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Pri.Sci.Nat # 400045/08

BOTANICAL ASSESSMENT OF PROPOSED NEW CULTIVATION ON ZONDERWATERKRAAL FARM, SUID BOKKEVELD, NORTHERN CAPE.

Prepared for: Footprint Environmental Services, Porterville

22 September 2016

DECLARATION OF INDEPENDENCE

In terms of Chapter 5 of the National Environmental Management Act of 1998 specialists involved in Impact Assessment processes must declare their independence and include an abbreviated Curriculum Vitae.

I, N.A. Helme, do hereby declare that I am financially and otherwise independent of the client and their consultants, and that all opinions expressed in this document are substantially my own.

NA Helme (Sole Proprietor: Nick Helme Botanical Surveys)

ABRIDGED CV:

Contact details as per letterhead.
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University of Cape Town, South Africa. BSc (Honours) – Botany (Ecology & Systematics). 1990.

Since 1997 I have been based in Cape Town, and have been working as a specialist botanical consultant, specialising in the diverse flora of the south-western Cape. Since the end of 2001 I have been the Sole Proprietor of Nick Helme Botanical Surveys.

A selection of relevant previous botanical work is as follows:

- Botanical assessment of proposed cultivation on Groot Patrysvlei, Clanwilliam (Cederberg Environmental Assessment Practise 2016)
- Botanical assessment of proposed cultivation on Rem. Andriesgrond 204, Clanwilliam (Cederberg Environmental Assessment Practise 2015)
- Botanical assessment of proposed dam on Grootbos farm, Riversdale (Cederberg Environmental Assessment Practise 2015)
- Botanical assessment of proposed dam on Modderfontein farm, Citrusdal (Cederberg Environmental Assessment Practise 2015)

- Botanical assessment of proposed cultivation on farms Laastedrif & Kleinvlakte, Bo Swaarmoed, Ceres (Cederberg Environmental Assessment Practise 2014)
- Botanical assessment of Remainder of Farm Rietfontein 244, Piketberg (Cederberg Environmental Assessment Practise 2014)
- Botanical Assessment of farm Draaihoek 293, Vredendal (Cederberg Environmental Assessment Practise 2013)
- Botanical Assessment of farm Gideonsoord 303, Klawer (Cederberg Environmental Assessment Practise 2013)
- Botanical assessment of proposed agricultural expansion on Remainder of Farm Chilton 160, Piketberg (Cederberg Environmental Assessment Practise 2013)
- Botanical assessment of proposed Namakwa Sands expansion area, Brand se Baai (SRK Consulting 2013)
- Botanical assessment of proposed new N7 alignment near Clanwilliam (CCA Environmental 2013)
- Scoping study of proposed Paleisheuwel Solar PV facility, near Leipoldtville (Sharples Environmental 2012)
- Botanical assessment of Farm 251, Vanrhynsdorp (PPC 2011)
- Botanical scoping study of proposed Wind Energy Facility near Brand se Baai (Savannah Environmental 2010)
- Botanical assessment of a portion of Sandrug farm, Leipoldtville (Footprint Environmental 2010)
- Botanical assessment of a portion of Kookfontein farm, Lambert's Bay (Footprint Environmental 2010)
- Botanical assessment of portion of Swartboskraal farm, Paleisheuwel (Footprint Environmental 2010)
- Botanical assessment of portion of Suurfontein farm, Lambert's Bay (Footprint Environmental 2010)
- Botanical basic assessment of Kruisfontein farm, Redelinghuys (Cederberg Environmental Assessment Practise, 2009)
- Botanical scoping and impact assessment for proposed Eskom Wind Energy Facility near Vredendal (Savannah Environmental, 2007)
- Best practise guidelines for Potato Farming in the Sandveld (CapeNature & Potatoes South Africa 2007)

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1. INTRODUCTION

This botanical assessment was commissioned in order to help inform decisions regarding the application to develop new rooibos tea fields on about 20.6ha of currently natural vegetation on the farm known as Zonderwaterkraal, about 55km south of Nieuwoudtville, in the Northern Cape. The southern boundary of the property is the Doring river.

Two original study areas were proposed (see Figures 1 & 2), but this was modified based on site surveys with the landowner, and four separate study areas were thus proposed and are here also assessed (see Figures 1 & 2). Area 1 is about 2.5ha, area 2 is about 10.8ha, area 3 is about 2.0ha and area 4 is about 1.2ha (16.5ha in total). The overall property is about 1050ha in extent.

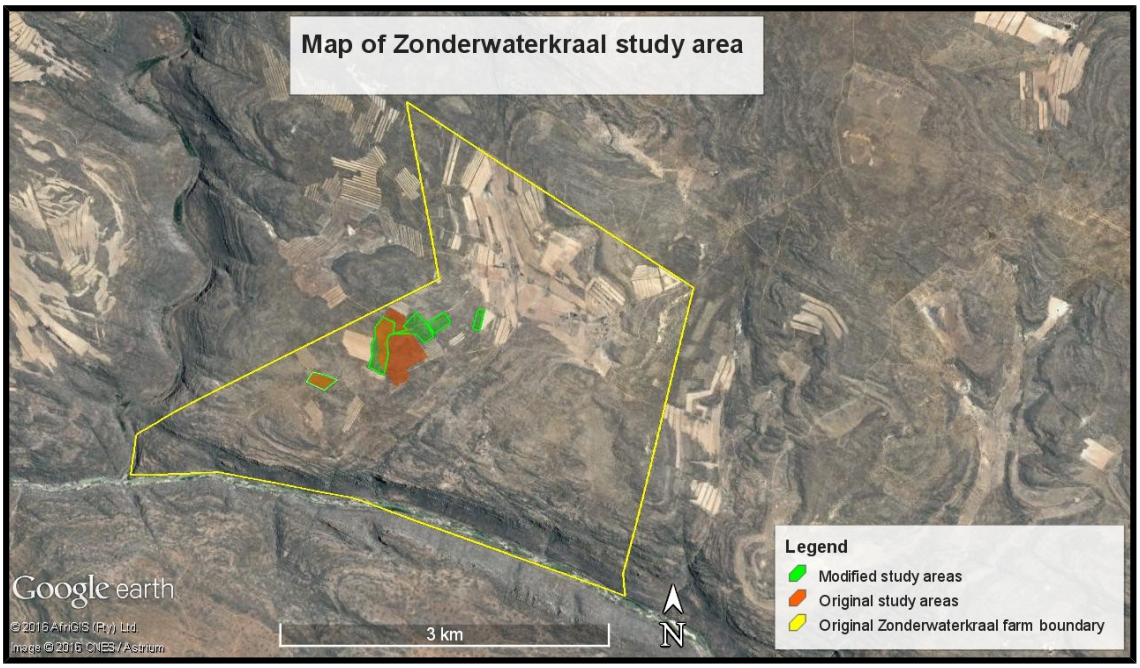

Figure 1: Satellite image showing the study areas. The original farm boundary is indicated by the yellow outline, but it would appear that this total area now has at least three separate owners.

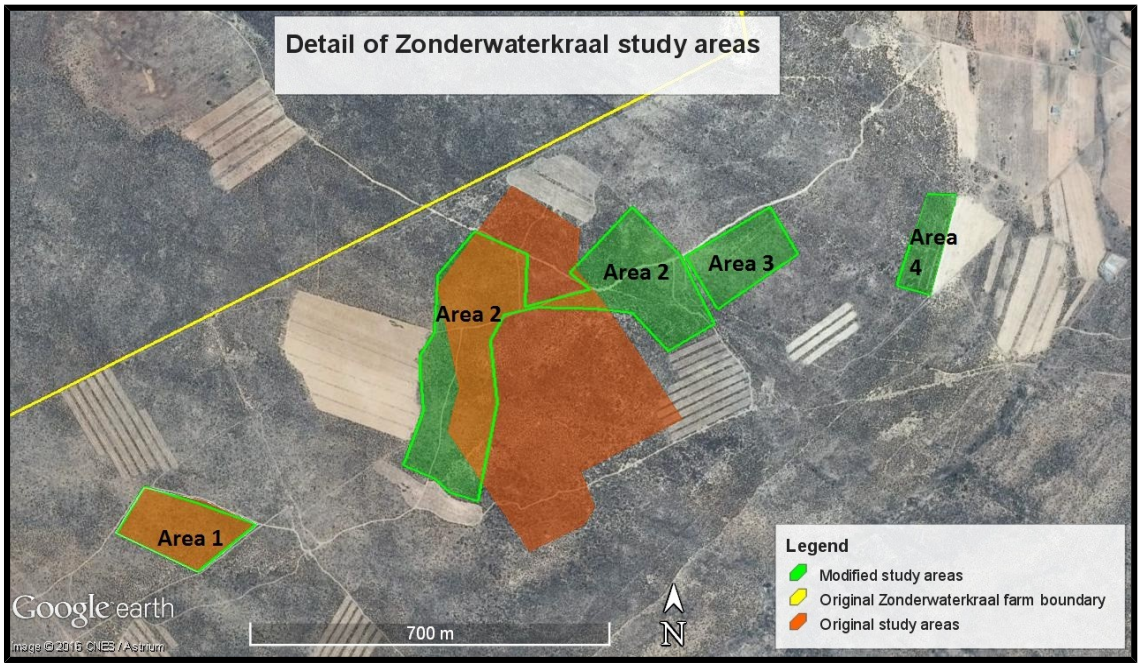

Figure 2: Map showing numbering and detail of the various study areas.

2. TERMS OF REFERENCE

The terms of reference for this study were as follows:

- undertake a site visit to assess the vegetation in the study areas
- compile a botanical report which describes the vegetation in the study area and places it in a regional context, including its status in terms of the CapeNature FineScale Conservation Assessment
- identify and map any plant Species of Conservation Concern in the study area
- map any wetlands in the study area
- provide an overview and map of the ecological conservation significance (sensitivity) of the proposed cultivation and the greater property
- identify likely botanical impacts of the proposed development layout
- assess the significance of the ecological impacts, as per standard Impact Assessment methodology
- provide recommendations in order to minimise the ecological impacts, including discussion of possible conservation tradeoff (offset) areas elsewhere on the greater property.

3. LIMITATIONS, ASSUMPTIONS AND METHODOLOGY

The site was visited on 7 and 8 September 2016. Although rainfall was well below average this rainy season (May – August) most of the seasonal bulbs and annuals were recorded flowering and were identifiable during the site visit, as were most of the shrubs. Most (but not all) of the potential localised and threatened species in the area can still be identified when not flowering, provided that the observer has experience with the species concerned, and is able to identify sterile or fruiting material. The seasonal constraints on the comprehensiveness of the botanical observations and findings are thus believed to be relatively minor. The confidence levels in the botanical findings are considered to be high, but it should be noted that certain species are always likely to be missed due to the fact that many species are identifiable or evident for only short periods during the year, some of which may be rare or threatened. It is thus possible that some of the areas were assessed as being of lower conservation value/sensitivity than they in fact are. The extreme age of the veld in the study area (<40yrs since fire) also means that many species may now be effectively invisible, being present only as soil stored seed or bulbs, which may result in a further underestimate of plant diversity and sensitivity.

In order to supplement the species data I used a habitat based approach, in which overall habitat quality, as determined by species richness and presence of key indicator species, is used to determine conservation value – which is a term often used interchangeably (but incorrectly) with “sensitivity”.

During the field visit I walked various transects across the sites, and drove most of the available tracks. I also walked and drove parts of the adjacent natural areas in order to form an opinion on the context and relative importance of the actual study area. During the walks I noted the condition of the veld and habitats, using community structure, species abundance and floristics (species present, notably the Species of Conservation Concern; SCC) as indicators. I recorded all plant species in a notebook, and took various digital photographs. Certain plant collections were made, which have been turned into voucher specimens and deposited at the Compton Herbarium at Kirstenbosch for future reference, and photos of most of the SCC are on the website ispot.org.za. The GIS based South African National Biodiversity Institute (SANBI) vegetation map for South Africa (Mucina & Rutherford 2012) was consulted, the Sandveld and Bokkeveld Fine Scale Vegetation Map and Conservation Plan (Helme 2007; Pence 2008), along with the National Spatial Biodiversity Assessment (NSBA;

Rouget *et al* 2004), the Western Cape Framework Update (Pence 2012) and the National List of Threatened Ecosystems (DEA 2011). Conclusions were drawn based on this documentation and twenty five years of professional experience in the area and the region.

Google Earth satellite imagery dated February 2016 (and earlier) was used to verify vegetation patterns, and for mapping purposes. Google Earth Pro was used to measure polygon areas.

The No Go alternative is assumed to be a continuation of the *status quo*, *i.e*. no further cultivation of virgin land in the study area, and moderate levels of livestock grazing.

It was agreed with the landowner on site that the new lands will consist of traditional "stroke" (strips) of cleared and adjacent natural vegetation, rather than total clearing of authorised areas, in order to minimise wind erosion and facilitate rehabilitation when the fields are no longer in use.

It is important to note that the original study area (see Figure 2) has been modified to exclude all the High sensitivity areas identified on site, as well as some rocky areas, and that the impact assessment uses the original areas as the pre mitigation scenario, and the modified study areas (also shown in Figure 2) as the post mitigation scenario. It is assumed that the preferred study areas, shown in green in Figure 2, will be the total extent of any eventual new vegetation clearing on the property.

4. STUDY AREA AND REGIONAL CONTEXT

Soils in the study areas are typically sandy soils derived from the underlying sandstone. In all four of the final study areas the sands are generally deep, although in places (generally outside the modified areas, but often within the original areas) there are small outcrops of sandstone bedrock. There are no wetlands or drainage areas within any of the study areas.

4.1 National and Regional Context

The site is part of the Northwest Fynbos bioregion (Mucina & Rutherford 2006), and this is part of the Fynbos biome, located within what is now known as the Core Region of the Greater Cape Floristic Region (GCFR; Manning & Goldblatt 2012). The GCFR is one of only six Floristic Regions in the world, and is the only one largely confined to a single country (the Succulent

Karoo component extends into southern Namibia). It is also by far the smallest floristic region, occupying only 0.2% of the world's land surface, and supporting about 11500 plant species, over half of all the plant species in South Africa (on 12% of the land area). At least 70% of all the species in the Cape region do not occur elsewhere, and many have very small home ranges (these are known as narrow endemics). Many of the lowland habitats are under pressure from agriculture (typically the biggest habitat threat nationally), urbanisation and alien plants, and thus many of the range restricted species are also under severe threat of extinction, as habitat is reduced to extremely small fragments. Data from the nationwide plant Red Listing process undertaken is that 67% of the threatened plant species in the country occur only in the southwestern Cape (which for this analysis includes the Bokkeveld), and these total over 1800 species (Raimondo *et al* 2009)! It should thus be clear that the southwestern Cape is a major national and global conservation priority, and is quite unlike anywhere else in the country in terms of the number of threatened plant species.

The study area falls within what is generally known as the Suid Bokkeveld, being part of the greater Bokkeveld region. The Bokkeveld was identified by Raimondo *et al* (2009) and the C.A.P.E. (Cape Action for People and the Environment) project as an area under heavy transformation pressure, primarily from agriculture, and the latter consequently initiated (via CapeNature) a Fine Scale Vegetation Mapping and Conservation Planning project (FSP) in order to identify key conservation priorities in the region (large parts of which are within the Western Cape). The FSP has identified key conservation areas that are needed to meet species, habitat connectivity and process targets in the Bokkeveld and Sandveld – these are known as Critical Biodiversity Areas (CBAs). This was updated for the Hantam Municipality (which includes the study area) in 2012 (Pence 2012), and drew on CapeNature data for this region.

