A Heritage report was completed by Paleo Field Services, of which Dr. Lloyd Rossouw has a BA(Hons) (SU); MSc (Wits), Ph.D. (UFS) and is ASAPA registered and an application to SAHRIS will also be made online.

Due consideration has been given to the potential impact of the proposed development on heritage and palaeontological resources. It is the opinion of the EAP that all factors regarding the heritage and palaeontological theme have been taken into account in this site sensitivity verification report. It is recommended that the impact on heritage be discussed in the Environmental Impact Assessment.

TERRESTRIAL BIODIVERSITY IMPACT ASSESSMENT

Terrestrial Biodiversity can be defined as the variety of life on land that includes the fauna, flora and habitat connectivity of an area. High biodiversity is often used as an indication of ecosystem health.

In terms of the flora or habitat representation of the site, a Botanical evaluation of the proposed development site was conducted by Dr. van Aardt, who is SACNASP registered, to assess if any natural vegetation is present on the proposed development site.

In her found that the study site is not regarded as a site of ecological importance when studying the vegetation nor does the site have any high conservation value. However, several protected species were found, however, these species are also present and plentiful in the natural areas surrounding the site. It would however be recommended that some of the geophytes be transplanted in other natural areas. Several large trees of the protected *Boscia albitrunca* were found at the site. If development does take place, the botanist recommended that effort is made to protect as many as possible of these species. Permits need to be obtained before any of these species can be removed. No red data species were found to be present at the site.

All alien invasive species, especially the *Prosopis glandulosa* should be removed and eradicated from the site as a high priority.

In terms of the faunal component, the occurrence of faunal species within the proposed area is likely, however, it is farm properties and generally fenced-in camps, which hinders the mobility of some of the larger wildlife that cannot jump a fence or the smaller wildlife that cannot borrow. As indicated, the clearing of vegetation would be restricted to limited areas

and the slow clearance rate would provide adequate time for migration of any animals remaining on-site to be sustained in similar adjoining habitats and therefore no detailed faunal survey would be recommended. Also, noise generated by vehicles will cause most animals to vacate the site temporarily. If certain species were to be affected they would simply vacate the proposed cleared areas during the day and return during the night.

Even though the Screening Tool Report indicates that this site has the potential for very high terrestrial biodiversity, the reality is that due to anthropogenic impact the site is not a fully functional terrestrial biodiversity area, unless the following is addressed:

- The immediate and surrounding land needs to be upgraded from agricultural land use to conservation, which will be a problem since the Applicant does not own all the abutting land is not in a position to enforce this transformation. In areas that do belong to the Applicant the transformation from agriculture to conservation will result in income loss generated from farming and job losses will occur for farmworkers.
- All neighboring property owners must agree to conserve their properties and fences must be removed to ensure a suitable size area that is a viable conservation area that can host biodiversity and act as a corridor for animal movement.
- All alien vegetation must be removed and indigenous vegetation must be established.

In conclusion, the site cannot be classified as a high terrestrial biodiversity area and for a conservation area to be successful it needs to interrelate with the broader landscape and socio-economic context within which they are situated. If surrounding areas are not going to change, the conservation of this section will be futile.

Therefore, it is not required for a Terrestrial Biodiversity Specialist Assessment or Terrestrial Biodiversity Compliance Statement to be compiled, although the impact should still be discussed in the Environmental Impact Assessment.

AQUATIC IMPACT ASSESSMENT

To assess the sensitivity of the site with regards to aquatic biodiversity, one has to establish what watercourses are present on the site, the functionality thereof, and if no watercourses are present on the site, what impact would a development have on abutting watercourses, and the sensitivity and functionality thereof.

Since the site does not host any watercourses, the sensitivity on the aquatic biodiversity must refer to the impact the proposed development might have on abutting drainage lines and wetland and the functionality thereof.

Drainage lines and wetlands do play important ecological roles, hence the reason it is also protected by the National Water Act. The site is surrounded with drainage lines, but 100m buffer zones will be kept and clearing of vegetation will not take place within the buffer zones. The site is also further than 500m from the Nama-Karoo Bushmanland Floodplain wetland, west of the site.

In conclusion, due consideration has been given to the potential impact of the proposed development on the aquatic environment. It is the opinion of the EAP that all factors regarding the aquatic theme were taken into account in this sensitivity verification report. The proposed development will pose a very limited if any impact on the abutting wetland or drainage lines.

Therefore, it is not required for an Aquatic Biodiversity Compliance Statement to be compiled, although the impact on surface water must still be discussed in the Environmental Impact Assessment.

HYDROLOGY IMPACT ASSESSMENT

The overall proposed development will have a very limited, if any, impact on the hydrological systems. The development will not result in any generation of sewage, soil pollutants, extraction of borehole water, excavation resulting in exposing groundwater, or establishment of any activity on site that could potentially pollute or impact groundwater (e.g. underground storage tanks).

It is the EAP's professional opinion that the proposed development will have no impact on groundwater and that most factors regarding the hydrology impacts have been taken into account in this site sensitivity verification report. Therefore, as the proposed development will have insignificant hydrological impacts, and a Hydrological Impact Assessment is thus not recommended.

SOCIO-ECONOMIC IMPACT ASSESSMENT

As discussed previously, this development will contribute to economic growth within the Siyathemba Municipal area. This development will not only benefit the Applicant but will also create job opportunities for many low-income households that will assist in poverty alleviation.

Due consideration has been given to the potential socio-economic impact of the proposed development. It is EAP's professional opinion that most factors regarding the socio-economic impact have been taken into account in this site sensitivity verification report. Therefore, as the proposed development will have a positive socio-economic impact, a Socio-Economic Impact Assessment is thus not required, although the impact on socio-economic must still be discussed in the Environmental Impact Assessment.

PLANT SPECIES IMPACT ASSESSMENT

The site photos included in this verification report and confirm that the site is not regarded as a site of ecological importance, nor does the site have any high conservation value. According to desktop studies, the site falls within a CBA1, therefore to ground-truth the status, a botanical evaluation of the proposed development site was conducted by Dr. van Aardt who is SACNASP registered.

The Botanical Survey found that several protected species were found, which included the trees of the protected *Boscia albitrunca.* However, these species are also present and plentiful in the natural areas surrounding the site. It was however recommended that some of the geophytes be transplanted in other natural areas.

The outcome of the Botanical evaluation report applies to both the Plant Species theme, as well as the Terrestrial Biodiversity Theme.

Due consideration has been given to the potential impact on the vegetation of the proposed development and it is the EAP's professional opinion that the specialist's survey and assessment are sufficient.

ANIMAL SPECIES ASSESSMENT

It should be noted that the proposed development will completely transform the vegetation and thus habitat on site.

However, the current status of animal diversity at the site is fairly limited due to the anthropogenic impact of the surrounding farming activities. A few wild animals are remaining on-site, but the movement is limited due to camp fencing. It is therefore not expected that the proposed development will have any impacts on sensitive animal species.

Due consideration has been given to the potential impact on the animal species and it is the EAP's professional opinion that a specialist survey and assessment is not required, however, the impact must still be discussed in the Environmental Impact Assessment.

CIVIL AVIATION IMPACT ASSESSMENT

During the site inspection, it was clear that no runways are visible from the proposed development site. The closest airfield mapped to the proposed development sites is the Prieska Landing Stip and is about 6km west from the site and thus the possible reason why Civil Aviation was categorised as 'high impact'.

It should be noted that the proposed development will not impact aviation, as previously discussed. Therefore, it is not required for a Civil Aviation Compliance Statement to be compiled.

CONCLUSION OF SITE SENSITIVITY VERIFICATION REPORT

Digital Soils Africa (DSA) was appointed by Uitdraai Boerdery (Pty) Ltd to facilitate the Scoping and Environmental Assessment Report (EIA) for the proposed development of transforming grazing land into a vineyard.

The proposed development will result in the establishment of about 163.82Ha of a vineyard over a period of 8-10 years.

There will be environmental impacts, but all could be mitigated and reduced to limited impacts on the surroundings. The proposed development will have a positive socio-economic outcome on the surrounding community. A Screening Tool Report has been generated for the proposed development.

According to the screening tool report the following specialist assessments were identified:

1. Agricultural Impact Assessment;
2. Landscape/Visual Impact Assessment;
3. Archaeological and Heritage Impact Assessment;
4. Palaeontological Impact Assessment;
5. Terrestrial Biodiversity Impact Assessment;
6. Aquatic Biodiversity Impact Assessment;
7. Hydrology Assessment;
8. Socio-Economic Assessment;
9. Plant Species Assessment; and
10. Animal Species Assessment.

As mentioned above soil suitability-, botanical survey- and archaeological assessment was conducted for the proposed development.

According to the professional opinion of the EAP and the outcome of this Site Verification Report the remaining specialist assessments identified in the Screening Tool Report do not require further specialist input. It is recommended to the Department of Agriculture, Environmental Affairs, Rural Development and Land Reform that the above-listed specialist studies are not necessary to be conducted, rather all direct, indirect and cumulative impacts must still be discussed in the EIA.

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Siyathemba Municipality 2021/2025: Integrated Development Plan (Final Review).

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APPENDIX E – SPECIALIST REPORTS

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February 2021

AN ECOLOGICAL REPORT ON THE FLORA: PORTION 18 (PORTION OF PORTION 15) OF THE FARM UITDRAAI NO.33 PRIESKA

A report commissioned by Digital Soils Africa

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CONTENTS

CONDITIONS RELATING TO THIS REPORT

Declaration of interest

Sparaxis Environmental PTY (Ltd) and its members/co-workers:

- Have no vested interest in the property studied nor is it affiliated with any other person/body involved with the property and/or proposed development.

- Is not a subsidiary, legally or financially of the proponent.

- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act No 107 of 1998) (NEMA).

- Declare that remuneration for services provided by Sparaxis Environmental PTY (Ltd) and its members/co-workers is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorizing this proposed project.

- Undertake to disclose, to the competent authority, any material information that has 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.

- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and/or further work in this field.

- Is committed to biodiversity conservation but concomitantly recognize the need for economic development. We reserve the right to form and hold our own opinions within the constraints of our specialties and experience, and therefore will not submit willingly to the interests of other parties or change our statements to appease them

The study was undertaken by Dr AC van Aardt (PhD UFS) and Mr JCL de Jager (MSc UFS)

They have the following qualifications

SPECIALIST	QUALIFICATION
Dr A.C. van Aardt	PhD – Botany MSc – Botany BSc Hons (Botany) BSc (Botany & Zoology)
JCL de Jager	MSc – Botany BSc Hons – Botany BSc (Botany, Zoology & Entomology)

Indemnity

Although Sparaxis Environmental Pty (Ltd) exercises due care and diligence in rendering services and preparing documents, the client takes full responsibility for this report and its implementation in terms of the National Environmental Management Act of 1998, and exempt Sparaxis Environmental Pty (Ltd) and its associates and their sub-contractors from any legal responsibility based on the timing of the assessment, the result and the duration thereof, which has an influence on the credibility and accuracy of this report. Sparaxis Environmental Pty (Ltd) accepts no liability , and the client, by receiving this document indemnifies Sparaxis Environmental Pty (Ltd) and its directors, managers, agents and employees all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Sparaxis Environmental Pty (Ltd) and by the use of the information contained in this report

Factors limiting the quality of this report

The formal site visit was undertaken on 19 January 2021. Although most grasses and trees could be identified some forb, shrub and geophytes could not be identified due to the absence of leaves or flowers. Plants that had flowers or had remnants of flowers at the time of the visit could be identified. Some of the more rare and cryptic species may have been overlooked due to their inconspicuous growth forms. Many of the rare and endangered succulent species can only be distinguished (in the veld) from their very similar relatives on the basis of their reproductive parts. These plants flower during different times of the year. Multiple visits to any site during the different seasons of the year could, therefore, increase the chances to record a larger portion of the total species complex associated with the area. The survey of the study site is however considered as successful with a correct identification of the different vegetation units and their ecological sensitivity.

Copyright

- The technology described in any report;
- Recommendations delivered to the Client.

Approach

Conclusions reached, and recommendations made are based not only on occurrence of individual species, but more appropriately on habitats and ecosystem processes. Planning must therefore allow for the maintenance of species, habitats and ecosystem processes, even if Red Data or endemic plant or animal species are absent.

Dr A.C. van Aardt
Sparaxis Environmental Pty (Ltd)

INTRODUCTION

The karoo environment is a harsh and unpredictable environment with indigenous plants and animals that were selected over hundreds of thousands of years. Knowledge of this extradentary ecosystem will enable better management and decision making about sustainable development. Vegetation forms the most obvious external feature that ecosystems are classified and defined on. Uncontrolled and ill-planned development is one of the biggest threats to naturally evolved life on earth. Development worldwide in the past and at present is responsible for the destruction of various plant and animal species as well as the habitats in which they occur. Therefore, a balance needs to be developed between the needs of humans and conservation of natural habitats or resources. This balance is one of the biggest challenges faced by decision-makers in the country.

