane, Gauteng
139. E. Butler. 2019. Palaeontological Desktop Assessment Of The Proposed Upgrade Of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction
140. **E. Butler. 2019.** Palaeontological Desktop Assessment Of The Expansion Of The Jan Kempdorp Cemetry On Portion 43 Of Farm Guldenskat 36-Hn, Northern Cape Province
141. **E. Butler. 2019.** Palaeontological Desktop Assessment of the Proposed Residential Development On Portion 42 Of Farm Geldunskat No 36 In Jan Kempdorp, Phokwane Local Municipality, Northern Cape Province
142. **E. Butler.** 2019. Palaeontological Impact Assessment of the proposed new Township Development, Lethabo Park, on Remainder of Farm Roodepan No 70, Erf 17725 And Erf 15089, Roodepan Kimberley, Sol Plaatjies Local Municipality, Frances Baard District Municipality, Northern Cape
143. **E. Butler.** 2019. Palaeontological Protocol for Finds for the proposed 16m WH Battery Storage System in Steinkopf, Northern Cape Province
144. **E. Butler.** 2019. Palaeontological Exemption Letter of the proposed 4.5WH Battery Storage System near Midway-Pofadder, Northern Cape Province
145. **E. Butler.** 2019. Palaeontological Exemption Letter of the proposed 2.5ml Process Water Reservoir at Gloria Mine, Black Rock, Hotazel, Northern Cape
146. **E. Butler.** 2019. Palaeontological Desktop Assessment for the Establishment of a Super Fines Storage Facility at Gloria Mine, Black Rock Mine Operations, Hotazel, Northern Cape:

147. **E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed New Railway Bridge, and Rail Line Between Hotazel And The Gloria Mine, Northern Cape Province
148. **E. Butler.** 2019. Palaeontological Exemption Letter Of The Proposed Mixed Use Commercial Development On Portion 17 Of Farm Boegoeberg Settlement Number 48, !Kheis Local Municipality In The Northern Cape Province
149. **E. Butler.** 2019. Palaeontological Desktop Assessment of the Proposed Diamond Mining Permit Application Near Kimberley, Sol Plaatjies Municipality, Northern Cape Province
150. **E. Butler.** 2019. Palaeontological Desktop Assessment of the Proposed Diamonds (Alluvial, General & In Kimberlite) Prospecting Right Application near Postmasburg, Registration Division; Hay, Northern Cape Province
151. **E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed diamonds (alluvial, general & in kimberlite) prospecting right application near Kimberley, Northern Cape Province.
152. **E. Butler.** 2019. Palaeontological Phase 1 Impact Assessment of the proposed upgrade of the Vaal Gamagara regional water supply scheme: Phase 2 and groundwater abstraction
153. **E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed seepage interception drains at Duvha Power Station, Emalahleni Municipality, Mpumalanga Province
154. **E. Butler.** 2019. Palaeontological Desktop Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng.
155. **E. Butler.** 2019. Palaeontological Phase 1 Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng.
156. **E. Butler.** 2019. Palaeontological field Assessment for the Proposed Upgrade of the Kolomela Mining Operations, Tsantsabane Local Municipality, Siyanda District Municipalitty, Northern Cape Province, Northern Cape
157. **E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed feldspar prospecting rights and mining application on portion 4 and 5 of the farm Rozynen 104, Kakamas South, Kai! Garib Municipality, Zf Mgcawu District Municipality, Northern Cape
158. **E. Butler.** 2019. Palaeontological Phase 1 Field Assessment of the proposed Summerpride Residential Development and Associated Infrastructure on Erf 107, Buffalo City Municipality, East London.
159. **E. Butler.** 2019. Palaeontological Desktop Impact Assessment for the proposed re-commission of the Old Balgray Colliery near Dundee, Kwazulu Natal.
160. **E. Butler.** 2019. Palaeontological Phase 1 Impact Assessment for the Proposed Re-Commission of the Old Balgray Colliery near Dundee, Kwazulu Nata.l
161. **E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery.

162. **E. Butler.** 2019. Palaeontological Impact Assessment and Protocol for Finds of a Proposed New Quarry on Portion 9 (of 6) of the farm Mimosa Glen 885, Bloemfontein, Free State Province
163. **E. Butler.** 2019. Palaeontological Impact Assessment and Protocol for Finds of a proposed development on Portion 9 and 10 of the Farm Mimosa Glen 885, Bloemfontein, Free State Province
164. **E. Butler.** 2019. Palaeontological Exemption Letter for the proposed residential development on the Remainder of Portion 1 of the Farm Strathearn 2154 in the Magisterial District of Bloemfontein, Free State
165. **E. Butler.** 2019. Palaeontological Field Assessment for the Proposed Nigel Gas Transmission Pipeline Project in the Nigel Area of the Ekurhuleni Metropolitan Municipality, Gauteng Province
166. **E. Butler.** 2019. Palaeontological Desktop Assessment for five Proposed Black Mountain Mining Prospecting Right Applications, Without Bulk Sampling, in the Northern Cape.
167. **E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and an Integrated Water Use Licence Application for the Reclamation of the Marievale Tailings Storage Facilities, Ekurhuleni Metropolitan Municipality - Gauteng Province.
168. **E. Butler.** 2019. Palaeontological Impact Assessment for the Proposed Sace Lifex Project, near Emalahleni, Mpumalanga Province.
169. **E. Butler.** 2019. Palaeontological Desktop Assessment for the proposed Golfview Colliery near Ermelo, Msukaligwa Local Municipality, Mpumalanga Province
170. **E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Kangra Maquasa Block C Mining development near Piet Retief, in the Mkhondo Local Municipality within the Gert Sibande District Municipality
171. **E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Amendment of the Kusipongo Underground and Opencast Coal Mine in Support of an Environmental Authorization and Waste Management License Application.
172. **E. Butler.** 2019. Palaeontological Exemption Letter of the Proposed Mamatwan Mine Section 24g Rectification Application, near Hotazel, Northern Cape Province
173. Palaeontological Field Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery
174. Palaeontological Desktop Assessment for the Proposed Extension of the South African Nuclear Energy Corporation (Necsa) Pipe Storage Facility, Madibeng Local Municipality, North West Province
175. Palaeontological Field Assessment for the Proposed Piggery on Portion 46 of the Farm Brakkefontien 416, Within the Nelson Mandela Bay Municipality, Eastern Cape
176. Palaeontological field Assessment for the proposed Rietfontein Housing Project as part of the Rapid Land Release Programme, Gauteng Province Department of Human Settlements, City of Johannesburg Metropolitan Municipality

177. Palaeontological Desktop Assessment for the Proposed Choje Wind Farm between Grahamstown and Somerset East, Eastern Cape
178. Palaeontological Desktop Assessment of the Proposed Prospecting Right Application for the Prospecting of Diamonds (Alluvial, General & In Kimberlite), Combined with A Waste License Application, Registration Division: Gordonia And Kenhardt, Northern Cape Province
179. Palaeontological Impact Assessment for the Proposed Clayville Truck Yard, Ablution Blocks and Wash Bay to be Situated on Portion 55 And 56 Of Erf 1015, Clayville X11, Ekurhuleni Metropolitan Municipality, Gauteng Province
180. Palaeontological Desktop Assessment for the Proposed Hartebeesthoek Residential Development
181. Palaeontological Desktop Assessment for the Proposed Mooiplaats Educational Facility, Gauteng Province
182. Palaeontological Impact Assessment for the Proposed Monument Park Student Housing Establishment
183. Palaeontological Field Assessment for the Proposed Standerton X10 Residential and Mixed-Use Developments, Lekwa Local Municipality Standerton, Mpumalanga Province
184. Palaeontological Field Assessment for the Rezoning and Subdivision of Portion 6 Of Farm 743, East London
185. Palaeontological Field Assessment for the Proposed Matla Power Station Reverse Osmosis Plant, Mpumalanga Province

CONFERENCE CONTRIBUTIONS

NATIONAL

PRESENTATION

Butler, E., Botha-Brink, J., and F. Abdala. A new gorgonopsian from the uppermost *Dicynodon Assemblage Zone*, Karoo Basin of South Africa.18 the Biennial conference of the PSSA 2014.Wits, Johannesburg, South Africa.

INTERNATIONAL

Attended the Society of Vertebrate Palaeontology 73th Conference in Los Angeles, America. October 2012.

CONFERENCES: POSTER PRESENTATION

NATIONAL

Butler, E., and J. Botha-Brink. Cranial skeleton of *Galesaurus planiceps*, implications for biology and lifestyle. University of the Free State Seminar Day, Bloemfontein. South Africa. November 2007.

Butler, E., and J. Botha-Brink. Postcranial skeleton of *Galesaurus planiceps*, implications for biology and lifestyle.14th Conference of the PSSA, Matjesfontein, South Africa. September 2008:

Butler, E., and J. Botha-Brink. The biology of the South African non-mammaliaform cynodont *Galesaurus planiceps*.15th Conference of the PSSA, Howick, South Africa. August 2008.

INTERNATIONAL VISITS

Natural History Museum, London July 2008

Paleontological Institute, Russian Academy of Science, Moscow November 2014

ANNEXURE I: FRESH WATER REPORT

WATER USE LICENSE APPLICATION
FOR THE PROPOSED URBAN DEVELOPMENT AT GROBLERSHOOP, NORTHERN CAPE

FRESH WATER REPORT

A REQUIREMENT IN TERMS OF SECTION 21 OF THE NATIONAL WATER ACT
MAY 2020

Index

Abbreviations

Northern Cape Department: Co-Operative Governance, Human Settlements and Traditional Affairs	COGHSTA
Critical Biodiversity Area	CBA
Department of Water and Sanitation	DWA
Ecological Importance	EI
Ecological Sensitivity	ES
Ecological Support Area	ESA
Environmental Impact Assessment	EIA
Electronic Water Use License Application (on-line)	eWULAA
Government Notice	GN
Hectares	ha
Legal water use	LWU
Metres Above Sea Level	masl
National Environmental Management Act (107 of 1998)	NEMA
National Freshwater Environment Priority Area	NFEPA
National Water Act (36 of 1998)	NWA
Non-government organization	NGO
Present Ecological State	PES
South Africa National Biodiversity Institute	SANBI
Section of an Act of Parliament	S
Water Use License Application	WULA

List of Figures

List of Tables

Figure 1 Public participation

1 Introduction

On 14 May 2020, an email message was received from Mr Len Fourie, director at Macroplan of Upington:

"The appointment of Gobetla Beplannings Dienste TA Macroplan by the Barzani Group (on behalf of COGHSTA) received on the 17th of April 2020 and the attached documentation have reference.

"We hereby confirm that Macroplan has been appointed as Town and Regional Planners to handle the formal Town Planning Process in accordance with the SPLUMA legislation (Act 16 of 2013). The mentioned process is for the provision of much needed residential erven in the sub-economic market that is of National and Provincial interest for towns in the !Kheis Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.

"Macroplan and all sub-consultants were requested to proceed with site verification, site visits, contour mapping, specialists environmental studies, geotechnical studies, as well as civil and engineering investigations for the mentioned project asap due to the importance of continued service delivery in the !Kheis Local Municipal area. Your firm as a sub-consultant of Macroplan is hereby requested to proceed with organising the site visits to the following areas that is located within the !Kheis Local Municipality."

This adequately explains the situation.

Enviro Africa of Somerset West was subsequently appointed to carry out the EIA, in terms of NEMA, together with the public participation process (Figure 1).

Likewise, WATSAN Africa was appointed to produce the Fresh Water Report and carry out the WULA in terms of the NWA. The required site visits were conducted on 20 and 21 May 2020.

The Fresh Water Report must contain adequate information to allow for informed decision-making. The decision to approve the proposed urban development rests with DWS officials, in terms of S21 of the NWA. The Fresh Water Report must contain specified information according to a set profile, which has been developed over a number of years over many such reports and in accordance with GN509. A Risk Matrix is to be completed, as published on the DWA webpage.

This then is the first of 7 reports. For each of these reports, the issues are very much the same, with a similar terrain and social-economic circumstances. Consequently, the reports are the same, being mirror images of one another, but adapted to the specific localities and specific issues for each of the townships.

2 Seven Townships

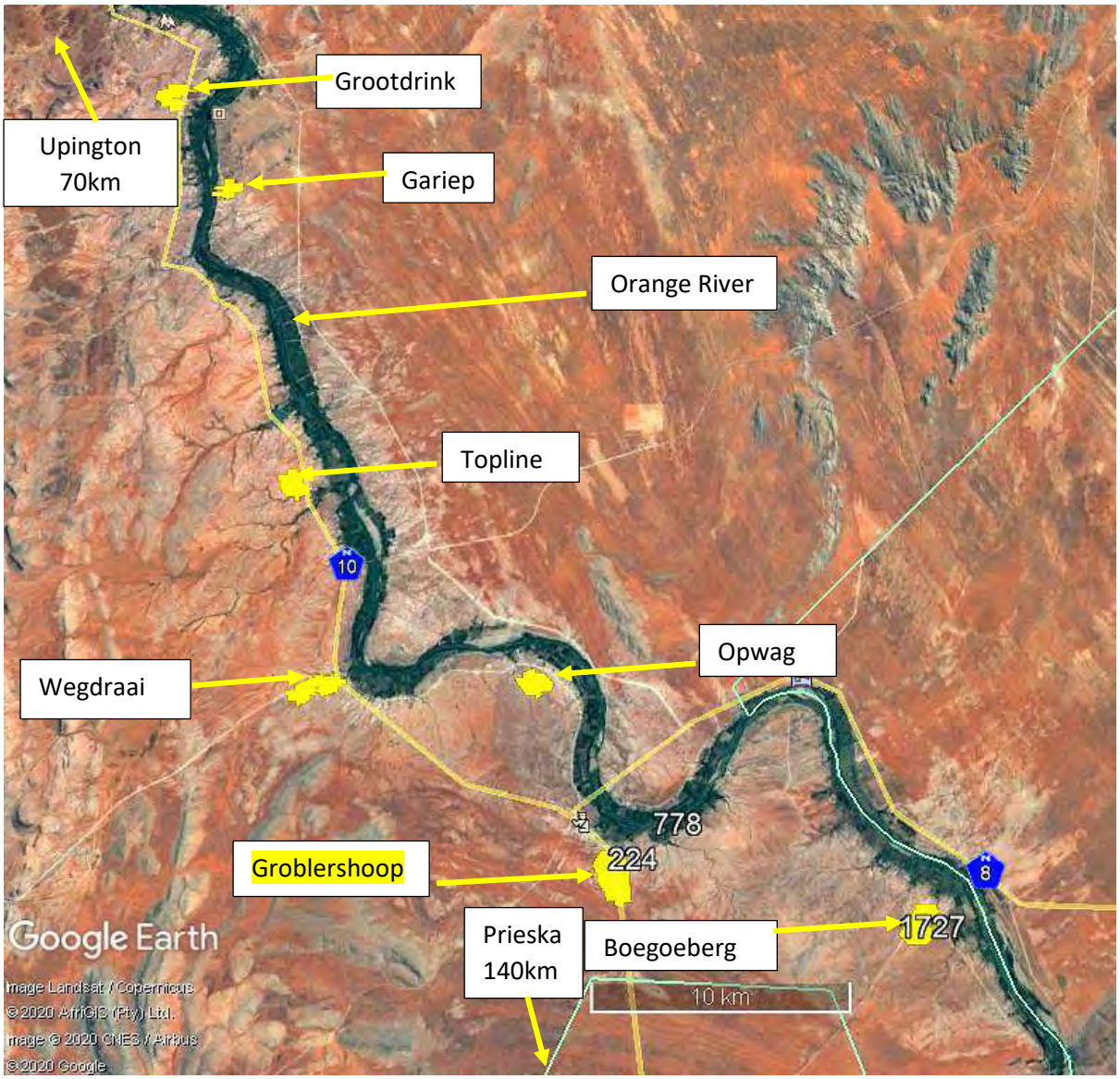


Figure 2 Seven townships

The seven townships that are being considered for extension are depicted in Figure 2. Groblershoop is highlighted in yellow and is the subject of this Fresh Water Report.

3 Legal Framework

The proposed development "triggers" sections of the National Water Act. These are the following:

S21 (c) *Impeding or diverting the flow of a water course*

The proposed development is spanning the banks of a drainage line. A drainage line would be altered, should the development go ahead.

S21 (i) *Altering the bed, bank, course of characteristics of a water course.*

Some part of the proposed development will alter the characteristics of the banks of a drainage line.

Government Notice 267 of 24 March 2017

Government Notice 1180 of 2002. *Risk Matrix.*

The Risk Matrix as published on the DWS official webpage must be completed and submitted along with the Water Use Licence Application (WULA). The outcome of this risk assessment determines if a letter of consent, a General Authorization or a License is required.

Government Notice 509 of 26 August 2016

An extensive set of regulations that apply to any development in a water course is listed in this government notice in terms of Section 24 of the NWA. No development take place within the 1:100 year-flood line without the consent of the DWS. If the 1:100-year flood line flood line is not known, no development may take place within a 100m from a water course without the consent of the DWS. The development is adjacent to drainage lines, which are defined as legitimate water resources.

Likewise, the development triggers a part of the National Environmental Management Act, NEMA, 107 of 1998).

The EIA Regulations of 2014 No.1 Activity 12 states that no development may take place within 32m of a water course without the consent of the Department of Environmental Affairs and its provincial representatives. A part of the development is adjacent to drainage lines. Consequently, this regulation is relevant to this application.

This Fresh Water Report is exclusively focussed in S21 (c) and (i) of the NWA

4 !Kheis Municipality Overview

Figure 3 !Kheis Municipality

According to available information

(municipalities.co.za/1181/kheis-local-municipality)

Area	11 107km^2
Population	16 566 (2016)
Households	4344

The municipal offices are located in Groblershoop.

Only 59% of the houses were listed as formal dwellings, 41% were connected to the urban sewerage system, 62% had formal refuse removal, 21% had piped water and 74% had electricity. As from the year 2020, 500 more households were provided with solar panels and batteries to provide electricity.

The average fertility rate over the past 5 years was 2.67%

(https://irr.org.za/reports/freefacts/files/00-2014-freefacts-2014-february-2020-draft.pdf)

This means, according to available demographic data, that currently at least 116 new houses are required every year.

To address any backlog and to make provision for future housing requirements, new plots are demarcated in the following locations:

Groblershoop	1500
Boegoeberg	550
Opwag	730
Wegdraai	360
Topline	248
Grootdrink	370
Gariep	135

Urban development is specifically required along the Orange River, where large-scale and labour-intensive farming of vineyards under irrigation sparks human settlements.

The municipality appointed the town and regional planning company Macroplan of Upinton to lay out the new plots in these 7 townships.

5 Climate Groblershoop

http://www.saexplorer.co.za/south-africa/climate/groblershoop_climate.asp

Groblershoop normally receives about 108mm of rain per year, with most rainfall occurring mainly during autumn. The chart below (Figure 4, lower left) shows the average rainfall values for Groblershoop per month. It receives the lowest rainfall (0mm) in June and the highest (32mm) in March. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Groblershoop range from 19°C in June to 33°C in January. The region is the coldest during July when the mercury drops to 2°C on average during the night. Consult the chart below (lower right) for an indication of the monthly variation of average minimum daily temperatures.

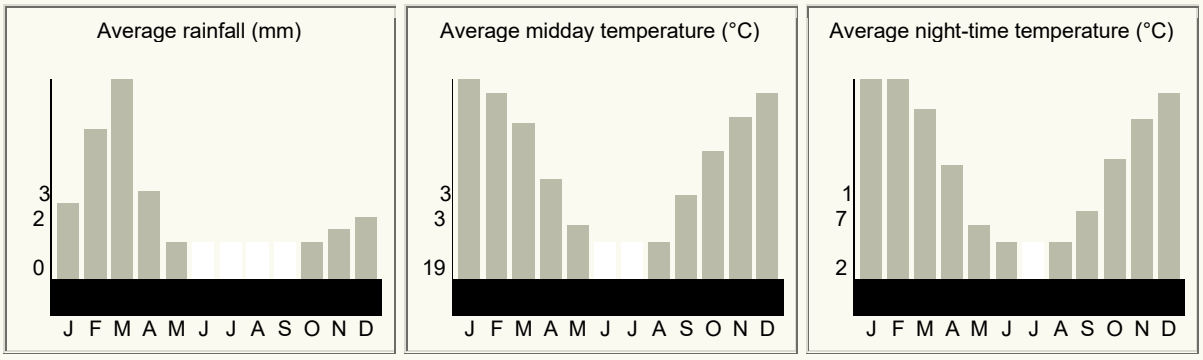


Figure 4 Climate Groblershoop

Groblershoop and surrounds is located in the Nama Karoo, which is from all points of view an arid area. For 4 months of the year there is no rainfall at all.

According to

https://weatherspark.com/y/86570/Average-Weather-in-Groblershoop-South-Africa-Year-Round

the dry season at Groblershoop lasts up to 6.4 months from April to November.

The evaporation rate in the nearby Upington, 70km to the north, is more than 2500mm per year. This is 27 times more than the annual precipitation.

http://www.dwaf.gov.za/orange/Low_Orange/upington.aspx

The local economy (agriculture) is entirely dependent on irrigation out of the Orange River.