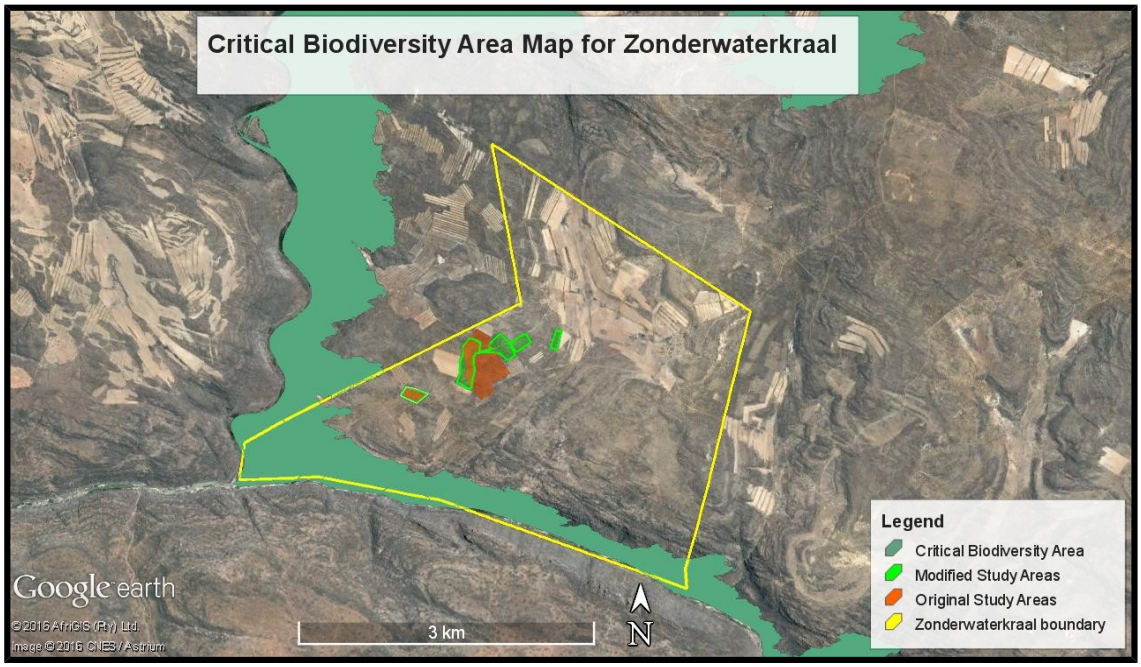

Figure 3: Extract of the Critical Biodiversity Area (CBA) map for the Hantam Municipality (Pence 2012). The mapped terrestrial CBAs are shown in green shading.

The CBA map for the study area is shown in Figure 3, and it can be seen that none of the study areas are included as CBAs. Areas on Zonderwaterkraal that have been selected as CBAs have been selected for habitat representation, priority subcatchments, edaphic interfaces and for ecological connectivity value.

5. THE VEGETATION ON SITE

5.1 Background

According to the SA Vegetation map all proposed development areas are within **Doringrivier Quartzite Karoo** (Mucina & Rutherford 2012). This is however very clearly a mistake for the sandy areas (probably caused by this author, as the person responsible for the Bokkeveld fine scale vegetation mapping!), and would obviously be best mapped as **Nardouw Sandstone Fynbos**. Consequently no extract of this vegetation map is included here, as it adds no value.

Nardouw Sandstone Fynbos was only recognised subsequent to drawing up of the national list of threatened habitats and is consequently not listed by DEA (2011). However, Pence (2014) re-assessed this and other habitats in the region for the Western Cape Biodiversity Framework Update, and found that it should be listed as a

Vulnerable vegetation type (Pence 2014), and this classification is supported and is used in this report.

Fire is an important driver of Fynbos dynamics, and is necessary perhaps once every fifteen to twenty five years in Arid Fynbos vegetation types in order to maintain optimal ecological functioning (Helme 2007, Cadman 2016). The vegetation in the study area is estimated to be at least 40 years old, with no signs of recent fire, and the area is consequently well overdue for a fire, with the vegetation showing extensive signs of senescence (old, woody plants dying of old age).

There are various spatial elements of ecological processes on the property, including soil type gradients (ecotones or edaphic interfaces), where loamy sands meet the sandy soils, and small soil moisture gradients. No wetlands are found within or close to the study areas. Most of the study areas currently have good ecological connectivity in all directions.

Livestock trampling and grazing impacts are evident in many parts of the property, but are not pronounced within the various study areas. There is no alien invasive vegetation in the study areas.

5.2. Area 1

The site is slightly southwest facing, and is part of a sandy plateau. Soils are generally deep sands, although these maybe shallower in places. Exposed bedrock is not evident. The vegetation is in fairly good condition, but is well overdue for a fire, with many senescent shrubs. Species diversity is moderate, and appears typical of these habitats in the Suid Bokkeveld.

Plate 1: Overview of Area 1, looking east. The large shrub at left is *Leucadendron procerum*.

Indigenous species present include *Willdenowia incurvata, Thamnochortus platypterus, Ruschia cf carolli, Amphiglossa tomentosa, Phylica rigidifolia, Aristida junciformis, Wahlenbergia* sp4 (undescribed), *Ficinia indica, Gymnodiscus capillaris, Euphorbia rhombifolia, E. tuberosa, E. burmanii, Heliophila pinnata, Lyperia tristis, Adenogramma glomerata, Helichrysum moeserianum, H. dasyanthum, Ursinia anthemoides, U. cakilefolia, Struthiola ciliata, Ruschiella lunulata, Convolvulus capensis, Ehrharta calycina, Dimorphotheca pluvialis, Cyanella hyacinthoides, Osteospermum monstrosum, Albuca cooperi, Leysera tenella, Muraltia spinosa, Gorteria personata, Lapeirousia fabricii, L. jacquinii, Cleretum bellidiforme, Lachenalia uniflora, L. mutabilis, Hermannia trifurca, Trachyandra revoluta, T. paniculata, Chlorophytum undulatum, Hebenstretia repens, Dischisma clandestinum, Ornithoglossum viride, Hymenogyne conica, Rumex cordatus, Oxalis flava, Moraea fugax, Anthospermum spathulatum, Felicia dubia, Crassula dichotoma, Ornithogalum thyrsoides, Selago sp., Searsia dissecta, Tetragonia spicata, Limeum africanum, Isolepis sp., Pelargonium triste, Pharnaceum lanatum, Gladiolus alatus, Asparagus capensis, Microloma sagittatum, Nemesia anisocarpa* and *Metalasia adunca.*

5.2.1 Species of Conservation Concern

Two plant Species of Conservation Concern (SCC; previously usually known as Red Data Book listed species; Raimondo *et al* 2009) were recorded from this area, and

there is a low likelihood that others may be present. Redlist status is according to www.redlist.sanbi.org.

One plant of *Metalasia adunca* (Near Threatened) is present here, and this is regarded as a regionally insignificant subpopulation, and its loss would not be of any significance, as this a typical Sandveld element, and is very wide ranging, from Hondeklipbaai to Cape Town.

Four plants of *Leucadendron procerum* (Near Threatened) are present. This is regarded as a regionally insignificant subpopulation, and its loss would not be of any significance, as this is still a fairly common Sandveld element, from here south to Redelinghuys.

5.3 Area 2

The original Area 2 covers about 18ha and includes some extensive areas of deep sands, mostly facing southeast, and shallower sands and even exposed bedrock in the northern plateau portions. Species composition is broadly similar to Area 1, but the differences are discussed below.

The High sensitivity portion is characterised by the presence of at least four plant Species of Conservation Concern (SCC; see Section 5.3.1) – namely *Leucospermum praemorsum* (see Plate 2), *Leucadendron procerum*, *Annessorhiza* sp nov., and *Metalasia adunca*. In some parts the former species are dominant, within a matrix of *Willdenowia incurvata*.

The Medium sensitivity portions of Area 2 are characterised by an absence of the four SCC noted above, and are dominated by *Willdenowia incurvata, Thamnochortus platypterus* and *Amphiglossa tomentosa.*

Plate 2: View of Medium sensitivity part of Area 2, looking west.

Plate 3: View of High sensitivity area on deep sands, within original large study area, looking south. The large shrubs in the foreground are *Leucospermum praemorsum* (Vulnerable), and the shrubs in the distance are *Leucadendron procerum* (Near Threatened). Zonkwasriet (*Willdenowia incurvata*) is dominant.

5.3.1 Species of Conservation Concern

Four plant Species of Conservation Concern were found within this study area, and the likelihood of there being others is deemed to be Low to Medium.

Three plants of *Metalasia adunca* (Near Threatened) are present here, and this is regarded as a regionally insignificant subpopulation, and its loss would not be of any

significance, as this a typical Sandveld element, and is very wide ranging, from Hondeklipbaai to Cape Town.

Four specimens of the very cryptic geophyte *Annessorhiza* sp nov. were found here. This undescribed carrot family member is known from just a few collections, all in the area from Vanrhynsdorp to Clanwilliam (A. Magee – pers. comm.), and is quite possibly both rare and threatened, but has not yet been assessed for the Redlist. It's presence here is regarded as regionally significant, even though it is likely to be present in larger numbers nearby.

At least thirty plants of *Leucadendron procerum* (Near Threatened) are present. This is regarded as a regionally fairly significant subpopulation, and its loss would not be of significance, even though it is still a fairly common Sandveld element, from here south to Redelinghuys.

Leucospermum praemorsum (Plate 3) has a remarkably wide range in the Sandveld, from here all the way north to Hondeklipbaai, but it has viable populations only here in a few parts of the Suid Bokkeveld, in a couple of remote spots near the Groen River, and in the Namaqua National Park east of Hondeklipbaai. Populations on the Gifberg and Nardou plateau have been decimated by rooibos tea cultivation over the last twenty years (pers. obs), and the species is Redlisted as Vulnerable (Rebelo *et al* 2005).

5.4 Area 3

This site is gently southeast facing, and the sands appear to be fairly deep, with no exposed bedrock. The vegetation is not in particularly good condition, and shows signs of having been heavily grazed and trampled.

Willdenowia incurvata is dominant, with *Struthiola ciliata*, *Amphiglossa tomentosa*, *Thamnochortus platypterus* and *Athanasia trifurcata*. Overall species composition is fairly similar to that found in Area 1, but tends to be a subset of that, with fewer species overall and more open space.

No plant Species of Conservation Concern were recorded here, and none are likely to occur.

Plate 4: View of area 3, looking east over this area.

5.5 Area 4

This east facing area of deep sands is located below a rocky ridge and above an existing cultivated land. The area has a moderate plant diversity, but lacks the longer lived, large shrubs.

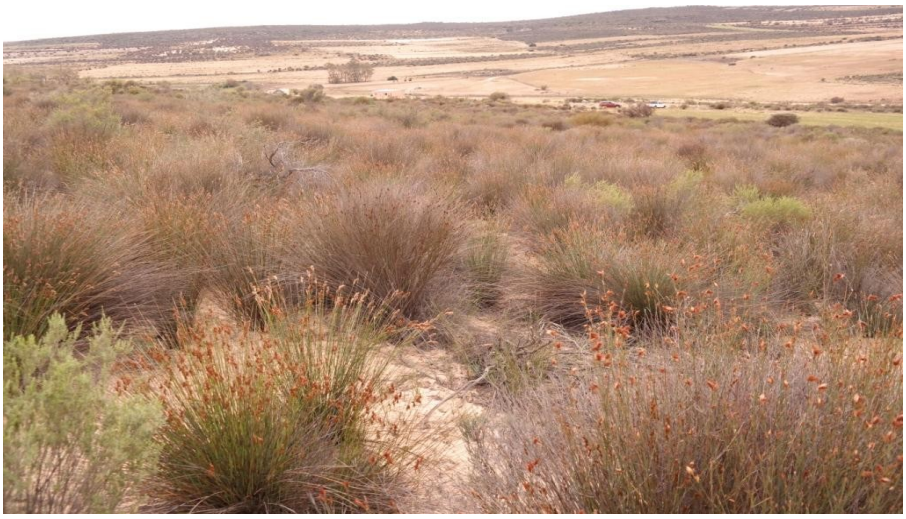

Plate 5: View of Area 4, looking east over the area.

The area is dominated by *Willdenowia incurvata, Thamnochortus platypteris, Adenogramma glomerata, Ehrharta thunbergii, Muraltia spinosa, Struthiola ciliata* and *Amphiglossa tomentosa*. Additional species include *Ficinia indica, Gladiolus alatus, Phylica rigidifolia, Oxalis flava, Searsia dissecta, Gymnodiscus capillaris, Wahlenbergia sp.4., Ursinia anthemoides, Helichrysum moeserianum, Athanasia trifurcata, Anthospermum spathulatum, Wiborgia obcordata, Hymenogyne conica,*

Albuca cooperi, Felicia dubia, Chlorophytum undulatum, C. viscosum, Dischisma clandestina and *Conicosia pugioniformis*.

No plant Species of Conservation Concern were recorded here, and none are likely to occur.

6. BOTANICAL SENSITIVITY

The terms conservation value and sensitivity are often used interchangeably, but this is not strictly correct. The term “conservation value” refers to the value of the habitat in local and regional conservation terms (*i.e.* answering the question how important is it?), whilst “sensitivity” strictly means how resilient is the habitat to disturbance. In the case of urban or industrial development any natural or partly natural habitat would effectively be permanently lost in the development footprint, and thus technically sensitivity would be high, irrespective of the conservation value of the underlying habitat. For agricultural development sensitivity in some ways reflects how well the area could potentially rehabilitate after cessation of cultivation, with high sensitivity areas having low rehabilitation potential and low sensitivity areas having high rehabilitation potential. The term sensitivity is however simpler and better understood by most and is thus used hereafter in this report.

The botanical sensitivity of a habitat is a product of species diversity, rarity of habitat, rarity of species, ecological viability and connectivity, vulnerability to impacts, and reversibility of threats (ease of rehabilitation). Extensive previous work in the region has allowed the author to make conclusions regarding the overall and relative sensitivity of the vegetation in the study area (see Figure 4).

Areas that have been cultivated or have otherwise been heavily disturbed, have low botanical diversity, and have no regionally important populations of plant Species of Conservation Concern (SCC) are considered to be of Low botanical sensitivity at a regional scale. There are no areas of Low sensitivity in the current study areas.

Areas with a moderate to high indigenous plant diversity and moderate to high structural heterogeneity, and with up to three recorded plant Species of Conservation Concern (SCC), of minor regional significance, are mapped as being of Medium sensitivity. The underlying vegetation type may be regionally threatened. Most of the vegetation in the study area is of Medium sensitivity.

High sensitivity areas support intact examples of a threatened vegetation type, and usually support significant populations of at least three plant Species of Conservation Concern, and typically support irreplaceable species assemblages or habitats. These areas are often also mapped CBAs (Critical Biodiversity Areas). Note that in some cases even degraded areas may be of High conservation value because of their ecological connectivity value, as they may connect two patches of High conservation value. High sensitivity areas should be considered No Go areas for development. In this study a large High sensitivity areas was identified in and around the original Area 2, with another smaller area to the north (see Figure 4).