Preventing the destruction of any ecosystem requires a need for systematic planning and co-ordination of human activities and development should be prioritised. The planning should include studies of the natural environment which include soil, water, vegetation, animals and cultural as well as historical aspects.

The plant community is seen as an important unit in any ecosystem and therefore forms the basis for environmental planning and the compiling of environmental management plans. Plant species assemblages is an indication of the habitat, ecosystem health, and rarity of the ecosystem, and are an important part of an Environmental Impact Assessment.

AIMS OF THE STUDY

This report aims to present ecological information on the flora of the section proposed for the development of vineyards and a pivot on the farm Portion (Portion Of Portion 15) of the Farm Uitdraai No.33 in the district of Prieska, Northern Cape, South Africa (hereafter referred to as the study area).

The objectives of this study were to:

- Identify, describe, and delineate the different vegetation units present on the property

- Compile a vegetation unit map of the area
- Indicate the presence of protected plant species or suitable habitat
- Identify alien invasive plant species
- To provide a sensitivity map of the study area (where applicable).

STUDY AREA

Location

The study site is located between the R357 between Prieska and Douglas (southern boundary and the Orange River (on northern side), approximately 15 km, east of Prieska (Figure 1). The site is surrounded by vineyards and pivots on the northern and western sides and natural veld to the north eastern side.

The site is in the least threatened Northern Upper Karoo (NKu3) vegetation type described by Mucina and Rutherford (2006). The size of the study site is approximately 200 ha.

Figure 1: Locality of the study area (Yellow lines) (Source: Google Maps)

Existing impacts on the site include:

- On the northern and western sides, the site is bordered by vineyards and pivots with agricultural crops
- The southern boundary is the R357 between Prieska and Douglas
- The old Prieska Douglas Road runs through the middle of the site

- An ESKOM line is also running through the eastern section of the site with a servitude under the line

METHODS

VEGETATION

Principles of the Braun-Blanquet survey technique were used to do the survey and describe plant communities as ecological units. Relevant literature was used to obtain an overview of the vegetation of the site. Ecological sensitivity of the plant communities was assessed and categorised according to the habitat and plant species assemblages. Aerial photographs were used to study the site and preliminary delineation of the different vegetation units were done. These vegetation units were verified on foot at the site and vegetation sample plots placed in each.

Data recorded included:

Data gathered included the physiognomy and floristic composition (species richness and canopy cover of each species) of each species. A list of plant species present, including, trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Additional notes were made of any features that might be of ecological significance.

Red data and protected species

An investigation was carried out on rare and protected plant that might possibly occur in the region. The National Red List of Threatened Plants of South Africa, Lesotho and Swaziland, compiled by the Threatened Species Programme, South African National Biodiversity Institute (SANBI) was used. The Northern Cape Nature Conservation Act (No. 9 of 2009) was also consulted as well as The Red List of South African Plants compiled by SANBI (2020). The New Plants of South Africa (SANBI 2016) was also used.

The presence of rare and protected species or suitable habitat was recorded during the field visit.

Data processing

Vegetation data was classified to identify, describe, and map vegetation types. Description of the vegetation units include tree, shrub, and herbaceous layers. Conservation priority for each vegetation unit was assessed by evaluating plant species composition in terms of the present knowledge of the vegetation of the Nama Karoo biome of South Africa. Four conservation priority categories were used for the different vegetation units:

High	Ecologically sensitive and valuable land with high species richness that should be conserved, and no development allowed.
Medium	Land that should be conserved but which low impact development could be considered under exceptional circumstances.
Medium-low	Land that has some conservation value but on which development could be considered with limited impact on the vegetation/ecosystem. It is recommended that certain sections of the vegetation be maintained.
Low	Land that has little conservation value and that could be considered for development with little to no impact on the vegetation/ecosystem.

RESULTS OF THE VEGETATION SURVEY

Vegetation units

Five different vegetation units could be identified and are indicated in Figure 2 namely

1. Karroid component (proposed pivot area)
2. Karroid with scattered grass component
3. Karroid grassland
4. Karroid rocky component
5. Drainage line

1. Karroid component (proposed pivot area)

Status	Natural
Vegetation structure	Natural vegetation with bare soil patches dominated by woody shrubs, forbs and grasses
Topography	Level to slightly (2.8%) W slope
Rock cover	No rocky cover
Conservation priority	Medium

Figure 2: Vegetation units of the study area (Image from Google Earth, 2020)

This unit is located on the western edge of the study site and comprises natural vegetation. The topography is relatively flat with a slight slope of 2.8% from east to west. This unit is approximately 6.8 ha in size.

The vegetation of this area is dominated by shrubs such as: *Asparagus africanus, Pentzia incana, Roepera lichtensteiniana, Salsola tuberculata;* forbs: *Tribilus cristatus* and the grasses: *Stipagrostis ciliata* and *Enneapogon desvauxii*. Vegetation cover is sparse with large open spaces in-between plant species.

Protected species

Aizoon burchelli – not listed
Aloe claviflora – least concern
Ammocharis coranica – least concern
Oxalis lawsonii – least concern
Plinthus sericeus – least concern

Alien plant species

Prosopis glandulosa

The following is a list of plant species identified during the survey (W=woody, G = grass, F= forb, Geo = geophytes, Fern = Fern, S=succulent):

Species	Family	Growth form
Aizoon burchelli	Aizoaceae	S
Aloe claviflora	Asphodelaceae	S
Ammocharis coranica	Amaryllidaceae	Geo
Aptosimum albomarginatum	Scrophulariaceae	F
Asparagus africanus	Asparagaceae	W
Barleria rigida	Acanthaceae	F
Berkheya cf *annectens*	Asteraceae	F
Eneappogon desvauxii	Poaceae	G
Eriopermum roseum	Ruscaceae	Geo
Heliotropium lineare	Boraginaceae	F
Hermania modesta	Malvaceae	F
Hermannia coccocarpa	Malvaceae	F
Indogofera daloides	Fabaceae	F
Justisia incana	Acanthaceae	F
Ledebouria apertiflora	Hyacinthaceae	Geo
Lycium bosciifolium	Solanaceae	W

Species	Family	Growth form
Lycium cinereum	Solanaceae	W
Ophiglossum pollyphylum	Ophioglossaceae	Fern
Oxalis lawsonii	Oxalidaceae	F
Pentzia sphaerocephala	Asteraceae	W
Plianthus sericeus	Aizoaceae	W
Rhigozum trihotomum	Bignoniaceae	W
Roepera incrustata	Zygophyllaceae	W
Roepera lichtensteiniana	Zygophyllaceae	W
Salsola tuberculata	Amaranthaceae	S/W
Stipagroatis uniplumis	Poaceae	G
Stipagrostis ciliata	Poaceae	G

2. Karroid with scattered grass components

Status	Natural
Vegetation structure	Natural vegetation with bare soil patches dominated by woody shrubs, forbs and grasses
Topography	Level to slightly north-western slope (1.48%)
Rock cover	Rocks ranging from 10-20 cm in diameter scattered at the soil surface
Conservation priority	Low

This unit is located on the central to western parts of the study site and is comprised of natural vegetation. The topography is relatively flat with a slight north-western slope of 1.48%. This unit is around 50 ha in size. Disturbances in this vegetation unit include a gwarry in the north-western corner, ground works on the central western border area as well as towards the edge of the south western corner. Some natural vegetation covered occur in this area.

The vegetation of this area is dominated by trees: *Senegalia mellifera* shrubs: *Pentzia sphaerocepala, Pentzia incana, Lycium cinereum, Lycium boscifolium, Roepera lichtensteiniana, Roepera incrustata, Rhigozum trichotomum* with some grasses *Enneapogon chenchroides, Enneapogon desvauxii, Stipagrostis uniplumis;* forbs: *Tribilus cristatus;* succulents *Mesembryanthemum crystallinum, Salsola tuberculata, Eriocephalus ericoides;* geophytes: *Nerine laticoma* . Vegetation cover is sparese with large open spaces in-between plant species.

In this vegetation unit there were areas where the *Rhigozum trichotomum* were more dense than in other areas. The same applies for the *Senegalia mellifera* trees that formed more dense stands in certain areas and occurred as small shrubs in other areas of the vegetation unit. Although *Nerine laticoma* was present throughout the vegetation unit it also had areas were it was more concentrated than in other areas. This area also contains large individuals of the protected *Boscia albitrunca.*

Protected species

Aizoon burchelli – not listed
Boscia albitrunca – least consern
Galenia sarcophylla – least concern
Mesembryanthemum coriarium – not listed
Mesembryanthemum crystallinum – least concern
Mesembryanthemum tetragonum – not listed
Nerine laticoma – least concern
Plinthus karooicus – least concern

Alien plant species

Prosopis glandulosa
Salsola kali

The following is a list of plant species identified during the survey (W=woody, G = grass, F= forb, Geo = geophytes, Fern = Fern, S=succulent):

Species	Family	Growth form
Acanthopsis hoffmannseggiana	Acanthaceae	W
Aizoon burchelli	Aizoaceae	W

Species	Family	Growth form
Aptosimum albomarginatum	Scrophulariaceae	F
Aptosimum lineare	Scrophulariaceae	F
Aptosimum procumbens	Scrophulariaceae	F
Asparagus africanus	Asparagaceae	W
Asparagus suaveolens	Asparagaceae	W
Boerhavia diffusa	Nyctaginaceae	S
Boscia albitrunca	Capparaceae	W
Chlorophytum fasciculatum	Agavaceae	Geo
Crotalaria orientalis	Fabaceae	F
Dipcadi bakerianum	Hyacinthaceae	Geo
Ehretia rigida	Boraginaceae	W
Enneapogon desvauxii	Poaceae	G
Enneapogon cenchroides	Poaceae	G
Eragrostis cylindriflora	Poaceae	G
Eragrostis echinochloidea	Poaceae	G
Eragrostis lehmanniana	Poaceae	G
Eragrostis nindensis	Poaceae	G
Eragrostis tef	Poaceae	G
Eriocephalus ericoides	Asteraceae	W
Eriospermum roseum	Ruscaceae	Geo
Felicia cf *muricana*	Asteraceae	F
Fingerhuthia africana	Poaceae	G
Galenia sarcophylla	Aizoaceae	S
Geigeria ornativa	Asteraceae	F
Hermannia abrotanoides	Malvaceae	F
Hermannia coccocarpa	Malvaceae	F
Indigofera cf. *zeyheri*	Fabaceae	F
Indigofera alternans	Fabaceae	F
Kewa salsoides	Kewaceae	F
Kleinia longiflora	Asteraceae	S
Ledebouria apertiflora	Hyacinthaceae	Geo
Limeum argute-carinatum	Limeaceae	F
Lycium bosciifolium	Solanaceae	W
Lycium cinereum	Solanaceae	W
Lycium horridum	Solanaceae	W
Mesembryanthemum coriarium	Aizoaceae	S
Mesembryanthemum crystallinum	Aizoaceae	S
Mesembryanthemum tetragonum	Aizoaceae	S
Nerine laticoma	Amaryllidaceae	Geo
Panicum coloratum	Poacece	G
Peliostomum leucorrhizum	Scrophulariaceae	F
Pentzia sphaerocephala	Asteraceae	W
Phaeoptilum spinosum	Nyctaginaceae	W
Plinthus karooicus	Aizoaceae	W
Portulaca oleracea	Portulacaceae	S
Prosopis glandulosa	Fabaceae	W

Species	Family	Growth form
Rhigozum trichotomum	Bignoniaceae	W
Roepera incrustata	Zygophyllaceae	W
Roepera lichtensteiniana	Zygophyllaceae	W
Salsola kali	Amaranthaceae	W
Salsola tuberculata	Amaranthaceae	S/W
Senegalia mellifera	Fabaceae	W
Sesamum capense	Pedaliaceae	F
Stipagrostis uniplumis	Poaceae	G
Tapinanthus oleifolius	Loranthaceae	F
Tetraena rigida	Zygophyllaceae	F
Tragus berteronianus	Poaceae	G
Tragus racemosus	Poaceae	G
Tribulus cristatus	Zygophyllaceae	F
Tribulus terrestris	Zygophyllaceae	F
Viscum rotundifolium	Santalaceae	Parasite
Ziziphus mucronata	Rhamnaceae	W

3. Karroid grassland

Status	Natural
Vegetation structure	Natural vegetation cover dominated by shrubs and grasses.
Topography	Level to slightly eastern slope 1.4%
Rock cover	Rocks ranging from 10-20 cm in diameter scattered at the soil surface
Conservation priority	Medium

This unit is located in the northern parts of the study area and is comprised of natural vegetation. The topography is relatively flat with a slight eastern slope 1.4%. This unit is around 42.7 ha in size.