6 Vegetation

The South African National Biodiversity Institute (SANBI) indicated the vegetation type on the property as Bushmanland Arid Grassland. The vegetation around the river is indicated as Lower Gariep Alluvial Vegetation. The Orange River is a National Freshwater Ecosystem Priority Area (NFEPA). The riparian area is indicated as Nama Karoo Bushmanland_Floodplain Wetland, despite that most of it today is manicured agriculture.

7 Quaternary Catchment

Groblershoop is in the D73D quaternary catchment.

8 Drainage Lines

The landscape around much of the Lower Orange River and the Sak River is dominated by a dense succession of drainage lines, each with their own sub-catchment. The drainage lines spread along the river with many smaller tributaries to cover the entire area. The iron oxides in the sands renders a red hue that is visible from space on the Google Earth images. These reds are concentrated in the drainage lines, making them even more visible (Figure 5).

The drainage lines are mostly dry, with water only during rains and perhaps shortly thereafter. During the odd thunder storm, drainage lines can come down in flood. These floods maintain the drainage line's morphological integrity, as sediments are moved and these water ways are scoured out.

Because rainfall events are far apart, the drainage lines must have been formed over millennia, even since geological times.

The vegetation in these arid parts is sparse, with a low diversity op plant species and a limited habitat variability. Drainage lines are often overgrown with a mature stand of sweet thorn *Vachellia karoo*, together with some other scrub and low trees such as *Searsia* species. In other parts the dominant tree is swarthaak *Senegalia mellifera.* This considerably adds to the habitat variability of the region. These tree lines stretch over the otherwise barren landscape and provide a linear connected habitat that would have been entirely absent if it was not for the shallow ground water in the unconfined aquifer in the drainage line's alluvium. Likewise, these tree lines provide habitat and nourishment to a variety of fauna that would have been entirely absent, was it not for the gradual migration of shallow ground water along the drainage lines.

All over the arid and semi-arid landscape of the western half of South Africa, these tree lines are considered to have a special and high conservation value.

Around the Orange River and even the Sak and Hartbees River, large-scale agriculture has changed the drainage lines into drainage channels among the vineyards and orchards. The upper reaches away from the rivers are less impacted,

even near-pristine, as intense agriculture is not possible, apart from those areas where water is piped over long distances from the Orange River.

The conservation of drainage lines along the Lower Orange River deserves and demands attention by decision-making authorities, environmental practitioners, the conservation and farming community alike. As more of these drainage lines are impacted upon, and because impacts are radical by nature, because sections of drainage lines are replaced by vineyards or other forms of agriculture, or transformed into return flow infrastructure, the necessity for a widely accepted conservation policy becomes urgent as development escalates.

Figure 5 Drainage Lines

9 The Groblershoop Housing Project

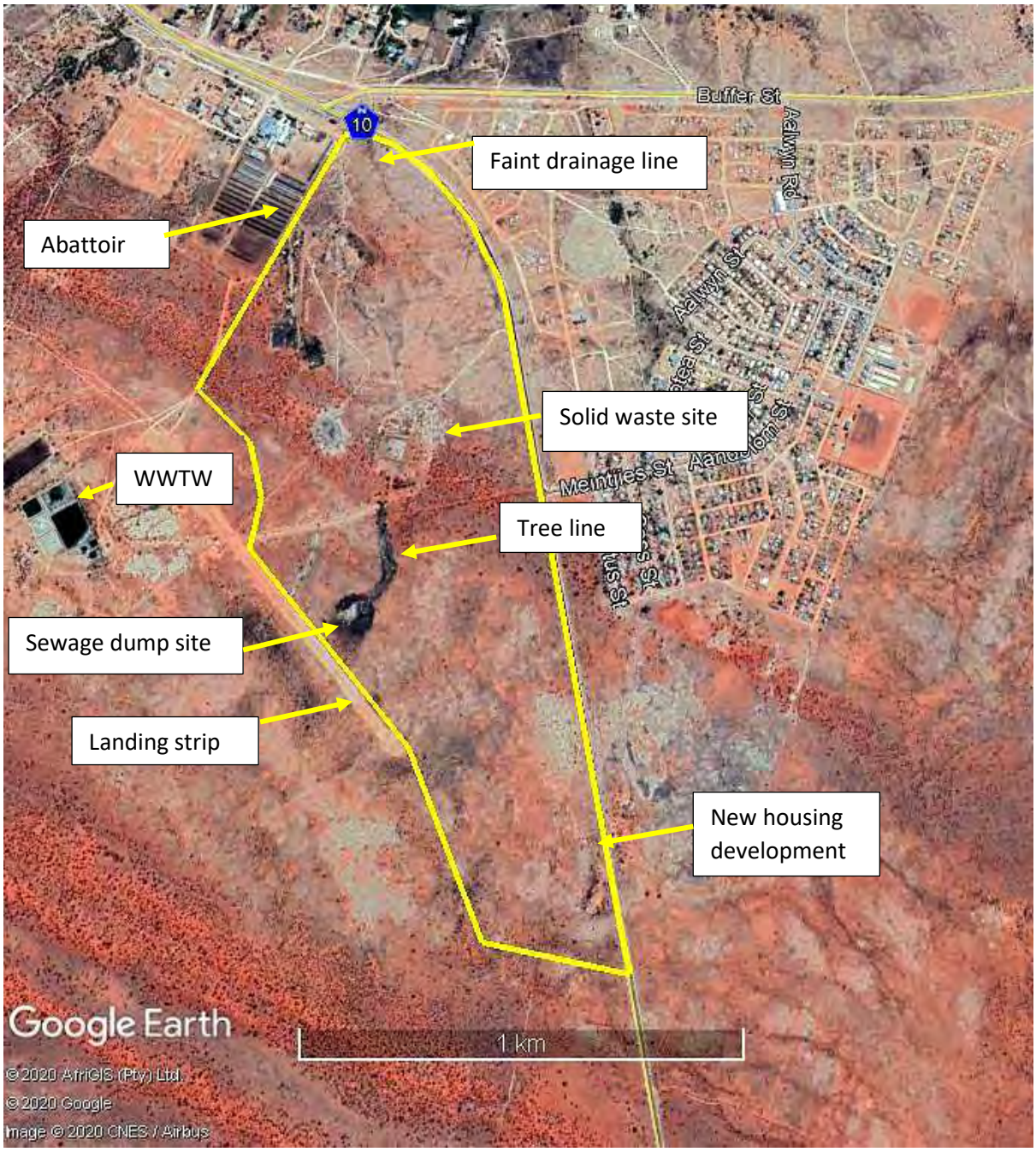


Figure 6 Groblershoop Housing

The area on which the housing is going to be built is depicted in Figure 6.

10 Groblershoop housing drainage lines

The only aquatic feature that triggered the WULA is the very faint and insignificant drainage line in the northern corner Figure 7, Figure 8). It is some 700m long and ends against the vineyards along the Orange River. Much of its existence probably depends on runoff from the N10 trunk road.

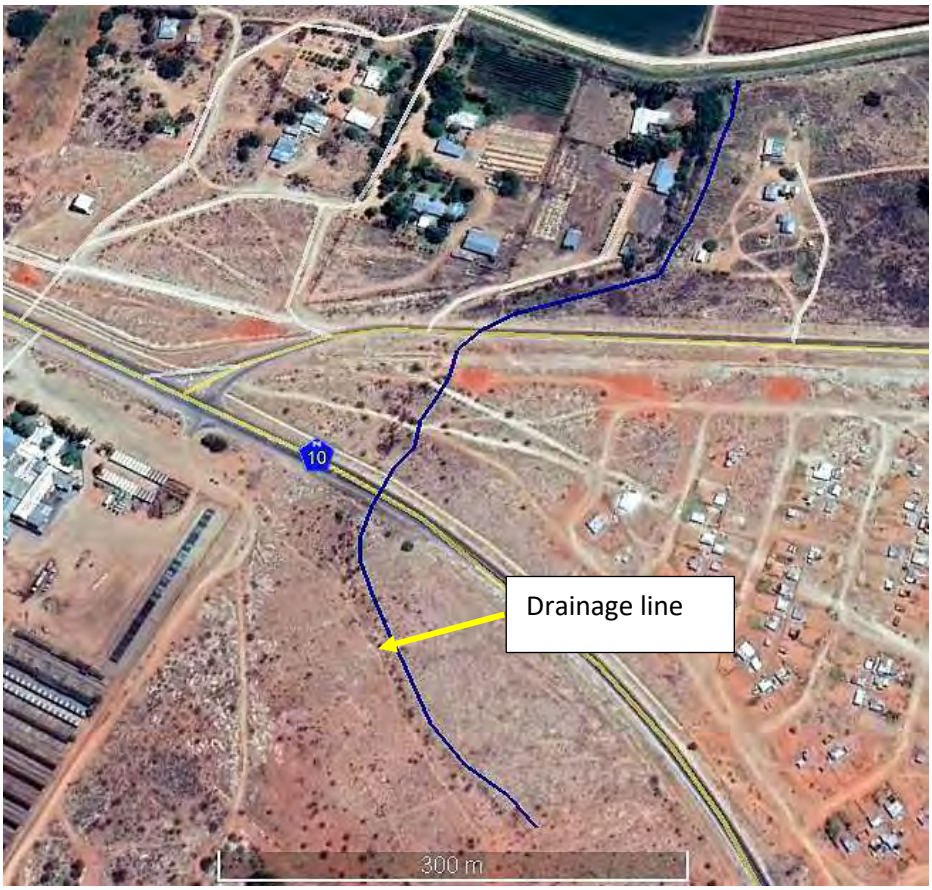


Figure 7 Drainage line

Figure 8 Faint drainage line vegetation

However, there is a prominent tree line on the site that resembles that of a drainage line. This is entirely artificial, as it is the result of raw sewage being dumped from tanker trucks on the site (Figure 9) and on its flow path (Figure 10) down the incline has created the conditions for the trees (Figure 11) to establish themselves. This tree line starts as abruptly as it ends and is not connected to any other drainage line.

The locality on which the dumping takes place and the flow path is clearly visible. This malpractice must have been going on for years, judging from the height of the trees. Since the tree line is not there because of natural circumstance, it cannot have any conservation status in terms of the requirements of the WULA and Fresh Water Report. It will therefore not be included in an Impact Assessment and Risk Matrix.

Reportedly, this is not the only place on the site where raw sewage is dumped.

Meanwhile the WWTW is lying idle. Initially it was used, but judging from the vegetation growth in the intake structure, it must have been idle for some time now (Figure 12). The ponds are partly filled to entirely empty and overgrown with reeds (Figure 13).

The WWTW and concomitant infrastructure was constructed at great cost (Figure 14). Currently this can probably be regarded as unfruitful expenditure.

Figure 9 Sewage

Figure 10 Sewage flow path

Figure 11 Tree line

Figure 12 Intake structure

Figure 13 Ponds

Figure 14 Cost

Adjacent to the proposed housing project is an abattoir (Figure 15). In relation to the housing area, this is quite a prominent undertaking, but evidently has no apparent impact on the housing area's aquatic environment.

Figure 15 Abattoir

The urban solid waste and building rubble can be construed as a threat to the aquatic environment, should it end up in the drainage lines, irrigation canals and in the Orange River.

There is a drainage line with its tree line further south, alongside the red dunes, which are visible on the Google Earth Image (Figure 16). The culvert underneath the N10 is shown in Figure 17. This drainage line is outside the area earmarked for development, but is of concern because it is possible, perhaps not unthinkable, given the current circumstances, that rubble and sewage from the urban area can end up there in the future.

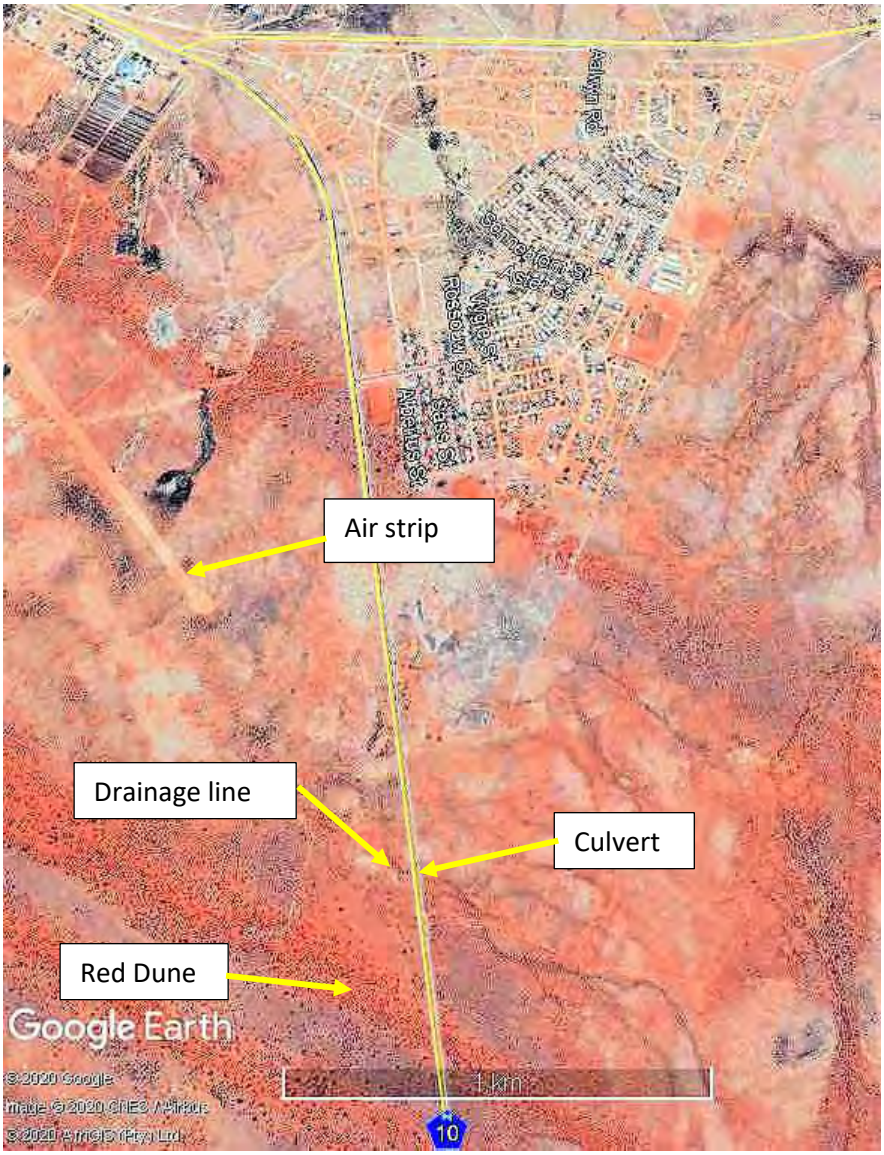


Figure 16 Southern drainage line

Figure 17 Culvert

The barren area on the south western boundary of the proposed development resembles an air strip for light airplanes. It has no connection to a drainage line, no hydraulic connectivity and is does not seem to constitute a preferential flow path.

11 Biomonitoring the Lower Orange River

The biomonitoring was carried out according to the description of Dickens & Graham (2002).

Biomonitoring was carried out on the Lowers Orange River during site visits for successive WULAs. So far 12 samples have been analyzed at 11 localities (Table 1). The site furthest east was at Hopetown and furthest west at Augrabies, with Upington in the middle. All of these are located upstream of the Augrabies Falls.

Another sample was analyzed at Styerkraal just east of the border post of Onseepkans downstream of the Augrabies Falls.

The river is mostly braided, with many smaller streams and with islands in the middle. The river sports many rapids and riffles, but also pool-like features where the river is broad and slower flowing.

The bottom is mainly muddy, with some large rocky outcrops in the middle of the river.

12 Impacts on the Lower Orange River

The river is heavily utilized for agriculture, with the banks entirely modified into cultured vineyards. A multitude of large electric water pumps have been placed in the river for abstracting large volumes of water for irrigation. Abstraction significantly lowers the flow in the river.

Berms for the purpose of flood protection have been constructed on the banks of the river for most of its length. These berms have been constructed by the Department of Water Affairs and now have been a feature of the landscape for many decades. The berms keep flood water out of adjacent agricultural land and has denaturalised the riparian zone.

The single most impact on the Orange River are the two very large dams, The Gariep Dam and the Vanderkloof Dam. The river flow has been modified to a much more even regime, different from the varied flown with high peak flows and low drought flows.

The Lower Orange River is lined with a dense system of mostly dry drainage lines. These drainage lines only flow during and shortly after heavy rains. Their contribution to the flow of the Orange River is insignificant. Most of the flow comes from the Lesotho Highlands and some from the Vaal River. However, many of these drainage lines have been transformed into engineered agricultural return flow furrows that carries the excess of over irrigation back to the Orange River. Agricultural return flow adds much to the nutrient load of the Orange River because runoff contains fertilizer. Nitrogen is added in large quantities. Since phosphorus readily binds to the soil, not much phosphorus is added.

Return flow can contain a heavy silt load, thereby elevating turbidity in the river.

It is suspected that pesticides in agricultural return flow have a heavy impact on biomonitoring results, significantly reducing the SASS5 score.

The banks of the Orange River in the area is densely overgrown with Spaanse Riet (*Arundo donax*). This is classified as an aggressive and exotic invasive plant, which effectively prevents access to the river. The reeds result in a homogeneous aquatic habitat. This lack of variation supresses the SASS5 score, with only a limited number of aquatic macroinvertebrate species present in this habitat.

13 Lower Orange River Biomonitoring Results

The biomonitoring results have been captured in Table 1 and depicted in Figure 18.

The classes from A to F in Figure 18 has been assigned for mature rivers on flood plains such as the Lower Orange River.

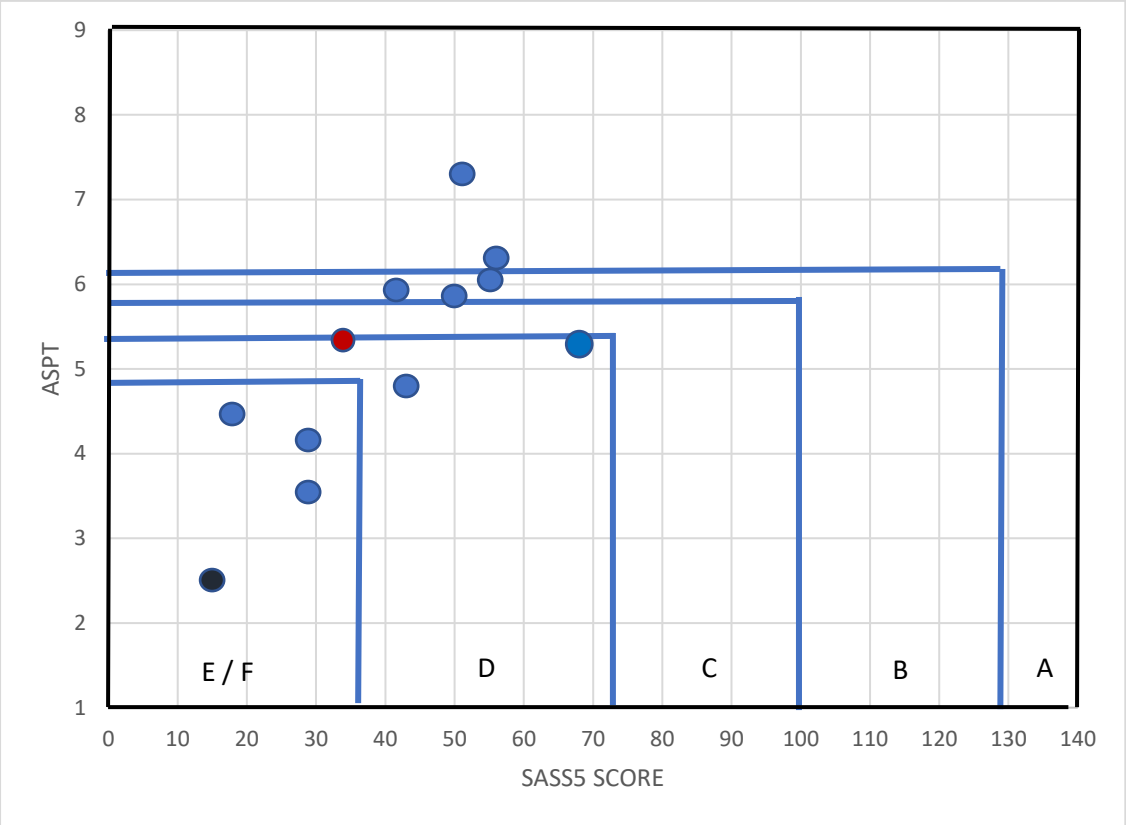
Only 2 of the samples were classified a good and relatively unimpacted (Class A). Four were in Class B and C, which can be regarded as acceptable under the circumstances of an impacted river reach. These classes can possible be labelled as the ideal, a compromise between agriculture and aquatic ecological functioning.

Four samples were poor (Classes E and F), an undesirable state of affairs.

The one sample downstream of the Augrabies Falls was extremely poor.