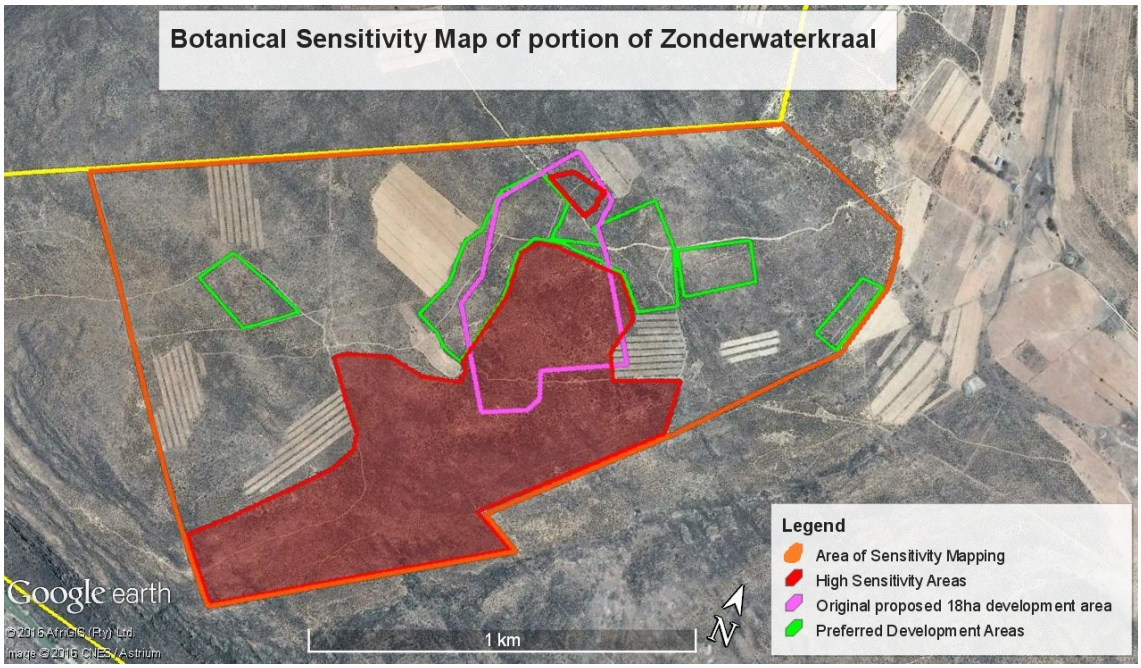

Figure 4: Botanical sensitivity map of a portion of Zonderwaterkraal. All unshaded areas within the mapped area are of Medium sensitivity (the natural vegetation, darker areas) or of Low botanical sensitivity (the cultivated, lighter areas).

Very High sensitivity areas have intact vegetation that supports irreplaceable plant populations or communities that are not known to occur elsewhere, or that occur elsewhere in only very low numbers. These areas often also support at least five plant Species of Conservation Concern. Very High sensitivity areas should be considered No Go areas for development. In this study no Very High sensitivity areas were identified.

7. IDENTIFICATION OF LIKELY IMPACTS

Any development usually has both direct and indirect impacts on the vegetation and ecology, and this would be the case with the proposed development. Direct impacts usually occur as a result of the construction or development phase, whilst the indirect impacts may occur at this stage but can also take place at the post development (operational) phase. Indirect impacts are often hard to observe and measure, but may in many cases be more significant than the direct impacts, although this is not usually the case in a partly natural agricultural landscape.

It is important to note that the original study area (see Figure 2) has been modified to exclude all the High sensitivity areas identified on site, as well as some rocky areas, and that the following assessment uses the original areas as the pre mitigation scenario, and the modified study areas (also shown in Figure 2, in green) as the post mitigation scenario.

7.1 Construction Phase Impacts

The development of about 20.6ha of new cultivation (original area, as shown in Figure 2) would effectively result in the permanent loss of nearly all existing natural vegetation (and most of the associated fauna and ecology) in the development footprint. The vegetation type to be impacted (Nardou Sandstone Fynbos) is regarded as a Vulnerable vegetation type at a regional and national scale (Pence 2014).

The proposed development (pre and post mitigation) would not result in the loss of any mapped Critical Biodiversity Areas.

The proposed development (pre mitigation) would result in the loss of the site populations of at least four different plant Species of Conservation (SCC; *Metalasia adunca, Leucospermum praemorsum, Leucadendron procerum and Annessorhiza sp nov*), and the latter three all have regionally significant populations within the largest proposed development area. All other direct botanical impacts would be relatively minor in relation to those noted above.

7.2 Operational Phase Impacts

Operational phase impacts will take effect as soon as the natural vegetation on the site is lost, and will persist in perpetuity, or as long as the area is cultivated. Operational phase impacts include loss of ecological connectivity across the sites (low - moderate

significance), habitat fragmentation (low - moderate significance), impact on natural fire regime (moderate significance), reduction in local populations of four threatened species and hence their local viability (moderate significance), and impacts on the associated animal fauna (probably of minor significance for all areas, mainly for invertebrates). All areas are for proposed rooibos tea lands (strips), which are likely to be regularly sprayed with various insecticides and fungicides, and spray drift is likely to have a significant negative impact (even if organic insecticides) on adjacent natural vegetation and fauna (notably the insects, which are key pollinators of many species).

8. IMPACT ASSESSMENT

8.1 Construction Phase Impacts

In the case of this project the primary construction phase impact is loss of natural vegetation within the new development footprint, which totals about 20.6ha.

For purposes of this assessment it is assumed that about 20.6ha of new cultivation will be undertaken, and this will be entirely within a Vulnerable vegetation type (Nardou Sandstone Fynbos). All of the areas to be cultivated are of Medium or High botanical sensitivity.

The proposed development (pre mitigation) would result in the loss of the site populations of at least four different plant Species of Conservation (SCC; *Metalasia adunca, Leucospermum praemorsum, Leucadendron procerum and Annessorhiza sp nov*), and the latter three all have regionally significant populations within the largest proposed development area. The only feasible mitigation for these species would be the first step in the mitigation hierarchy – complete avoidance.

No mapped CBAs will be lost within the proposed development footprint.

The loss of the High sensitivity vegetation, and the associated 4 SCC in the larger of the two focus areas (about 10.6ha) is likely to be of **High negative** botanical significance, before mitigation. The loss of the Medium sensitivity vegetation component (about 10ha) is likely to have a Low - Medium negative botanical impact.

Primary required mitigation is in this case would be modifying the development footprint to avoid all the mapped areas of High botanical sensitivity (which include all 4 SCC), and this has been done, as per the green polygons in Figure 2. This avoidance

mitigation is enough to reduce the direct botanical impacts of the development to Low - Medium negative.

Alternative	Extent of impact	Duration of impact	Intensity	Probability of occurrence	Degree of confidence	Significance before mitigation	Significance after mitigation
Two Development Areas (about 20.6ha)	Local	Permanent	High	Definite	High	High negative	Low – Medium negative
No Go alternative	Local	Unknown; possibly temporary	Neutral (but unknown)	High	Medium	Neutral	Not Applicable

Table 1: Impact table for Construction Phase botanical impacts associated with the proposed cultivation and loss of about 20.6ha of natural vegetation, plus loss of portion of local populations of at least 4 plant Species of Conservation Concern. Primary mitigation would be avoidance of all the High sensitivity areas, and reduction of the total footprint to 16.5ha.

8.2 Operational Phase Impacts

The most obvious operational phase impact is likely to be increased habitat fragmentation and loss of current terrestrial ecological connectivity across the cultivated parts of the focus areas. The overall intensity of this change is likely to be fairly low in a regional context, as no CBAs will be lost, and no essential or irreplaceable ecological corridors will be severed or interrupted, primarily because there is still fairly extensive natural habitat around the two study areas. Avoiding the High sensitivity areas will not mitigate this particular impact in any significant way.

Pesticide spray drift (especially under windy conditions often prevalent during spraying) into the adjacent natural veld is known to have a significant negative effect on the natural insect life and consequently on the pollination and seed set of various plants (Knight *et al* 2005; Pretorius 2010), and is thus likely to be an issue on most of the edges of the new development. Although its magnitude is very difficult to assess it is likely to be relatively low, at least in the areas more than 10m from the cultivated edges. Avoiding the High sensitivity areas will unfortunately in no way mitigate this particular impact.

High value standing crops such as rooibos fields obviously need to be protected from wildfires, and thus the adjacent areas of natural vegetation often also get protected from wildfire. This is likely to be a factor on this site, as the surrounding natural vegetation is both fire prone and largely fire dependant (Helme 2007; Cadman 2016). The conversion of large parts of the Bokkeveld escarpment from livestock grazing (when fire was used as a grazing management tool) to rooibos cultivation (active fire suppression) is in fact a major problem in terms of the negative impact on natural fire regimes (Helme 2007), and at least 70% of this region is now well overdue for a fire, with many areas not having been burnt for more than fifty years (pers. obs). Natural, optimal fire cycles in this area are likely to be in the order of once every 20 – 25 years, yet the vegetation on site is now well over forty years old. The negative impact on surrounding fire regimes (reduction in extent and frequency of fire) is thus likely to be one of the more significant negative botanical impacts, and is likely to be Medium negative. Avoiding the High sensitivity areas will unfortunately in no way mitigate this particular impact.

The loss of the site populations of the four recorded plant Species of Conservation Concern is likely to have a low - moderate negative impact on the metapopulations of these species, as the fewer plants may mean less successful pollination, outcrossing and seedset. This particular impact can be largely eliminated by avoiding the mapped High sensitivity areas.

Overall, combined, operational phase botanical impacts are likely to be of Medium negative significance before mitigation, and Low – Medium negative after mitigation.

Alternative	**Extent of impact**	**Duration of impact**	**Intensity**	**Probability of occurrence**	**Degree of confidence**	**Significance before mitigation**	**Significance after mitigation**
2 Development Areas (20.6ha)	Local	Permanent (at least for duration of cultivation)	Medium	Very likely	Medium - High	Medium negative	Low - Medium negative

No Go alternative	Local	Unknown; probably temporary	Very Low (but unknown)	Low	Medium	Neutral	Not Applicable

Table 2: Impact table for combined Operational Phase botanical impacts associated with the 20.6ha of proposed cultivation. Impacts include habitat fragmentation, pesticide drift and disruption of natural fire regimes. Primary mitigation would be the avoidance of the mapped High sensitivity areas, as well as possible controlled burns of the natural vegetation on the property.

8.3 The No Go Alternative

The No Go alternative usually implies the continuation of the status quo. In this case there would thus be no expansion of agriculture into currently natural vegetation (that would total about 20.6ha). There is currently livestock on the property, and existing rooibos fields, and grazing is a factor in most of the property, but is generally at acceptable levels, except around kraals and fields, but increasing stock levels could damage the vegetation in many areas. The property has a low carrying capacity and this landuse would not generate any significant income. And given the general lack of compliance by landowners in many regions (pers. obs.) there is always the real possibility of illegal cultivation, without any form of authorisation or mitigation, notwithstanding the threat of a fine of up to R5m.

On balance however, the No Go scenario (assuming no illegal cultivation) is likely to have no more than a Neutral botanical and ecological impact.

8.4 Cumulative Impacts

The cumulative botanical impacts of the proposed development are understood to be broadly equivalent to the regional botanical impacts, in that the vegetation type to be impacted by the proposed development has been, and will continue to be, impacted by numerous agricultural developments and other factors (the cumulative impacts) within the region. Agricultural expansion is by far the most important factor causing habitat loss in the region (Raimondo et al 2009), and there is currently something of a boom in the fruit and rooibos producing areas, and the author is currently involved with assessment of at least 800ha of new lands in this region, which is in itself a significant cumulative impact.

Because the development footprint is only 20.6ha, and significant natural vegetation still remains on the greater property, the overall cumulative botanical impact of the proposed development is Low - Medium negative before mitigation, and Low – Medium negative after mitigation.

9. REQUIRED MITIGATION

- No development or vegetation clearing should be authorised in the areas mapped as being of High botanical sensitivity (see Figure 4).
- Up to 16.5ha of new cultivation can instead be authorised in the four areas labelled in Figure 4 as “Preferred development areas”.

10. CONCLUSIONS AND RECOMMENDATIONS

- All proposed development areas are within Nardou Sandstone Fynbos, which is considered a Vulnerable vegetation type at a national and regional level (Pence 2014).
- Four plant Species of Conservation Concern (*Metalasia adunca, Leucospermum praemorsum, Leucadendron procerum and Annessorhiza sp nov*) were recorded in the High sensitivity areas, and within the assessed and originally proposed development area. The loss of the site populations of these species would be regionally significant and is thus not recommended.
- All mitigation outlined in Section 9 is considered reasonable and feasible, and is factored into the assessment, and is thus considered to be essential and mandatory. It is assumed that all mitigation proposed will be effectively and timeously implemented.
- Overall construction phase botanical impacts of the proposed 20.6ha development is considered to be an unacceptable High negative before mitigation. With the proposed mitigation (reduction to 16.5ha, and excluding all High sensitivity areas) this could be reduced to an acceptable Low – Medium negative.
- Overall operational phase botanical impacts of the proposed 20.6ha development is considered to be an acceptable Medium negative before mitigation. With the proposed mitigation this could be reduced to an even more acceptable Low – Medium negative.
- It is recommended that the modified, preferred development layout, as shown in green in Figures 2 and 4, be approved.

- A Search and Rescue program for the many plants within the development areas was considered, but none of the translocatable species known to occur on the development areas are so rare that they really need to be translocated, and secondly translocation itself would further disturb the receiving areas, and thus no program has been recommended. All translocatable species within the development areas are also well represented in the remaining natural areas on the greater property.
- Strip clearing is recommended over complete clearing of the approved areas, in order to minimise wind erosion and to aid rehabilitation of the areas if or when cultivation is abandoned.
- Given that the development will be in a fire prone and fire dependant ecosystem, and that the area is well overdue for a fire, consideration should be given to undertaking a few controlled burns on the property prior to development. This will require specialist input and management, but would be very beneficial for biodiversity in the long term, and would also substantially reduce the ever increasing risk of a runaway wildfire, by reducing the available fuel load for a period of at least ten years after the fire.

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HERITAGE IMPACT ASSESSMENT

PROPOSED CULTIVATION OF ROOIBOS TEA ON FARM 951 ZONDERWATERKRAAL, NEAR NIEUWOUDTVILLE HANTAM MUNICIPALITY, NORTHERN CAPE

Assessment conducted under Section 38 (3) of the National Heritage Resource Act (No. 25 of 1999)

Prepared for

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By

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SEPTEMBER 2016

EXECUTIVE SUMMARY

1. Introduction

ACRM was instructed by Footprint Environmental Services to conduct a Heritage Impact Assessment (HIA) for the proposed development of 21 ha of new Rooibos tea fields on Farm 951 Zonderwaterkraal (Hantam Municipality) near Niewoudtville in the Northern Cape Province.

The proposed tea fields will be located on deep sandy soils on a sloping plateau about 1.2 kms east of the Dooring River and about 50 kms south of Nieuwoudtville. Access to the farm is via Moedveloer, a gravel road that eventually connects with the R364 to Calvinia / Clanwilliam.

The establishment of the new fields entails the clearance of natural vegetation, firstly by brush cutting. 10m wide strips of vegetation are retained between the cultivated fields to serve as a refuge for beneficial insects and to provide wind beaks to prevent erosion. Cleared vegetation will either be removed from the fields and ploughed back into the soils, or moved to adjacent fields where it will decompose naturally.