The vegetation of this area is dominated by shrubs: *Rhigozum trichotomum, Roepera lichtensteiniana, Roepera incrustaca, Lycium cinereum, Lycium boscifolium, Pentzia sphaerocepala, Pentzia incana,* with some grasses *Enneapogon chenchroides, Stipagrostis ciliatauniplumis*. The vegetation cover in this area was abundant with only a few areas where bare soil was visible.

The tree layer of this vegetation unit was composed of scattered species of *Boscia albitrunca, Ziziphus mucronata, Prosopis glandulosa* and *Senegalia mellifera*. Although *Nerine laticoma* were present they only occur in isolated areas of this vegetation unit. *Ammocharis coranica* were also present in isolated patches.

Protected species

Ammocharis coranica – least concern
Boscia albitrunca – least concern
Galenia sarcophylla – least concern
Mesembryanthemum coriarium – not listed
Mesembryanthemum crystallinum – least concern
Nerine laticoma – least concern
Oxalis lawsonii – least concern
Plinthus karooicus – least concern

Alien plant species

Prosopis glandulosa

Salsola kali

The following is a list of plant species identified during the survey (W=woody, G = grass, F= forb, Geo = geophytes, Fern = Fern, S=succulent):

Species	Family	Growth form
Ammocharis coranica	Amaryllidaceae	Geo
Aptosimum albomarginatum	Scrophulariaceae	F
Aptosimum lineare	Scrophulariaceae	F
Aptosimum procumbens	Scrophulariaceae	F
Aristida congesta	Poaceae	G
Asparagus africanus	Asparagaceae	W
Asparagus suaveolens	Asparagaceae	W
Asparagus africanus	Asparagaceae	W
Boerhavia diffusa	Nyctaginaceae	S
Cenchrus ciliaris	Poaceae	G
Chenopodium album	Amaranthaceae	G
Chlorophytum fasciculatum	Agavaceae	Geo
Dicoma capensis	Asteraceae	F
Dipcadi bakerianum	Hyacinthaceae	Geo
Enneapogon cenchroides	Poaceae	G
Enneapogon desvauxii	Poaceae	G
Enneapogon scoparius	Poaceae	G
Eragrostis annulata	Poaceae	G
Eragrostis lehmanniana	Poaceae	G
Eragrostis tef	Poaceae	G
Eriocephalus ericoides	Asteraceae	W
Eriocephalus spinescence	Asteraceae	W
Eriospermum roseum	Ruscaceae	Geo
Euphorbia inaequilatera	Euphorbiaceae	S
Galenia sarcophylla	Aizoaceae	S
Geigeria ornativa	Asteraceae	F
Hermannia coccocarpa	Malvaceae	F
Hertia pallens	Asteraceae	S
Indigofera cf *zeyheri*	Fabaceae	F
Justicia incana	Acanthaceae	F
Kewa salsoloides	Kewaceae	F
Kohautia caespitosa	Rubiaceae	F
Ledebouria apertifolia	Hyacinthaceae	
Limeum argute-carinatum	Limeaceae	F
Lycium bosciifolium	Solanaceae	W
Lycium cinereum	Solanaceae	W
Lycium horridum	Solanaceae	W
Mesembryanthemum coriarium	Aizoaceae	S

Species	Family	Growth form
Mesembryanthemum crystallinum	Aizoaceae	S
Nerine laticoma	Amaryllidaceae	Geo
Oropetium capense	Poaceae	G
Oxalis lawsonii	Oxalidaceae	F
Panicum coloratum	Poaceae	G
Peliostomum leucorrhizum	Scrophulariaceae	F
Pentzia incana	Asteraceae	W
Pentzia sphaerocephala	Asteraceae	W
Plinthus karooicus	Aizoaceae	W
Portulaca oleracea	Portulacaceae	S
Prosopis glandulosa	Fabaceae	W
Rhigozum trichotomum	Bignoniaceae	W
Roepera incrustata	Zygophyllaceae	W
Roepra lichtensteiniana	Zygophyllaceae	W
Salsola kali	Amaranthaceae	W
Salsola tuberculata	Amaranthaceae	S/W
Salvia disermas	Lamiaceae	F
Senegalia mellifera	Fabaceae	W
Sesamum capense	Pedaliaceae	F
Setaria verticillata	Poaceae	G
Solanum linnaeanum	Solanaceae	F
Sporobolus acinifolius	Poaceae	G
Stipagrostis ciliata	Poaceae	G
Stipagrostis uniplumis	Poaceae	G
Tragus berteronianus	Poaceae	G
Tribulus cristatus	Zygophyllaceae	F
Tribulus terrestris	Zygophyllaceae	F
Viscum rotundifolium	Santalaceae	Parasite
Ziziphus mucronata	Rhamnaceae	W

4. Karroid rocky component

Status	Natural
Vegetation structure	Natural vegetation cover dominated by shrubs and grasses.
Topography	Level to slightly south western slope 1.8%
Rock cover	Rocks ranging from 10-20 cm in diameter scattered at the soil surface
Conservation priority	Medium-low

This unit is located on the central and western parts of the study area and is comprised of natural vegetation. The topography is relatively flat with a slight western slope of 1.8%. This unit is around 101 ha in size.

The vegetation of this area is dominated by shrubs: *Rhigozum trichotomum, Roepera lichtensteiniana, Roepera incrustaca,* with some grasses *Enneapogon chenchroides, Orepetium capense*. The vegetation cover in this area was abundant is some areas

while scattered in other areas. The soil surface had a lot of rock cover with sizes ranging from 10 to 20 cm in diameter.

The tree layer of this vegetation unit was composed of scattered species of large indivicuals of *Boscia albitrunca, Ziziphus mucronata, Prosopis glandulosa* and *Senegalia mellifera.*

Protected species

Aizoon burchellii – not listed
Euphorbia braunsii – least concern
Boscia albitrunca – least concern
Galenia sarcophylla – least concern
Gomphocarpus fruticosus – least concern
Nerine laticoma – least concern
Plinthus karooicus – least concern

Alien plant species

Prosopis glandulosa

The following is a list of plant species identified during the survey (W=woody, G = grass, F= forb, Geo = geophytes, Fern = Fern):

Species	Family	Growth form
Aizoon burchellii	Aizoaceae	W
Aptosimum albomarginatum	Scrophulariaceae	F
Aptosimum procumbens	Scrophulariaceae	F
Aristida congesta	Poaceae	G
Asparagus africanus	Asparagaceae	W
Asparagus suaveolens	Asparagaceae	W
Boerhavia diffusa	Nyctaginaceae	S
Cenchrus ciliaris	Poaceae	G
Chenopodium album	Amaranthaceae	F
Chlorophytum fasciculatum	Agavaceae	Geo
Enneapogon cenchroides	Poaceae	G
Enneapogon desvauxii	Poaceae	G
Enneapogon scoparius	Poaceae	G
Eragrostis echinochloidea	Poaceae	G
Eragrostis lehmanniana	Poaceae	G
Eragrostis nindensis	Poaceae	G

Species	Family	Growth form
Eriocephalus ericoides	Asteraceae	W
Euphorbia braunsii	Euphorbiaceae	S
Fingerhuthia africana	Poaceae	G
Galenia sarcophylla	Aizoaceae	S
Geigeria ornativa	Asteraceae	F
Gomphocarpus fruticosus	Apocynaceae	F
Indigofera cf *zeyheri*	Fabaceae	F
Justicia incana	Acanthaceae	F
Kleinia longiflora	Asteraceae	S
Ledebouria revuluta	Hyacinthaceae	Geo
Limeum argute-carinatum	Limeaceae	F
Lycium bosciifolium	Solanaceae	W
Monsonia salmoniflora	Geraniaceae	F
Nerine laticoma	Amaryllidaceae	Geo
Oropetium capense	Poaceae	G
Panicum coloratum	Poaceae	G
Pavonia senegalensis	Malvaceae	F
Pentzia incana	Asteraceae	W
Plinthus karooicus	Aizoaceae	W
Prosopis glandulosa	Fabaceae	W
Rhigozum trichotomum	Bignoniaceae	W
Roepera incrustata	Zygophyllaceae	W
Roepera lichtensteiniana	Zygophyllaceae	W
Salsola tuberculata	Amaranthaceae	S/W
Senegalia mellifera	Fabaceae	W
Setaria verticillata	Poaceae	G
Stipagrostis ciliata	Poaceae	G
Stipagrostis uniplumis	Poaceae	G
Tapinanthus oleifolius	Loranthaceae	F
Tragus berteronianus	Poaceae	G
Tribulus terrestris	Zygophyllaceae	F
Tulbaghia leucantha	Aliaceae	Geo
Viscum rotundifolium	Santalaceae	Parasite
Ziziphus mucronata	Rhamnaceae	W

5. **Drainage line**

Status	Invaded
Vegetation structure	Natural vegetation invaded by alien invasive trees
Topography	Flat to slight sloping in a north-western (1.1%) direction
Rock cover	No rock cover
Conservation priority	High

This unit is located on the southern edge of the eastern section of the study area. The drainage channel contains individuals of the declared alien invader tree *Prosopis glandulosa* that has displaced many native species. From a plant ecological perspective the area has a medium conservation value due to the invasion, however due to it being a water channelling system the area has an important ecosystem functioning and the unit is therefore regarded as having a high ecologicl sensitivity. The topography is relatively flat with a slight north western slope of 1.1%. This unit is around 11 ha in size.

The vegetation of this area is dominated by trees: *Prosopis glandulosa, Ziziphus mucronata, Searsia lancea* and *Vachellia karroo;* shrubs: *Pentzia incana, Lycium boscifolium* and *Lycium cinereum;* herbs: *Felicia muricata* and *Nidorella resedifolia*.

Protected species

Galenia sarcophylla – least concern

Nerine laticoma – least concern

Plinthus karooicus -least concern

Alien plant species

Argemone ochroleuca

Prosopis glandulosa

The following is a list of plant species identified during the survey (W=woody, G = grass, F= forb, Geo = geophytes, Fern = Fern):

Species	Family	Growth form
Aptosimum albomarginatum	Scrophulariaceae	F
Argemone ochroleuca	Papaveraceae	F
Asparagus africanus	Asparagaceae	W
Asparagus suaveolens	Asparagaceae	W
Berkheya annectens	Asteraceae	F
Chenopodium album	Amaranthaceae	F
Convolvulus sagittatus	Convolvulaceae	F
Dipcadi bakerianum	Hyacinthaceae	Geo
Enneapogon cenchroides	Poaceae	G
Eragrostis cf *bicolor*	Poaceae	G
Eragrostis lehmanniana	Poaceae	G
Eragrostis tef	Poaceae	G

Species	Family	Growth form
Eriospermum roseum	Ruscaceae	Geo
Felicia muricata	Asteraceae	W
Galenia sarcophylla	Aizoaceae	S
Geigeria ornativa	Asteraceae	F
Heliotropium lineare	Boraginaceae	F
Hermannia coccocarpa	Malvaceae	F
Indigofera cf *zeyheri*	Fabaceae	F
Justicia incana	Acanthaceae	F
Lycium bosciifolium	Solanaceae	W
Lycium cinereum	Solanaceae	W
Lycium horridum	Solanaceae	W
Melianthus comosus	Melianthaceae	W
Nerine laticoma	Amaryllidaceae	Geo
Nidorella resedifolia	Asteraceae	F
Panicum coloratum	Poaceae	G
Peliostomum leucorrhizum	Scrophulariaceae	W
Pentzia incana	Asteraceae	W
Plinthus karooicus	Aizoaceae	W
Prosopis glandulosa	Fabaceae	W
Rhigozum trichotomum	Bignoniaceae	W
Roepera lichtensteiniana	Zygophyllaceae	W
Salsola tuberculata	Amaranthaceae	S/W
Salvia verbenaca	Lamiaceae	F
Searsia lancea	Anacardiaceae	W
Talinum caffrum	Talinaceae	F
Thesium hystrix	Santalaceae	F
Tribulus terrestris	Zygophyllaceae	F
Vachellia karroo	Fabaceae	W
Wiborgia sericea	Fabaceae	F
Ziziphus mucronata	Rhamnaceae	W

DISCUSSION

VEGETATION

Vegetation type

The vegetation of the study area is classified as the **least threatened** Northern Upper Karoo (NKu3) (Figure 3) vegetation type (Mucina and Rutherford, 2006). The Northern Upper Karoo is threatened by cultivation, building of dams and an increase in human settlements especially in the north-east. Furthermore, erosion and invasion of alien invasive species also contribute to the destruction of the vegetation type. No percentage of the biome is formally conserved in statutory conservation areas, however only 4 % have been cleared for cultivation. The vegetation of this vegetation unit is characterized by small trees: *Acacia mellifera*, *Boscia albitrunca*. Tall Shrubs:

Lycium cinereum, L. horridum, L. oxycarpum, L. schizocalyx, Rhigozum trichotomum. Low shrubs: *Pentzia incana, P. globosa, Rosenia humilis, Amphiglossa trifloral, Aptosimum spinescens, Asparagus glaucus Berkheya annectens, Eriocephalus ericoides, Felicia muricata, Hermannia spinosa, Plinthus karooicus, Tetragonia arbuscula.* Succulent shrubs: *Hertia pallens, Salsola glabrescens.* Herbs: *Dicoma capensis, Hermannia comosa, Indigofera alternans, Tribulus terrestris.* Succulent herbs: *Psilocaulon coriarium.* Graminoids: *Aristida congesta, A. diffusa, Enneapogon desvauxii, Eragrostis lehmanniana, Eragrostis obtusa, Eragrostis truncata, E. porosa, E. bicolor, Sporobolus fimbriatus, Stipagrostis obtusa, S. ciliata, Fingerhuthia africana, Heteropogon contortus, Themeda triandra, Tragus berteronianus, T. koelerioides, T. racemosus.*

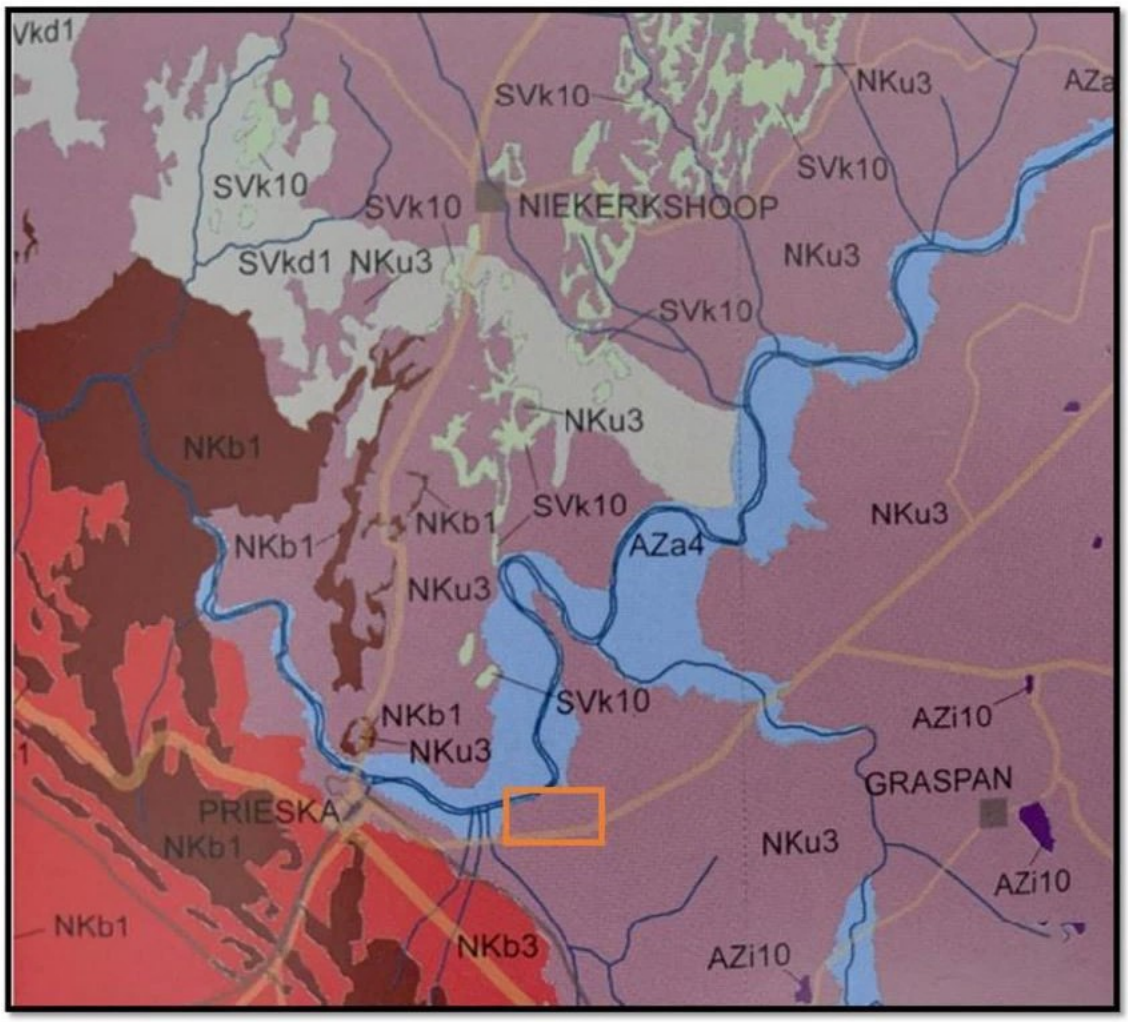

Figure 3: Approximate location (orange rectangle) of the study area within the Northern Upper Karoo (Nku3) vegetation type (image obtained Mucina and Rutherford, 2006).

The vegetation type is considered as least threatened due to little agricultural or anthropogenic influences. The vegetation of the study site shows resemblance to Nku3 with some presence of alien invasive species.

Vegetation units

Vegetation unit 1 (Karroid component (proposed pivot area)) differs in species composition from the other vegetation units due to the well-developed shrub layer in the form of karroid shrubs. The ground cover is sparce with a few grass species, succulents and also some ferns. The protected geophyte *Ammocharis coranica* was found in this vegetation unit. The succulent *Aloe claviflora* was also found in this unit. The vegetation in this unit is natural with a few individuals of *Prosopis glandulosa* present among the vegetation.

Vegetation unit 2 (Karroid grassy component) is mostly dominated by a well-developed shrub layer. The tree layer is not well developed; however, some large individuals can be found in scattered locations. There is one area in this vegetation unit that has a dense stand of *Senegalia mellifera.* The protected Shepards tree (*Boscia albitrunca*) was also present. These individuals vary from large trees to shrub sized individuals. Grasses and forbs are found throughout the vegetation unit; however, they occur in patches, or around the shrub and tree components. *Nerine laticoma* is also found in this vegetation unit, scattered as individuals as well as concentrated in high densities in certain areas. The declared alien invasive *Prosopis glandulosa* is also present in isolated patches. Some areas of this unit might have been used for the extraction of gravel in the past.

Vegetation unit 3 (Karroid grassland) has a very well-developed grass layer with a high relative cover abundance. The shrub layer is also very well developed and form dense stands. The geophytes *Nerine laticoma* (scattered individuals) and *Ammocharis coranica* (located in scattered areas with high cover abundance) which are both protected species were present in the vegetation unit. Other species from the family Aizoaceae, also a protected family, were also present in this vegetation unit. The tree layer is mostly dominated by scattered large or shrub sized individuals of *Boscia albitrunca* a protected species. In this unit scattered individuals of the alien invasive

Prosopis glandulosa were found. The vegetation in this unit is natural vegetation of the Northern Upper Karoo.

Vegetation unit 4 (Karroid rocky component) has a very well-developed shrub layer. The ground cover is composed of different gras species, some forbs, and scattered succulents. The tree layer present is dominated by scattered individuals, large and shrub sized, of the protected *Boscia albitrunca* and some species of the invasive *Prosopis glandulosa*. The vegetation in this unit is natural vegetation of the Northern Upper karoo.

Vegetation unit 5 (Drainage line) is present on the southern border of the study area and dominated by large trees (*Ziziphus mucrontata, Searsia lancea, Vachellia karroo* and *Prosopis glandulosa*) that grow close to areas the sometimes experience water saturation during the rainy season. The shrub layer is also well developed in this unit. Although some grass and forb species are present the layers are not as well developed as in the other vegetation units.

Alien plant species

			Vegetation units				
Species	**NEMA**	**CARA**	**1**	**2**	**3**	**4**	**5**
Argemone ochroleuca	1b	1					**X**
Prosopis glandulosa	1b (EC, FA, NWP, WC)	2	**X**	**X**	**X**	**X**	**X**
Salsola kali	1b	Not listed		**X**	**X**		**X**

Alien species pose a risk to the natural environment, locally as well as in the surrounding areas. These species are indicative of degraded conditions in the areas where they occur. Alien plant species outperform the indigenous plant specie in terms of reproduction and establishment, furthermore, they also cause deterioration of the habitat in terms of soil water content, soil pH and erosion.

Red data species

A list of possible red data species that were recorded in the larger region is listed below

(Please note that the list is confidential and may not be made available for public perusal)

Species	Conservation status	Comments
Vachellia erioloba	Declining	Not found
Dinteranthus pole-evansii	Vulnerable	Not found

Drainage and connectivity

The study area is located between the Orange River to the north and the R357 to the south. The southern boundary of the study site has a natural drainage line that are seasonally wet. This drainage line connects to a larger drainage line to the south-western corner of the study area. The larger drainage line then flows into the Orange River. The larger drainage line flows outside of the study area.

Ecosystem classification

The study site falls within the Griqualand West centre of endemism however, a 2019 study by Frisby *et al.* indicated that the increasingly densely populated Kimberley area, the banded ironstone hill ranges as well as the unique environment of the Ghaap Plateau are highlighted as areas of conservation importance. Prieska and it's surrounding environment as well as the location of the study site does not fall within the mentioned areas of conservation importance

CONCLUSION AND RECOMMENDATIONS

The study site is located between the Orange River and the R357. This area is surrounded by vineyards and pivots. An ESKOM servitude stretches along the southern border of the area. Furthermore, there is also the presence of the old Douglas-Prieska road the form the norther border of vegetation units two and four. The environment surrounding the study site is and has already been impacted by development of agriculture or roads.

The study site itself is not regarded as a site of ecological importance when studying the vegetation nor does the site have any high conservation value. Vegetation unit 1

is natural with some invasion by alien invasive plants in the form of the tree *Prosopis gladulosa.* The vegetation is composed of a lot of natural occurring vegetation of the Northern Upper Karoo. Vegetation unit 2 is degraded due to previous possible extraction of gravel in the unit. The unit has some protected plants such as *Boscia albitrunca, Nerine laticoma,* several *Mesembryanthemum* species and *Aloe claviflora* as well as areas covered with dense stands of *Senegalia mellifera* and *Rhigozum trichotomum* which indicates overgrazing. Vegetation unit 3 is dominated by shrubs (*Rhigozum trichotomum Roepera incrustata, Roepera lichtensteiniana* and various *Lycium* species) and grasses (*Enneapogon cenchroides, E. desvauxii, E, scoparius Stipagrostis ciliata Stipagrostis uniplums* and *Eragrostis lehmanniana*) that are characteristic of the Northern Upper Karoo. The area also has the presence of *Boscia albitrunca* and therefore has a medium conservation value. Vegetation unit 4 is dominated by scattered shrubs with a low cover abundance of various grass species. It is however evident that the vegetation in this unit are also characteristic of the Northern Upper Karoo dominated by *Rhigozum trichotomum, Roepera lichtenstainiana, Roepera incrustata, Enneapogon chenchroides* and *Orepetium capense.* Vegetation unit 5 has several individuals of the alien invasive tree *Prosopis* glandulosa but is considered an area with high ecological sensitivity due to the area being a drainage line with an important ecosystem function.

With the above-mentioned factors in mind the site is not listed as an endangered or protected ecosystem with only the drainage line as an important ecological feature with ecological functions. The areas surrounding the site towards the north, west and south are transformed due to agricultural activities or national roads. Other disturbances such as the old Prieska-Douglas road and the ESKOM servitude is also present in the area under study. Vegetation towards the east is still in a natural condition and representative of veld in the Northern Upper Karoo. However, the area has limited connection to other environments with natural conditions that represent the Northern Upper Karoo.

Several protected species were found; however, these species are also present and plentiful in the natural areas surrounding the site. It would however be recommended that some of the geophytes be transplanted in other natural areas. Several large trees

of the protected *Boscia albitrunca* were found at the site. If development do take place it is recommended that effort is made to protect as many as possible of these species. Permits need to be obtained before any of these species can be removed. No red data species were found to be present at the site.

All alien invasive species, especially the *Prosopis glandulosa* should be removed and eradicated from the site as a high priority.

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Curriculum Vitae

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CURRICULUM VITAE
PERSONAL INFORMATION

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DATE OF BIRTH	16 March 1985
MARITAL STATUS	Single
CHILDREN	None
NASIONALITY	South African Citizen
LANGAUGE	Afrikaans
OTHER LANGUAGES	English (Read, Write and Speak)
DRIVERS LICENCE	Code B
COMPUTER SKILLS	Microsoft Office Word, Excel and PowerPoint TWINSPAN and JUICE PRECIS DATABASE ArcGIS R statistical program

→ EDUCATIONAL HISTORY

SCHOOL	Hoërskool Staatspresident Swart, BRANDFORT
HIGHEST GRADE PASSED	Grade 12
YEAR	2003
SUBJECTS	Afrikaans, English, Biology, Physical Science, Mathematics, Computyping, Physiology.