Table 1 Biomonitoring in the Lower Orange River

Locality	Coordinates	Date	SASS 5	No Taxa	ASPT
Augrabies Lair trust	28°38'41.53S 20°26'08.49E	5/09/17	18	4	4.5
Augrabies Lair Trust	28°38'41.53S 20°26'08.49E	5/10/17	43	9	4.8
Groblershoop	28°52'31.80S 21°59'13.49E	14/8/18	41	7	5.9
Kakamas Triple D	28°45'08.37S 20°35'06.16E	15/8/18	50	9	5.6
Hopetown Sewer	29°36'05.07S 24°06'05.00E	7/10/18	29	7	4.1
Hopetown Sewer	29°36'08.06S 24°21'06.16E	7/10/18	29	8	3.6
Keimoes Housing	28°42'37.12S 20°55'07.81E	8/02/19	51	7	7.3
Upington Erf 323	28°27'11.91S 21°16'14.02E	12/2/19	56	9	6.2
Upington Affinity	28°27'11.91S 21°16'14.02E	20/5/19	54	9	6
Styerkraal	28°27'25.28S 21°15'01.87E	21/5/19	15	6	2.5
Grootdrink Bridge	28°17'15.30S 21°03'50.87E	17/5/20	34	7	5.3
Turksvy Dam	28°27'09.21S 21°17'20.72E	17/5/20	69	13	5.3



Integrity Class	Description
A	Pristine; not impacted
B	Very Good; slightly impacted
C	Good; measurably impacted with most ecological functioning intact
D	Fair; impacted with some loss of ecological functioning
E	Poor; loss of most ecological function
F	Very Poor; loss of all ecological function

Figure 18 Lower Orange River Biomonitoring Results

The red dot on the graph represents the result at the Grootdrink Bridge. All of the other dots represent previous sampling.

14 Sampling Site

Figure 19 Sampling Site

Figure 20 Orange River at Sampling Point

The sampling point (Figure 19, Figure 20) was chosen downstream as far as possible in order to pick up the combined impact of all of the housing projects along the reach of the Orange River from Boegoeberg to Grootdrink. This, of course, is not a realistic view, because the impact of agriculture would dwarf any other, if it could be separated, which is not possible. So, the reasoning is rather theoretical, not entirely realistic, but nevertheless required in terms of the WULA requirements.

However, if the cumulative impact of raw sewage from the many townships in the Orange River would ever realize as a threat, a biomonitoring result at this location would be of great benefit to assess the situation.

Moreover, sewage and its concomitant microbiological contamination would be a serious threat to the grape, other fruit and food export industry.

The sampling point was chosen because of accessibility. The dense stand of reeds renders most of the river's banks out of reach. There was a break in the reeds, probably kept open by local fishermen.

The available habitat was emerging vegetation (reeds), submerged vegetation (a single strand of parrot's feather), bedrock and muddy bottom.

The SASS5 score was only 34, which low and can be attributed to the limited available habitat. The ASPT came to 5.3, which can be expected for a mature river reach such as the Orange River at Grootdrink Bridge. The score indicated a "fair" rating, with some if it lost but with most ecological functioning still intact.

15 **Present Ecological State** (PES)

Table 2 Habitat Integrity according to Kleynhans, 1999

A	Unmodified, natural	90 – 100
B	Largely natural with few modifications. A small change in natural habitats and biota, but the ecosystem function is unchanged	80 – 89
C	Moderately modified. A loss and change of the natural habitat and biota, but the ecosystem function is predominantly unchanged	60 – 79
D	Largely modified. A significant loss of natural habitat, biota and ecosystem function.	40 – 59
E	Extensive modified with loss of habitat, biota and ecosystem function	20 – 39
F	Critically modified with almost complete loss of habitat, biota and ecosystem function. In worse cases ecosystem function has been destroyed and changes are irreversible	0 - 19

The PES and EIS are protocols that have been produced by Dr Neels Kleynhans (Table 2 and 3) in 1999 of the then DWAF to assess river reaches. The PES is one of the evaluations that is prescribed for S21 (c) and (i) WULA's. The scores given are solely that of the practitioner and are based on expert opinion.

The only drainage line of concern is the short one in the northern corner of the proposed development. The one that exists because of the dumping of sewage is not going to be evaluated. Likewise, the one along the N10 to the south of the proposed development is too far away.

The flow is heavily modified by the trunk road, the irrigation canal and the vineyards. Runoff is added from the N10 trunk road. Urban waste was present in the drainage line during the site visit. Goats and other domestic animals were regarded as exotic fauna.

The upper part is still in a reasonable state, while the last reach in among the vineyards is non-existent, with only drainage channels between the blocks of vineyard. This vast difference renders a valid evaluation difficult. Nevertheless, the WULA requires the best estimate.

Table 3 Present Ecological State of the Drainage Line

Instream	Score	Weight	Product	Maximum score
Water abstraction	24	14	336	350
Flow modification	12	13	156	325
Bed modification	15	13	195	325
Channel modification	19	13	247	325
Water quality	17	14	238	350
Inundation	13	10	130	250
Exotic macrophytes	23	9	207	225
Exotic fauna	13	8	104	200
Solid waste disposal	10	6	60	150
Total		100	1673	2500
% of total			66.9	
Class			C	
Riparian				
Water abstraction	24	13	312	325
Inundation	13	11	143	275
Flow modification	12	12	144	300
Water quality	17	13	221	325
Indigenous vegetation removal	20	13	260	325
Exotic vegetation encroachment	21	12	252	300
Bank erosion	23	14	322	350
Channel modification	19	12	228	300
Total			1882	2500
% of total			75.3	
Class			C	

Both the instream and riparian habitat score a “C”, with the loss of ecological functioning, but with some of it still intact.

Much has been published on the ecological state of South African rivers and the Orange River is no exception. In fact, it seems somewhat arrogant to assess the Lower Orange River, even at the sampling point, with a team of one and with the financial backing of a single WULA. This is a large undertaking that is to be contemplated by a team of experts. Nevertheless, this is what the WULA requires.

The river at the Grootdrink sampling point, as elsewhere, has been impacted by major dams, large-scale water abstractions, an influx of agricultural chemicals,

encroachment of reeds and exotic macrophytes, translocated and exotic fish, levees, bridges and many other infarctions.

Table 4 Present Ecological State Orange River

Instream	Score	Weight	Product	Maximum score
Water abstraction	15	14	210	350
Flow modification	15	13	195	325
Bed modification	20	13	260	325
Channel modification	22	13	286	325
Water quality	15	14	210	350
Inundation	12	10	120	250
Exotic macrophytes	18	9	162	225
Exotic fauna	15	8	120	200
Solid waste disposal	20	6	120	150
Total		100	1593	2500
% of total			63.7	
Class			C	
Riparian				
Water abstraction	15	13	195	325
Inundation	14	11	154	275
Flow modification	15	12	180	300
Water quality	15	13	195	325
Indigenous vegetation removal	15	13	195	325
Exotic vegetation encroachment	15	12	180	300
Bank erosion	20	14	280	350
Channel modification	18	12	216	300
Total			1595	2500
% of total			63.8	
Class			C	

However, the river at Groottdrink was less impacted than further downstream, as at Kakamas. The river at Grootdrink was stronger flowing, with much more water. The condition of the river gradually deteriorates as water abstraction and return flows increases downstream.

Hence the river was scored a C (Table 4), which signifies that it has been impacted, but despite these impacts still exhibits appreciable ecological functioning. The riparian zone scores a C as well.

There is a good chance that other practitioners would score the river very much the same.

Importantly, the proposed development at Groblershoop is not about to change the PES of the Orange River at Grootdrink.

16 Ecological Importance

The Ecological Importance (EI) is based on the presence of especially fish species that are endangered on a local, regional or national level (Table 5).

There are no fish in the drainage line, as there is no permanent water. According to this assessment, which is prescribed for WULA's, the drainage line is not important.

No other endangered species, either plant or animal, were detected in or near the drainage line.

Table 5 Ecological Importance according to endangered organisms (Kleynhans,1999).

Category	Description
1	One species or taxon are endangered on a local scale
2	More than one species or taxon are rare or endangered on a local scale
3	More than one species or taxon are rare or endangered on a provincial or regional scale
4	One or more species or taxa are rare or endangered on a national scale (Red Data)

As has been stated before, the higher vegetation in and around the drainage lines are of particular importance in these arid regions and add significantly to biodiversity. These should be considered as ecologically important.

The Orange River is most important, according to this assessment.

According to Skelton (1993) 12 species of indigenous fish occur in the Lower Orange River. Since 2011 another one was added, as well as 3 exotic species. These are the following:

Barbus trimaculatus
B paludinosus
B. hospus
Labeobarbus kimberleyensis (Near threatened)
L aenus
Labeo umbratus
L capensis
Austroglanis sclateri (Widespread elsewhere)
Clarias gariepinus
Pseudocrenilabrus philander (Threatened locally but abundant elsewhere)
Pseudobarbus quathlabae
Mesobola brevianalis (critically endangered)

Exotic and translocated fish:

Cyprinus carpio
Tilapia sparrmanii
Oreochromus mossambicus

Those in blue are endangered to a varying extent. Those indicated in red are exotic or translocated fish.

The only one that causes real concern in the largemouth yellow-fish *Labeobarbus kimberleyensis*. It is endemic to the Orange River system and hence is threatened not only on a local scale, but on a national scale as well. This puts the Lower Orange in category 4. This renders the Orange River as important.

According to the owners of the Kalahari River and Safari Co. along the northern bank of the Orange River on the Riemvasmaak Road, mature blue kurper *Oreochromus mossambicus* are regularly captured in increasing numbers. It now takes at least 4 man-days to capture a single yellow fish.

Yellow fish are generally infected with cestode bladder worms, while darters (*Anhinga rufa*) that predate on these fish are heavily infected with tape worms. It seems as if the translocated Tilapia are not affected by these parasites.

According to Mr Chris van der Post, a renown angling guide and the owner of the Gkhui Gkhui River Lodge near Hopetown, there are still many smallmouth-yellow fish around, but largemouth yellow-fish are scarce.

17 Ecological Sensitivity

Ecological Sensitivity (ES) is often described as the ability of aquatic habitat to assimilate impacts. It is not sensitive if it remains the same despite of the onslaught of impacts. Put differently, sensitive habitat changes substantially, even under the pressure of slight impacts.

The Ecological Sensitivity also refers to the potential of aquatic habitat to bounce back to an ecological condition closer to the situation prior to human impact. If it recovers, it is not regarded as sensitive.

17.1 Ecological Sensitivity Drainage Line

The question arises**,** according to the ES definition, if the drainage lines would recover to its original ecological state prior to any human impact. If the roads and vineyards, along with the rubble and trash be removed, would the drainage line recover? The answer is probably yes, even though the drainage lines would find new routes and even though it would take many decades, perhaps more than a century, in this semi-arid region where re-growth of vegetation can take a long time. However, this is not a realistic scenario. Development is here to stay, together with its impacts. From this point of view the drainage line can be considered as ecologically sensitive.

17.2 Ecological Sensitivity Orange River

The Lower Orange River has absorbed numerous and deep-cutting human impacts. Yet is still functions as an aquatic ecosystem. In the highly improbable event of ceased human impact, the river here would probably bounce back to its previous glory. In this respect the river cannot be categorised as sensitive. It is dreaded among conservation minded people that the Lower Orange River might have some more capacity to absorb further impact.

18 Probable Impacts

The drainage line in the northern corner of the proposed development is small, almost insignificant. The catchment area is small. Houses and streets will probably be built right through it, without concern for creating a storm water conduit.

Likewise, the proposed impact of this development on the Orange River is insignificant. However, the cumulative impact of all developments along the Orange River in the !Kheis municipality can be substantial.

19 Mitigation Measures

No mitigation measures are proposed. The loss of this very small drainage line is of little concern.

The significant combined impact of the various developments stem from the sewage and waste issues must be addressed. Adequate municipal services should resume.

20 Impact Assessment

Table 6 Impact Assessment

Description of impact Cumulative impact of sewage and solid waste ending up in the drainage line and Orange River **Mitigation measures** Construction only during the dry season, limit the foot print, vegetate disturbed areas.								
Type Nature	Spatial Extent	Severity	Duration	Significance	Probability	Confidence	Reversibility	Irreplaceability
Without mitigation								
Cumulative	Regional	Medium	Long term	Medium	Probable	Certain	Reversible	Replaceable
With mitigation measures								
Cumulative	Local	Low	Short term	Low	Unlikely	Sure	Reversible	Replaceable

Some of the decision-making authorities prescribe an impact assessment according to a premeditated methodology (Table 23.1, Appendix).

The main benefit of this exercise is that it allows for the evaluation of mitigation measures. Later follows the Risk Matrix. This is different from the Impact Assessment as it does not attempt to weigh the success of mitigation measures.

The assessment indicates that the impacts are acceptable, provided that the mitigation measures are adequate to contain these impacts (Table 6).

21 Risk Matrix

The purpose of the Risk Matrix is to determine if a General Authorisation of a License is applicable.

The assessment was carried out according to the interactive Excel table that is available on the DWS webpage. Table 7 is a replica of the Excel spreadsheet that has been adapted to fit the format of this report. The numbers in Table 7 (continued) represent the same activities as in Table 7, with sub-activities added.

The methodology is tabled in the Appendix.

This is a very small drainage line of very little significance. The only risk of importance is the possibility of a sewage spill and urban waste down the drainage line and into the Orange River. The risk increases because of the cumulative risks posed by the various developments along the reach of the Orange River. It is supposed that if the contamination in the river rises and the farming community becomes aware of it, that there would be a strong reaction, leading to curbing or ending the problem. This assumption influenced the score for “duration”, as the problem was perceived not to continue.

In most cases loosened soil and silt that can be washed down the drainage lines during construction are considered to be a risk to the aquatic environment. In the event of the Groblershoop development, the risk is so small that it is not worth considering in a Risk Matrix.

The Risk Matrix indicates that the risks to the aquatic environment are low. A General Authorisation should be in order for this application and a License is deemed not to be the indicated level of authorisation.

Table 7 Risk Matrix

No.	Activity	Aspect	Impact	Significance	Risk Rating
1	Sewage collection and treatment	Sewage spill	Sewage contamination in the drainage line and Orange River	45	Low
2	Urban solid waste	Waste ending up in the drainage line and in the river	Pollution of the river	48	Low

Table 7 Continued Risk Rating

No	Flow	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Conse-quence
1 2	1 1	2 1	1 1	1 1	1.25 1	1 1	2 2	4.5 4

No	Frequency of activity	Frequency of impact	Legal issues	Detection	Likelihood	Significance	Risk Rating
1 2	2 3	2 3	5 5	1 1	10 12	45 48	Low Low

22 Resource Economics

Table 8. Goods and Services

Goods & Services	Score
Flood attenuation	2
Stream flow regulation	2
Sediment trapping	2
Phosphate trapping	1
Nitrate removal	1
Toxicant removal	1
Erosion control	2
Carbon storage	1
Biodiversity maintenance	3
Water supply for human use	0
Natural resources	0
Cultivated food	1
Cultural significance	0
Tourism and recreation	0
Education and research	0

0	Low
5	High

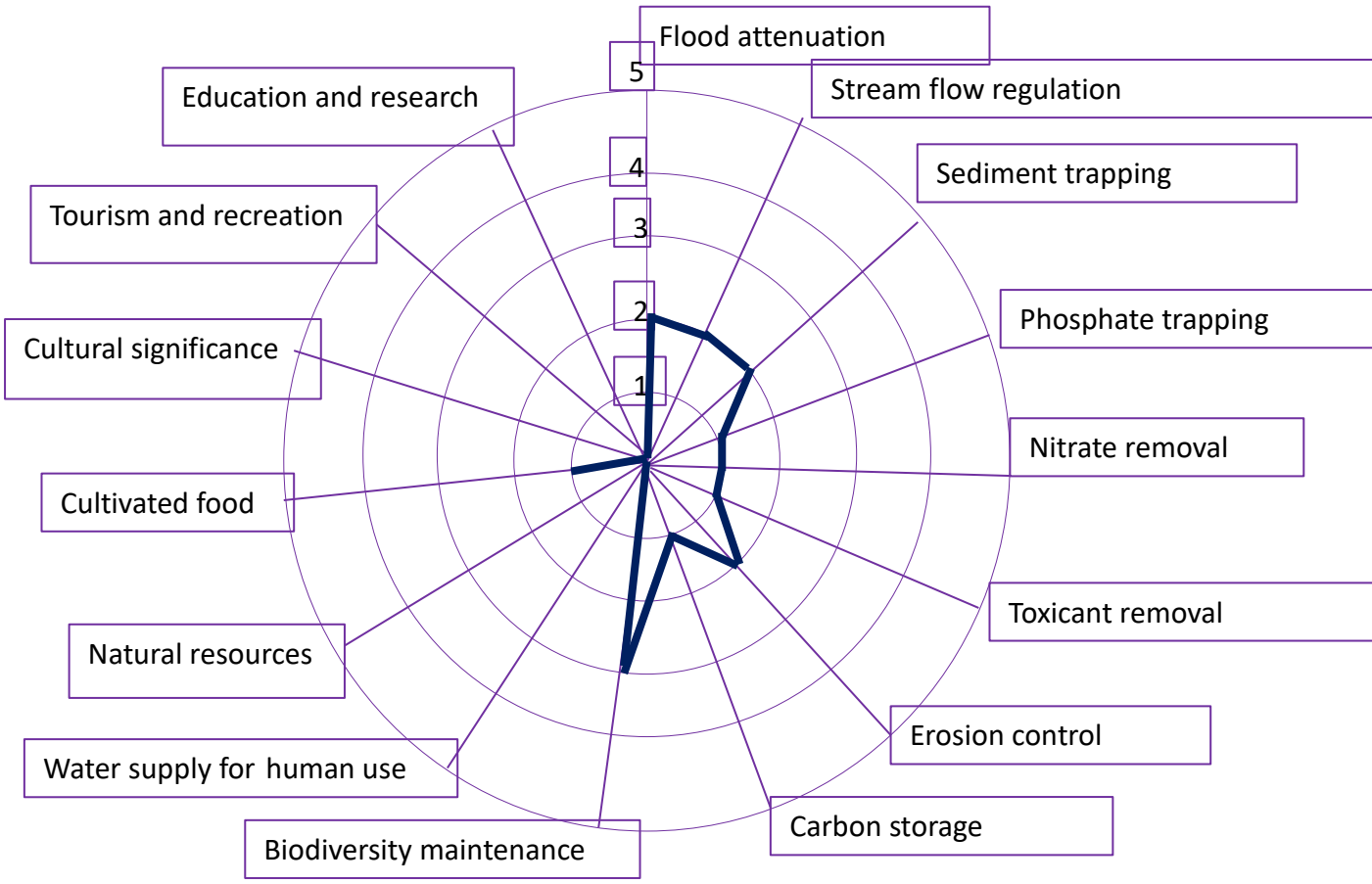


Figure 21. Resource Economics Footprint of the Drainage Line

The goods and services delivered by the environment, in this case the drainage line at the new Groblershoop housing development, is a Resource Economics concept as adapted by Kotze *et al* (2009). The methodology was designed for the assessments of wetlands, but in the case of the drainage line the goods and services delivered are particularly applicable and important, hence it was decided to include it in the report.

The diagram (Figure 21) is an accepted manner to visually illustrate the resource economic footprint the drainage line, from the data in Table 8.

The size of the star shape attracts the attention of the decision-makers. This shape (spider diagram, Figure 21) is very small, indicating that the water course has a small economic foot print. If this drainage line is lost because of development, it won't represent a mentionable loss in environmental goods and services.

23 Site Visits: General Observations

Pertaining to Fresh Water Reports in general, urban wastewater is of importance because untreated waste ends up in water ways, which rebels against the NWA and other contemporary South African environmental legislation. Photographic evidence is presented in several of the seven !Kheis townships where anaerobic pond systems for the treatment of sewage lie idle and are not being utilized for the treatment of urban sewage. Instead raw sewage is dumped in drainage lines. Likewise, several sewage pump stations are dysfunctional, overflowing, with large quantities of raw sewage flowing down drainage lines.

Household solid waste is not collected and removed according to standard municipal operating procedures. Very large quantities of waste accumulate in the townships and the streets. Large quantities of waste end up in the drainage lines as well.

These two aspects are crucial to the WULA and environmental authorisation of any further urban development. If these malpractices are allowed to continue and if the normal municipal services continue to be absent, this untenable situation would become worse when these townships expand.

It should be noted that functional municipal services are part and parcel of the !Kheis Municipality's Technical Director's KPA's, stated in his published service contract. However, wastewater and solid waste management are not pertinently mentioned in this contract, which may explain why these services are not satisfactory.

This is not only a tangible threat to human health and human well-being at !Kheis, but in many South African municipalities, as well as in cities elsewhere in the world where WATSAN Africa concluded contracts.

In a number of the townships, graveyards are illegally located right in drainage lines or within the 32m buffer zone from drainage lines.

There is no shortage of the aloe *Aloe claviflora* (Figure 22) in the district. They are plentiful and not endangered in any way, although aloes are protected plants in terms of legislation. These aloes are cleared from plots where people are putting up their houses. There will be a major clearance once the new housing schemes are launched. These aloes have a considerable monetary value if sold in cities such as Pretoria, Johannesburg and Cape Town. A formal scheme should be devised to collect and sell these aloes, the proceeds could be transferred to a reputable NGO, for community-based projects, such as building class rooms or additions to clinics.