2. Aim of the HIA

The overall purpose of the HIA is to assess the sensitivity of archaeological resources in the proposed new fields, to determine the potential impacts on such resources, and to avoid and/or minimise such impacts by means of management and/or mitigation measures.

According to consulting palaeontologist, Dr John Almond, the proposed development site / Farm 951 `are underlain by fluvial sandstones of the Rietvlei Formation (uppermost Table Mountain Group) that are of low palaeontological sensitivity'.

3. Results of the HIA

A site assessment was undertaken on the 01 September 2016, in which the following observations were made:

One broken Later Stone Age silcrete flake of *low* (Grade 3C) significance was recorded during the study.

4. Conclusion

The proposed activity will not impact on significant archaeological heritage.

No settlement sites or evidence of human occupation were found during the baseline study.

Indications are that, in terms of archaeological heritage, the proposed new fields are not a sensitive landscape.

The impact significance of the proposed development on archaeological heritage is therefore assessed as LOW.

5. Recommendations

1. No archaeological mitigation is required.

2. If any other unmarked human remains, or ostrich eggshell caches, for example, are exposed or uncovered during excavations these must immediately be reported to Heritage Western Cape (Att: Ms Natasha Higgit 021 462 4509), or the contracted archaeologist (Jonathan Kaplan 082 321 0172).

3. The above recommendations must be incorporated into the Environmental Management Plan (EMP) for the proposed development.

Table of Contents

1. INTRODUCTION

ACRM was instructed by Footprint Environmental Services, on behalf of Mr G Koopman to conduct a Heritage Impact Assessment (HIA) for the proposed cultivation of new Rooibos tea fields on Farm 951 Zonderwaterkraal (Hantam Municipality), near Nieuwoudtville in the Northern Cape Province (Figures 1 & 2).

The proposed tea fields will be located on deep sandy soils on a sloping plateau about 1.2 kms east of the Dooring River and about 50 kms south of Nieuwoudtville. Access to the farm is via Moedveloer, a gravel road that eventually connects with the R364 to Calvinia / Clanwilliam.

The applicant intends to expand the current Rooibos tea production potential on Farm 951 by developing an additional 21 ha of new tea fields. A limited amount of Rooibos is currently grown on the farm.

Footprint Environmental Consultants is the appointed independent Environmental Assessment Practitioner (EAP) responsible for facilitating the assessment process.

2. THE DEVELOPMENT PROPOSAL

Two new tea fields (A & B) are planned, of which field A (18ha) is the largest (Figure 3). The establishment of the new field lands entails the clearance of natural vegetation, firstly by brush cutting. 10m wide strips of vegetation are retained between the cultivated fields to serve as a refuge for beneficial insects and to provide wind beaks to prevent erosion. Cleared vegetation will either be removed from the fields and ploughed back into the soils, or moved to adjacent fields where it will decompose naturally.

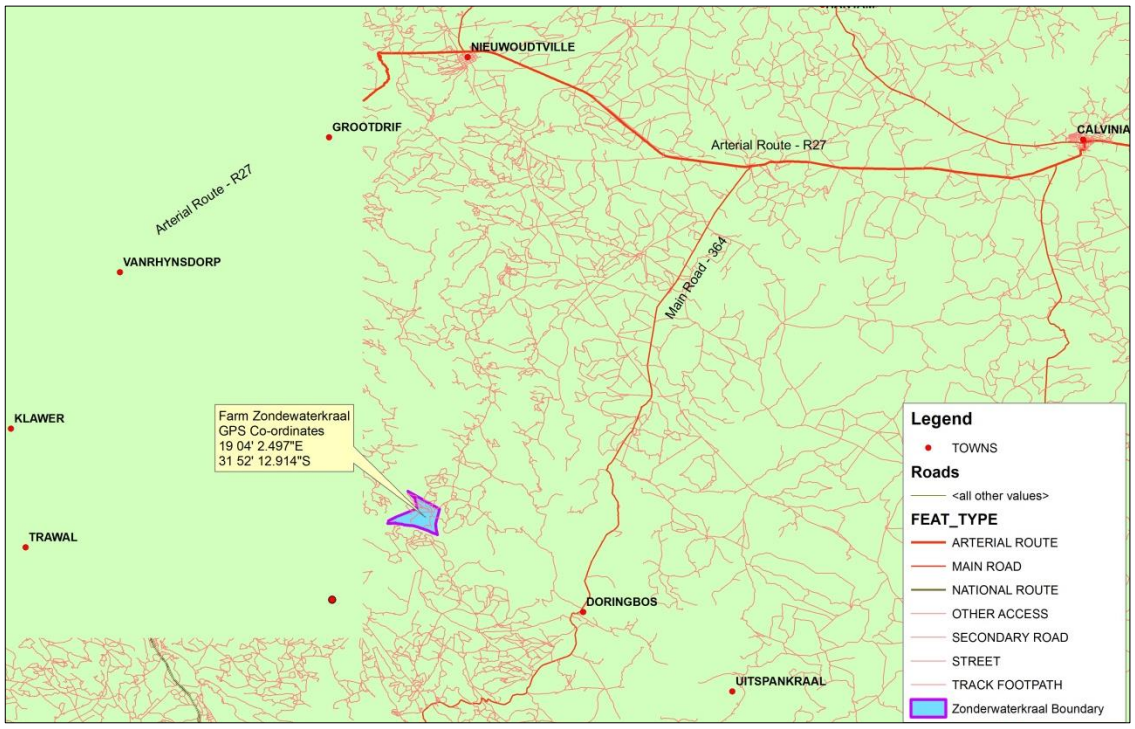

Figure 1. Locality map, Farm 951/0 Zonderwaterkraal.

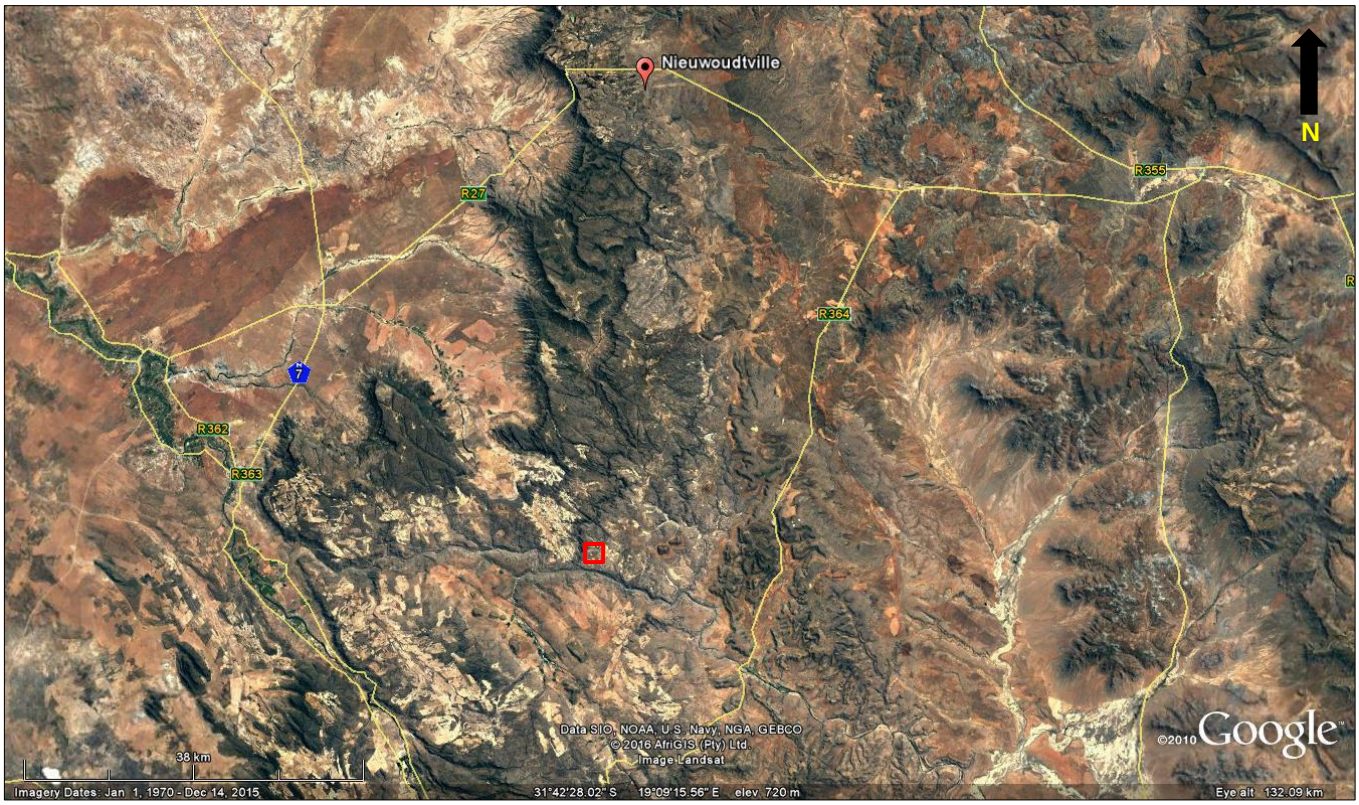

Figure 2. Google map indicating the location of the proposed new Rooibos tea fields on Farm 951/0, Nieuwoudtville. Red polygon indicates the location of the study site

Figure 3. Zonderwaterkraal development: Proposed layout of new Rooibos tea fields (A & B)

3. HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA No. 25 of 1999) protects archaeological and palaeontological sites and materials, as well as graves/cemeteries, battlefield sites and buildings, structures and features over 60 years old. The South African Heritage Resources Agency (SAHRA) administers this legislation nationally, with Heritage Resources Agencies acting at provincial level. According to the Act (Sect. 35), it is an offence to destroy, damage, excavate, alter of remove from its original place, or collect, any archaeological, palaeontological and historical material or object, without a permit issued by the SAHRA or applicable Provincial Heritage Resources Agency, *viz*. Heritage Western Cape (HWC).

Notification of SAHRA is required for proposed developments exceeding certain dimensions (Sect. 38), upon which they will decide whether or not the development must be assessed for heritage impacts (an HIA) that may include an assessment of archaeological (a AIA) or palaeontological heritage (a PIA).

4. TERMS OF REFERENCE

The terms of reference for the study were to:

- Determine whether there are likely to be any important archaeological resources that may be impacted by the proposed development;

- Indicate any constraints that would need to be taken into account in considering the development proposal;

- Identify possible `No-Go` areas, and

- Recommend mitigation action

5. DESCRIPTION OF THE RECEIVING ENVIRONMENT

Zonderwaterkraal is located about 50 kms south of Niewoudtville. The farm is accessed via the Moedveloer road, which eventually connects with the R364 to Calvinia / Clanwilliam. The proposed new fields are located on deep, light-yellow coloured sandy soils on a sloping plateau about 1.2 kms east of the Dooring River. The affected fields slope slightly to the south, south / west, and are covered in a mix of Restio grasses, shrubs and large, mature Protea trees (Field A) with open patches of loose sandy soils. There are no significant landscape features on the proposed development sites, although a small outcropping of sandstone occurs in the northeastern portion of Field A, alongside existing fields of Rooibos tea (Figures 4-8). There is very little surface stone in the affected fields.

Surrounding land use comprises existing tea fields, and vast tracts of vacant agricultural land.

Figure 4. Proposed new Rooibos tea fields (Field A), Farm 951. View facing south west

Figure 5. Proposed new Rooibos tea fields (Field A), Farm 951. View facing west

Figure 6. Proposed new Rooibos tea fields (Field A), Farm 951. View facing south west

Figure 7. Proposed new Rooibos tea fields (Field B), Farm 951. View facing south

Figure 8. Proposed new Rooibos tea fields (Field B), Farm 951. View facing north

6. STUDY APPROACH

6.1 Method

The purpose of the HIA is to assess the sensitivity of archaeological resources in the study area, to determine the potential impacts on such resources, and to avoid and/or minimize such impacts by means of management and/or mitigation measures

The significance of archaeological resources was assessed in terms of their content and context. Attributes considered in determining significance include artefact and/or ecofact types, rarity of finds, exceptional items, organic preservation, potential for future research, density of finds and the context in which archaeological traces occur.

The field assessment was undertaken by ACRM on 01 September 2016. The position of identified archaeological resources, were plotted using a hand held GPS unit set on the map datum wgs 84.

A track path of the survey was also captured. A literature survey was carried out to assess the heritage context surrounding the proposed development site.

According to consulting palaeontologist, Dr John Almond (email correspondence dated 21 November 2015), the proposed development site / Farm 951 `is underlain by fluvial sandstones of the Rietvlei Formation (uppermost Table Mountain Group) that are of low palaeontological sensitivity'.

6.3 Constraints and limitations

While vegetation cover was sometimes quite thick on the ground, there were no constraints or limitations associated with the study. Mobility over the site was fairly easy.

6.4 Identification of potential risks

The results of the study indicate there are no archaeological risks associated with the proposed development of new Rooibos tea fields.

7. ARCHAEOLOGICAL HERITAGE

In terms of archaeological heritage, the Nieuwoudtville area has not been very well documented, although one or two selective surveys have been undertaken. A few studies are listed on the SAHRIS website but these do not have any bearing on the current study. Numerous surveys have been undertaken near Loeriesfontein by this archaeologist and others, but the town is located more than 50kms north of the town.

An large number of rock art sites, including a few small artefact scatters occur at the Oorlogskloof Nature Reserve (Webley & Orton 2012, & personnel observation) a few kilometers outside Niewoudtville, alongside the R27 just before one enters the village, while rock art sites also occur on the Farms Paapkuilsfontein and Sewefontein about 25kms south of the town (personnel observation). Dispersed scatters of Later Stone Age remains, and isolated Middle Stone Age implements have also been found by this archaeologist at Sewefontein.

Hollmann (1993) did a survey of rock paintings in the Koebee River Valley, a tributary of the Doorn River, located to the south of Oorlogskloof, near Niewoudtville, while Humphreys *et al* (1991) have described rock art sites to the east of the Koebee River. At Oorlogskloof, Hollmann (1993) describes paintings of eland hartebeest, fat-tailed sheep scratches, palettes and handprints. Amschwand (2009) describes stone walling in the Onder Bokkeveld “which may indicate the presence of pastoralists”, as well as pottery and rock art considered to be of Khoekhoen origin.

According to Webley and Orton (2012), Khoisan presence in the `Onder Bokkeveld’ in the 1720s and 1730s discouraged early colonial settlement. In 1739 a Boer commando attacked Captain Jantje Klipheuwel‟s farm in the Bokkeveld. At least 13 Khoisan were killed during this raid. The place was subsequently named “Oorlogskloof” – a name it retains to this day. The commando continued to scour the Bokkeveld for any further kraals. A kraal was later attacked near Doorn River and 17 Khoisan were killed. These tactics eventually put an end to an independent Khoisan existence in the Bokkeveld. The trekboers later moved into the Onder Bokkeveld and by 1770s the Bokkeveld was completely settled by white colonists (Webley & Orton 2012; Penn 2005).

8. FINDINGS

One broken silcrete flake (Site 661 GPS reading 31°52'5.04"S 19° 3'11.04"E), was located in Field A, while no archaeological heritage was encountered in Field B (Figure 9).

No graves or typical grave markers were found.

Grading of the archaeological resources: *low* (Grade 3C)

Figure 9. Google satellite map of the proposed Rooibos fields (A & B) on Farm 951. Blue lines are track paths. Note the surrounding tea fields

9. CONCLUSION

The proposed activity (i. e. cultivation of new Rooibos tea fields) is not likely to impact on significant archaeological heritage.