→ TERTIARY EDUCATION

INSTITUTE	University of the Free State
DEGREES	**BSc Botany** (2006) (Botany & Zoology) **BSc Honours Botany** (2007) **MSc Botany** (2010) with distinction

PhD Botany (2016) – VEGETATION ECOLOGY OF THE PUTATIVE PALAEO-KIMBERLEY AND PALAEO-MODDER RIVERS AND THEIR CATCHMENTS, FREE STATE, SOUTH AFRICA
University of the Free State
Promotors: Professors P. Johann du Preez and Louis Scott

Completed Soil Science as an undergraduate subject to complement my Ph.D. research.

→ ACADEMIC ACHIEVEMENTS

Received the E.M. van Zinderen Bakker prize for the student with an outstanding PhD study in Botany (2017).

Received the E.M.van Zinderen Bakker prize for the student with an outstanding M.Sc. study in Botany (2011).

Member of the Golden Key International Honour Society (2011)

→ EDUCATIONAL EXPERIENCE

Practical assistant for first year **Biology** practical during 2006, 2007, 2008, 2009, 2010 and 2011.

Practical assistant for third year **Microbiology** practical during 2007, 2008 and 2009.

Practical assistant for third year **Botany** students during an excursion to De Hoop Nature Reserve (2007, 2008, 2009 and 2010).

During 2010 and 2011, I presented the **BLG 124 (first year Biology)** practicals.
During 2013, I presented the **BLG 144 (first year Biology)** practical's

Facilitator for **LWB 114 Agricultural** students during 2011 and 2012 at Vista Campus where I lectured the classes.

Practical assistant for third year **Botany** students on the Excursion to Hogsback (2012, 2013, 2014 and 2015).

Lecturing third year **Plant Ecology** students (2012).

→ **COMPLEMENTARY EDUCATION**

2020
Became part of the Emerging Scholars Accelerator Program at the UFS.

Presentation Skills Workshop presented by the ESAP at the UFS.

Time Management Workshop presented by the ESAP at the UFS.

Outlook Productivity Course presented by the ESAP at the UFS.

Summative assessment webinar presented by the Centre for Teaching and Learning at the UFS.

UFSTeachOn webinar presented by the Centre for Teaching and Learning at the UFS.

Training Course for Supervisors of Doctoral Candidates at African Universities presented by CREST at the University of Stellenbosch.

Training Course for Remote Supervision presented by the Research Development Academy at the University of Cape Town

2019
Attended the African Pollen Database meeting, presented by the Institute de Recherche pour le Developpement, Bondy France.

Examine a thesis/thesis examiner Workshop, presented by the Post Graduate School at the UFS.

Post graduate student well-being Workshop, presented by the Post Graduate School at the UFS.

Turnit in Training Workshop presented by the Post Graduate School at the UFS.

2018
Turnitin Training Workshop presented by the Centre for Teaching and Learning at UFS.

Grant application Workshop presented by the Post Graduate School at the UFS.

Curriculum Transformation and Innovation Discussions Series presented by Elzmarie Oosthuizen (Teaching and Learning Manager) from the Dean's office at Natural and Agricultural Sciences.

2017
Workshop on Palaeofire knowledge for current and future ecosystem management. Presented by the Global Paleofire Working Group. Presented in Montreal, Canada.

Assessment made practical Workshop, presented by the Centre for Teaching and Learning at UFS.

From paper to e-assessment the basics Workshop, presented by the Centre for Teaching and Learning at the UFS

Busting the multiple-choice myth Workshop, presented by the Centre for Teaching and Learning at the UFS.

Good practice supervising post graduate students' Workshop presented by the Post Graduate School at the UFS.

2016
Completed AVCASA Crop Protection course. Presented online in Pretoria, South Africa.

2015
Timac Agro in Spain for training on the products sold by Vitas South Africa and learning more about the Agriculture in Spain, Pamplona, Murcia and Seville in Spain.

Workshop on Analysing palaeoecological data with R. Presented by Prof. Steve Juggins at the AFQUA 2015 Conference and workshops, Cape Town, South Africa.

2014
Workshop in Scientific Writing Skills for Theses and Dissertations. Presented by the Postgraduate School at the University of the Free State, Bloemfontein, South Africa.

Workshop in Scientific Writing Skills for Research Proposals. Presented by the Postgraduate School at the University of the Free State, Bloemfontein, South Africa.

2013
AllWet RES Summer School in Germany. Presented by DAAD Higher Education Cooperation Program. "Welcome to Africa", presented at various wetlands in Germany.

2012
Wetland Management: Introduction & Delineation Short Course (Rietvlei Nature Reserve, Pretoria) presented by the Centre for Environmental Management, UFS at Rietvlei Nature Reserve in Pretoria.

2011
GIS Intermediate Short Course at the Centre for Environmental Management at the University of the Free State, Bloemfontein, South Africa.

M&D Academic Writing Seminar presented by the Unit for the Development of Rhetorical and Academic Writing at the University of the Free State, Bloemfontein, South Africa.

Determination of the present ecological state within the ecoclassification process Course at the Centre for Environmental Management, UFS in Bloemfontein, South Africa.

2009
GIS and GPS Course at the Centre for Environmental Management, UFS in Bloemfontein, South Africa.

2007
Aquatic Biodiversity Winter School at: The Institute for Aquatic Biodiversity in Grahamstown, South Africa.

→ EMPLOYMENT HISTORY

Lecturer at the Department of Plant Sciences, University of the Free State
January 2017 - currently

Postdoctoral Fellow at the University of the Free State
April 2016 – December 2016

Agronomist at Vitas South Africa
August 2015 – March 2016.

Research assistant at the Department of Plant Sciences, University of the Free State.
March 2015 – July 2015.

Research assistant at the Department of Soil, Crop and Climate Science, University of the Free State.
January 2013 – December 2014.

Internship at SANBI working on the DNA Barcoding Project on Alien Invasive species.
July 2012 – March 2013.

Internship in the Geo Potts Herbarium of UFS (2007).

→ FIELD EXPERIENCE

Field assistant for Dr B. Janecke, PhD project.

Fieldwork for own Honours, Masters and PhD projects.
Assisting Prof Johann du Preez with ESKOM power line EIAs.

Palaeoecology sampling for radiocarbon dating and pollen and phytolith extraction (Baden-Baden spring, Dealesville) in collaboration with Prof Louis Scott.

→ PUBLICATION RECORD

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PEER REVIEWED PUBLICATIONS

Scott, L., Sobol, M., Neuman, F.H., Gil Romera, G., Fernández-Jalvo, Y., Bousman, C.B., Horwitz, L.K. and **Van Aardt, A.C.** submitted (Accepted). Late Quaternary palaeoenvironments in the central semi-arid region of South Africa from pollen in cave, pan, spring, stream and dung deposits. *Quaternary International*. IF 2.190. Q1

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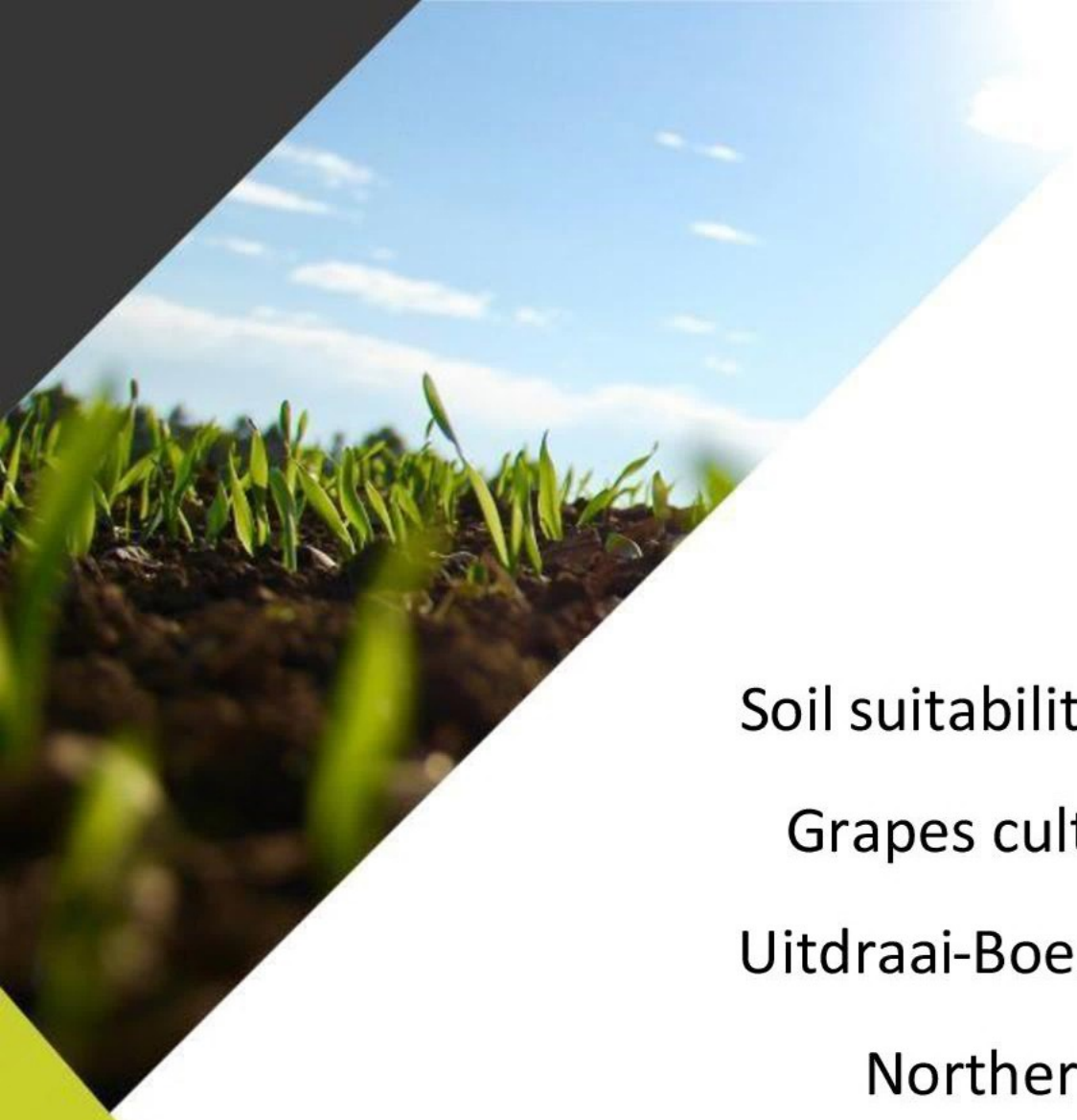
2nd Regional Conference of the Southern African Young Water Professionals at the CSIR international Convention Centre, Pretoria, South Africa.

→ **Memberships**

South African Association of Botanists since 2018
South African Society for Quaternary Scientists since 2018
SA Akademie vir Wetenskap en Kuns since 2020



Soil suitability report for Grapes cultivation at Uitdraai-Boerdery in the Northern Cape

February 2021

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SPECIALIST CV

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EDUCATION

PhD Soil Science	University of the Free State	2018
M.Sc. Soil Science	University of the Free State	2013
B.Sc. Soil Science (Hon)	University of the Free State	2009
B.Sc. Soil Science	University of the Free State	2008
Matric certificate	Queens College	2005

PROFESSIONAL AFFILIATIONS

- SACNASP- Pri Nat Sci 400081/16
- Member of the Soil Science Society of South Africa
- Member of the Soil Classification Work Group
- Member of South African Soil Surveyors Organisation

WORK EXPERIENCE

- Digital Soils Africa / Soil Scientist - May 2012 – Present
- Ghent University / Researcher- January 2016 - December 2016
- University of the Free State/ Assistant Researcher- January 2011- December 2015

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PUBLICATIONS

Bouwer, D., Le Roux, P. A., van Tol, J. J., & van Huyssteen, C. W. (2015). Using ancient and recent soil properties to design a conceptual hydrological response model. Geoderma, 241, 1–11.

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JAN-DIRK MARX

EDUCATION

B.Sc. Soil Science	University of the Free State	2019
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PROFESSIONAL AFFILIATIONS

WORK EXPERIENCE

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SPECIALIST DECLARATION

I, Jan-Dirk Marx, declare that –

- I act as the independent specialist in this application;
- I regard the information contained in this report to be true and correct;

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- I do not have a conflict of interest in this project;
- I will conduct the work relating to the project in an objective manner.