From a Fresh Water Report perspective, a Licence or General authorisation should probably not be granted until the sewage and waste issues are satisfactory and sustainably resolved. But then this is entirely the prerogative of the DWS and its officials.

Figure 22 *Aloe claviflora*

24 Conclusions

Figure 23 has been adapted from one of the most recent DWS policy documents.

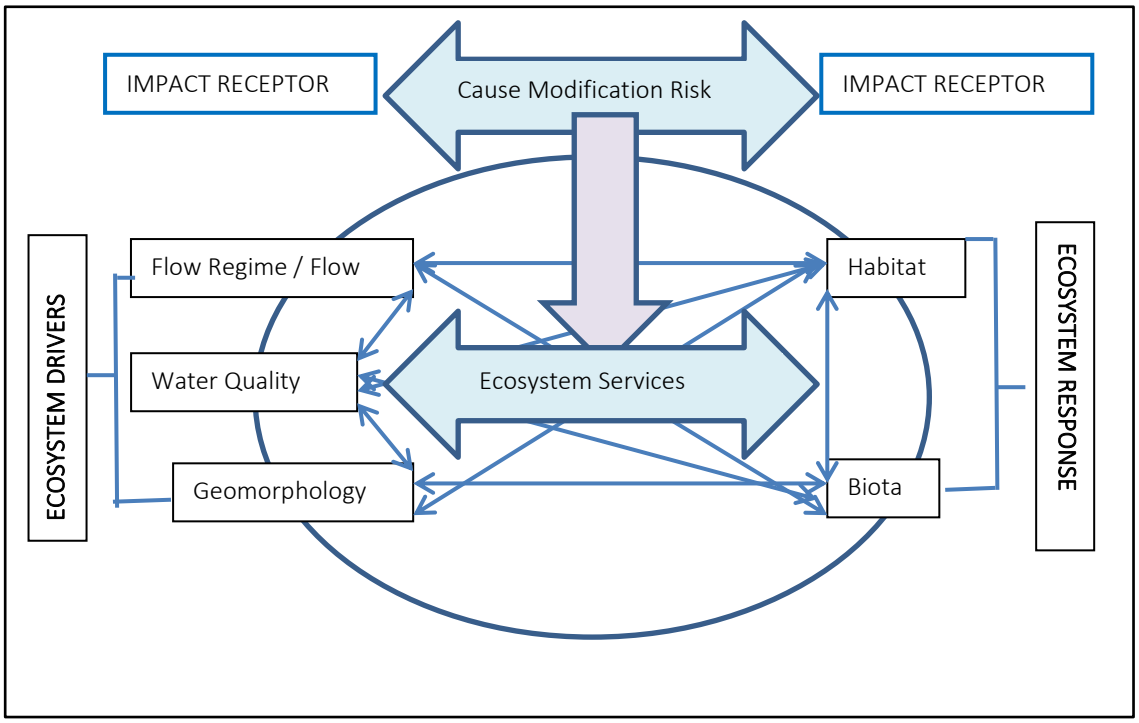


Figure 23 Minimum Requirements for a S21(c) and (i) Application

An anthropogenic activity can impact on any of the ecosystem drivers or responses and this can have a knock-on effect on all of the other drivers and responses. This, in turn, will predictably impact on the ecosystem services (Figure 23). The WULA and the EAI must provide mitigation measured for these impacts.

The driver of the drainage lines is the occasional flood that follows sudden and intense rainfall events. This is followed by prolonged droughts and intense summer heat that prevents the development of any viable aquatic habitat. This is apart from shallow ground water that explains the growth of a somewhat more prolific vegetation along the drainage lines.

The current sewage and solid waste situation are threats to the WULA. The authorities may insist that these issues be resolved before a General Authorization is approved.

Apart from this, the findings of this Fresh Water Report indicate that a general Authorization would be in order for the development of an urban housing scheme at Groblershoop.

25 References

Dickens, CWS & PM Graham. 2002. *The South African Scoring System (SASS) Version 5 Rapid Bioassessment Method for Rivers*. African Journal of Aquatic Science 27: 1–10

Kleynhans, C.J. 1999. *Assessment of Ecological Importance and Sensitivity*. Department of Water Affairs and Forestry. Pretoria.

Kotze, G., G. Marneweck, A. Batchelor, D. Lindley & Nacelle Collins. 2009. *A technique for rapidly assessing ecosystem services supplied by wetlands.* Water Research Commission, Pretoria.

Skelton, P. 1993. *Freshwater Fishes of Southern Africa*. Southern Book Publishers, Halfway House.

26 Declaration of Independence

I, Dirk van Driel, as the appointed independent specialist hereby declare that I:

- Act/ed as the independent specialist in this application
- Regard the information contained in this report as it relates to my specialist input/study to be true and correct and;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management act;
- Have and will not have vested interest in the proposed activity;
- Have disclosed to the applicant, EAP and competent authority any material information have or may have to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the environmental Impact Assessment Regulations, 2010 and any specific environmental management act.
- Am fully aware and meet the responsibilities in terms of the NEMA, the Environmental Impacts Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R543) and any specific environmental management act and that failure to comply with these requirements may constitute and result in disqualification;
- Have ensured that information containing all relevant facts on respect of the specialist input / study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties facilitated in such a manner that all interested and affected parties were provided with reasonable opportunity to participate and to provide comments on the specialist input / study;
- Have ensured that all the comments of all the interested and affected parties on the specialist input were considered, recorded and submitted to the competent authority in respect of the application;
- Have ensured that the names of all the interested and affected parties that participated in terms of the specialist input / study were recorded in the register of interested and affected parties who participated in the public participation process;
- Have provided the competent authority with access to all information at my disposal regarding the application, weather such information is favourable or not and;
- Am aware that a false declaration is an offence in terms of regulation 71 of GN No. R543.

Signature of the specialist:  30 May 2020

27 Résumé

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Water Scientist

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Experience

WATSAN Africa, Cape Town. Scientist **2011 - present**

USAID/RTI, ICMA & Chemonics. Iraq & Afghanistan **2007 -2011**
Program manager.

City of Cape Town **1999-2007**
Acting Head: Scientific Services, Manager: Hydrobiology.

Department of Water & Sanitation, South Africa **1989 – 1999**
Senior Scientist

Tshwane University of Technology, Pretoria **1979 – 1998**
Head of Department

University of Western Cape and Stellenbosch University 1994- 1998 part-time

- Lectured post-graduate courses in Water Management and Environmental Management to under-graduate civil engineering students
- Served as external dissertation and thesis examiner

Service Positions

- Project Leader, initiator, member and participator: Water Research Commission (WRC), Pretoria.
- Director: UNESCO West Coast Biosphere, South Africa
- Director (Deputy Chairperson): Grotto Bay Home Owner's Association
- Member Dassen Island Protected Area Association (PAAC)

Membership of Professional Societies

- South African Council for Scientific Professions. Registered Scientist No. 400041/96
- Water Institute of South Africa. Member

Reports

- Process Review Kathu Wastewater Treatment Works
- Effluent Irrigation Report Tydstroom Abattoir Durbanville
- River Rehabilitation Report Slangkop Farm, Yzerfontein
- Fresh Water and Estuary Report Erf 77 Elands Bay
- Ground Water Revision, Moorreesburg Cemetery
- Fresh Water Report Delaire Graff Estate, Stellenbosch
- Fresh Water Report Quantum Foods (Pty) Ltd. Moredou Poultry Farm, Tulbagh
- Fresh Water Report Revision, De Hoop Development, Malmesbury
- Fresh Water Report, Idas Valley Development Erf 10866, Stellenbosch
- Wetland Delineation Idas Valley Development Erf 10866, Stellenbosch
- Fresh Water Report, Idas Valley Development Erf 11330, Stellenbosch
- Fresh Water Report, La Motte Development, Franschhoek
- Ground Water Peer Review, Elandsfontein Exploration & Mining
- Fresh Water Report Woodlands Sand Mine Malmesbury
- Fresh Water Report Brakke Kuyl Sand Mine, Cape Town
- Wetland Delineation, Ingwe Housing Development, Somerset West
- Fresh Water Report, Suurbraak Wastewater Treatment Works, Swellendam
- Wetland Delineation, Zandbergfontein Sand Mine, Robertson
- Storm Water Management Plan, Smalblaar Quarry, Rawsonville
- Storm Water Management Plan, Riverside Quarry
- Water Quality Irrigation Dams Report, Langebaan Country Estate
- Wetland Delineation Farm Eenzaamheid, Langebaan
- Wetland Delineation Erf 599, Betty's Bay
- Technical Report Bloodhound Land Speed Record, Hakskeenpan
- Technical Report Harkerville Sand Mine, Plettenberg Bay
- Technical Report Doring Rivier Sand Mine, Vanrhynsdorp
- Rehabilitation Plan Roodefontein Dam, Plettenberg Bay
- Technical Report Groenvlei Crusher, Worcester
- Technical Report Wiedouw Sand Mine, Vanrhynsdorp
- Technical Report Lair Trust Farm, Augrabies
- Technical Report Schouwtoneel Sand Mine, Vredenburg
- Technical Report Waboomsrivier Weir Wolseley
- Technical Report Doornkraal Sand Mine Malmesbury
- Technical Report Berg-en-Dal Sand Mine Malmesbury
- Wetland Demarcation, Osdrif Farm, Worcester
- Technical Report Driefontein Dam, Farm Agterfontein, Ceres
- Technical Report Oewerzicht Farm Dam, Greyton
- Technical Report Glen Lossie Sand Mine, Malmesbury
- Preliminary Report Stellenbosch Cemeteries
- Technical Report Toeka & Harmony Dams, Houdenbek Farm, Koue Bokkeveld
- Technical Report Kluitjieskraal Sand & Gravel Mine, Swellendam
- Fresh Water Report Urban Development Witteklip Vredenburg
- Fresh Water Report Groblershoop Resort, Northern Cape
- Fresh Water Report CA Bruwer Quarry Kakamas, Northern Cape
- Fresh Water Report, CA Bruwer Sand Mine, Kakamas, Northern Cape
- Fresh Water Report, Triple D Farms, Agri Development, Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Kakamas
- Fresh Water Report, Keren Energy Photovoltaic Plant Hopetown

- Fresh Water Report Hopetown Sewer
- Fresh Water Report Hoogland Farm Agricultural Development, Touws River
- Fresh Water Report Klaarstroom Waste Water Treatment Works
- Fresh Water Report Calvinia Sports Grounds Irrigation
- Fresh Water Report CA Bruwer Agricultural Development Kakamas
- Fresh Water Report Zwartfontein Farm Dam, Hermon
- Statement Delsma Farm Wetland, Hermon
- Fresh Water Report Lemoenshoek Farms Pipelines Bonnyvale
- Fresh Water Report Water Provision Pipeline Brandvlei
- Fresh Water Report Erf 19992 Upington
- Botanical Report Zwartejongensfontein Sand Mine, Stilbaai
- Fresh Water Report CA Bruwer Feldspath Mine, Kakamas
- Sediment Yield Calculation, Kenhardt Sand Mine
- Wetland Demarcation, Grabouw Traffic Center
- Fresh Water Report, Osdrift Sand Mine, Worcester
- Fresh Water Report, Muggievlak Storm Water Canal, Vredenburg
- Fresh Water Report, Marksman's Nest Rifle Range, Malmesbury
- Biodiversity Report, Muggievlak Storm Water Canal, Vredenburg
- Strategic Planning Report, Sanitation, Afghanistan Government, New Delhi, India
- Fresh Water Report, Potable Water Pipeline, Komaggas
- Fresh Water Report, Wastewater Treatment Works, Kamieskroon
- Fresh Water Report Turksvy Farm Agricultural Development, Upington

28 Appendix

28.1 Biomonitoring Score Sheet

SASS5 Score Sheet										
Date	17 May 20	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**	**Taxon**	**Weight**	**Score**
Locality	Orange River	Porifera	5		**Hemiptera**			**Diptera**		
	Grootdrink Bridge	Coelenterata	1		Belostomatidae	3		Athericidae	10	
		Turbellaria	3		Corixidae	3	3	Blepharoceridae	15	
		Oligochaeta	1		Gerridae	5		Ceratopogonidae	5	
Coordinates	28°27' 15.30"	Huridinea	3		Hydrometridae	6		Chironomidae	2	2
	21°17'03.50"	**Crustacea**			Naucoridae	7		Culicidae	1	
		Amphipodae	13		Nepidae	3		Dixidae	10	
DO mg/l	8.6	Potamonautidae	3		Notonectidae	3	3	Empididae	6	
Temperature °C	17.2	Atyidae	8	8	Pleidae	4	4	Ephydridae	3	
pH	7.15	Palaemonidae	10		Veliidae	5		Muscidae	1	
EC mS/m	33	Hydracarina	8		**Megaloptera**			Psychodidae	1	
		Plecoptera			Corydalidae	10		Simuliidae	5	5
SASS5 Score	34	Notonemouridae	14		Sialidae	8		Syrphidae	1	
Number of Taxa	7	Perlidae	12		**Trichoptera**			Tabanidae	5	
ASPT	5.3	**Ephemeroptera**			Dipseudopsidae	10		Tipulidae	5	
		Baetidae 1 sp	4	4	Ecnomidae	8		**Gastropoda**		
Other Biota	Tadpoles	Baetidae 2 sp	6		Hydropsychidae 1 sp	4		Ancylidae	6	
		Baetidae >3 sp	12		Hydropsychidae 2 sp	6		Bulinidae	3	
		Caenidae	6		Hydropsychidae <2 sp	12		Hydrobiidae	3	
		Ephemeridae	15		Phylopotamidae	10		Lymnaeidae	3	
		Heptageniidae	13		Polycentropodidae	12		Physidae	3	
		Leptophlebiidae	9		Psychomyidae	8		Planorbidae	3	
		Oligoneuridae	15		**Cased Caddis**			Thiaridae	3	
Comments		Polymitarcyidae	10		Barbarochthonidae	13		Viviparidae	5	
		Prosopistomatida	15		Calamoceratidae	11		**Pelecipoda**		
		Teloganodidae	12		Glossostomatidae	11		Corbiculidae	5	
		Trichorythidae	9		Hydroptilidae	6		Sphariidae	3	
		Odonata			Hydrosalpingidae	15		Unionidae	6	
		Calopterygidae	10		Leptostomatidae	10				
		Clorocyphidae	10		Leptoceridae	6				
		Chorolestidae	8		Petrothrincidae	11				
		Coenagrionidae	4		Pisulidae	10				
		Lestidae	8		Sericostomatidae	13				
		Platycnemidae	10		**Coleoptera**					
		Protoneuridae	8		Dyticidae	5	5			
		Aesthnidae	8		Elmidae Dryopidae	8				
		Corduliidae	8		Gyrinidae	5				
		Gomphidae	6		Haliplidae	5				
		Libellulidae	4		Helodidae	12				
		Lepidoptera			Hydraenidae	8				
		Pyralidae	12		Hydrophilidae	5				
					Limnichidae	10				
					Psephenidae	10				
Score				12			15			7

28.2 Methodology used in determining significance of impacts

The methodology to be used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives is provided in the following tables:

Table 28.2.1 Nature and type of impact

Nature and type of impact	Description
Positive	An impact that is considered to represent an improvement to the baseline conditions or represents a positive change
Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new negative factor
Direct	Impacts that result from the direct interaction between a planned project activity and the receiving environment / receptors
Indirect	Impacts that result from other activities that could take place as a consequence of the project (e.g. an influx of work seekers)
Cumulative	Impacts that act together with other impacts (including those from concurrent or planned future activities) to affect the same resources and / or receptors as the project

Table 28.2.2 Criteria for the assessment of impacts

Criteria	Rating	Description
Spatial extent of impact	National	Impacts that affect nationally important environmental resources or affect an area that is nationally important or have macro-economic consequences
	Regional	Impacts that affect regionally important environmental resources or are experienced on a regional scale as determined by administrative boundaries or habitat type / ecosystems
	Local	Within 2 km of the site
	Site specific	On site or within 100m of the site boundary
Consequence of impact/ Magnitude/ Severity	High	Natural and / or social functions and / or processes are severely altered
	Medium	Natural and / or social functions and / or processes are notably altered
	Low	Natural and / or social functions and / or processes are slightly altered
	Very Low	Natural and / or social functions and / or processes are negligibly altered
	Zero	Natural and / or social functions and / or processes remain unaltered
Duration of impact	Temporary	Impacts of short duration and /or occasional
	Short term	During the construction period
	Medium term	During part or all of the operational phase
	Long term	Beyond the operational phase, but not permanently
	Permanent	Mitigation will not occur in such a way or in such a time span that the impact can be considered transient (irreversible)

Table 28.2.3 Significance Rating

Significance Rating	Description
High	High consequence with a regional extent and long-term duration High consequence with either a regional extent and medium-term duration or a local extent and long-term duration Medium consequence with a regional extent and a long-term duration
Medium	High with a local extent and medium-term duration High consequence with a regional extent and short-term duration or a site-specific extent and long-term duration High consequence with either local extent and short-term duration or a site-specific extent with a medium-term duration Medium consequence with any combination of extent and duration except site-specific and short-term or regional and long term Low consequence with a regional extent and long-term duration
Low	High consequence with a site-specific extent and short-term duration Medium consequence with a site-specific extent and short-term duration Low consequence with any combination of extent and duration except site-specific and short-term Very low consequence with a regional extent and long-term duration
Very low	Low consequence with a site-specific extent and short-term duration Very low consequence with any combination of extent and duration except regional and long term
Neutral	Zero consequence with any combination of extent and duration

Table 28.2.4 Probability, confidence, reversibility and irreplaceability

Criteria	Rating	Description
Probability	Definite	>90% likelihood of the impact occurring
	Probable	70 – 90% likelihood of the impact occurring
	Possible	40 – 70% likelihood of the impact occurring
	Unlikely	<40% likelihood of the impact occurring
Confidence	Certain	Wealth of information on and sound understanding of the environmental factors potentially affecting the impact
	Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact
	Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact
Reversibility	Reversible	The impact is reversible within 2 years after the cause or stress is removed
	Irreversible	The activity will lead to an impact that is in all practical terms permanent
Irreplaceability	Replaceable	The resources lost can be replaced to a certain degree
	Irreplaceable	The activity will lead to a permanent loss of resources.

28.3 Risk Matrix Methodology

RISK ASSESSMENT KEY (Referenced from DWA RISK-BASED WATER USE AUTHORISATION APPROACH AND DELEGATION GUIDELINES)

Negative Rating

TABLE 1- SEVERITY

How severe does the aspects impact on the environment and resource quality characterisitics (flow regime, water quality, geomorfology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5

Where "or wetland(s) are involved" it means

TABLE 2 – SPATIAL SCALE

How big is the area that the aspect is impacting on?

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catch	3
National (impacting beyond seconday catchment or provinces)	4
Global (impacting beyond SA boundary)	5

TABLE 3 – DURATION

How long does the aspect impact on the environment and resource quality?

One day to one month, PES, EIS and/or REC not impacted
One month to one year, PES, EIS and/or REC impacted but no change in status
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation
Life of the activity, PES, EIS and/or REC permanently lowered
More than life of the organisation/facility, PES and EIS scores, a E or F

TABLE 4 – FREQUENCY OF THE ACTIVITY

How often do you do the specific activity?

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

TABLE 5 – FREQUENCY OF THE INCIDENT/IMPACT

How often does the activity impact on the environment?

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

TABLE 6 – LEGAL ISSUES

How is the activity governed by legislation?