No settlement sites or evidence of human occupation were found during the study of the affected landholdings.

Indications are that, in terms of archaeological heritage, the proposed new fields are not a sensitive landscape.

The impact significance of the proposed development on important archaeological heritage is therefore assessed as LOW.

10. RECOMMENDATIONS

With regard to the proposed development of new Rooibos tea fields on Farm 951 Zonderwaterkraal near Nieuwoudtville, the following recommendations are made:

1. No mitigation is required prior to development activities commencing.

2. If any other unmarked human remains, or ostrich eggshell caches, for example, are exposed or uncovered during excavations these must immediately be reported to Heritage Western Cape (Att: Ms Natasha Higgit 021 462 4509), or the contracted archaeologist (Jonathan Kaplan 082 321 0172).

3. The above recommendations must be incorporated into the Environmental Management Plan (EMP) for the proposed development

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ROOIBOS SOIL REPORT

COMPLETE SOIL INVESTIGATION SURVEY TO ASCERTAIN THE SUITABILITY FOR THE CULTIVATION OF VIRGIN SOIL FOR THE PRODUCTION OF ROOIBOS TEA AT SONDERWATERKRAAL AND TWEERIVIER, NIEUWOUDTVILLE AREA, NORTHERN CAPE PROVINCE.

CONTRACT: NC/DALLET/0128, PROJECT NR: 31630

3 DECEMBER 2014

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BVi Consulting Engineers

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INTRODUCTION AND BACKGROUND

BVi Consulting Engineers was appointed to do a complete soil investigation at Sonderwaterkraal and Tweerivier, near Nieuwoudtville in the Northern Cape Province. The purpose of the investigation is to ascertain the suitability of virgin soil for the production of rooibos tea.

Originally approximately 26ha was identified for the soil investigation. However after consultation with the Department of Agriculture and local community members, approximately 39ha was identified and investigated.
The proposed development consists of 2 areas at Sonderwaterkraal and 3 areas at Tweerivier.

The proposed area was surveyed, and profile pits were set out on a 100m x 100m grid. The profile pits were prepared by a local contractor and filled-up after completion of the soil pit investigation.

BVi requested the services of Digital Soils Africa, under direction of Dr Pieter le Roux to assist with the soil investigation. Dr le Roux is very well known in the field of soil science and is an expert in this area.

The field work was completed in September, where after the chemical analysis and reporting was done.

Please find attached the complete soil report for Sonderwaterkraal and Tweerivier. The contour map is also available in electronic format.

I trust that the report provides the necessary information as required. Please contact me should you require any further information.

M. PRETORIUS Pr. Eng.

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Soil Suitability for Rooibos Tea Production

A soil survey to ascertain the suitability for cultivation of virgin soil for the production of Rooibos tea at Tweerivier and Sonderwaterkraal, Nieuwoudtville area, Northern Cape Province.

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EXECUTIVE SUMMARY

The sandy, acid Clovelly soils of these farms are suitable for production of Rooibos Tea and meet all the norms of the Department. Lack of research on the required soil water regime expressed in soil depth x rainfall requirements of Rooibos Tea, the minimum soil depth was set at 1 m. This boundary should be applied cautiously as the soils has a morphology indicating a wet subsoil that can store water and is getting interflow water from upslope. Rooibos Tea is drought resistant and recorded to grow wild on very shallow soils. Areas indicated as suitable have a relatively wet soil water regime. It stores water deep with limited soil evaporation (because it is sand), it stores draining water in the deep subsoil and make it available between rain events (as the underlying sandstone is impermeable) and receive water from higher lying Mispah soils (water flows on the impermeable layer).

The climate is suitable. The farms are close to the scarp and higher rain is expected here. Rainfall is expected to drop drastically and temperatures to rise, lowering effective rain, to the inland. It also explains why the farms are on the edge of the Rooibos Tea production area. Rooibos Tea grows wild on the sites and shows vitality in spite of being harvested regularly for “Wild Rooibos Tea” which has a very high market value. The two farmers currently produce organic Rooibos Tea as a sole and main income respectively.

Potential degradation hazards are soil compaction by mechanical operations and wind erosion. These limitations need to be addressed right from the beginning.

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1. INTRODUCTION

Soil surveys are important for effective planning and optimization of land use, decreasing the risk of land degradation and increasing the benefit of effective management. Soil suitability for dry land cropping is very dependent on soil type, effective depth and intended crop, with different scenarios requiring a different management practice for optimized results.

The main objective was to map the soils Sonderwaterkraal and Tweerivier and interpret the morphology, chemistry in terms of suitability for Rooibos Tea production. The properties limiting the suitability of the soils and precautionary measures normally recommended for sustained use will also be given.

1.1. Site Description

Sonderwaterkraal and Tweerivier is situated roughly 55 km south of Nieuwoudtville, Northern Cape Province (Figure 1.1).

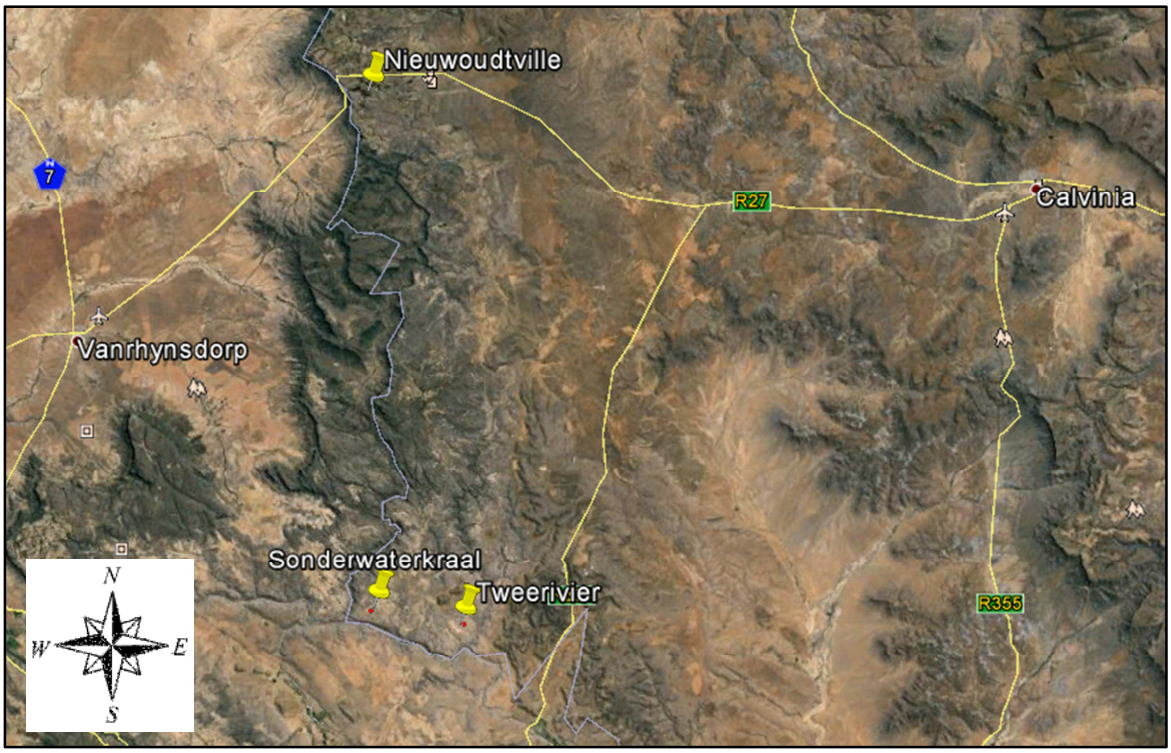

Figure 1.1 Location of Sonderwaterkraal and Tweerivier, Northern Cape Province.

Nieuwoudtville has a Mediterranean climate, receiving most of the 250 m.a.p. in the winter (Figure 1.2). The rainfall peaks in June, July and August, with the least rain in December, January and

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February. The average monthly temperatures are seen in Figure 1.3. The average daily temperatures range from 30.1 C in summer to 17 C in in winter.

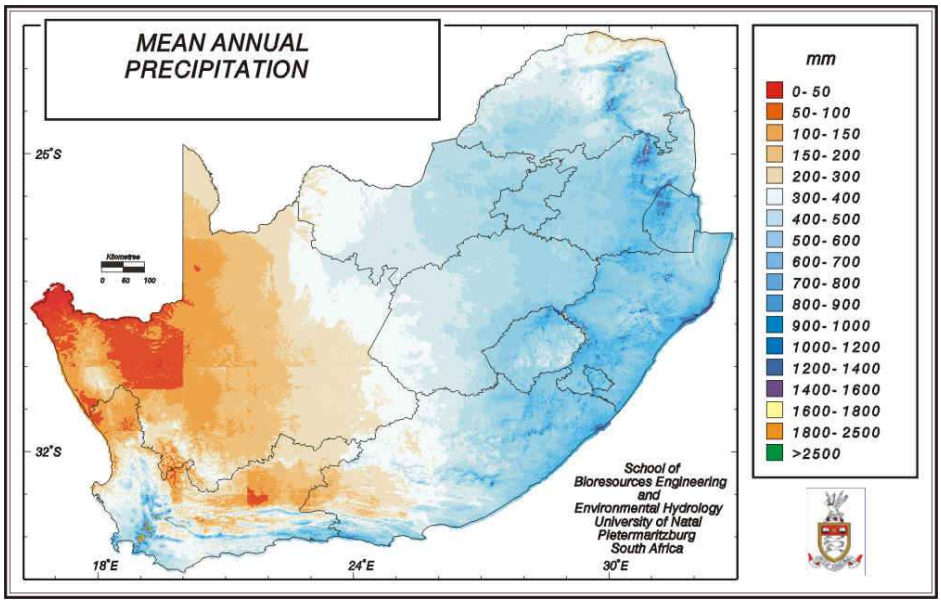

Figure 1.2 Mean Annual Precipitation of South Africa

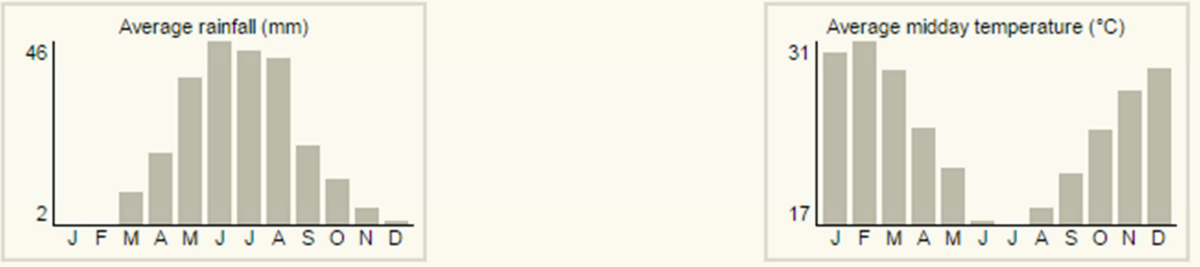

Figure 1.3 Average monthly rainfall and midday temperatures of Nieuwoudtville.

2. METHODOLOGY

The survey consisted of 44 profiles, the procedure included the identification and demarcation of master horizons. Diagnostic horizons were described and classified according to Soil Classification Working Group (1991). Samples were taken from representative soil profiles from each diagnostic horizon. pH was measured using 1.0 N KCl extract at 1:2.5 ration. The P content was measured using a spectrophotometer and a Bray I extract 1:7.5 ratio. Two methods were used in determining the cation concentrations. Firstly the soil was leached with Ammonium Acetate extract with a 1:10 ratio and Trace elements were calculated by an 0.1 N HCl extract at a 1:2.5 ratio. Secondly cations were determined by the Mehlich III extract with a 1:10 ratio. The CEC was determined by saturation of

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Ammonium Acetate and extracted by 1.0 N KCL. Hydrometer was used to calculate the texture of the samples.

3. RESULTS

3.1. Soil Classification

Soil Form	Master Horizon	Diagnostic Horizon
Clovelly (Cv)	A	Orthic
	B	Yellow-brown apedal B horizon
	C	Unspecified

3.2. Morphological Properties

The Clovelly soils with slightly darkened Orthic A horizon, yellow-brown apedal B horizons as subsoil and underlying fractured rock, as is the case in these sites, are freely drained soils. Red accumulations in the fractured quartzite underlying the Clovelly varies from hardened concretions formed around quartzite fractures to hardened surfaces of quartzite fractures and soft impregnated quartzite fractures and solid rocks.

3.3. Chemical Properties

The pH of the soils varies from very strongly acidic to neutral. It is generally low throughout the profile. The K and Ca contents are low and the Na and Mg concentration very low. The CEC is extremely low due to a low clay content and humus content.

There is a difference in soil chemical properties between the two areas surveyed. There is an increase in CEC in the profiles at Sonderwaterkraal, thereby increasing cation concentration in the soil. Even with increase in chemical properties the properties are still low.

Table 1 Selected soil chemical properties.

Ref No	pH (KCl)	K	Na	Ca	Mg	CEC
		mg/kg	mg/kg	mg/kg	mg/kg	cmol(c)/kg
N1.1	4.38	37	9	70	6	0.62
N1.2	4.06	41	8	33	7	0.48
N9.1	4.59	22	8	26	5	0.21
N9.2	4.01	20	6	14	1	0.43
N18.1	4.84	40	7	35	7	0.28
N18.2	5.28	35	8	38	10	0.32
N22.1	6.31	34	13	46	12	0.40

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Ref No	pH (KCl)	K	Na	Ca	Mg	CEC
N22.2	4.30	34	9	25	8	0.49
N27.1	4.51	30	6	39	13	0.36
N27.2	4.37	28	5	18	2	0.14
S15.1	5.74	121	29	1005	38	3.48
S15.2	6.20	51	241	2316	20	6.42
S15.2	6.01	31	411	2261	15	5.22
S17.1	6.29	61	8	918	24	2.46
S17.3	6.24	32	16	2381	10	8.33
S19.1	5.80	97	7	1236	30	4.67
S19.2	6.57	146	31	1970	37	5.43
S19.3	6.37	26	76	2301	10	9.21
S21.1	6.59	90	12	1708	25	6.42
S21.3	6.85	40	101	2740	15	8.32
S23.1	6.03	79	25	1319	43	5.14
S23.2	6.74	30	48	2130	15	7.76
S23.3	6.12	38	56	1612	16	4.33
S25.1	6.56	234	138	2243	76	7.28
S25.2	6.39	30	17	394	14	1.06
S25.3	6.03	34	60	2315	38	8.63
S1.1	5.38	22	8	61	6	0.31
S1.2	4.35	17	7	27	6	0.28
S7.1	4.11	19	12	37	6	0.33
S7.2	4.40	17	9	14	3	0.24
S23.1	4.47	41	16	50	12	0.51
S23.2	4.23	34	10	51	15	0.46

Table 2 General interpretation of pH ranges (Bruce & Raymond, 1982)

pH	Rating
>9	Very strongly alkaline
9 - 8.5	Strongly alkaline
8.4 - 7.9	Moderately alkaline
7.8 - 7.4	Mildly alkaline
7.3 - 6.6	Neutral
6.5 - 6.1	Slightly acid
6 - 5.6	Moderately acidic
5.5 - 5.1	Strongly acidic
5 - 4.5	Very strongly

The low chemical values are probably more a result of the very low base status rather than leaching (Table 3). The low clay contents prohibit high CEC.