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EXECUTIVE SUMMARY

A soil survey was conducted on the farm Uitdraai-Boerdery on approximately 174 ha of land near Prieska in the Northern Cape to determine whether the land would be suitable for the cultivation of Vineyards. The soil forms found included, Coega, Brandvlei, Glenrosa, Olienhout and Prieska. Vineyards are best suitable for soil that has a pH between 5.5 and 6.5. The required phosphorus should be 40 to 50 ppm. The main risk for Vineyard cultivation in the UitdraaiBoerdery study area is whether the underlying material being soft and hard carbonate will meet the depth requirements for Vineyard cultivations and if not if those horizons could be ripped. For Vineyards to be successful a depth of between 600 mm and 800 mm are required. By breaking up the soil, deep ripping can free the way for roots to penetrate the soil and access water and nutrients, leading to yield increases.

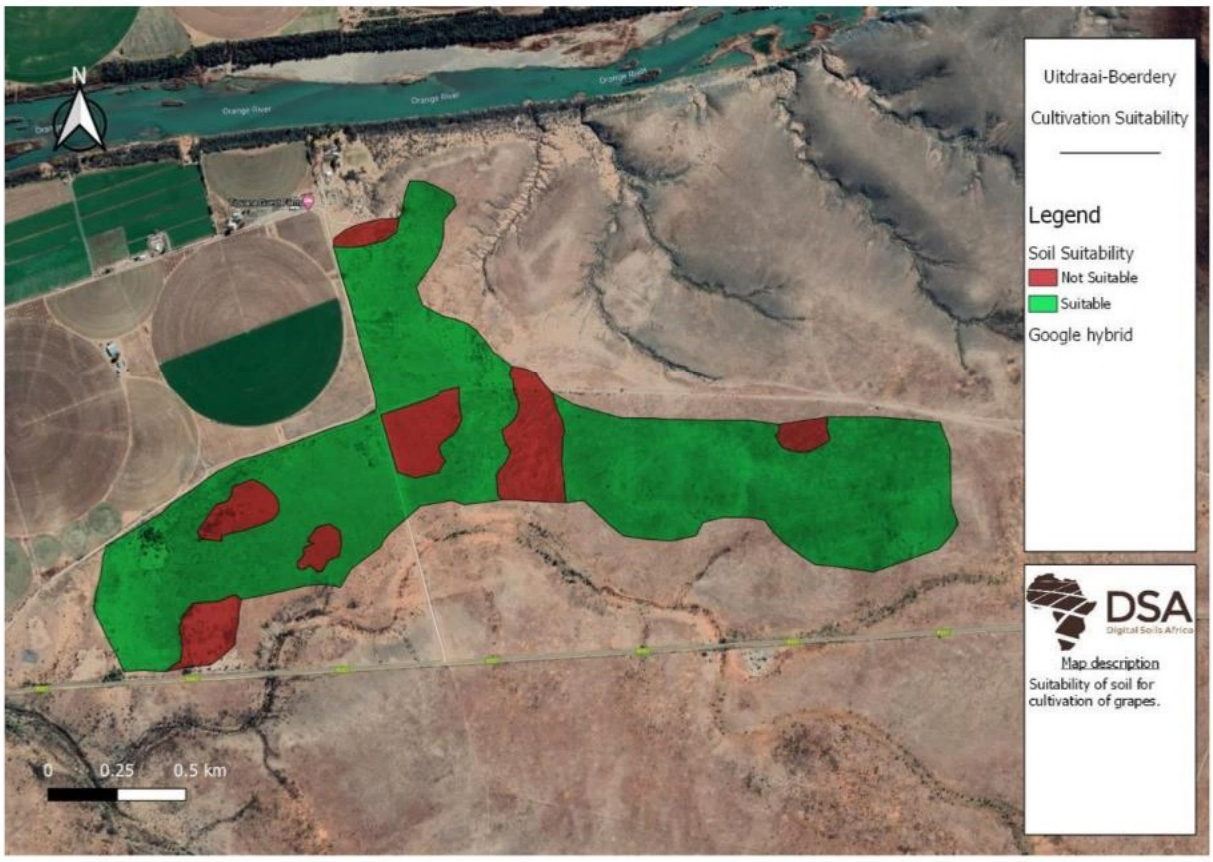

FIGURE 11: SUITABILITY FOR VINEYARD CULTIVATION.

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INTRODUCTION

Digital Soils Africa conducted a soil Survey on approximately 174 ha on the farm UitdraaiBoerdery near Prieska in the Northern Cape Province. The aim of the survey was to determine the suitability of Vineyards.In South Africa more than 90% of dryland vineyards are planted in Malmesbury, Stellenbosch and Paarl. Their most important feature for the performance of vineyard cultivation is related to the soil form. It is for this reason that an Oakleaf soil with homogeneous texture and a suitable depth is preferred for cultivation. It is also preferable that the soil is drainable for roots to take up water. The Glenrosa soil form was also deemed suitable for vineyard cultivation due to a net of roots that form on the surface of the rock and makes any water and nutrients thereon available to the vineyard. In the Robertson area the dominant soil forms for cultivation of Vineyards were Brandvlei and Augrabies soils (B. Oberholzer – Personal communication, 2013). In order for Vineyards to be productive the restrictive layers up to 800-1000 mm should be broken to maximise soil volumes available for root growth. Tillage practices should enhance productive transpiration through the vine and minimise unproductive evaporation from the soil. Where sufficient water-holding capacity is absent, irrigation practises should be considered, especially in regions with dry summers such as the Western Cape of South Africa for this specific reason the Department of Agriculture, Northern Cape, established guidelines/requirements to which the depth of land need to be met. For this purpose, soil samples and the depth of the soil were identified.

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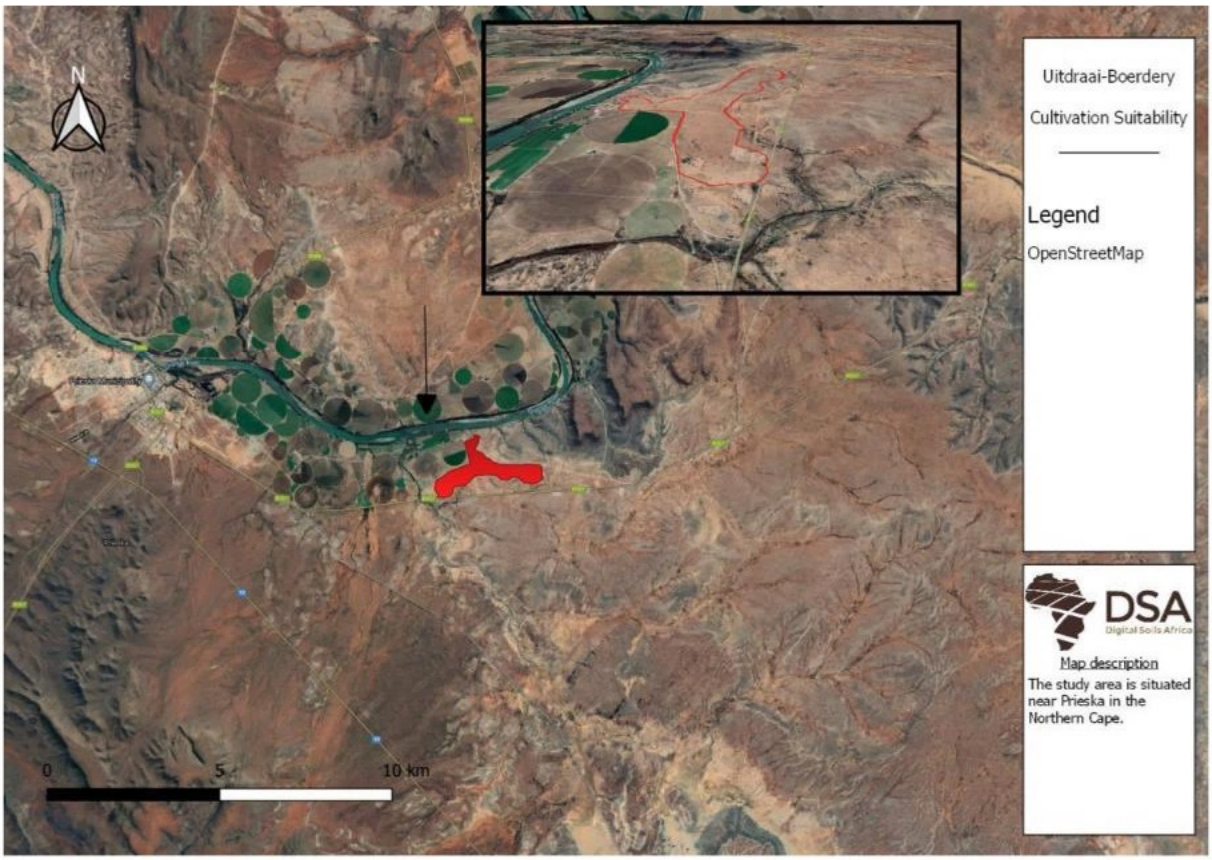

FIGURE 1: UITDRAAI-BOERDERY.

METHODOLOGICAL APPROACH

DESKTOP SURVEY

A field visit was conducted on the 19th and 20th of January 2021. A total of 55 profiles were opened by the client using a TLB, the profiles were opened to 2 m or until a restricted layer was reached. Soils were classified according to the Taxonomic Soil Classification System (Soil Classification Working Group, 2018). Soil depth, freely drainable depth and limiting material were noted and mapped. Samples were taken at profiles 6,27,30,38. Texture was measured with the pipette method, basic cations from a 1:10 NH4OAc extract (White 2006) and soil 6 pH in a 1:2.5 KCl extract. Phosphorus was measured with Olsen method.

FIGURE 2: OBSERVATION POINTS.

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RESULTS

SOIL FORMS

Coega soil forms cover most of the area followed by the Brandvlei soil form (Figure 4). The Glenrosa covered approximately 1.9 ha and was found in the Northern area of the study area. The Prieska Soil form was situated in the Western, Eastern and in the central part of the farm and occupied 17.95 ha. The Olienhout soil form was found in the Western part of the farm and covered 5.38 ha.

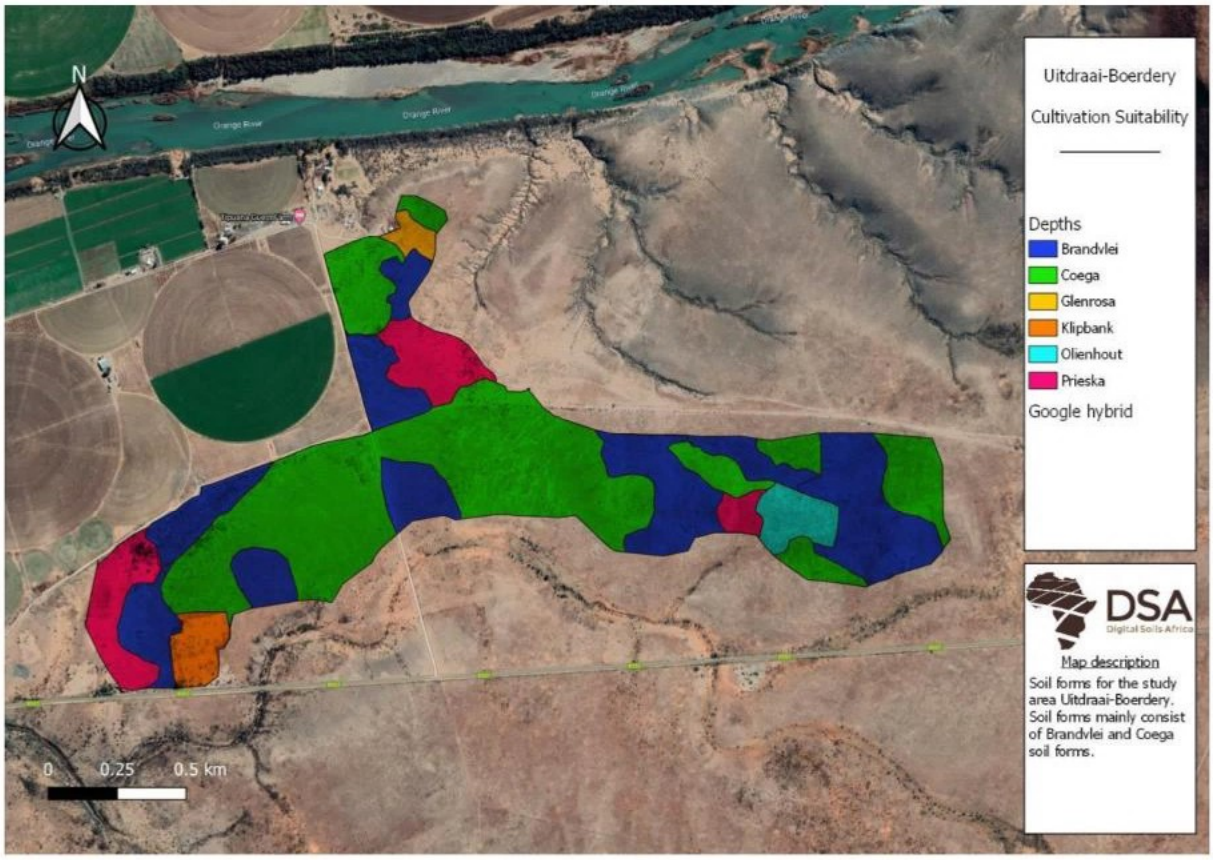

FIGURE 3: SOIL FORMS FOR THE FOCUS SITE.