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5

Located within the regulated areas

TABLE 7 – DETECTION	
How quickly can the impacts/risks of the activity be observed on the environment (water resourc	
Immediately	
Without much effort	
Need some effort	
Remote and difficult to observe	
Covered	

TABLE 8: RATING CLASSES		
RATING	**CLASS**	**MANAGEMENT DESCRIPTION**
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale
A low risk class must be obtained for all activities to be considered for a GA		

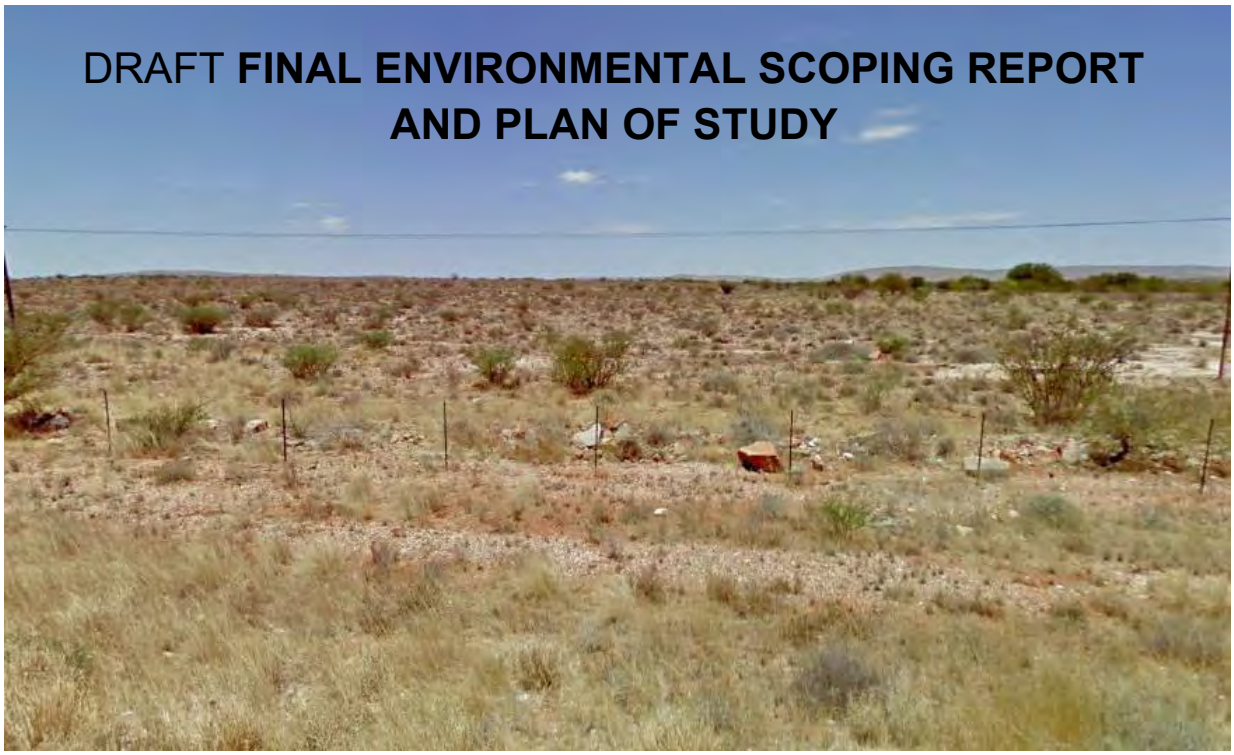
TABLE 9: CALCULATIONS

Consequence = Severity + Spatial Scale + Duration
Likelihood=Frequency of Activity + Frequency of Incident +Legal Issues + Detection
Significance \Risk= Consequence X Likelihood

ANNEXURE J: FINAL SCOPING REPORT

EnviroAfrica
Environmental Management and Impact Assessment | Omgewingsbestuur en Impakbeoordeling

PROPOSED NEW TOWNSHIP DEVELOPMENT ON PORTION 16 OF FARM 48, GROBLERSHOOP, !KHEIS LOCAL MUNICIPALITY, NORTHERN CAPE



SEPTEMBER 2020

!KHEIS LOCAL MUNICIPALITY

PROPOSED NEW TOWNSHIP DEVELOPMENT ON PORTION 16 OF FARM 48, GROBLERSHOOP, !KHEIS LOCAL MUNICIPALITY, NORTHERN CAPE

PREPARED FOR:
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CONTENTS

FIGURES

TABLES

APPENDICES

ACRONYMS

BGIS	Biodiversity Geographic Information System
CBA	Critical Biodiversity Area
DEA	Department of Environmental Affairs
DENC	Department of Environment and Nature Conservation
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
ECA	Environment Conservation Act (Act No. 73 of 1989)
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMP	Environmental Management Programme
HIA	Heritage Impact Assessment
I&APs	Interested and Affected Parties
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
NID	Notice of Intent to Develop
NWA	National Water Act
OESA	Other Ecological Support Area
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
WULA	Water Use Licence Application

1. INTRODUCTION

1.1 BACKGROUND

Consideration is being given to the development of a new township, consisting of approximately 1500 erven, including associated infrastructure, on Portion 16 of Farm 48, Groblershoop.

The applicant is !Kheis Local Municipality who will undertake the activity should it be approved. EnviroAfrica CC has been appointed as the independent environmental assessment practitioner (EAP) responsible for undertaking the relevant EIA and the Public Participation Process required in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA).

This Scoping Report, which will be submitted to the Department of Environment and Nature Conservation (DE&NC) for consideration, forms part of the EIA process.

The purpose of this Draft Environmental Scoping Report is to describe the proposed project, the process followed to date, to present alternatives and to list issues identified for further study and comment by specialists.

Should the EIA process be authorised by DE&NC, the Specialist Studies (noted in Section 8) will be undertaken and the significant issues (noted in Section 6) will be investigated and assessed during the next phase of this application.

1.2 DESCRIPTION OF THE PROPOSED ACTIVITY

The !Kheis Local Municipality is proposing that a new township development, consisting of approximately 1500 erven and associated infrastructure on Portion 16 of Farm 48, Groblershoop.

The proposed project entails the development of approximately 1500 erven with an average including associated infrastructure such as roads, and water, stormwater, effluent and electricity reticulation. The total area to be developed measures 95 (ninety-five) hectares.

The site is located to the south-east of Groblershoop, to the west of the N10, in the !Kheis Local Municipality, Northern Cape.

Site co-ordinates: Proposed site: 28° 54’ 33.90” S, 21° 59’ 44.90” E.

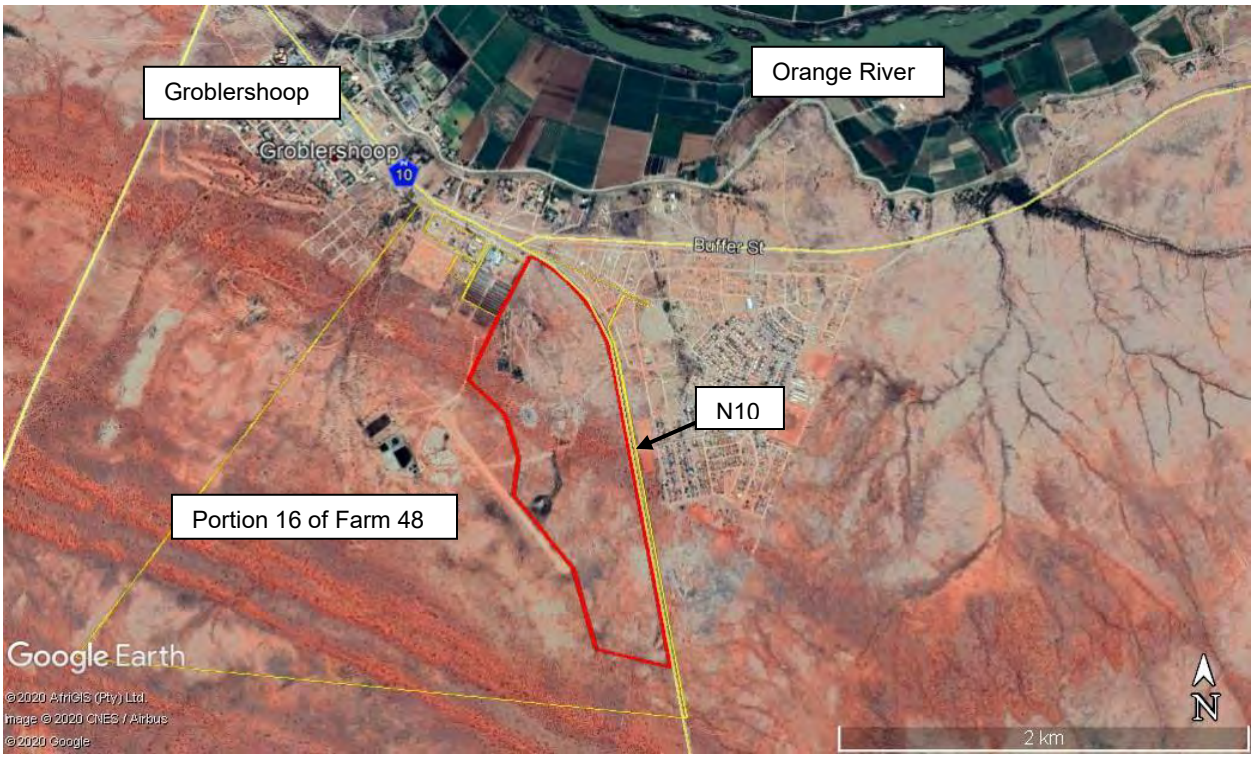

Figure 1: Google Earth image of the site. The proposed site is indicated by the red polygon.

2. NEED AND DESIRABILITY

In terms of the National Environmental Management Act, as amended, EIA 2014 regulations the Scoping/EIA report must provide a description of the need and desirability of the proposed activity. The consideration of "need and desirability" in EIA decision-making requires the consideration of the strategic context of the development proposal along with the broader societal needs and the public interest.

While the concept of need and desirability relates to the *type* of development being proposed, essentially, the concept of need and desirability can be explained in terms of the general meaning of its two components in which *need* refers to *time* and *desirability* to *place* – i.e. is this the right time and is it the right place for locating the type of land-use/activity being proposed? Need and desirability can be equated to *wise use of land* – i.e. the question of what is the most sustainable use of land.

2.1 NEED

Housing is a national need, including in the !Kheis Local Municipality.

The !Kheis Local Municipality's aims to promote socioeconomic development through the eradication of backlogs associated with water and sanitation, electricity, and housing, as well as improve basic services within Groblershoop. In order to meet the needs of the community within Groblershoop, the Council resolved that a project business plan be submitted to Co-operative Governance, Human Settlements and Traditional Affairs (COGHSTA) as well as the construction of 1500 erven in Groblershoop over the short to medium term, along with associated infrastructure. As per the !Kheis Integrated Development Plan (IDP) 2019/2020, a key performance indicator includes the provision of infrastructure and basic service through securing suitable land for human settlement projects, where suitable land was previously identified in Boegoeberg, Topline, Wegdraai, Grootdrink, Gariep, and Opwag. The provision of affordable housing units remains a high priority for the Municipality which will restore the dignity of poor people by providing shelter and access to basic human rights as enshrined in the Constitution of South Africa.

The proposed !Kheis housing development falls in line with the !Kheis IDPs key strategic and development objectives of the KLM, to improve and maintain basic service delivery through specific infrastructural projects including human settlements, water, sanitation, electricity, as well as streets and storm water management[1]. As per the Land Development Plan/ Rural Spatial Development Framework (2014), Groblershoop has been identified as a High Development Potential/Low Human Development Need (Category 1 Investment type = Infrastructure capital, large - scale monetary capital). The demographic profile of the KLM includes the total population of 16 637 individuals in 2011 with a total number of 4 145 households. This community requires formalized, state-instituted housing, and associated, infrastructure. The proposed development will distribute the density of the population, improve community member's standard of living, as well as access to essential services including roads, electricity, water supply, appropriate sewage disposal infrastructure, and environmental health in the area. Therefore, the proposed development will enable adequate housing to be constructed, thereby promoting access to basic service delivery as well as socioeconomic development in Groblershoop and its surroundings.

The proposed Groblershoop Housing development is in line with the !Kheis IDPs key strategic and development objectives, namely to improve and maintain basic service delivery through specific

[1] Integrated Development Plan of !Kheis Municipality, 2017-2022 (Review for 2019 – 2020 Financial Year).

infrastructural projects including human settlements and basic services, in the poverty-stricken Groblershoop Township. According to the SDF, the population in Groblershoop increased from 741 (in 2001) to 4938 in 2011 (where 50% of the population are male and 50% female). Therefore, this community requires formalized, state-instituted housing, and associated, infrastructure. The proposed development will distribute the density of the population, improve community member's standard of living, as well as access to essential services including roads, electricity, water supply, appropriate sewage disposal infrastructure, and environmental health in the area. Therefore, the proposed development will enable adequate housing to be constructed, thereby promoting access to basic service delivery as well as socioeconomic development in the Groblershoop Township and its surroundings. !Kheis Local Municipality is committed to the vision of the National Government of which it committed itself towards accelerating shared growth to halve poverty and unemployment and promote social inclusions. Housing is one of the social inclusions in this vision.

The majority of the KLM population is located in five settlements, namely: Grootdrink, Topline, Wegdraai, Groblershoop and Boegoeberg, with the largest of those settlements being Groblershoop, Grootdrink and Wegdraai. With regards to the functional age groups, 60% of KLM's population is of working age (15---64). Grootdrink (40%) and Boegoeberg (40%) have the highest percentages of population aged between 0 and 14, which is decidedly higher than the district percentage of 28%. Education levels and school attendance have increased in KLM. Grootdrink has the lowest percentage individuals with Gr.12 at 9,1%, while Topline has the highest percentage of individuals with 'no schooling' at 17,5%. In comparison Groblershoop has the highest percentage of individuals with Gr.12 (18,5%) and individuals with higher education (1,7%).

Figure 2. Socioeconomic status associated with the proposed Groblershoop Housing Development.

2.2 DESIRABILITY

The following factors determine the desirability of the area for the proposed development.

2.2.1 Location and Accessibility

The proposed location is considered to be a viable option. The proposed site is adjacent to the existing residential area of Groblershoop and the N10, allowing accessibility and linking to the existing services infrastructure. Any upgrades or additional services infrastructure that will be required will be investigated, and included in the Environmental impact Report.

The desirability and location of the proposed development will be further investigated in the Environmental Impact Report, and the town planning motivational report.

2.2.2 Compatibility with the Surrounding Area

The proposed site is adjacent to the existing residential area of Groblershoop. As stated above, this would provide accessibility and allow the proposed development to link to the existing services infrastructure.

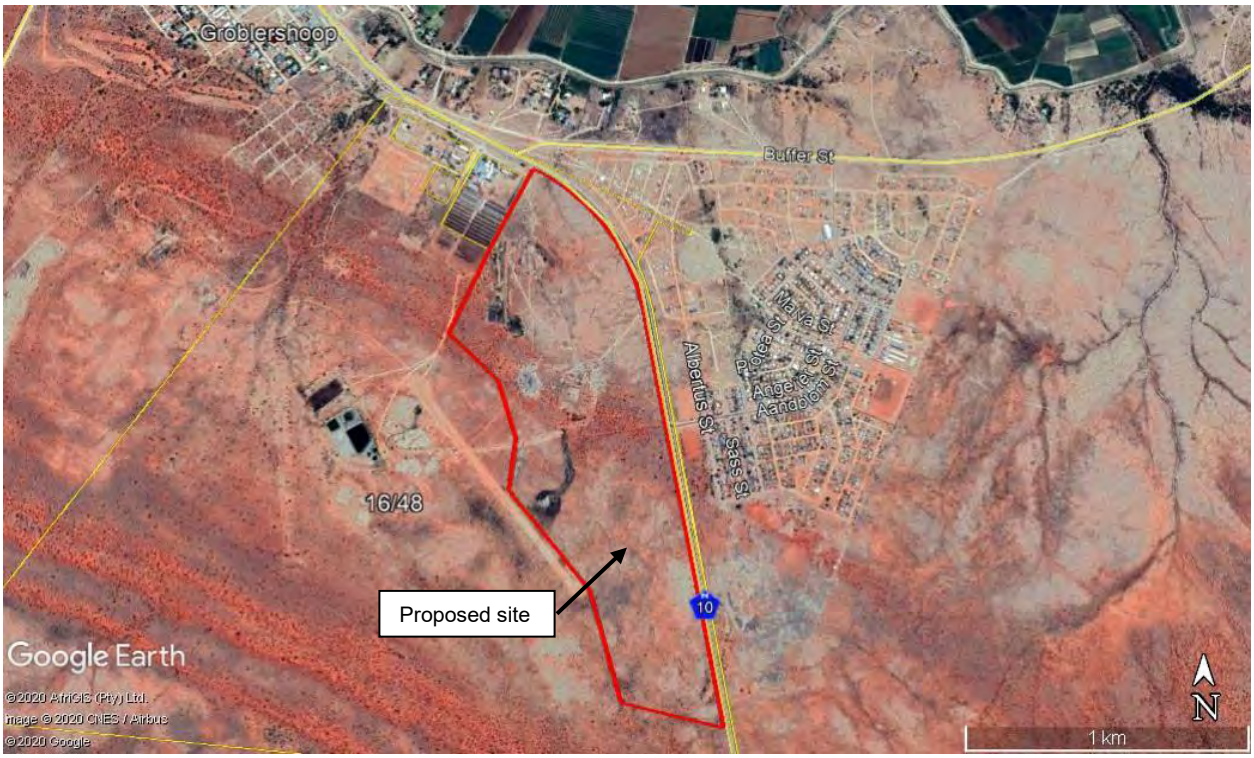

Figure 3: Google Earth image of the surrounding landscape, showing the location of the proposed development in location with the existing residential areas.

3. LEGAL REQUIREMENTS

The current assessment is being undertaken in terms of the National Environmental Management Act (Act 107 of 1998, NEMA), to be read with section 24 (5): NEMA EIA Regulations 2014. However, the provisions of various other Acts must also be considered within this EIA.

The legislation that is relevant to this study is briefly outlined below.

3.1 THE CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA

The Constitution of the Republic of South Africa (Act 108 of 1996) states that everyone has a right to a non-threatening environment and that reasonable measure are applied to protect the environment. This includes preventing pollution and promoting conservation and environmentally sustainable development, while promoting justifiable social and economic development.

3.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT 107 OF 1998)

The National Environmental Management Act (Act 107 of 1998) (NEMA), as amended, makes provision for the identification and assessment of activities that are potentially detrimental to the environment and which require authorisation from the relevant authorities based on the findings of an environmental assessment. NEMA is a national act, which is enforced by the Department of Environmental Affairs (DEA). These powers are delegated in the Northern Cape to the Department of Environment and Nature Conservation (DE&NC).

On the 04 December 2014 the Minister of Water and Environmental Affairs promulgated regulations in terms of Chapter 5 of the NEMA, namely the EIA Regulations 2014. These were amended on 07 April 2017 (GN No. 326, No. 327 (Listing Notice 1), No. 325 (Listing Notice 2), No. 324 (Listing Notice 3) in Government Gazette No. 40772 of 07 April 2017). Listing Notice 1 and 3 are for a Basic Assessment and Listing Notice 2 for a full Environmental Impact Assessment.

According to the regulations of Section 24(5) of NEMA, authorisation is required for the following listed activities for the proposed agricultural development:

Government Notice R327 (Listing Notice 1) listed activities:

12 The development of;

(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres;

(ii) infrastructure or structures with a physical footprint of 100 square metres or more;

where such development occurs;

(a) within a watercourse;

(b) in front of a development setback; or

(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;

19 The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;

(a) will occur behind a development setback;
(b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or
(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.

24 The development of a road;
(i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or
(ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres;

but excluding a road;
(a) which is identified and included in activity 27 in Listing Notice 2 of 2014; or
(b) where the entire road falls within an urban area; or
(c) which is 1 kilometre or shorter

27 The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for;
(i) the undertaking of a linear activity; or
(ii) maintenance purposes undertaken in accordance with a maintenance management plan.

56 The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre;
(i) where the existing reserve is wider than 13,5 meters; or
(ii) where no reserve exists, where the existing road is wider than 8 metres;

excluding where widening or lengthening occur inside urban areas.

Government Notice **R325** (Listing notice 2) listed activities:

15 The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for;
(i) the undertaking of a linear activity; or
(ii) maintenance purposes undertaken in accordance with a maintenance management plan.

Government Notice **R324** (Listing notice 3) listed activities:

4 The development of a road wider than 4 metres with a reserve less than 13.5 metres

12 The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.

14 The development of;
(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 10 square metres;

(ii) infrastructure or structures with a physical footprint of 10 square metres or more;

where such development occurs;
(a) within a watercourse;
(b) in front of a development setback; or
(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;
Excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour;

An Application Form will be submitted to DE&NC. On acknowledgment from DE&NC this Scoping Process is being undertaken to identify potential issues.

The principles of environmental management as set out in section 2 of NEMA have been taken into account. The principles pertinent to this activity include:

- People and their needs will be placed at the forefront while serving their physical, psychological, developmental, cultural and social interests. The activity seeks to provide additional employment and economic development opportunities, which are a local and national need – *the proposed activity is expected to have a beneficial impact on people, especially developmental and social benefits, as well providing additional employment and economic development opportunities.*
- Development will be socially, environmentally and economically sustainable. Where disturbance of ecosystems, loss of biodiversity, pollution and degradation, and landscapes and sites that constitute the nation's cultural heritage cannot be avoided, are minimised and remedied. The impact that the activity will potentially have on these will be considered, and mitigation measures will be put in place - *potential impacts have been identified and considered, and any further potential impacts will be identified during the public participation process. Mitigation measures will be included in the EMP*.
- Where waste cannot be avoided, it will be minimised and remedied through the implementation and adherence of the Environmental Management Programme (EMP) – *this will be included in the EIR*.
- The use of non-renewable natural resources will be responsible and equitable.
- The negative impacts on the environment and on people's environmental rights will be anticipated, investigated and prevented, and where they cannot be prevented, will be minimised and remedied.
- The interests, needs and values of all interested and affected parties will be taken into account in any decisions through the Public Participation Process.
- The social, economic and environmental impacts of the activity will be considered, assessed and evaluated, including the disadvantages and benefits.
- The effects of decisions on all aspects of the environment and all people in the environment will be taken into account, by pursuing what is considered the best practicable environmental option.

3.3 NATIONAL HERITAGE RESOURCES ACT

The protection and management of South Africa's heritage resources are controlled by the National Heritage Resources Act (Act No. 25 of 1999). South African National Heritage Resources Agency (SAHRA) is the enforcing authority.