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Table 3 Different concentrations of Ca, Mg, Na and K in soil (Metson, 1961)

Cation	Very low	Low	Moderate	High	Very high
Ca mg/kg	0- 400	400 - 1000	1000-2000	2000-4000	>4000
Mg mg/kg	0- 35	35- 120	120- 360	360-970	>970
Na mg/kg	0- 23	23- 70	70- 160	160- 460	>460
K mg/kg	0- 80	80- 120	120- 275	275- 780	>780

3.4. Physical Properties

The clay content of the soils is very low. The difference in chemistry does not correlate with texture of the soil the soil texture is relatively similar at both sites.

Table 4 Particle size distribution and textual class

Ref No	Clay (%)	Silt(%)	Sand(%)	Texture class
	8	2	90	Sand
N1.1	8	2	90	Sand
N1.2	8	2	90	Sand
N9.1	8	2	90	Sand
N9.2	8	2	90	Sand
N18.1	8	2	90	Sand
N18.2	8	2	90	Sand
N22.1	8	2	90	Sand
N22.2	8	2	90	Sand
N27.1	8	2	90	Sand
N27.2	8	3	89	Sand
S15.1	8	5	87	Sand
S15.2	10	5	85	Sand
S15.2	6	4	90	Sand
S17.1	10	10	80	Loamy Sand
S17.3	6	2	90	Sand
S19.1	8	2	90	Sand
S19.2	10	8	82	Loamy Sand
S19.3	6	3	91	Sand
S21.1	10	6	84	Loamy Sand
S21.3	6	5	89	Sand
S23.1	6	9	85	Sand
S23.2	8	5	87	Sand
S23.3	8	8	84	Loamy Sand
S25.1	6	4	90	Sand
S25.2	8	6	86	Sand
S25.3	8	2	90	Sand
S1.1	8	2	90	Sand
S1.2	8	14	78	Loamy Sand

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Ref No	Clay (%)	Silt(%)	Sand(%)	Texture class
S7.1	8	2	90	Sand
S7.2	8	2	90	Sand
S23.1	8	2	90	Sand
S23.2	6	4	90	Sand

4. SUITABILITY FOR ROOIBOS TEA PRODUCTION

4.1. Environmental indicators

Both farmers are cultivating Rooibos Tea on their farms as a primary income. Wild Rooibos Tea plants are growing on the areas delineated for potential cultivation. The farms are on the edge of the scarp expected to get more rain than the inland plato.

4.2. Soil morphology

The deep, sandy Clovelly soil with some oxidation morphology in the saprolite is suitable for dryland cropping of Rooibos Tea. The depth criterion should be applied with care as the soil stores large amounts of water in the deep subsoil.

The texture of the soils are sandy and will therefore water infiltration during rain will be high, enhancing the effectivity of rain. The rain water will also be stored deep in the subsoil limiting soil evaporation. The water holding capacity is limited by the sandy nature of the soil but the soil depth and impermeable underlying quarzitic sandstone stores large amounts of water. Redoximorphic features in the fractured rock are an indication that water accumulates on underlying impermeable rock. Due to the slope of the land the water table forming in the fractured rock, water will flow down slope in the deep subsoil and fractured rock. This water will be available for established crops and increase production.

4.3. Soil chemistry

The acidic, leached sand is typical of the soils of the area where Rooibos are cultivated (Lötter & Maitre, 2014).

4.4. Soil fertility

The intention of the farmers is to do organic farming excluding fertilisation of any kind.

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4.5. Agronomic potential

No research results are available to guide evaluation of soil analysis for Rooibos Tea. It grows under annual rainfall as low as 250 mm and soils as shallow as 70mm (Lötter & Maitre, 2014). Roots grow deeper than 2m. It requires well drained sandy soil with pH between 4.5 en 5.5 and low P levels of less than 25 ppm. The area is climatically marginal.

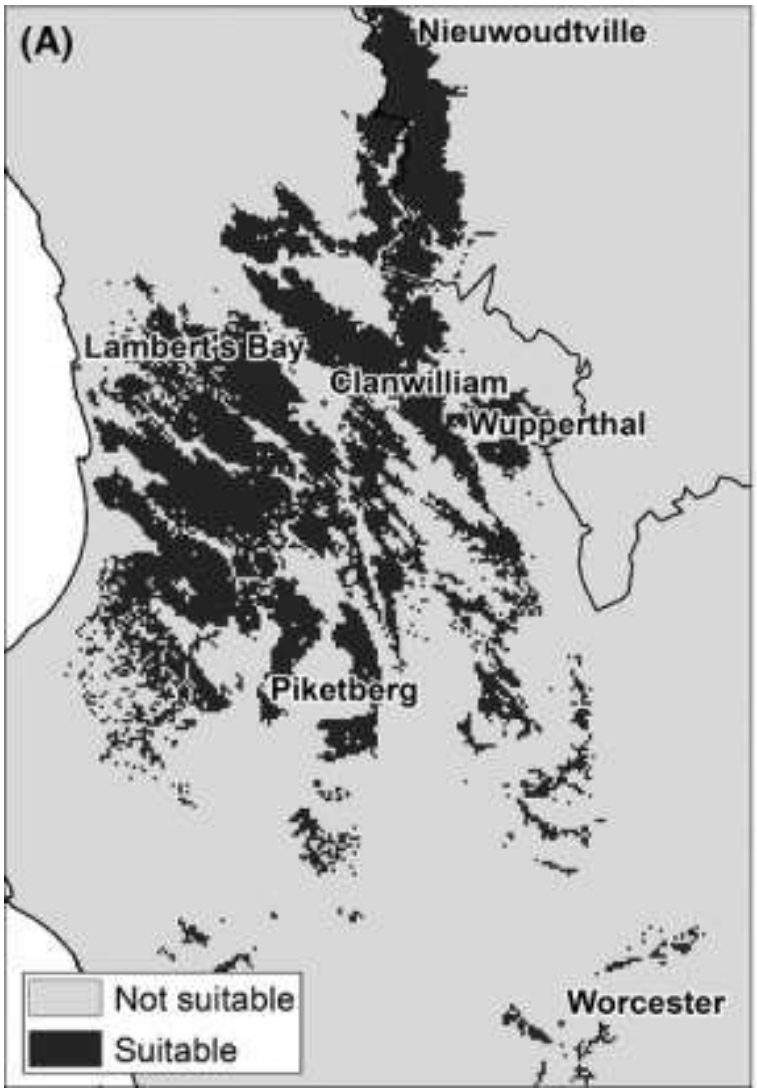

Figure 4.5 Suitability areas for Rooibos Tea (Lötter & Maitre, 2014).

5. MAPS

Soil class and depth maps for five areas are presented, three for Tweerivier (N1, N2 and N3) (Figures 5.1 and 5.2) and two for Sonderwaterkraal (S1 and S2) (Figures 5.3 and 5.4).

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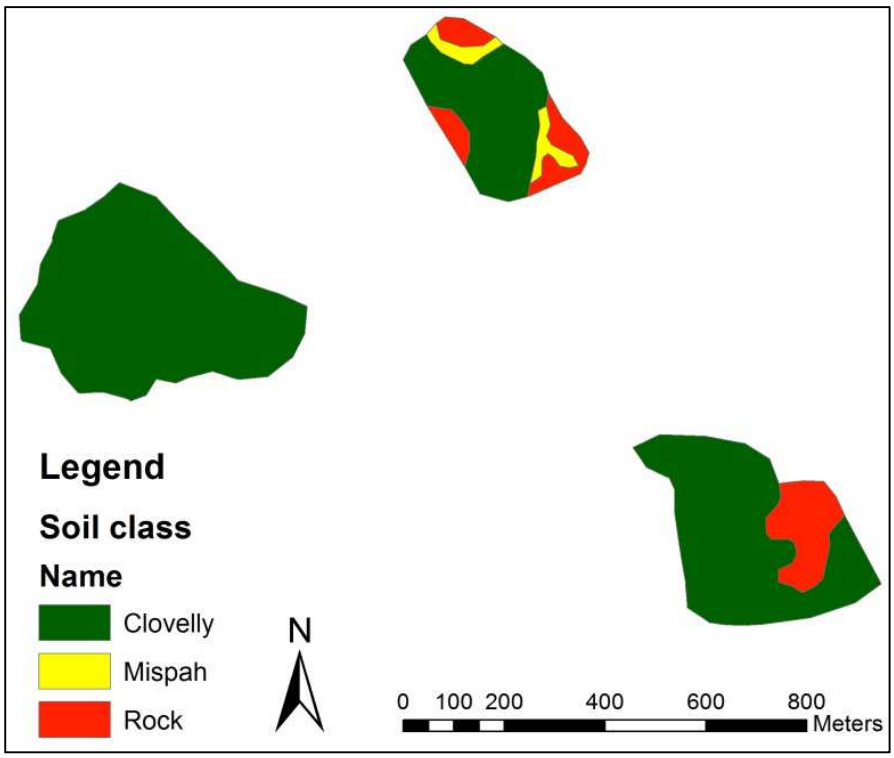

Figure 5.1: Soil class map for the three areas of Tweerivier farm

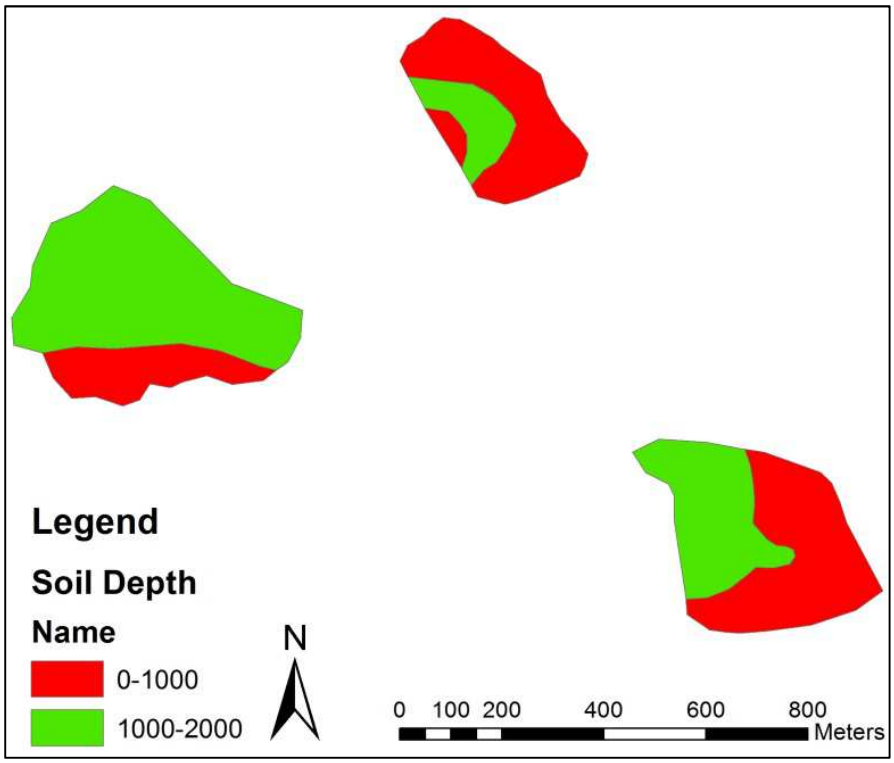

Figure 5.2: Soil depth map for the three areas of Tweerivier farm

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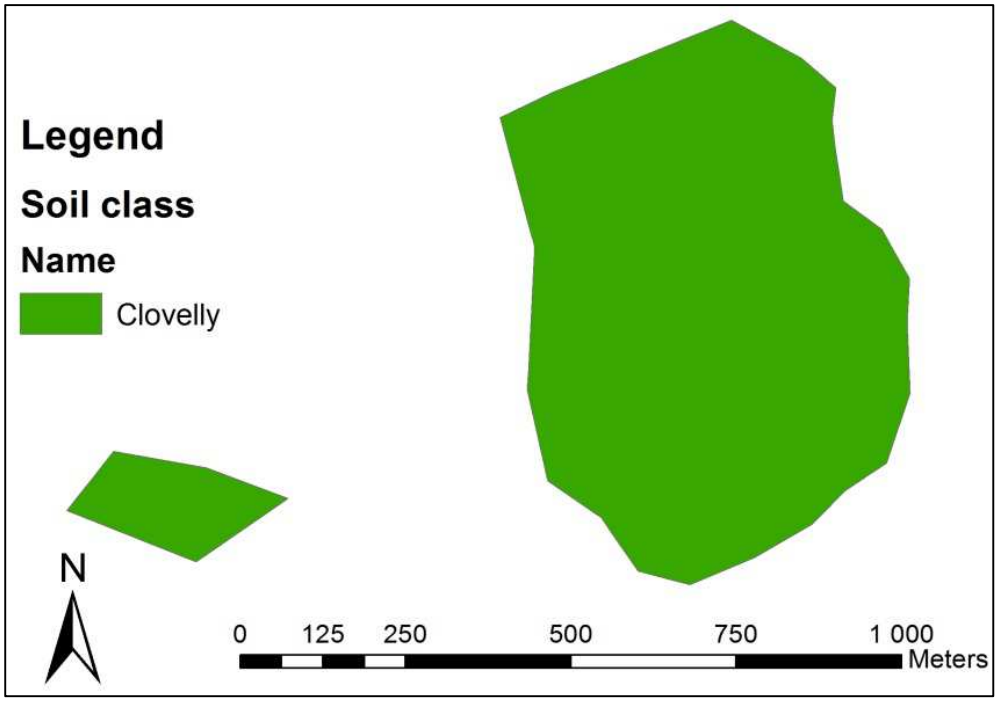

Figure 5.3: Soil class map for the two areas of Sonderwaterkraal

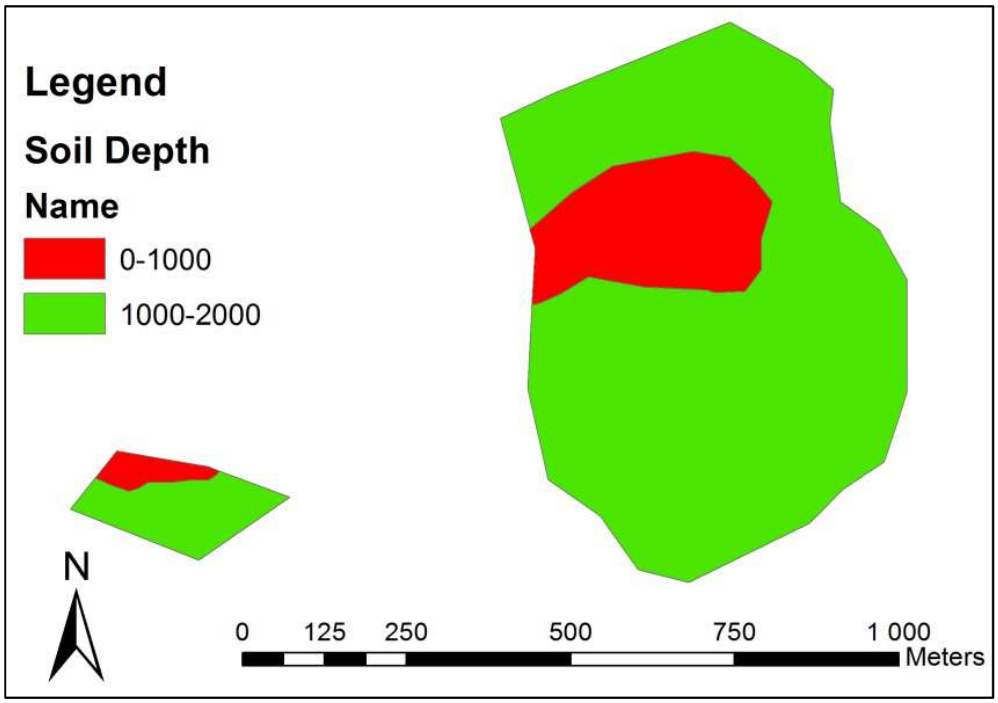

Figure 5.4: Soil depth map for the two areas of Sonderwaterkraal

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6. RECOMMENDATIONS

Both farmers currently produce organic Rooibos Tea as a main income. This implies that the climate is suitable. Rooibos Tea grows wild on the sites earmarked for cropping. The farms are close to the edge of the scarp suggesting a localised high rainfall.