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BRANDVLEI 2100

The Brandvlei soil form consists of an Orthic A over Soft Carbonate. The Brandvlei soil forms are quite deep reaching average depths of 1200 mm. Brandvlei soil forms usually have a Lithic horizon underlying it. This was also consistent with results found by the neighbouring farm which is successfully producing grapes. Soft Carbonate is weakly structured indicating that is can easily be fragmented thus making it easy to rip. Soft Carbonate is also freely drained and retains water.

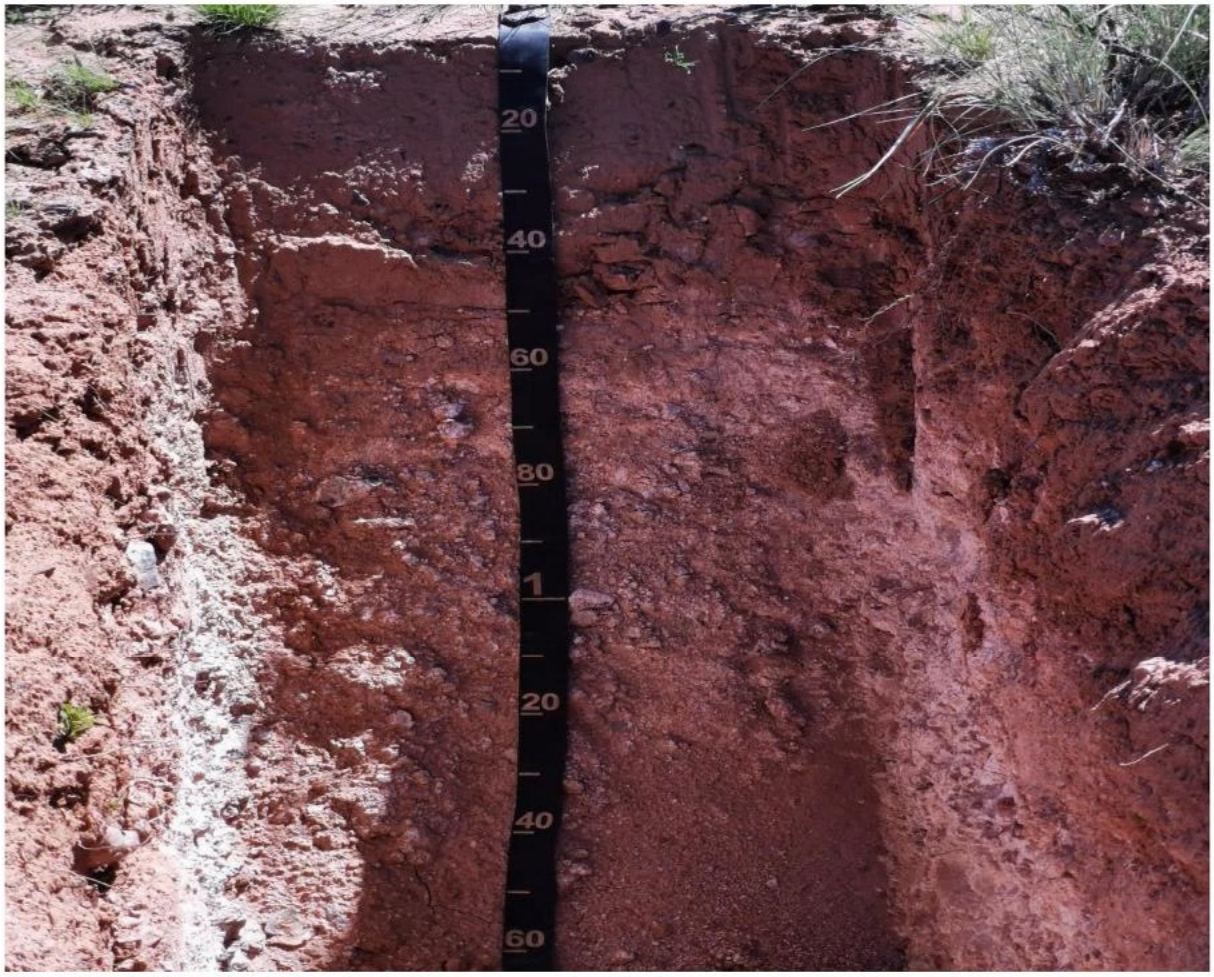

FIGURE 4: BRANDVLEI SOIL FORM.

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COEGA 2200

The Coega soil form consist of an Orthic A with Hard Carbonate underlying it. The Coega soils found on site had a maximum depth of 800 mm,. Sepiolite was not present within the hard carbonate. Hard carbonate is massive, vesicular or platy and has a hard to extremely hard consistence. It was observed that the majority hard carbonate of the Coega's could be broken by a TLB thus giving reason that the hard carbonate would be able to be mechanically ripped (figure 5 A) Once the hard carbonate is broken, the soil would be freely drained and roots could penetrate the subsoil. In Figure 5 A, the hard carbonate is considered thin enough to rip, while in Figure 5 B, it is considered impermeable.

FIGURE 5: COEGA SOIL FORMS.

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GLENROSA 2220

The Glenrosa horizon consists of an Orthic A horizon on a Lithic horizon. The Lithic horizon was classified as Geolithic which is an illuvial infilling between partly weathered rocks. The Glenrosa was only found on a small part of the study area and had a depth of 600 mm. Carbonate concretions were also present within the Lithic horizon. Glenrosa soils are characterised by weathering shale parent material. If the material is soft, weathered and/or layering is vertically positioned, it will favour root penetration to greater depths.

FIGURE 6: GLENROSA SOIL FORM.

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PRIESKA 2120

The Prieksa Soil form consist of an Orthic A horizon on Neocarbonate on Hard Carbonate. The Neocarbonate was identified as brown with Luvic characteristics. Only 3 observations were classified as Prieska soil form and had depths of 1000, 1200 and 2000 mm respectively. The Prieska soil form can easily be ripped due to Neocarbonate being weakly structured and the Hard Carbonate only starting at 1000-1400 mm.

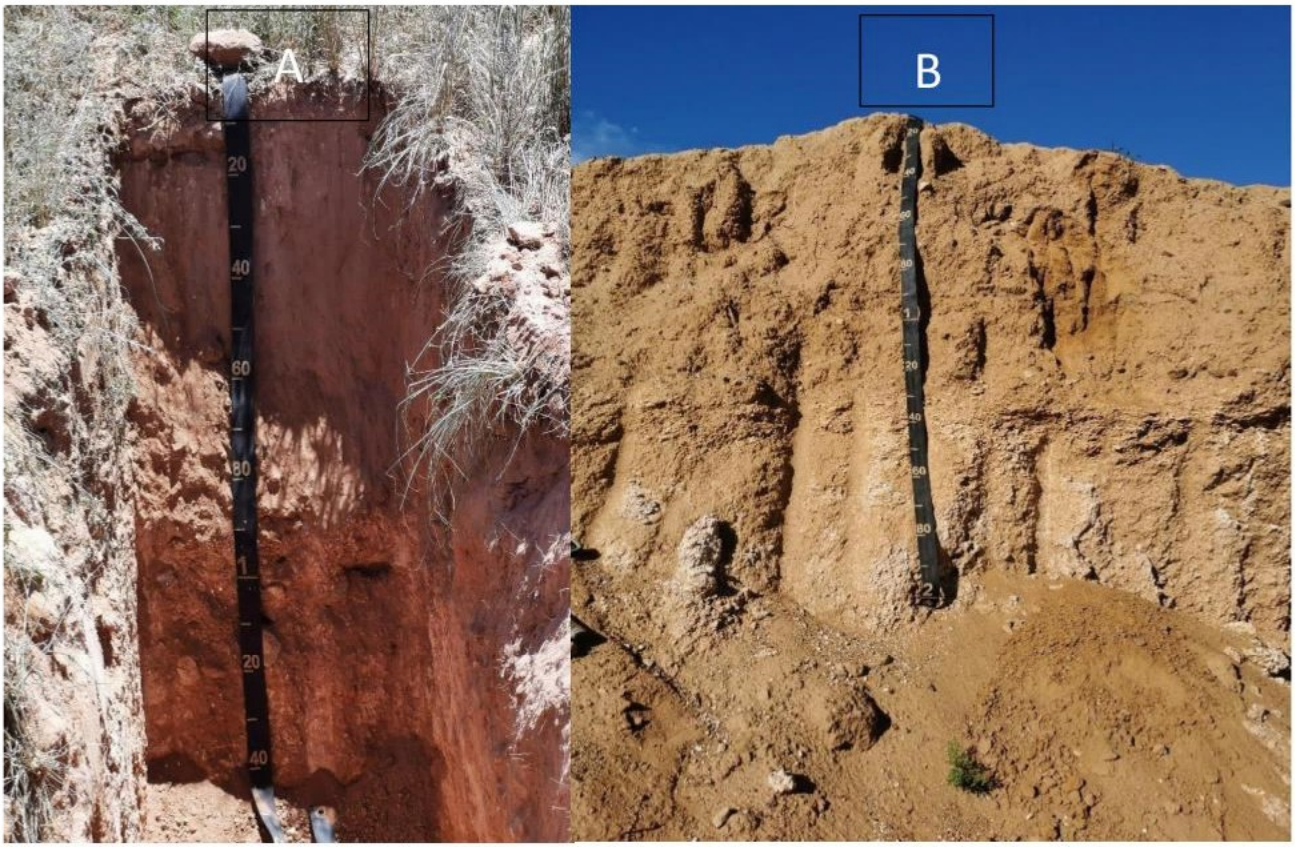

FIGURE 7: PRIESKA SOIL FORM.

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OLIENHOUT

The Olienhout soil form consists of an Orthic A on Soft Carbonate on Hard Carbonate. The topsoil also contained carbonate. The depths of the Olienhout were 1200 mm and was only found on small parts of the study area. The Olienhout will function the same as the Prieska soil form in regards to ripping. The Hard Carbonate for the Olienhout soil form only starts at 1200 mm thus only leaving the Soft Carbonate which is easily ripped. Briers-Louw (2016) states that Soft Carbonate has a high storage capacity and suitable for grape production.

FIGURE 8: OLIENHOUT SOIL FORM.

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SOIL DEPTHS

The depths of the soils are categorised in three groups nl. 0-0.5 m, 0.5-1 m and 1-1.50 m. For the Brandvlei, Prieska and Olienhout soil forms the depths ranged from 1000 mm to 2000 mm and were classified as deep. Whereas for the Coega soil form depths were below 1000 mm and varied between 200-800 mm, the Coega soil form was also classified as Shallow soil. The limiting layers were soft carbonate for the deep soils and hard carbonate for the shallow soils.

FIGURE 9: TOTAL SOIL DEPTHS FOR THE STUDY AREA.