In terms of Section 38 of the National Heritage Resources Act, SAHRA will require a Heritage Impact Assessment (HIA) where certain categories of development are proposed. Section 38(8) also makes provision for the assessment of heritage impacts as part of an EIA process and indicates that if such an assessment is found to be adequate, a separate HIA is not required.
The National Heritage Resources Act requires relevant authorities to be notified regarding this proposed development, as the following activities are relevant:

- *any development or other activity which will change the character of a site exceeding 5 000 m² in extent;*
- *the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length*

Furthermore, in terms of Section 34(1), no person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit issued by the SAHRA, or the responsible resources authority. Nor may anyone destroy, damage, alter, exhume or remove from its original position, or otherwise disturb, any grave or burial ground older than 60 years, which is situated outside a formal cemetery administered by a local authority, without a permit issued by the SAHRA, or a provincial heritage authority, in terms of Section 36 (3). In terms of Section 35 (4), no person may destroy, damage, excavate, alter or remove from its original position, or collect, any archaeological material or object, without a permit issued by the SAHRA, or the responsible resources authority.

3.4 EIA GUIDELINE AND INFORMATION DOCUMENT SERIES

The following are the latest guidelines and information Documents that have been consulted:

- Department of Environmental Affairs and Development Planning's (DEA&DP) *Environmental Impact Assessment Guideline and Information Document Series (Dated: March 2013)*:
  - ✓ *Guideline on Transitional Arrangements*
  - ✓ *Generic Terms of Reference for EAPs and Project Schedules*
  - ✓ *Guideline on Alternatives*
  - ✓ *Guideline on Public Participation*
  - ✓ *Guideline on Exemption Applications*
  - ✓ *Guideline on Appeals*
  - ✓ *Guideline on Need and Desirability*

- Department of Environmental Affairs and Tourism (DEAT*) Integrated Environmental Management Information Series*

3.5 NATIONAL WATER ACT

Besides the provisions of NEMA for this EIA process, the proposed development may also require authorizations under the National Water Act (Act N0. 36 of 1998). The Department of Water and Sanitation, who administer that Act, will be a leading role-player in the EIA.

If, and as required by the Department of Water and Sanitation, a Water Use Licence Application (WULA) may be compiled and submitted.

3.6 NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT

The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) is part of a suite of legislation falling under NEMA, which includes the Protected Areas Act, the Air Quality Act, the Integrated Coastal Management Act and the Waste Act. Chapter 4 of NEMBA deals with threatened and protected ecosystems and species and related threatened processes and restricted activities. The need to protect listed ecosystems is addressed (*Section 54*).

3.7 NATIONAL FORESTS ACT

The National Forests Act, 1998 (Act 84 of 1998) (NFA) makes provisions for the management and conservation of public forests.

In terms of section 15(1) of the National Forests Act, 1998, no person may

(a) cut, disturb. damage or destroy any protected tree; or

(b) posses, collect. remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, or any forest product derived from a protected tree, except

  (i) under a license granted by the Minister; or

  (Ii) in terms of an exemption from the provisions of this subsection published by the Minister in the Gazette.

3.8 NORTHERN CAPE CONSERVATION ACT, ACT 09 OF 2009

On the 12th of December 2011, the new Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect, which provides for the sustainable utilization of wild animals, aquatic biota and plants. Schedule 1 and 2 of the Act give extensive lists of specially protected and protected fauna and flora species in accordance with this act. The NCNCA is a very important Act in that it put a whole new emphasis on a number of species not previously protected in terms of legislation.

It also put a new emphasis on the importance of species, even within vegetation classified as “Least Threatened” (in accordance with GN 1002 of 9 December 20011, promulgated in terms of the National Environmental Management Biodiversity Act 10 of 2004). Thus, even though a project may be located within a vegetation type or habitat previously not considered under immediate threat, special care must still be taken to ensure that listed species (fauna & flora) are managed correctly.

3.9 THE SPATIAL PLANNING AND LAND USE MANAGEMENT ACT (ACT 16 OF 2013)

The subject area falls under the jurisdiction of the local municipality and the appropriate zoning and subdivision would need to be allocated in order to permit the development of the land for the intended purpose.

4. ALTERNATIVES

Alternatives to the proposed development are very limited and have therefore not been considered for the following reasons described below.

4.1 SITE ALTERNATIVES

The proposed site is the only viable site available at this stage and the only one that will be investigated in this application. Housing is a constant need in the municipality, with other sites possibly earmarked for residential development that will not form part of this application. These will be addressed in the Environmental Impact Report.

4.2 ACTIVITY ALTERNATIVES

Activity alternatives are also very limited with no feasible alternatives besides residential development to assess. Due to the need for housing in the !Kheis Local Municipality, the housing development and associated infrastructure on the property is therefore the only activity considered.

The development may include a number of different land-uses however, besides just residential opportunities, to be incorporated into the layout. These will be investigated during the Environmental Impact Report phase.

4.3 LAYOUT ALTERNATIVES

Various layout alternatives will be investigated during the Environmental Impact Report. These will be compiled with input from the municipality and its requirements, as well as input and/or recommendations of the various specialists, as well as input from Interested and Affected Parties, including the community

4.4 NO-GO ALTERNATIVE

This is the option of not developing the proposed residential development.

Although the no-go development might result in no potential negative environmental impacts, the direct and indirect socio-economic benefits of not constructing the residential development will not be realised. The need for additional housing opportunities in the !Kheis Local Municipality will not be realised. These potential negative and/or positive environmental impacts will be assessed in the Environmental Impact Report.

5. SITE DESCRIPTION

5.1 LOCATION

The proposed site is located to the south-east of Groblershoop, to the west of the N10, in the !Kheis Local Municipality, Northern Cape.

Site co-ordinates: Proposed site: 28° 54' 33.90" S, 21° 59' 44.90" E.

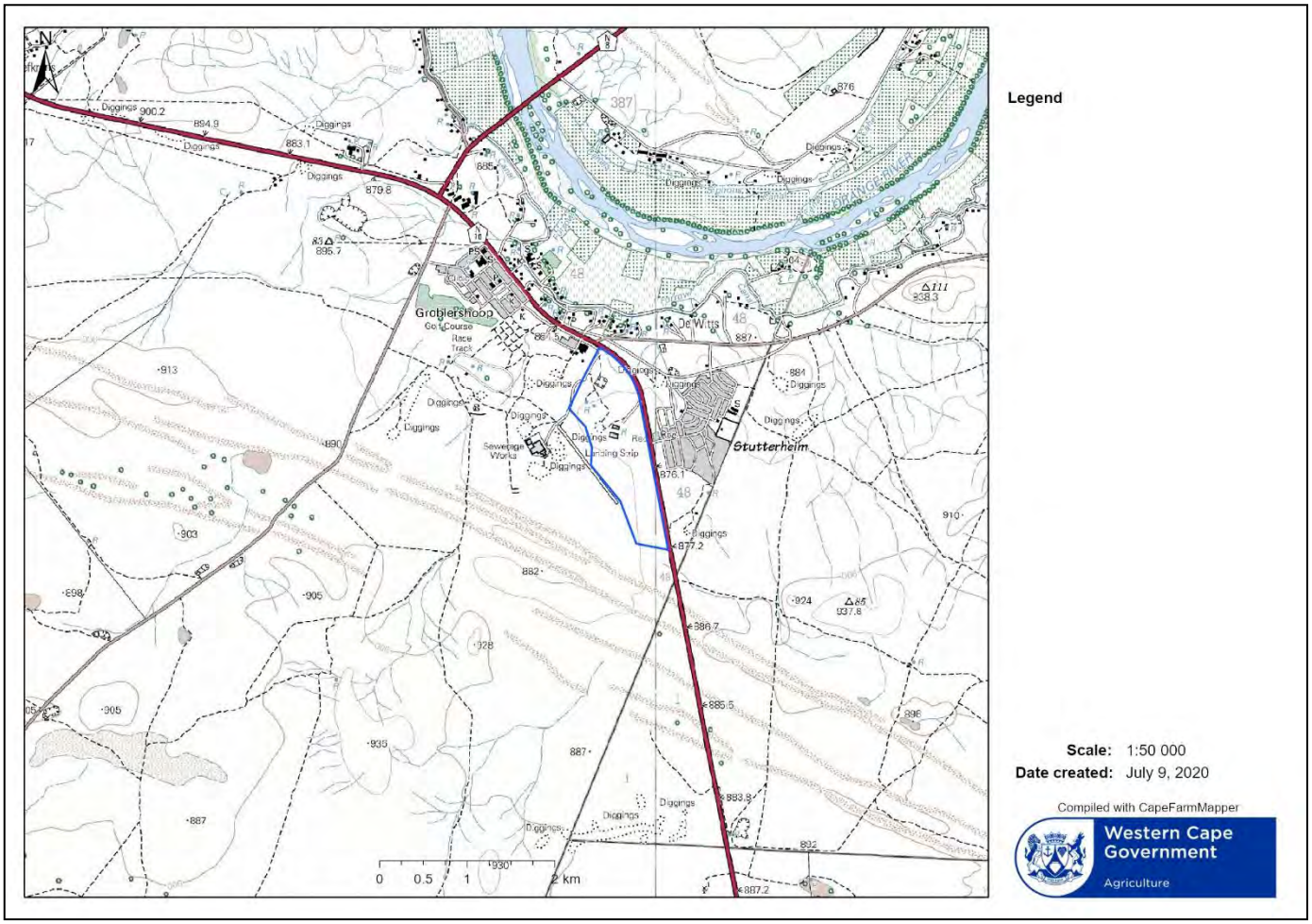

Figure 4: 1: 50 000 Locality Map showing the proposed Groblershoop Housing Development.

5.2 VEGETATION

The proposed site of the residential development is generally undeveloped and generally near natural. The northern and central part of the site, especially near the existing tracks and closer to the town, are disturbed.

According to the Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006, as updated in the 2012 beta version) only one broad vegetation type is expected on the majority of the proposed site, namely Bushmanland Arid Grassland.

Gordonia Duneveld is identified on SANBI BGIS adjacent to the site to the south-west, and Lower Gariep Alluvial Vegetation to the north of the site (Orange River).

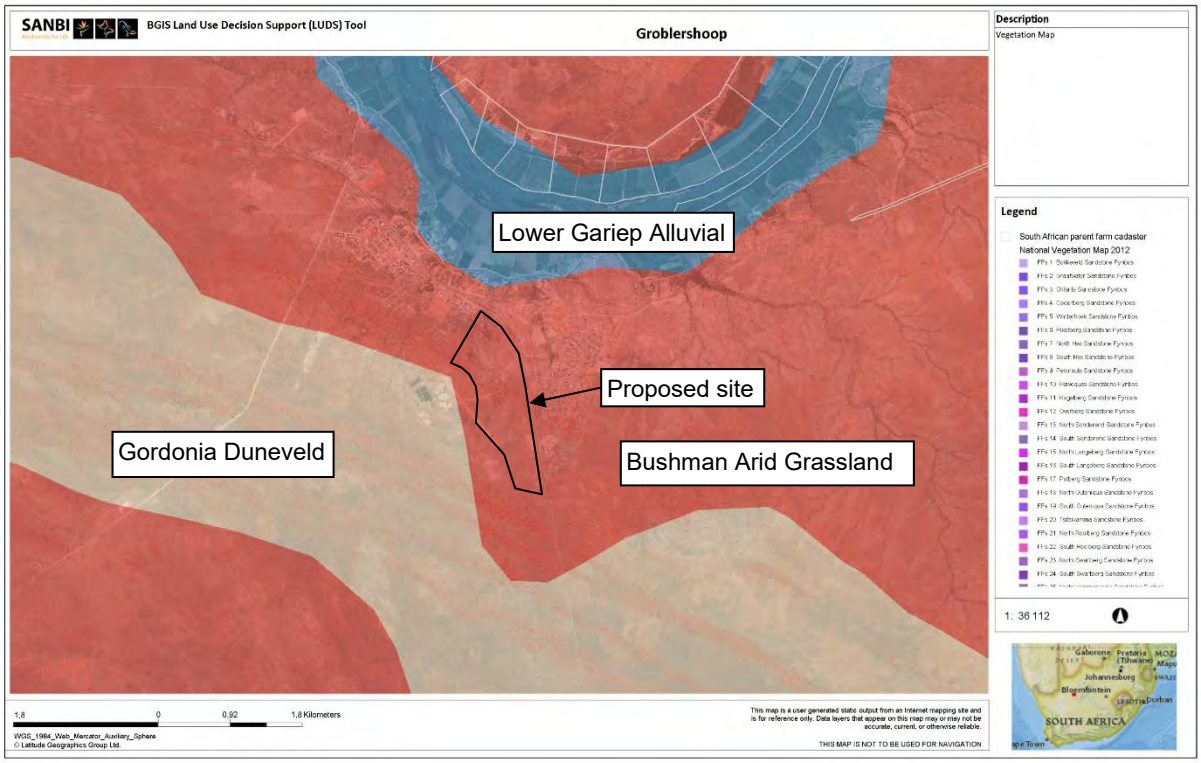

Figure 5: SANBI Vegetation map of the area.

According to the Northern Cape Critical Biodiversity Areas (CBA) maps the proposed site falls within a CBA area (Figure 6). However, there is no alternative on Municipal land that will not impact on the CBA. The 2016, Northern Cape CBA Map (Figure 6) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). The 2016 Northern Cape Critical Biodiversity Area (CBA) Map updates, revises and replaces all older systematic biodiversity plans and associated products for the province (including the Namakwa District Biodiversity Sector Plan, 2008). Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem

Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes.

Figure 6: CBA areas associated with the proposed site for development.

5.3 FRESHWATER

From the SANBI National Freshwater Ecosystem Priority Areas map (see Figure 7 below), there are no natural watercourses, however, two “wetlands” were identified in the middle of the site on the NFEPA overlay.

The source and nature of this water is to be investigated during the Scoping Phase, and if these are determined to be natural watercourses/wetlands, the impact of the proposed development on these watercourses are to investigated in the Environmental Impact Report.
The Orange River is also located approximately 1km north of the site.

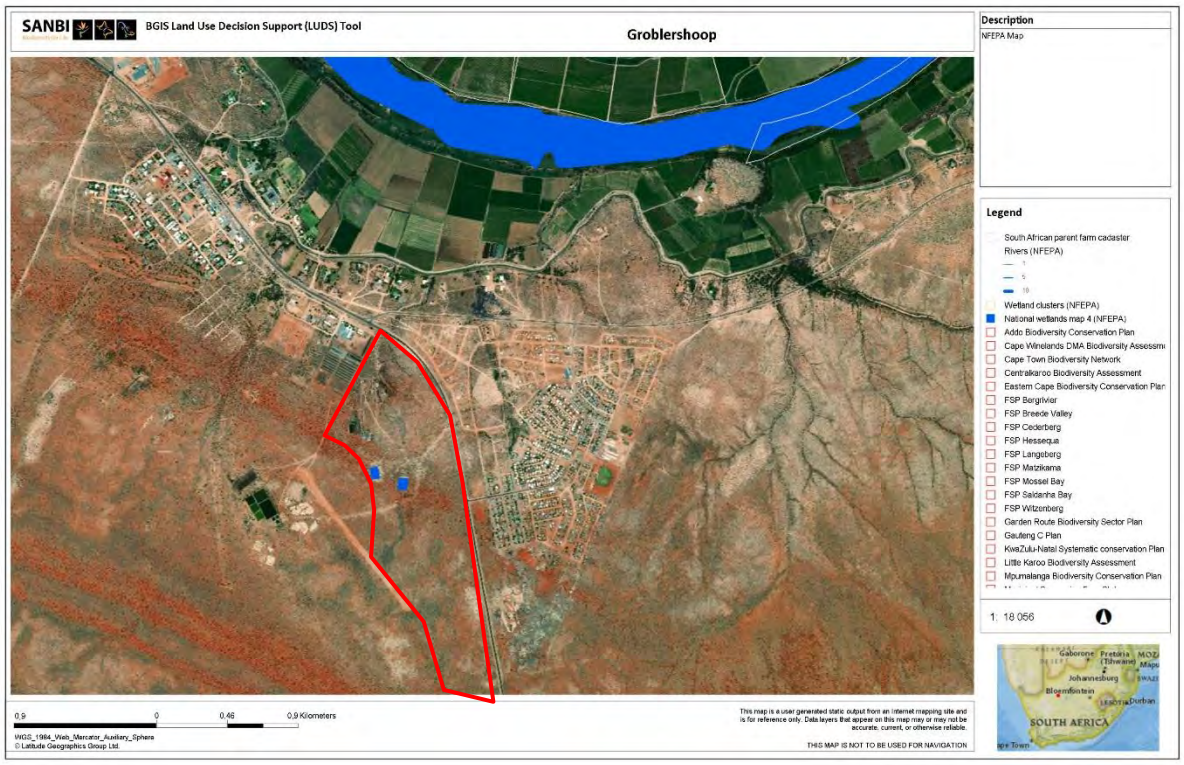

Figure 7: SANBI NFEPA map of the area.

5.4 CLIMATE

Climate data for Upington will be used, the nearest town (approximately 90km from Groblershoop) with reliable data. The Upington area is regarded as an arid area (regions with a rainfall of less than 400 mm per year are regarded as arid). This area normally receives about 180 mm of rain per year, with rainfall largely in summer. It receives the least amount of rain in winter (July), and the most amount during March.

The average annual temperature is 19.3^{0}C, with an average of 26.2^{0}C in January, and 11.5^{0}C in July.

5.5 SOCIO-ECONOMIC CONTEXT

Housing is a national need, including in the !Kheis Local Municipality.

The !Kheis Local Municipality's aims to promote socioeconomic development through the eradication of backlogs associated with water and sanitation, electricity, and housing, as well as improve basic services within Groblershoop. In order to meet the needs of the community within Groblershoop, the Council resolved that a project business plan be submitted to Co-operative Governance, Human Settlements and Traditional Affairs (COGHSTA) as well as the construction of 1500 erven in Groblershoop over the short to medium term, along with associated infrastructure. As per the !Kheis Integrated Development Plan (IDP) 2019/2020, a key performance indicator includes the provision of infrastructure and basic service through securing suitable land for human settlement projects, where suitable land was previously identified in Boegoeberg, Topline, Wegdraai, Grootdrink, Gariep, and Opwag. The provision of affordable housing units remains a high priority for the Municipality which will restore the dignity of poor people by providing shelter and access to basic human rights as enshrined in the Constitution of South Africa.

The proposed !Kheis housing development falls in line with the !Kheis IDPs key strategic and development objectives of the KLM, to improve and maintain basic service delivery through specific infrastructural projects including human settlements, water, sanitation, electricity, as well as streets and storm water management[2]. As per the Land Development Plan/ Rural Spatial Development Framework (2014), Groblershoop has been identified as a High Development Potential/Low Human Development Need (Category 1 Investment type = Infrastructure capital, large - scale monetary capital). The demographic profile of the KLM includes the total population of 16 637 individuals in 2011 with a total number of 4 145 households. This community requires formalized, state-instituted housing, and associated, infrastructure. The proposed development will distribute the density of the population, improve community member's standard of living, as well as access to essential services including roads, electricity, water supply, appropriate sewage disposal infrastructure, and environmental health in the area. Therefore, the proposed development will enable adequate housing to be constructed, thereby promoting access to basic service delivery as well as socioeconomic development in Groblershoop and its surroundings.

The proposed Groblershoop Housing development is in line with the !Kheis IDPs key strategic and development objectives, namely to improve and maintain basic service delivery through specific infrastructural projects including human settlements and basic services, in the poverty-stricken Groblershoop Township. According to the SDF, the population in Groblershoop increased from 741 (in 2001) to 4938 in 2011 (where 50% of the population are male and 50% female). Therefore, this community requires formalized, state-instituted housing, and associated, infrastructure. The proposed development will distribute the density of the population, improve community member's standard of living, as well as access to essential services including roads, electricity, water supply, appropriate sewage disposal infrastructure, and environmental health in the area. Therefore, the proposed development will enable adequate housing to be constructed, thereby promoting access to basic service delivery as well as socioeconomic development in the Groblershoop Township and its surroundings. !Kheis Local Municipality is committed to the vision of the National Government of which it committed itself towards accelerating shared growth to halve poverty and unemployment and promote social inclusions. Housing is one of the social inclusions in this vision.

[2] Integrated Development Plan of !Kheis Municipality, 2017-2022 (Review for 2019 – 2020 Financial Year).

The majority of the KLM population is located in five settlements, namely: Grootdrink, Topline, Wegdraai, Groblershoop and Boegoeberg, with the largest of those settlements being Groblershoop, Grootdrink and Wegdraai. With regards to the functional age groups, 60% of KLM's population is of working age (15---64). Grootdrink (40%) and Boegoeberg (40%) have the highest percentages of population aged between 0 and 14, which is decidedly higher than the district percentage of 28%. Education levels and school attendance have increased in KLM. Grootdrink has the lowest percentage individuals with Gr.12 at 9,1%, while Topline has the highest percentage of individuals with 'no schooling' at 17,5%. In comparison Groblershoop has the highest percentage of individuals with Gr.12 (18,5%) and individuals with higher education (1,7%).