The Clovelly soils of these farms are suitable for production of Rooibos Tea and meet all the norms of the Department. Lack of research on the depth x climate requirement of Rooibos Tea the minimum soil depth was set at 1 m. This should be applied cautiously as the soils are getting interflow water from upslope and the crop is drought resistant. The terrain is shelving and the transition from 1m deep Clovelly soils to Mispah soils and rock outcrops quite narrow.

Areas indicated as suitable have a relatively wet soil water regime. It stores water in the deep subsoil and receive water from higher lying soils. Although the farms are on the boundary of the Rooibos Tea production area and reliable climate data is not available, the soils indicate relatively wet conditions.

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Appendix 1

Modal profile Description and photograph

Profile No		S2	Soil type	Clovelly (Cv)			Soil Family			Setlagole (3100)
Latitude		19.13477472					Slope			0
Longitude		-31.89081545					Planform curvature			VV
Surface stoniness		Very few					Profile curvature			VV
Chemical weathering		Subsoil					TMU			1
Parent material		In situ weathering sandstone					Occurrence of Flooding			No
Geology		Sandstone					Vegetation			Shrub
Master Horizon	Depth (mm)	Diagnostic Horizon	Transition	Structure			Soil Colour	Mottling	Comment	
				Type	Size	Grade				
A	0-80	ot	Clear	Apedal	Single grain	-	7.5 YR 6/4 (Dry) 7.5 YR 5/4 (Wet)	None	-	
B	80-3000	ye	-	Apedal	Single grain	-	7.5 YR 6/4 (Dry) 7.5 YR 5/4 (Wet)	None		

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Photograph of modal profile (N2)

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Appendix 2

Soil observations

Sonderwaterkraal					Tweerivier				
Obs	Latitude	Longitude	Soil type	Depth (mm)	**Obs**	Latitude	Longitude	Soil type	Depth (mm)
S1	19.04735	-31.86818611	Cv	1200	**N1**	19.13312	-31.8895528	Cv	500
S2	19.04592778	-31.86856944	Cv	2000	**N3**	19.13465	-31.8897722	Cv	800
S3	19.04502778	-31.86808333	Cv	2000	**N4**	19.1337	-31.89025	Cv	1200
S4	19.04545833	-31.86747222	Cv	1000	**N6**	19.13521	-31.8905972	Cv	700
S5	19.04643333	-31.86771944	Cv	500	**N7**	19.13574	-31.8913583	Ms	200
S6	19.05186111	-31.86588889	Cv	600	**N8**	19.13492	-31.8918	Cv	500
S7	19.05236111	-31.86666389	Cv	2000	**N9**	19.13842	-31.8977694	Cv	1500
S8	19.05289167	-31.86748611	Cv	2000	**N10**	19.13881	-31.898625	Cv	1300
S9	19.05353889	-31.86816667	Cv	2000	**N11**	19.13902	-31.8995111	Cv	550
S10	19.05433333	-31.86775278	Cv	2000	**N12**	19.14008	-31.8992056	Cv	950
S11	19.05474167	-31.86654167	Cv	2000	**N14**	19.13974	-31.8982444	Cv	1000
S12	19.055175	-31.86530833	Cv	2000	**N16**	19.1407	-31.8980472	Cv	600
S13	19.05558333	-31.86605833	Cv	2000	**N17**	19.1411	-31.8988444	Cv	650
S14	19.05445278	-31.86577778	Cv	2000	**N18**	19.13904	-31.8974083	Cv	1200
S15	19.05453333	-31.86447778	Cv	1600	**N19**	19.13875	-31.8971139	Cv	1500
S16	19.05365556	-31.86503889	Cv	450	**N20**	19.1384	-31.896625	Cv	1800
S18	19.05296389	-31.86539444	Cv	2000	**N21**	19.13754	-31.8968361	Cv	1800
S19	19.05338889	-31.86631111	Cv	2000	**N22**	19.12729	-31.8943722	Cv	2000
S20	19.05391314	-31.86689736	Cv	2000	**N23**	19.12827	-31.8943731	Cv	2000

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S21	19.0514186	-31.86782334	Cv	600	**N24**	19.12935	-31.8942361	Cv	2000
S22	19.05179722	-31.863875	Cv	2000	**N25**	19.12939	-31.8950833	Cv	600
S23	19.05236944	-31.86316389	Cv	1200	**N26**	19.12828	-31.8951722	Cv	400
S24	19.05288611	-31.86246944	Cv	2000	**N27**	19.13448	-31.8918028	Cv	800
S25	19.05393889	-31.86290278	Cv	450					
S26	19.05325278	-31.86368889	Cv	2000					

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Appendix 3

Table 1 Soil chemical properties with Ammonium Acetate extraction results

Ref No	pH (KCl)	PBray1	K	Na	Ca	Mg	EA.KCl	%Ca	%Mg	%K	%Na	ACID SAT
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(c)/kg	%	%	%	%	%
N1.1	4.38	3	37	9	70	6	0.37	38.94	5.12	10.67	4.33	40.94
N1.2	4.06	3	41	8	33	7	0.31	24.77	8.13	15.76	5.36	45.98
N9.1	4.59	9	22	8	26	5	0.00	49.94	16.19	21.36	12.52	0.00
N9.2	4.01	9	20	6	14	1	0.43	11.74	1.41	8.80	4.26	73.79
N18.1	4.84	2	40	7	35	7	0.00	47.44	16.30	27.61	8.65	0.00
N18.2	5.28	7	35	8	38	10	0.00	47.70	21.39	22.42	8.49	0.00
N22.1	6.31	5	34	13	46	12	0.00	49.22	20.46	18.27	12.04	0.00
N22.2	4.30	4	34	9	25	8	0.19	24.79	12.92	17.06	7.54	37.69
N27.1	4.51	5	30	6	39	13	0.00	48.39	25.55	19.15	6.91	0.00
N27.2	4.37	10	28	5	18	2	0.00	44.30	9.66	34.83	11.21	0.00
S15.1	5.74	5	121	29	1005	38	0.00	87.03	5.37	5.38	2.21	0.00
S15.2	6.20	1	51	241	2316	20	0.00	89.60	1.29	1.01	8.10	0.00
S15.2	6.01	1	31	411	2261	15	0.00	85.04	0.92	0.59	13.45	0.00
S17.1	6.29	7	61	8	918	24	0.00	92.24	3.96	3.13	0.67	0.00
S17.3	6.24	1	32	16	2381	10	0.00	98.06	0.70	0.68	0.56	0.00
S19.1	5.80	6	97	7	1236	30	0.00	92.13	3.70	3.68	0.49	0.00
S19.2	6.57	2	146	31	1970	37	0.00	92.43	2.82	3.50	1.25	0.00
S19.3	6.37	1	26	76	2301	10	0.00	95.98	0.70	0.54	2.77	0.00
S21.1	6.59	4	90	12	1708	25	0.00	94.60	2.25	2.56	0.59	0.00
S21.3	6.85	1	40	101	2740	15	0.00	95.39	0.84	0.71	3.06	0.00
S23.1	6.03	3	79	25	1319	43	0.00	90.87	4.85	2.77	1.51	0.00
S23.2	6.74	1	30	48	2130	15	0.00	96.28	1.12	0.70	1.90	0.00
S23.3	6.12	1	38	56	1612	16	0.00	94.45	1.54	1.13	2.87	0.00

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Ref No	pH (KCl)	PBray1	K	Na	Ca	Mg	EA.KCl	%Ca	%Mg	%K	%Na	ACID SAT
S25.1	6.56	12	234	138	2243	76	0.00	86.04	4.76	4.59	4.60	0.00
S25.2	6.39	3	30	17	394	14	0.00	88.15	5.02	3.45	3.37	0.00
S25.3	6.03	1	34	60	2315	38	0.00	94.62	2.54	0.72	2.13	0.00
S1.1	5.38	5	22	8	61	6	0.00	68.33	11.41	12.27	7.98	0.00
S1.2	4.35	7	17	7	27	6	0.24	27.76	9.25	9.05	5.97	47.96
S7.1	4.11	2	19	12	37	6	0.19	35.26	9.94	9.32	9.61	35.87
S7.2	4.40	3	17	9	14	3	0.19	19.31	5.65	11.61	10.41	53.01
S23.1	4.47	4	41	16	50	12	0.18	35.70	13.81	15.02	9.81	25.66
S23.2	4.23	14	34	10	51	15	0.12	40.63	20.19	13.69	6.64	18.85

Ref No	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Value	Na:K	T	Density	S AmAc	CEC
	1.5-4.5	**10.0-20.0**	**3.0-4.0**	**cmol(+)/kg**		**cmol(c)/kg**	**g/cm3**	**mg/kg**	**cmol(c)/kg**
N1.1	7.60	4.13	0.48	0.53	0.41	0.89	1.49	5.06	0.62
N1.2	3.05	2.09	0.52	0.36	0.34	0.67	1.53	3.03	0.48
N9.1	3.09	3.10	0.76	0.26	0.59	0.26	1.56	2.46	0.21
N9.2	8.32	1.49	0.16	0.15	0.48	0.58	1.56	3.46	0.43
N18.1	2.91	2.31	0.59	0.37	0.31	0.37	1.51	1.73	0.28
N18.2	2.23	3.08	0.95	0.40	0.38	0.40	1.55	1.78	0.32
N22.1	2.41	3.81	1.12	0.47	0.66	0.47	1.56	3.24	0.40
N22.2	1.92	2.21	0.76	0.32	0.44	0.51	1.56	2.32	0.49
N27.1	1.89	3.86	1.33	0.40	0.36	0.40	1.54	1.57	0.36
N27.2	4.58	1.55	0.28	0.21	0.32	0.21	1.54	3.14	0.14
S15.1	16.19	17.18	1.00	5.77	0.41	5.77	1.45	0.70	3.48
S15.2	69.49	89.68	1.27	12.92	7.99	12.92	1.68	10.37	6.42
S15.2	92.31	146.05	1.57	13.29	22.85	13.29	1.55	61.46	5.22

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Ref No	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Value	Na:K	T	Density	S AmAc	CEC
S17.1	23.30	30.70	1.26	4.97	0.21	4.97	1.53	4.79	2.46
S17.3	139.51	145.95	1.04	12.14	0.83	12.14	1.50	5.38	8.33
S19.1	24.88	26.03	1.01	6.71	0.13	6.71	1.63	4.70	4.67
S19.2	32.80	27.21	0.80	10.66	0.36	10.66	1.64	4.55	5.43
S19.3	136.71	177.44	1.29	11.99	5.08	11.99	1.54	8.58	9.21
S21.1	41.97	37.77	0.88	9.03	0.23	9.03	1.64	5.43	6.42
S21.3	114.02	136.06	1.18	14.36	4.33	14.36	1.54	9.24	8.32
S23.1	18.74	34.57	1.75	7.26	0.54	7.26	1.62	1.64	5.14
S23.2	85.93	138.81	1.60	11.06	2.70	11.06	1.65	5.17	7.76
S23.3	61.26	84.70	1.36	8.53	2.53	8.53	1.56	8.34	4.33
S25.1	18.06	19.77	1.04	13.04	1.00	13.04	1.49	10.49	7.28
S25.2	17.54	27.02	1.46	2.24	0.98	2.24	1.44	0.40	1.06
S25.3	37.32	135.63	3.54	12.23	2.97	12.23	1.58	5.85	8.63
S1.1	5.99	6.50	0.93	0.45	0.65	0.45	1.60	3.29	0.31
S1.2	3.00	4.09	1.02	0.25	0.66	0.49	1.59	2.22	0.28
S7.1	3.55	4.85	1.07	0.33	1.03	0.52	1.53	3.68	0.33
S7.2	3.42	2.15	0.49	0.17	0.90	0.37	1.57	2.57	0.24
S23.1	2.58	3.30	0.92	0.52	0.65	0.70	1.52	4.24	0.51
S23.2	2.01	4.44	1.47	0.51	0.49	0.63	1.56	2.70	0.46

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Table 2 Mehlich III results

Ref No	Ref No	P	K	Na	Ca	Mg	EA.KCl	%Ca	%Mg	%K	%Na	ACID SAT
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(c)/kg	%	%	%	%	%
N1.1	N1.1	6	41	11	115	11	0.37	48.44	7.75	8.86	4.03	30.93
N1.2	N1.2	6	45	13	70	15	0.31	36.85	12.82	12.06	5.98	32.29
N9.1	N9.1	8	23	7	28	8	0.00	47.62	21.73	20.15	10.50	0.00
N9.2	N9.2	7	22	7	21	4	0.43	16.03	5.60	8.61	4.41	65.36
N18.1	N18.1	3	43	7	41	11	0.00	46.54	21.16	25.20	7.10	0.00
N18.2	N18.2	9	38	7	38	14	0.00	44.19	26.33	22.70	6.78	0.00
N22.1	N22.1	7	34	13	58	19	0.00	48.89	26.69	14.82	9.60	0.00
N22.2	N22.2	3	39	10	39	12	0.19	30.69	16.16	15.76	7.05	30.34
N27.1	N27.1	7	32	9	57	21	0.00	49.16	29.67	14.24	6.93	0.00
N27.2	N27.2	13	31	7	27	7	0.00	44.91	19.22	26.26	9.61	0.00
S15.1	15.1	48	134	30	1193	84	0.00	83.68	9.70	4.81	1.82	0.00
S15.2	15.2	12	54	253	3479	55	0.00	91.15	2.37	0.72	5.76	0.00
S15.2	15.2	11	36	423	4286	46	0.00	90.27	1.59	0.39	7.75	0.00
S17.1	17.1	21	65	14	1822	71	0.00	91.85	5.86	1.68	0.61	0.00
S17.3	17.3	9	35	19	13575	47	0.00	99.18	0.57	0.13	0.12	0.00
S19.1	19.1	31	92	11	1476	80	0.00	88.71	7.91	2.83	0.56	0.00
S19.2	19.2	14	154	26	2632	75	0.00	92.11	4.32	2.76	0.80	0.00
S19.3	19.3	10	26	79	5144	36	0.00	97.33	1.12	0.25	1.30	0.00
S21.1	21.1	20	86	14	2180	65	0.00	93.07	4.54	1.88	0.51	0.00
S21.3	21.3	7	43	92	3482	39	0.00	95.46	1.75	0.60	2.19	0.00
S23.1	23.1	21	76	23	1439	73	0.00	88.95	7.40	2.40	1.25	0.00
S23.2	23.2	8	35	45	2687	37	0.00	95.79	2.16	0.64	1.41	0.00
S23.3	23.3	10	40	59	2264	42	0.00	94.16	2.85	0.86	2.13	0.00
S25.1	25.1	39	244	142	2880	153	0.00	85.24	7.41	3.69	3.65	0.00
S25.2	25.2	16	40	23	826	54	0.00	86.53	9.24	2.17	2.06	0.00