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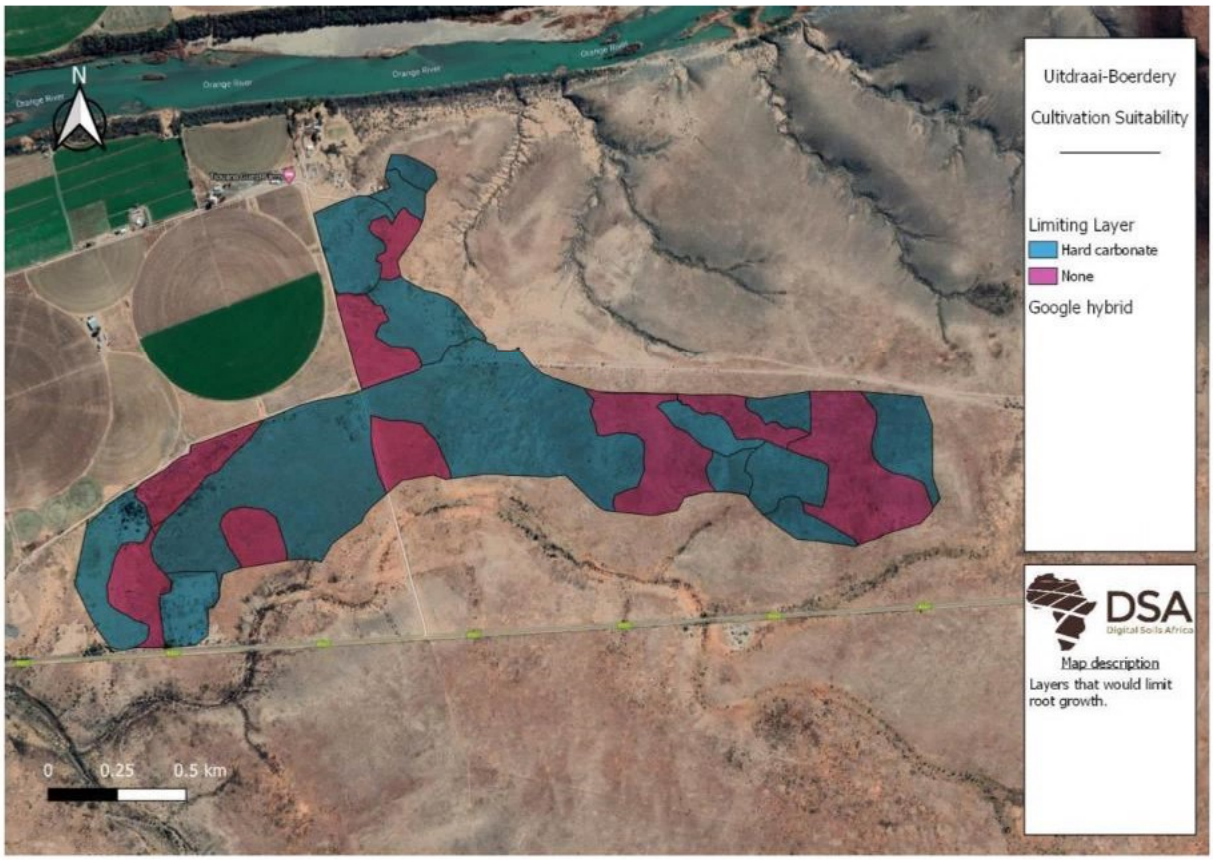

FIGURE 10: LIMITING LAYERS.

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CHEMICAL AND TEXTURAL ANALYSIS

Table 2 (chemical) and Table 3 (texture) present selected soil properties of the samples taken from modal profiles. According to the chemical analysis all soils will be suitable for cultivation of Vineyards. An optimum pH for Vineyard soil is between 5.5 and 6.5. As the chemical results reveal the pH of Uitdraai-Boerdery vary between 6 and 6.15. The CEC of the soil should be above 10 cmol/kg. In the case of Uitdraai boerdery the CEC varies between 17 and 38 cmol/kg. The P in the soil is typically very low for virgin soils, with concentrations between10-19 mg/kg, as the recommended concentration is 40 mg/kg. It is thus recommended that triple super phosphate be applied to prevent plant deficiencies. The EC is also below 400 mS/s. As for texture all soils have a clay content below 35%. Due to ESP being very low the salts will be dominated by Ca and Mg. This results in a low risk of dispersion and soil ersion. Furthermore, the low EC values would not harm Vineyards as EC is only harmful to Vineyards at 150 mS/s. Based on the chemical results the soils of Uitdraai-Boerdery the requirements for Vineyard cultivation are met.

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TABLE 2: SELECTED CHEMICAL PROPERTIES FOR MODAL SOIL PROFILES

Observations	Soil Forms	pH (KCL)	EC	Ca	Mg	K	Na	CEC	ESP	S	P
			mS/s	cmol(+)/kg					%	mg/kg	
UTB 5	Pr2120	6,06	46.5	36,96	1,29	0,15	0,11	38,5	0,29	18,9	10
UTB 5	Pr2120	6,02	35.3	32,81	1,12	0,32	0,02	34,26	0,06	20,93	15,2
UTB 27	Br2100	6,13	46.9	13,03	4,32	0,54	0,05	17,93	0,28	22,8	16,8
UTB 30	Br2100	6,15	49.2	35,85	0,71	0,34	0,08	36,97	0,22	17,14	14,8
UTB 38	Cg2200	6,05	74.4	32,76	1,57	0,4	0,16	34,89	0,46	15,67	19

TABLE 3: PARTICLE SIZE DISTRIBUTION OF MODAL SOIL PROFILES

Observation	Soil Form	% clay	% Silt	% Sand
UTB 6	Pr2120	23.2	9.8	68.3
UTB 6	Pr2120	18.2	8.0	74.7
UTB 27	Br2100	23.6	11.6	66.4
UTB 30	Br2100	27.2	10.2	64.3
UTB 38	Cg2200	24.8	11.8	65.3

SUITABILITY

An important criterion in evaluating a soils suitability for vineyards is drainage. Therefore, soils that had depths greater than 800 mm, were considered to be suitable for vineyard cultivation. This makes approximately 145-ha of the 174-ha suitable for cultivation of vines (Figure 11).

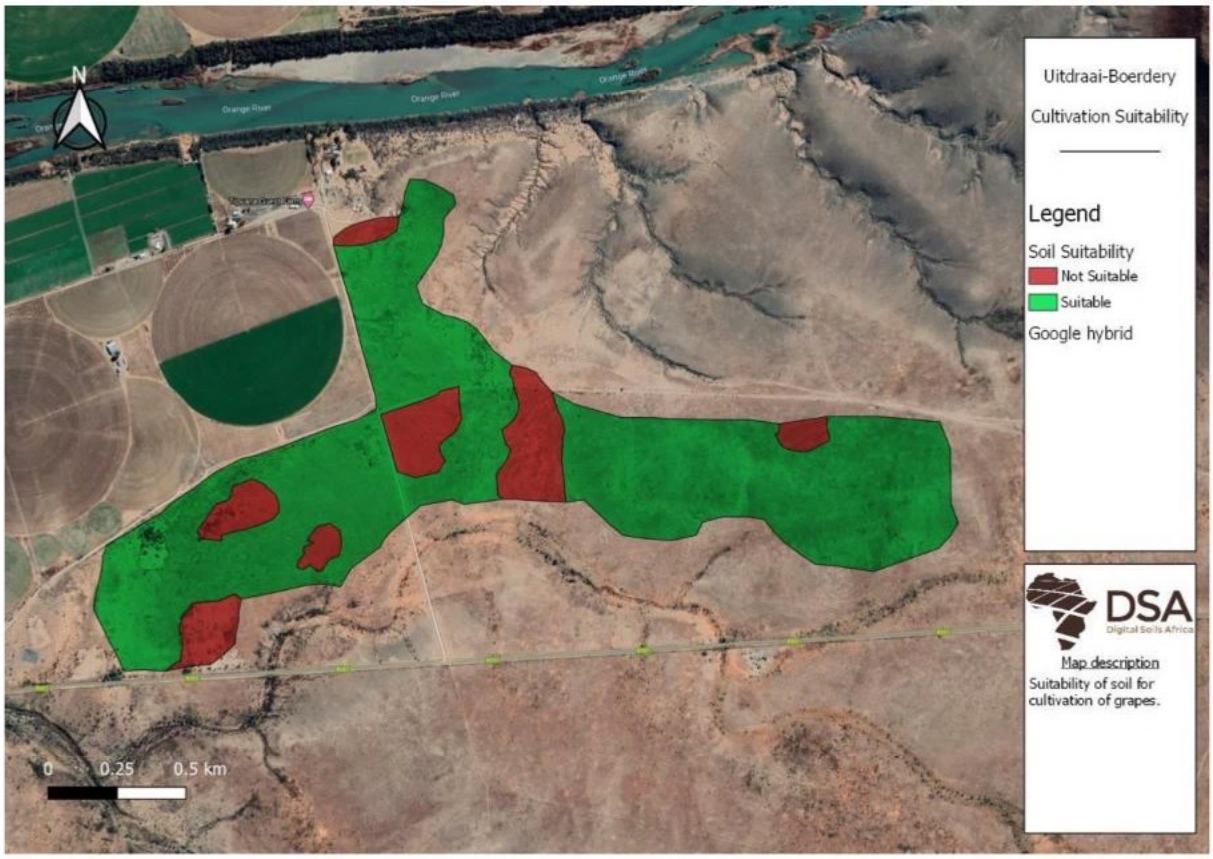

FIGURE 11: CULTIVATION SUITABILITY.

CONCLUSIONS

The soil survey along with the chemical analysis indicates that 145 ha of the 174 ha would be suitable for cultivation of vineyards according to the norms and standards provided by the Northern Cape Department of Agriculture. Drainage is of most importance and would require deep ripping of the soft and hard carbonate.

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DISCLAIMER

Digital Soils Africa cannot be held responsible for any advice given based on incorrect laboratory analysis given by our providers. Although all care is taken to ensure that the results reported are correct, we are dependent on services from other companies.

TABLE 1: OBSERVATION LOCATIONS FOR UITDRAAI-BOERDERY STUDY SITE AND TYPE OF OBSERVATIONS.

GPS	X	Y	Observation type
UTB 1	22.844	-29.681	Profile

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UTB 2	22.846	-29.680	Profile
UTB 3	22.848	-29.680	Profile
UTB 4	22.849	-29.682	Profile
UTB 5	22.849	-29.684	Profile
UTB 6	22.849	-29.686	Profile with sample
UTB 7	22.849	-29.687	Profile
UTB 8	22.849	-29.689	Profile
UTB 9	22.847	-29.689	Profile
UTB 10	22.847	-29.687	Profile
UTB 11	22.847	-29.686	Profile
UTB 12	22.846	-29.684	Profile
UTB 13	22.845	-29.684	Profile
UTB 14	22.846	-29.682	Profile
UTB 15	22.844	-29.682	Profile
UTB 16	22.844	-29.687	Profile
UTB 17	22.842	-29.688	Profile
UTB 18	22.840	-29.689	Profile
UTB 19	22.838	-29.689	Profile

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UTB 20	22.836	-29.691	Profile
UTB 21	22.838	-29.691	Profile
UTB 22	22.840	-29.691	Profile
UTB 23	22.842	-29.691	Profile
UTB 24	22.842	-29.689	Profile
UTB 25	22.845	-29.691	Profile
UTB 26	22.845	-29.689	Profile
UTB 27	22.837	-29.692	Profile with sample
UTB 28	22.838	-29.693	Profile
UTB 29	22.840	-29.693	Profile
UTB 30	22.865	-29.690	Profile with sample
UTB 31	22.865	-29.689	Profile
UTB 32	22.865	-29.687	Profile
UTB 33	22.863	-29.687	Profile
UTB 34	22.863	-29.689	Profile
UTB 35	22.863	-29.690	Profile
UTB 36	22.861	-29.690	Profile
UTB 37	22.861	-29.689	Profile

UTB 38	22.861	-29.687	Profile with sample
UTB 39	22.859	-29.687	Profile
UTB 40	22.859	-29.689	Profile
UTB 41	22.859	-29.691	Profile
UTB 42	22.857	-29.691	Profile
UTB 43	22.857	-29.689	Profile
UTB 44	22.857	-29.687	Profile
UTB 45	22.855	-29.686	Profile
UTB 46	22.855	-29.687	Profile
UTB 47	22.855	-29.689	Profile
UTB 48	22.855	-29.691	Profile
UTB 49	22.853	-29.691	Profile
UTB 50	22.853	-29.689	Profile
UTB 51	22.853	-29.687	Profile
UTB 52	22.853	-29.686	Profile
UTB 53	22.851	-29.686	Profile
UTB 54	22.851	-29.687	Profile
UTB 55	22.851	-29.689	Profile

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TABLE 4: PERIMETER POINTS OF THE SUITABLE AREAS FROM FIGURE 7 FOR THE UITDRAAI-BOERDERY SITE

No	X	Y
1	22.846	-29.680
2	22.848	-29.680
3	22.849	-29.682
4	22.849	-29.684
5	22.849	-29.686
6	22.849	-29.687
7	22.849	-29.689
8	22.847	-29.689
9	22.847	-29.686
10	22.846	-29.684
11	22.845	-29.684
12	22.846	-29.682
13	22.844	-29.682
14	22.844	-29.687
15	22.842	-29.688
16	22.838	-29.689
17	22.836	-29.691
18	22.838	-29.691
19	22.840	-29.691
20	22.842	-29.689

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21	22.845	-29.691
22	22.845	-29.689
23	22.837	-29.692
24	22.840	-29.693
25	22.865	-29.690
26	22.865	-29.689
27	22.865	-29.687
28	22.863	-29.687
29	22.863	-29.689
30	22.863	-29.690
31	22.861	-29.690
32	22.861	-29.689
33	22.859	-29.687
34	22.859	-29.689
35	22.859	-29.691
36	22.857	-29.691
37	22.857	-29.689
38	22.857	-29.687
39	22.855	-29.687
40	22.855	-29.689
41	22.855	-29.691

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