5.6 HERITAGE FEATURES

Due to the nature and size of the proposed development, potential heritage resources may be affected by the development. Heritage resources include any of the following, as defined by the National Heritage Resources Act (Act 25 of 1999):

- living heritage as defined in the National Heritage Council Act No 11 of 1999 (cultural tradition; oral history; performance; ritual; popular memory; skills and techniques; indigenous knowledge systems; and the holistic approach to nature, society and social relationships);
- Ecofacts (non-artefactual organic or environmental remains that may reveal aspects of past human activity; definition used in KwaZulu-Natal Heritage Act 2008);
- places, buildings, structures and equipment;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds;
- public monuments and memorials;
- sites of significance relating to the history of slavery in South Africa;
- movable objects, but excluding any object made by a living person; and
- battlefields.

6. SERVICES

Due to the scale of the development, the availability of bulk services for the development will need to be investigated. The !Kheis Local Municipality will more than likely be the service provider for the bulk services.

BVi Engineers will prepare the Bulk Engineering Services Reports on the external services for the proposed development.

6.1 WATER

The water source, upgrades to existing water reticulation infrastructure and connection with the proposed internal water network will need to be determined. Back-up storage will also need to be investigated.

The availability and confirmation that sufficient capacity exists to service the proposed development will need to be addressed, and confirmation received from the engineers and/or municipality.

6.2 SEWER

The availability of sewer services, the potential upgrades to existing infrastructure or the potential development of new infrastructure to adequately service the proposed development will need to be investigated.

The availability and confirmation that sufficient capacity exists to service the proposed development will need to be addressed and confirmed by the engineers and/or the municipality.

6.3 ROADS

The internal road network and design standards, including any access roads, will need to be determined in line with the proposed layout design. The main entrance to the development is expected to be off an unnamed access road off the N10.

A Traffic Impact Assessment will be conducted to determine the design of the internal roads, including any upgrades that will be required to existing roads to provide adequate access to the site, or if new access points will be needed.

6.4 STORMWATER

The internal stormwater network and links and upgrades to the existing external stormwater network, will need to be determined and addressed in the Bulk Engineering Services Reports. This will be determined once a conceptual site layout plan has been developed.

6.5 SOLID WASTE (REFUSE) REMOVAL

Refuse removal will be via the Municipal waste stream and disposed of at the nearest municipal bulk solid waste disposal site. Sufficient capacity to adequately service the proposed development will need to be confirmed by the engineers and municipality.

6.6 ELECTRICITY

The proposed internal electrical network, electrical infrastructure requirements, upgrades to the existing external electrical network, including the provider and confirmation of sufficient capacity will need to be determined and addressed in the Bulk Engineering Services Reports.

7. ENVIRONMENTAL ISSUES AND POTENTIAL IMPACTS

Environmental issues were raised through informal discussions with the project team, specialists and authorities. All issues raised will be assessed in the specialist reports and will form part of the Environmental Impact Report. Additional issues raised during the public participation will be listed in the Final Scoping Report.

The following potential issues have been identified:

7.1 BOTANICAL

A botanical impact assessment will be conducted to determine if there is any sensitive or endangered vegetation on the proposed site. Due to the size of the development (approximately 95ha), there will be a loss of vegetation during the construction phase of the project.

A Botanical Impact Assessment will be conducted, which will describe and assess the botanical sensitivity of the area. The terms of reference for this study required a baseline analysis of the flora of the property, including the broad ecological characteristics of the site.

The botanical assessment will include the following:

- The significance of the potential impact of the proposed project, alternatives and related activities – with and without mitigation – on biodiversity pattern and process at the site, landscape and regional scales.
- Recommended actions that should be taken to prevent or, if prevention is not feasible, to mitigate impacts.

7.2 FRESHWATER

Freshwater ecosystems were identified on desktop analysis, and due to the size and nature of the development and the unknown source of standing water within the development site, a freshwater impact assessment will be conducted. Any potential impacts to the Orange River will also be investigated.

The terms of reference for the Freshwater assessment are as follows:

- Literature review and assessment of existing information
- Site Assessment of the proposed activities and impact on the associated freshwater systems. This will include an assessment of the freshwater ecological condition, using river health indices such as in-stream and riparian habitat integrity, aquatic macro-invertebrates and riparian vegetation to determine set back lines and geomorphological condition of the streams, which will then determine the overall Ecostatus of the streams and provide data that will inform the Water Use Licence Application of the project.
- Describe ecological characteristics of freshwater systems and compile report based on the data and information collected in the previous two tasks, describe ecological characteristics of the freshwater systems, comment on the conservation value and importance of the freshwater systems and delineate the outer boundary of the riparian zones/riverine corridors.
- Evaluate the freshwater issues on the site and propose mitigation measures and measures for the rehabilitation of the site as well as setback lines for future development.

- Compilation of the documentation for submission of the water use authorisation application (WULA) to the Department of Water and Sanitation (if deemed necessary).

7.3 HERITAGE

The possible impact on heritage resources has been identified as a possible environmental impact as a result of the development.

A Heritage Impact Assessment will be conducted on the site.

The terms of reference for the heritage and archaeological study are as follows:

- To determine whether there are likely to be any important archaeological sites or remains that might be impacted by the proposed development;
- To identify and map archaeological sites/remains that might be impacted by the proposed development;
- To assess the sensitivity and conservation significance of archaeological sites/remains in the inundation area;
- To assess the status and significance of any impacts resulting from the proposed development, and
- To identify measures to protect any valuable archaeological sites/remains that may exist within the estimated inundation area.

7.4 VISUAL IMPACT

The potential impact on the sense of place of the proposed development will also be considered. However, due to the nature of the activity, the surrounding land-uses, and that the sense of place is not expected to be significantly altered by the proposed development, no further studies are suggested.

7.5 OTHER ISSUES IDENTIFIED

Any further issues raised during the public participation process or by the Competent Authority not mentioned in this section, will be dealt with during the EIA phase.

8. DETAILS OF THE PUBLIC PARTICIPATION PROCESS

Potential Interested and Affected Parties (I&APs) have been and will be identified throughout the process. Landowners adjacent to the proposed site, relevant organs of state, organizations, ward councillors and the Local and District Municipality were added to this database. A complete list of organisations and individual groups identified to date is shown in **Appendix 1.**

Public Participation will be conducted for the proposed development in accordance with the requirements outlined in Regulation 41 of the NEMA EIA Regulations 2014. The issues and concerns raised during the scoping phase will be dealt with in the EIA phase of this application.

As such each subsection of Regulation 41 contained in Chapter 6 of the NEMA EIA Regulations 2014 will be addressed separately to thereby demonstrate that all potential Interested and Affected Parties (I&AP's) were notified of the proposed development.

R54 (2) (a):

R41 (2) (a) (i): The site notices (A2 and A3 sizes) were placed at different locations around the project site as well as at the municipality office in town.

The posters contained all details as prescribed by R41(3) (a) & (b) and the size of the on-site poster was at least 60cm by 42cm as prescribed by section R41 (4) (a).

R41 (2) (a) (ii): N/A. There is no alternative site.

R41 (2) b):

R41 (2) (b) (i): N/A. The Applicant is the landowner

R41 (2) (b) (ii): Notification letters will be circulated to residents adjacent to/within close proximity of the project site. **Appendix 1C**

R41 (2) (b) (iii): An initial notification letter will be sent to the municipal Ward councillor at the !Kheis Local Municipality, for the ward in which the site is situated.

R41 (2) (b) (iv): No notification letter will be sent to the !Kheis Local Municipality as the municipality is the Applicant

R54 (2) (b) (v): The Draft Scoping Report and notification letters will be sent to the following organs of state having jurisdiction in respect of any aspect of the activity:

- Department of Water and Sanitation
- Department of Agriculture and Land Reform
- Department of Roads and Public Works
- Department of Agriculture, Forestry and Fisheries
- Department of Cooperative Governance, Human Settlements and Traditional Affairs
- SANRAL
- Department of Environment and Nature Conservation
- South African Heritage Resources Agency

R41 (2) (c) (i): An advertisement was placed in the local newspaper.

R41 (2) (d): N/A

R41 (6):
R41 (6) (a): All relevant facts in respect of the application were made available to potential I&AP's.

R41 (6) (b): I&AP's will be given more than 60-days to register and/or comment on the Draft Scoping Report.

R42 (a), (b), (c) and R43(2): A register of interested and affected parties was opened, maintained and is available to any person requesting access to the register in writing.

Please find attached in **Appendix 1**:

- Proof of Notice boards, advertisements and notices that were sent out
- List of potential interested and affected parties
- Summary of issues raised by interested and affected parties

9. PLAN OF STUDY FOR THE EIA

9.1.1 TASKS TO BE UNDERTAKEN

Due to the nature of the proposed development there are a number of activities that will still need to be undertaken during the next phase of the project. The proposed process is as described as follows (This follows from a Scoping process to be accepted by the D:E&NC):

The NEMA Application Form will be submitted to D:E&NC along with the Draft Scoping Report which will be available for a 60-day comment period starting from the **03 August 2020 to 07 October 2020**. Comments received during the Public Participation Process will be incorporated into the Final Scoping Report, to be submitted to D:E&NC for a decision.

The following is a list of tasks to be performed as part of the EIA Process. Should the process be modified significantly, changes will be copied to D:E&NC.

Table 1. Detailed Project Plan as per NEMA Scoping and EIA Regulations 2014 (as amended): !Kheis Housing Development: Groblershoop Housing

No.	Action		Target Date	Progress
Pre-Application Phase				
1	Clarification meeting with client and appointment of environmental assessment practitioner (EAP) for EIA and environmental authorisation (EA) application		17th April 2020	
2	Appointment of specialists for EIR assessments	Botanical Specialist Freshwater Specialist Archaeological Specialist	7th May 2020	
3	Draft Scoping Report compilation		10-14th May 2020	
4	EAP site visit		19th May 2020	
5	Public participation (PP): - Letter drops (Adjacent Landowner Notification); - Poster placement (Public notice board at the !Kheis Local Municipality, public notice board of AgriMark (Groblershoop), Municipal Offices in Boegoeberg, Aunt Dolletjies Municipal Library in Boegoeberg, different conspicuous locations along the boundary of the proposed site for development (with a lot of foot traffic), and three tuckshops/ stores. - Advertisement publication (*published on 11th June 2020*) - Notified ward councillor. PP comment period must be a minimum of 60 days[3]		19th May 2020	

[3]**As per section 4 of the 'Directions Regarding Measures to Address, Prevent and Combat the Spread of COVID-19 Relating to National Environmental Management Permits and Licenses', published on the 5th June 2020 by the Department of Environment, Forestry and Fisheries (DEFF). These new directions state that any notice given after the 5th June 2020 requires an extended 30-day comment period in addition to the legislated 30-day comment period (total of 60-day comment period). If PP was conducted before the 27th March 2020, the formal comment period between 27th March and 5th June 2020 are null and void and therefore, restarted on the 6th June 2020. The initial comment period must be extended by additional 21 days (total of 51 day). Please note that we are still waiting for directives from DEFF on application timelines. These Directives published on the 5th June 2020 apply to Level 3 Lockdown Period and are subject to change.**

6	Specialist site visits	Botanical Assessment (Mr Peet Botes)	18-22nd May 2020	
		Freshwater Assessment (Dr Dirk Van Driel)	18-22nd May 2020	
		Archaeological Assessment (Mr Jan Engelbrecht)	18-31st May 2020	
7	Application Form Compilation		12th June 2020	
8	Receive specialist reports		31st May – 14th August 2020	
9	Advert comment period ends (*60-day comment period as per new directions*)		14th August 2020	
Application and Scoping Phase				
10	Application Form Compilation and Submission (Competent Authority have 10 days to respond)		7 days	
11	EAP to compile the draft Scoping Report (SR) (incl. the Plan of Study for EIA) and submit with Application Form			
12	If in order, the Department to acknowledge the application.		10 days	
13	EAP to notify I&APs (incl. the State departments) EAP to notify the registered I&APs (incl. the State departments) of the availability of the draft SR.		7 days	
14	Commenting period of 30 days + 30days for I&APs and State departments to comment.		60 days	
15	EAP to consider the comments received and complete the final SR.		3 days	
16	Following the commenting period the EAP to submit the Final SR together with any comments received on the final SR to the Department (within 74 days of submission of the Application Form)		7 days	
17	Department to acknowledge SR & Plan of Study for EIA.		10 days	
18	If in order, the Department to accept the SR & Plan of Study for EIA (within 43 days + 30 days of receipt of Final SR)		73 days	
Application and Scoping Phase				
19	EAP to undertake the EIA and compile the draft EIA Report ("EIAR") (including the draft EMP)		40 days	
20	EAP to notify registered I&APs (incl. the State departments) of the availability of the draft EIAR for comment.		7 days	
21	Commenting period of 60 days for I&APs and State departments.		60 days	
22	EAP to consider the comments received and complete the final EIAR.		7 days	
23	Following the commenting period the EAP to submit the final EIR together with any comments received on the final EIR to the Department.		7 days	
24	Department to acknowledge EIR.		10 days	
25	After having received the EIR, the Department to decide whether or not to grant or refuse Environmental Authorisation (within 107 days)		137 days	
26	Applicant/EAP to notify I&APs of outcome and if authorised may only commence 20 days after the date of the authorisation.		20 days	

EIA PROCESS

TASK	TIMEFRAMES
Submit NEMA Application and Draft Scoping Report (FSR) and Plan of Study for EIA to D:E&NC and distribute to registered I&APs for comment	July 2020
Submit Final Scoping Report and Plan of Study to D:E&NC for a decision	October 2020
Receive approval for the FSR and the Plan of Study for EIA.	December 2020
Compile the Draft Environmental Impact Report (EIR) for public comment based on specialist information.	December 2020
Submit Draft EIR for public comment.	January 2021
Receive responses to the Draft EIR.	March 2021
Preparation of a FINAL EIR and submission to D:E&NC.	April 2021

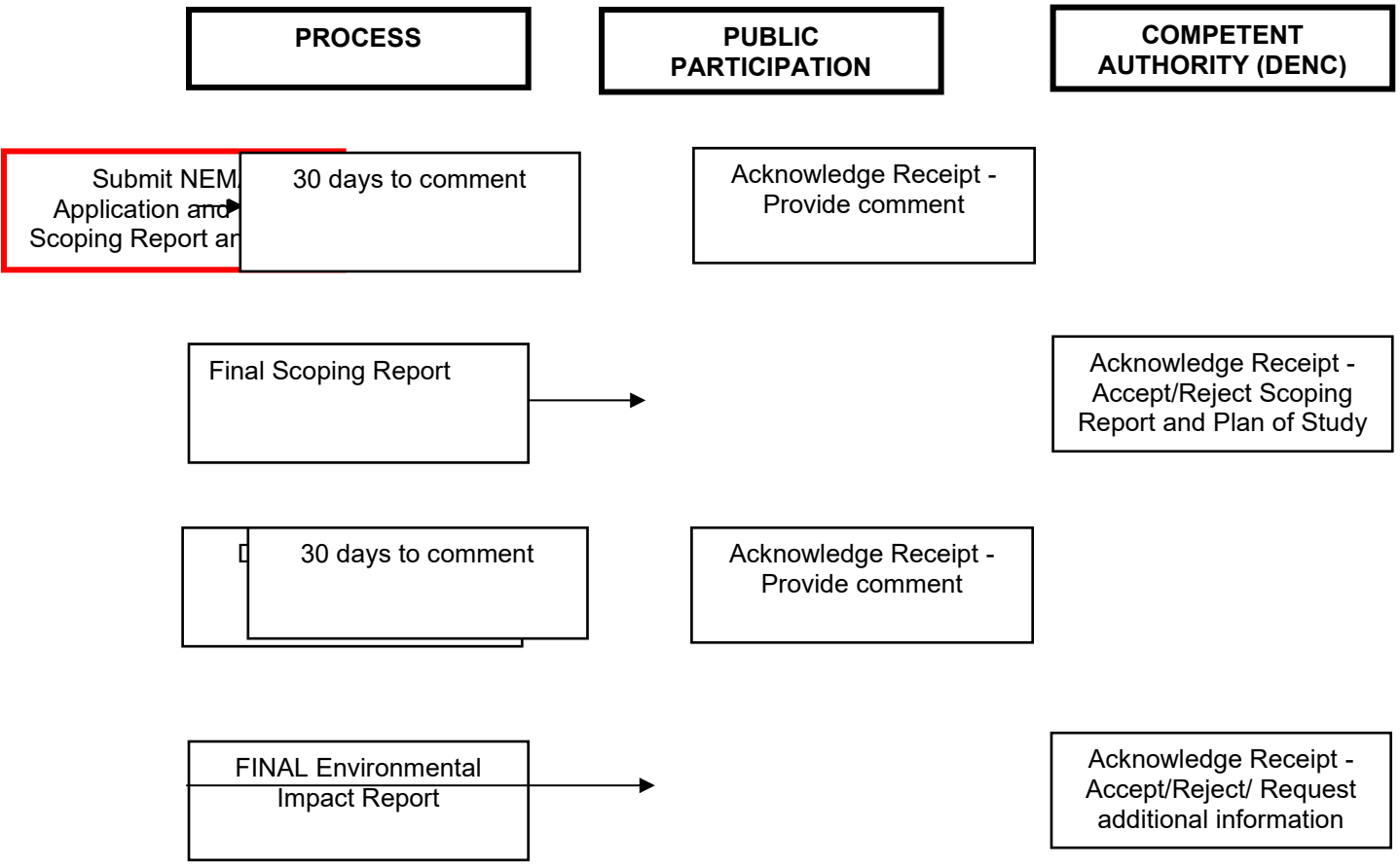

Figure 8. Summary of the EIA process and public participation process. The red indicates the stages where the competent authority will be consulted during the process.

9.2 PUBLIC PARTICIPATION AND INTERESTED AND AFFECTED PARTIES

Please refer to Figure 6 to see where the public participation process is present in the environmental impact assessment. The Interested and Affected Parties will have a chance to view and comment on all the reports that are submitted. The figures also indicated what timeframes are applicable to what stage in the process. If required, meetings with key stakeholders will be held.

At the end of the comment period, the EIR will be revised in response to feedback received from I&APs. All comments received and responses to the comments will be incorporated into the Final Environmental Impact Report (EIR). The Final EIR will then be submitted to D:E&NC for consideration and decision-making.

Correspondence with I&APs will be via post, fax, telephone, email and newspaper advertisements.

Should it be required, this process may be adapted depending on input received during the on-going process and as a result of public input. D:E&NC will be informed of any changes in the process.

9.3 CRITERIA FOR SPECIALIST ASSESSMENT OF IMPACTS

As a result of the environmental issues and potential impacts identified in *Section 6*, the need for the following specialist studies has been identified:

- Biodiversity Assessment
- Freshwater Assessment
- Heritage Impact Assessment

The impacts of the proposed activity on the various components of the receiving environment will be evaluated in terms of duration (time scale), extent (spatial scale), magnitude and significance as outlined in Table 1. These impacts could either be positive or negative.

The magnitude of an impact is a judgment value that rests with the individual assessor while the determination of significance rests on a combination of the criteria for duration, extent and magnitude. Significance thus is also a judgment value made by the individual assessor.

Table 2: Criteria used for evaluating impacts

Criteria	Category
Nature of impact	This is an evaluation of the effect that the construction, operation and maintenance of a proposed dam would have on the affected environment. This description should include what is to be affected and how.
Duration (Predict whether the lifetime of the Impact will be temporary (less than 1 year) short term (0 to 5 years); medium term (5 to 15 years); long term (more than 15 years, with the Impact ceasing after full implementation of all development components with mitigations); or permanent.	**Temporary:** < 1 year (not including construction) **Short-term:** 1 – 5 years **Medium term:** 5 – 15 years **Long-term:** >15 years (Impact will stop after the operational or running life of the activity, either due to natural course or by human interference) **Permanent:** Impact will be where mitigation or moderation by natural course or by human interference will not occur in a particular means or in a particular time period that the impact can be considered temporary
Extent (Describe whether the impact occurs on a scale limited to the site area; limited to broader area; or on a wider scale)	**Site Specific:** Expanding only as far as the activity itself *(onsite)* **Small:** restricted to the site's immediate environment within 1 km of the site *(limited)* **Medium:** Within 5 km of the site *(local)* **Large:** Beyond 5 km of the site *(regional)*
Intensity (Describe whether the magnitude (scale/size) of the Impact is high; medium; low; or negligible. The specialist study must attempt to quantify the magnitude of impacts, with the rationale used explained)	**Very low:** Affects the environment in such a way that natural and/or social functions/processes are not affected **Low:** Natural and/or social functions/processes are slightly altered **Medium:** Natural and/or social functions/processes are notably altered in a modified way **High:** Natural and/or social functions/processes are severely altered and may temporarily or permanently cease
Probability of occurrence Describe the probability of the Impact actually occurring as definite (Impact will occur regardless of mitigations	**Improbable:** Not at all likely **Probable:** Distinctive possibility **Highly probable:** Most likely to happen **Definite:** Impact will occur regardless of any prevention measures
Status of the Impact Describe whether the Impact is positive, negative (or neutral).	**Positive:** The activity will have a social/ economical/ environmental benefit **Neutral:** The activity will have no affect **Negative:** The activity will be socially/ economically/ environmentally harmful
Degree of Confidence in predictions State the degree of confidence in predictions based on availability of information and specialist knowledge	**Unsure/Low:** Little confidence regarding information available (<40%) **Probable/Med:** Moderate confidence regarding information available (40-80%) **Definite/High:** Great confidence regarding information available (>80%)
Significance (The impact on each component is determined by a combination of the above criteria and defined as follows) The significance of impacts shall be assessed with and without mitigations. The significance of identified impacts on components of the affected biophysical or socio-economic environment (and, where relevant, with respect to potential	**No change:** A potential concern which was found to have no impact when evaluated **Very low:** Impacts will be site specific and temporary with no mitigation necessary. **Low:** The impacts will have a minor influence on the proposed development and/or environment. These impacts require some thought to adjustment of the project design where achievable, or alternative mitigation measures **Moderate:** Impacts will be experienced in the local and surrounding areas for the life span of the development and may result in long term changes. The impact can be lessened or improved by an amendment in the project design or implementation of effective mitigation measures.

legal requirement/s) shall be described as follows:	**High:** Impacts have a high magnitude and will be experienced regionally for at least the life span of the development, or will be irreversible. The impacts could have the no-go proposition on portions of the development in spite of any mitigation measures that could be implemented.

In addition to determining the individual impacts against the various criteria, the element of mitigation, where relevant, will also be brought into the assessment. In such instances the impact will be assessed with a statement on the mitigation measure that could/should be applied. An indication of the certainty of a mitigation measure considered, achieving the end result to the extent indicated, is given on a scale of 1-5 (1 being totally uncertain and 5 being absolutely certain), taking into consideration uncertainties, assumptions and gaps in knowledge.

Table 3: The stated assessment and information will be determined for each individual issue or related groups of issues and presented in descriptive format in the following table example or a close replica thereof.

Impact Statement:		
Mitigation:		
Ratings	Duration	
	Extent	
	Intensity	
	Probability of impact	
	Status of Impact (Positive/negative)	
	Degree of confidence	
Significances	Significance **without** Mitigation	
	Significance ***WITH*** Mitigation	
Indication of the certainty of a mitigation measure considered, achieving the end result to the extent indicated, is given on a scale of 1-5 (1 being totally uncertain and 5 being absolutely certain), taking into consideration uncertainties, assumptions and gaps in knowledge		
Legal Requirements (Identify and list the specific legislation and permit requirements which are relevant to this development):		

10. CONCLUSION AND RECOMMENDATIONS

A scoping exercise is being undertaken to present the proposed activities to the I&APs and to identify environmental issues discussed in this report and concerns raised as a result of the proposed development alternatives to date. The issues and concerns were raised by I&APs, authorities, the project team as well as specialist input, based on baseline studies undertaken.

This Draft Scoping Report, being undertaken in terms of NEMA, summarises the process undertaken, the alternatives presented, and the issues and concerns raised.

As a result of the above, the need for the following specialist studies, have been identified:

- Biodiversity Assessment
- Freshwater Assessment
- Heritage Impact Assessment

Any further issues raised as a result of the Public Participation Process will be dealt with during the EIA phase.

The significance of the impacts associated with the alternatives proposed will be assessed in these specialist studies, as part of the EIA. Once the specialist studies have been completed, they will be summarised in an Environmental Impact Report (EIR), which integrates the findings of the assessment phase of the EIA.

Based on the significance of the issues raised during the ongoing Public Participation Process and Scoping Phase, it is evident that an Environmental Impact Assessment (EIA) is required. ***It is therefore recommended that authorisation for the commencement of an EIA for the proposed development is granted.*** Should the EIA process be authorised, the significant issues raised in the process to date will be addressed and the specialist studies noted in this report, will be undertaken.

11. DETAILS AND EXPERTISE OF THE EAP

This Draft Scoping Report was prepared by Clinton Geyser who has a MSc. Degree in Environmental Management. He has been working as an Environmental Assessment Practitioner since 2009 and is currently employed at EnviroAfrica CC.

Report compiled by Clinton Geyser -
Qualifications:

- BSc. Earth Sciences, Majors in Geology and Geography and Environmental Management (1998 – 2000) and;
- BSc. (hons): Geography and Environmental Management (2001) and;
- MSc. Geography and Environmental Management (2002), all from the University of Johannesburg.

Expertise:
Clinton Geyser has over ten years' experience in the environmental management field as an Environmental Assessment Practitioner and as an Environmental Control Officer, having worked on a variety of projects in the Western, Eastern and Northern Cape. Previous completed applications include, but not limited to:

- Civil engineering infrastructure including pipelines, Wastewater Treatment Works, and roads in the Western and Northern Cape.
- Agricultural developments, including reservoirs and dams, in the Western and Northern Cape.
- Telecommunications masts in the Western and Eastern Cape
- Housing Developments in the Western and Northern Cape.
- Resort developments in the Western and Northern Cape.
- Cemeteries in the Western Cape
- Waste Management Licences in the Western Cape

Employment:
Previous employment as an EAP: Doug Jeffery Environmental Consultants (2009 – 2012)
Current employment: EnviroAfrica cc (2012 – present).

The whole process and report was supervised by Bernard de Witt who has more than 20 years' experience in environmental management and environmental impact assessments.

(----------END----------)

ANNEXURE K: SANRAL NO-OBJECTION

MACROPLAN TOWN & REGIONAL PLANNERS

• 4A MURRAY AVENUE • P.O.BOX 987 • UPINGTON • 8800 • [T] 054 332 3642 • [F] 054 332 4283 • WWW.MACROPLAN.INFO • GOBETLA BEPLANNINGSDIENSTE CC •
• CC REG. NO. 2006/017796/23 • VAT NO. 4070226610 • CENTRAL SUPPLIER DATABASE SUPPLIER NUMBER: MAAA0235531 •

Reference: Date:

(ENQ.PC.SAN) 201013 Groblershoop Township Establishment Project 13 October 2020

South African National Road Agency Limited
Private Bag X19
Bellville
7530

ATT: Me René de Kock / Shaun Dyers

PROJECT: GROBLERSHOOP TOWNSHIP ESTABLISHMENT PROJECT

INVOLVED PROPERTIES SUMMARY:

- PORTION 16 OF THE FARM BOEGOEBERG SETTLEMENT, NO. 48, KENHARDT RD, !KHEIS LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE;

The above mentioned matter, as well as the attached documentation, refer.

Our office, Macroplan Town and Regional Planners, has been appointed by Barzani Development on behalf of the Department of Cooperative Governance, Human Settlements and Traditional Affairs (hence referred to as COGHSTA), to facilitate the needed town planning procedures involved with the township expansion of Groblershoop. Groblershoop, along with the various smaller settlements of the !Kheis Municipality, have experienced normal population growth over the last few years, however, due to Groblershoop's status as the primary urban centre of the !Kheis Local Municipality, the town has seen a significant greater increase in residents. In contrast to the other settlements of the !Kheis Municipality, the increase in the local population has been adequately managed by the local municipality by means of allocating municipal owned land within existing communities that were meant for other purposes, such as public open spaces. The commitment from COGHSTA to address the housing backlog within the Northern Cape, provided the !Kheis Municipality with the ideal opportunity to make adequate provision for further population growth of Groblershoop. Groblershoop as the primary urban centre and administrative seat of the !Kheis Local Municipality will therefore be subject to a substantial township expansion project that will not only include 1500 residential properties, but also provide for land uses normally associated with a sustainable community/ neighbourhood, such as a school, business nodes, municipal uses and open spaces.

In terms of the Spatial Planning and Land Use Management Act, Act No. 16 of 2013, approval / input from any state or semi-state department is required for any development that can directly or indirectly impact on the general functioning of said departments (in this instance the South African National Roads Agency SOC Ltd, from here on referred to as SANRAL). The development site, which comprises of a 90ha portion of Portion 16 of the Farm Boegoeberg Settlement, No. 48, borders to the N10 National Road, as such approval in terms of the South African National Roads Agency Limited and National Roads Act, 1998 (Act 7 of 1998), is required for this proposed township expansion project. In the case of the land portion involved, the objective is to have the properties subdivided and rezoned, in terms of the Spatial Planning and Land Use Management Act, Act No. 16 of 2013, in order to allow for the expansion of the town of Groblershoop.

It should furthermore be noted that due to the magnitude of the proposed township expansion, a new access point from the N10 National Road is proposed, as well as the utilisation of the existing access point that provides access to the industrial area of Groblershoop.

GROBLERSHOOP TOWNSHIP ESTABLISHMENT PROJECT DESCRIPTION:

The undertaking of the township expansion project, consisting of 1500 residential erven, for the Groblershoop Community by Macroplan, derives from an indirect appointment by COGHSTA and is therefore a project of national and provincial importance. The development site comprises of a 90ha portion of Portion 16 of the Farm Boegoeberg Settlement, no. 48, which is located to the west of the community of Sternham, south-east of the industrial area of Groblershoop and south-east of the town of Groblershoop. The study area is owned by the !Kheis Local Municipality and borders directly to the N10 National Road to the west. The proposed township establishment project will mainly provide sub-economic housing with the end goal of securing ownership of land for future residents, however, a small quantity of medium income housing are also provided for in the township expansion layout, as allowed by COGHSTA. At present the development site is not being occupied by any informal structures, due to the municipality`s admirable management of informal houses and the preparation of other municipal owned land as a temporary solution. This provides for a development site on which a town planning layout can be designed that complies with planning principles and promotes sustainability. The Groblershoop township expansion will not only provide housing and economic opportunities for the future residents of Groblershoop, but will also play an integral role in connecting the community of Sternham with the town of Groblershoop. Integration and accessibility of land are key planning principles on which town planning legislation are based on and this had to be kept in mind during the design of the town planning layout.

The planned expansion of Groblershoop will create 1500 residential erven of which ±60 erven will be medium income properties. Due to the magnitude of the development proposal, provision also needs to be made for business nodes that will promote economic prosperity. Graves were captured by the appointed land surveyors and subsequently these graves have to be accommodated. A new cemetery is also proposed in the southernmost corner of the study area. The number of residential properties furthermore constitute the development of a primary school. Religious properties and municipal uses have also been provided for in the proposed layout.

At this stage the project has progressed to a point where a concept layout (Annexure C) has been prepared that may be subject to minor alterations to comply with the findings of the specialist studies and or other organs of state, but the general layout and functioning thereof should be maintained.

INFORMATION CONCERNING SANRAL:

The township expansion of Groblershoop borders to the N10 National Road, as such SARNAL needs to be informed of the planned development where to subsequent requirements and feedback from SANRAL needs to be obtained and ultimately, approval from SANRAL is also required. The following aspects may be highlighted that is of utmost importance:

- SPLUMA Process: The township expansion project for Groblershoop is a legal process guided by the Spatial Planning and Land Use Management Act (Act 16 of 2013) and this legislation clearly states that all state and semi-state departments need to be informed of any developments that may directly or indirectly impact on the general functioning of said departments. The portion of the property that comprise the study area will impact on the N10 National Road, as such, SANRAL needs to be informed of the planned township expansion project and an approval/ no-objection, South African National Roads Agency Limited and National Roads Act, 1998 (Act 7 of 1998), is needed before the land use change application can be submitted to the local authority. It is hereby requested that SANRAL review this formal notification letter and issue an approval in this regard, should the proposed layout comply with the requirements and standards of SANRAL.

- Compliance with Municipal Spatial Development Framework: The portion of land identified for the Groblershoop Expansion Project falls within the urban edge of Groblershoop and has furthermore been earmarked (See Annexure E) for low-cost housing, as such the development proposal is in line with the spatial vision of Groblershoop.

- **Distance from National Road:** As per the attached planning diagram (Annexure D), a building line of 30m from the national road reserve has been implemented for the proposed Groblershoop expansion. This proposed building is in line with the building line of Sternham on the opposite side of the N10. No problems are expected in this regard.

- **Proposed access points:** Due to the magnitude of the planned Groblershoop expansion access from the N10 national road is important. As per the attached planning diagram (Annexure D) the following should be noted:

    1. **Existing Industrial Access:** It is proposed that the existing access (Lat: 28°54'4.75"S; Long: 21°59'37.44"E) to the industrial area also be used for the Groblershoop expansion. It is assumed that this is an approved access point, kindly indicate if otherwise.

    2. **Proposed New Access:** A new access (Lat: 28°54'36.55"S; Long: 21°59'57.88"E) from the N10, opposite the existing access to Sternham, is proposed for the expansion of Groblershoop. This locale will avoid scattered intersections and it is assumed that sight distances meet the minimum requirements of SANRAL, since the community of Sternham receives access from this point. This proposed access will serve as an extension of Aandblom Street, which is the main road in Sternham, and will run through the proposed development and link up with the town of Groblershoop in the future, thereby fulfilling the import role of integrating the community of Sternham and the town of Groblershoop. The undertaking of a traffic impact assessment and submission of detailed engineering drawings can be uphold as condition to approval.

The requested approval must provide a no-objection towards the processes of subdivision and rezoning, as well as any other land use changes that the planned township establishment may require. This inclusion of a no-objection towards the processes of subdivision and rezoning is needed in order to proceed with the submission of the formal land use change application at the local municipality.

The objectives of this letter are as follow:

1. To notify SANRAL of the proposed township establishment project;
2. To obtain a no-objection for the land use changes (subdivision and rezoning), in terms of the Spatial Planning and Land Use Management Act (Act 16 of 2013), that needs to be followed for the planned township establishment;
3. To obtain approval in terms of the South African National Roads Agency Limited and National Roads Act, 1998 (Act 7 of 1998);
4. To obtain approval from SANRAL in regards to the proposed access point.

In order to supplement this letter, please find the following documents attached:

A. Copy of Title Deed
B. Locality Map
C. Preferred Township Establishment Layout
D. Planning Diagram indicating proposed development in relation to the N10
E. SDF Map

Kindly take note that this submission is lodged in accordance to the provision of the !Kheis Final SPLUMA By-Laws and according to §32.(1) of this policy, if an organ of state fails to comment or provide information within 60 days from the date of which this notification letter has been furnished, that organ of state is deemed to have no comment or information to furnish.

Please let us know if this letter for an approval meets your requirements and if any additional information needs to be provided. We trust that you will find these matters to be in order and if there are any additional components we can assist you with, please do not hesitate to request such information

We look forward to your inputs in this regard. Please feel free to contact our office in the case of any further inquiries.

Yours Sincerely,

Justus Petrus Theron Pr.Pln. A/2394/2016

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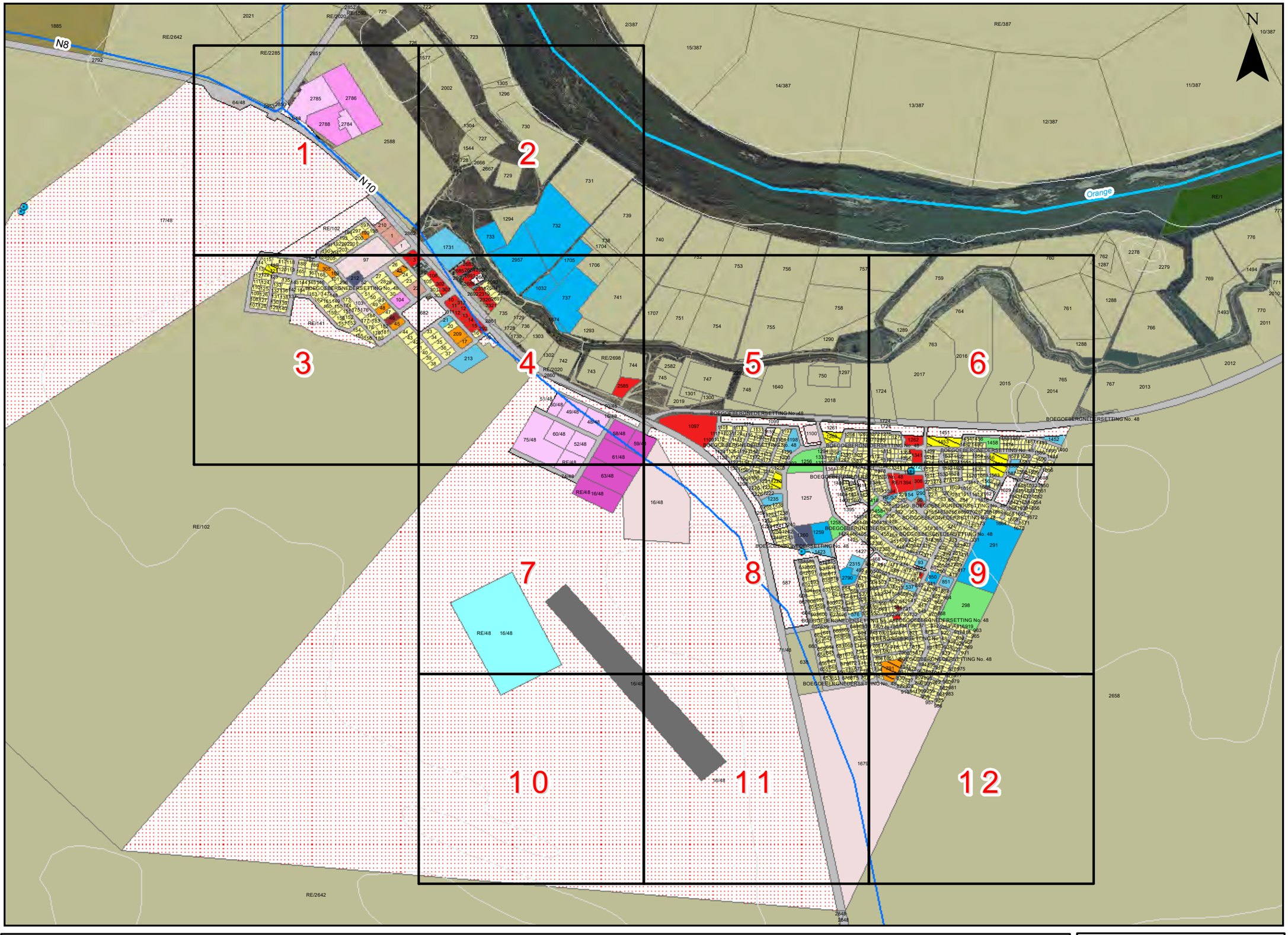
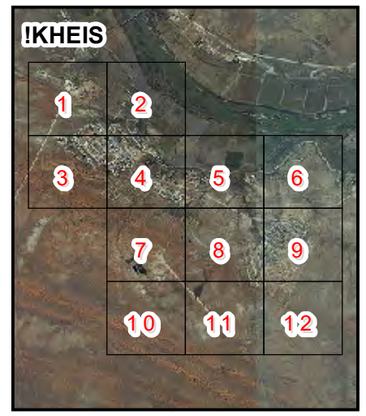
E jptheron@mweb.co.za

ANNEXURE L: SDF MAP

MUNICIPAL CODE: NC084 !KHEIS LOCAL MUNICIPALITY LAND USE SCHEME 2019 GROBLERSHOOP KEY MAP





LAND USE ZONES:

- Agricultural Zone I
- Agricultural Zone II
- Authority Zone I
- Authority Zone II
- Business Zone I
- Business Zone II
- Business Zone III
- Business Zone IV
- Business Zone V
- Business Zone VI
- Industrial Zone I
- Industrial Zone II
- Industrial Zone III
- Industrial Zone IV
- Institutional Zone I
- Institutional Zone II
- Institutional Zone III
- Open Space Zone I
- Open Space Zone II
- Open Space Zone III
- Residential Zone I
- Residential Zone II
- Residential Zone III
- Residential Zone IV
- Residential Zone V
- Residential Zone VI
- Resort Zone I
- Special Zone
- Transport Zone I
- Transport Zone II
- Transport Zone III
- Undetermined
- Utility Zone I
- Utility Zone II
- Utility Zone III

KEY:

- Reservoirs
- Substations
- Railway
- Main Roads
- National Roads
- Proposed HV Line
- Eskom HV Lines
- Eskom HV Lines 15m Buffer
- !Kheis
- Settlement Boundary
- 20m Contours
- Rivers
- Rivers 50m Buffer
- Secondary Roads
- Main Dams
- Wetlands
- Game Farm

0 0.175 0.35 0.7 Km

! Kheis Municipality

MVD Kalahari

ANNEXURE N: SACPLAN REGISTRATION CERTIFICATES

The South African
Council for Planners
SACPLAN

REGISTRATION CERTIFICATE

Issued in terms of Section 13 (4) of the Planning Profession Act, 2002
(Act 36 of 2002)

This is to Certify that

Justus Petrus Theron

I.D. NUMBER 9106135096085

is registered as a

Professional Planner

In terms of the Planning Profession Act, 2002 and is authorised to act as such in accordance with the said Act and the Rules prescribed thereunder.

Issued under the Seal of the Council

CHAIRPERSON

REGISTRAR

25/11/2016
DATE

REGISTRATION NUMBER: A/2394/2016

The South African
Council for Planners
SACPLAN

REGISTRATION CERTIFICATE

Issued in terms of Section 13 (4) of the Planning Profession Act, 2002
(Act 36 of 2002)

This is to Certify that

Len Jacobus Fourie

I.D. NUMBER 7411095141083

is registered as a

Professional Planner

In terms of the Planning Profession Act, 2002 and is authorised to act as such in accordance with the said Act and the Rules prescribed thereunder.

Issued under the Seal of the Council

CHAIRPERSON

REGISTRAR

REGISTRATION NUMBER: A/1322/2006

06/06/2007
DATE