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Ref No	Ref No	P	K	Na	Ca	Mg	EA.KCl	%Ca	%Mg	%K	%Na	ACID SAT
S25.3	25.3	6	46	49	2502	69	0.00	93.30	4.22	0.88	1.60	0.00
S1.1	S1.1	4	19	9	80	12	0.00	68.54	16.25	8.54	6.67	0.00
S1.2	S1.2	9	20	8	38	9	0.24	32.25	12.98	8.68	6.20	39.89
S7.1	S7.1	2	16	8	31	8	0.19	31.94	13.56	8.53	7.16	38.81
S7.2	S7.2	2	21	10	29	7	0.19	29.60	11.29	10.97	8.49	39.64
S23.1	S23.1	5	46	14	57	15	0.18	37.25	15.88	15.44	7.80	23.63
S23.2	S23.2	16	34	11	93	22	0.12	51.70	20.29	9.67	5.25	13.08

Continued

Ref No	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Value	Na:K	T	Density	Fe	Mn	Cu	Zn	S	B	Al
	1.5-4.5	**10.0-20.0**	**3.0-4.0**	**cmol(+)/kg**		**cmol(c)/kg**	**g/cm3**			**mg/kg**				
N1.1	6.25	6.34	0.87	0.82	0.45	1.18	1.49	46.62	2.99	0.15	0.32	4.80	0.25	136.03
N1.2	2.87	4.12	1.06	0.65	0.50	0.95	1.53	36.70	4.56	0.30	0.28	4.90	0.24	131.53
N9.1	2.19	3.44	1.08	0.29	0.52	0.29	1.56	29.73	1.74	0.11	0.20	3.57	0.29	124.64
N9.2	2.86	2.51	0.65	0.23	0.51	0.65	1.56	32.85	0.49	0.09	0.14	2.98	0.24	134.07
N18.1	2.20	2.69	0.84	0.44	0.28	0.44	1.51	24.45	2.89	0.09	0.27	3.80	0.32	86.16
N18.2	1.68	3.11	1.16	0.43	0.30	0.43	1.55	31.39	0.99	0.07	0.09	2.27	0.23	128.40
N22.1	1.83	5.10	1.80	0.59	0.65	0.59	1.56	48.52	3.18	0.06	0.15	3.88	0.24	107.02
N22.2	1.90	2.97	1.03	0.44	0.45	0.63	1.56	47.01	0.44	0.09	0.13	4.04	0.26	88.38
N27.1	1.66	5.53	2.08	0.58	0.49	0.58	1.54	24.30	7.18	0.22	0.42	3.11	0.27	132.98
N27.2	2.34	2.44	0.73	0.30	0.37	0.30	1.54	32.87	1.92	0.10	0.14	3.08	0.24	189.13
S15.1	8.63	19.43	2.02	7.13	0.38	7.13	1.45	38.35	33.22	0.92	0.34	5.06	0.34	235.01
S15.2	38.44	129.95	3.29	19.09	8.00	19.09	1.68	15.25	27.62	1.08	0.23	11.75	0.36	124.59
S15.2	56.65	236.86	4.11	23.74	19.98	23.74	1.55	3.27	6.23	0.46	0.34	82.13	0.82	3.61
S17.1	15.68	58.28	3.49	9.92	0.37	9.92	1.53	19.46	17.10	0.57	0.37	11.36	0.41	84.92
S17.3	174.50	760.56	4.33	68.44	0.92	68.44	1.50	3.55	5.49	0.80	0.35	19.77	0.39	4.86

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Ref No	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Value	Na:K	T	Density	Fe	Mn	Cu	Zn	S	B	Al
S19.1	11.22	34.16	2.80	8.32	0.20	8.32	1.63	22.90	22.18	0.65	0.31	5.85	0.33	112.99
S19.2	21.30	34.98	1.57	14.29	0.29	14.29	1.64	18.41	27.08	0.73	0.24	7.30	0.31	101.89
S19.3	87.25	386.29	4.38	26.43	5.09	26.43	1.54	2.39	4.06	0.80	0.29	21.73	0.53	4.81
S21.1	20.51	51.97	2.42	11.71	0.27	11.71	1.64	24.39	24.91	0.76	0.30	7.24	0.35	147.89
S21.3	54.63	161.21	2.90	18.24	3.63	18.24	1.54	4.09	7.18	0.80	0.25	18.39	0.51	5.63
S23.1	12.02	40.10	3.08	8.09	0.52	8.09	1.62	37.74	29.62	0.87	0.30	5.22	0.36	218.53
S23.2	44.29	153.49	3.39	14.03	2.20	14.03	1.65	19.88	30.31	0.62	0.22	7.49	0.38	186.21
S23.3	33.05	113.20	3.32	12.02	2.49	12.02	1.56	23.06	34.30	1.00	0.26	10.07	0.50	190.00
S25.1	11.51	25.08	2.01	16.89	0.99	16.89	1.49	32.94	39.91	1.32	0.72	12.06	0.57	241.87
S25.2	9.37	44.19	4.26	4.77	0.95	4.77	1.44	43.31	20.99	0.49	0.24	4.30	0.33	135.03
S25.3	22.10	111.14	4.81	13.41	1.82	13.41	1.58	26.63	25.46	0.51	0.27	7.56	0.45	178.58
S1.1	4.22	9.93	1.90	0.58	0.78	0.58	1.60	29.01	2.63	0.15	0.20	3.35	0.23	131.04
S1.2	2.49	5.21	1.49	0.35	0.71	0.59	1.59	37.68	0.40	0.13	0.19	2.70	0.25	128.57
S7.1	2.36	5.34	1.59	0.29	0.84	0.48	1.53	29.74	0.69	0.09	0.18	2.19	0.30	79.37
S7.2	2.62	3.73	1.03	0.30	0.77	0.49	1.57	67.15	0.33	0.10	0.20	4.30	0.23	84.90
S23.1	2.35	3.44	1.03	0.58	0.51	0.76	1.52	36.90	3.47	0.12	0.30	4.17	0.25	101.02
S23.2	2.55	7.44	2.10	0.78	0.54	0.90	1.56	64.43	1.10	0.13	0.95	4.79	0.30	113.82

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Appendix 4a

Site location and contour map: Tweerivier

Tweerivier google printed on 04 Dec 2014 at 11:32:51

NOTES/ LEGEND

DATE	INITIAL	No/CODE	REVISION DESCRIPTION

CLIENT

agriculture, land reform & rural development

Department:
agriculture, land reform & rural development
NORTHERN CAPE PROVINCE
REPUBLIC OF SOUTH AFRICA

bvi ENGINEERING PROCUREMENT MANAGEMENT

Upington Office
Registration no. 1998/000204/07

ISO 9001 Registered

BBBEE Level 2

CESA Consulting Engineers South Africa

PROJECT

DEPARTMENT AGRICULTURE: TWEERIVIER SOIL ANALYSIS

DRAWING TITLE

LOCALITY PLAN

APPROVED BY BVi

M. Pretorius	2001 0016	
ENGINEER/TECHNOLOGIST	REG. NO.	DATE

SCALE	1:5000	DRAWN	W. Krauze
DESIGNED	M. Pretorius	CHECKED	M. Pretorius

PLAN NUMBER	REVISION NO.	DATE SAVED
U31630C/100/03	A	04 Dec 2014

Tweerivier google.dwg

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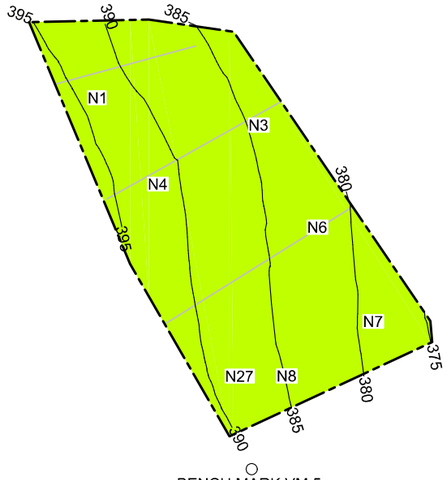

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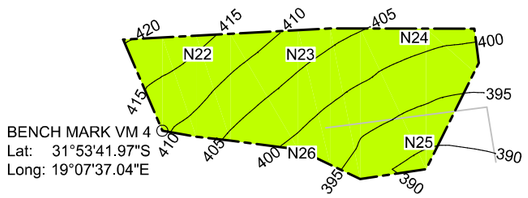
Long: 19°08'04.53"E



BENCH MARK VM 4
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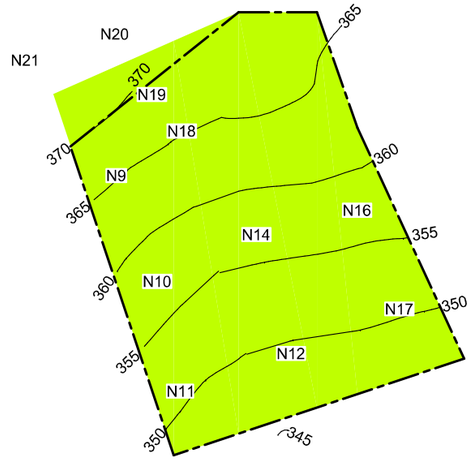
Long: 19°07'37.04"E

BENCH MARK TRST1
Lat: 31°53'44.37"S
Long: 19°07'57.02"E



NOTES/ LEGEND

DATE	INITIAL	No/CODE	REVISION DESCRIPTION

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REPUBLIC OF SOUTH AFRICA

bvi ENGINEERING PROCUREMENT MANAGEMENT
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Registration no. 1998/000204/07

nqa ISO 9001 Registered UKAS
BBBEE Level 2
CESA Consulting Engineers South Africa

PROJECT

DEPARTMENT AGRICULTURE:
TWEERIVIER SOIL ANALYSIS

DRAWING TITLE

SITE LAYOUT
& CONTOUR MAP

APPROVED BY BVI

M. Pretorius	2001 0016	
ENGINEER/TECHNOLOGIST	REG. NO.	DATE

SCALE	1:5000	DRAWN	J. Pretorius
DESIGNED	M. Pretorius	CHECKED	M. Pretorius

PLAN NUMBER	REVISION NO.	DATE SAVED
U31630C/100/01	A	03 Dec 2014

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Appendix 4b

Site location and contour map: Sonderwaterkraal

NOTES/ LEGEND

DATE	INITIAL	No/CODE	REVISION DESCRIPTION

CLIENT

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Department:
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REPUBLIC OF SOUTH AFRICA

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PROJECT

DEPARTMENT AGRICULTURE:
SONDERWATERKRAAL
SOIL ANALYSIS

DRAWING TITLE

LOCALITY PLAN

APPROVED BY BVI

M. Pretorius — ENGINEER/TECHNOLOGIST
2001 0016 — REG. NO.
DATE

SCALE	1:3500	DRAWN	W. Krauze
DESIGNED	M. Pretorius	CHECKED	M. Pretorius

PLAN NUMBER	REVISION NO.	DATE SAVED
U31630C/100/04	A	04 Dec 2014

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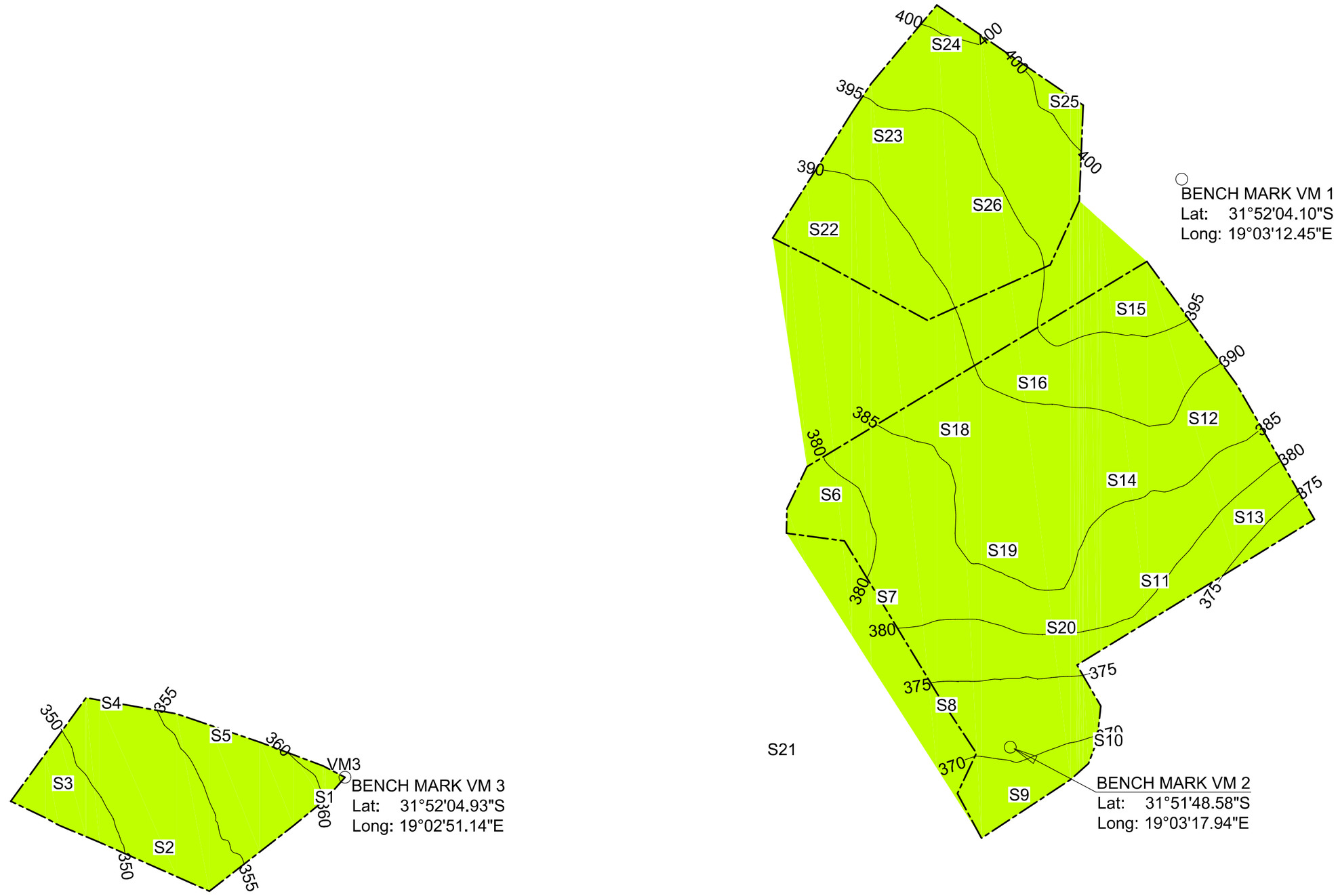

NOTES/ LEGEND

DATE	INITIAL	No/CODE	REVISION DESCRIPTION

CLIENT

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Department:
agriculture, land reform & rural development
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REPUBLIC OF SOUTH AFRICA

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Upington Office
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BBBEE Level 2
CESA Consulting Engineers South Africa

PROJECT

DEPARTMENT AGRICULTURE:
SONDERWATERKRAAL
SOIL ANALYSIS

DRAWING TITLE

SITE LAYOUT
& CONTOUR MAP

APPROVED BY BVI

M. Pretorius — ENGINEER/TECHNOLOGIST
2001 0016 — REG. NO.
DATE

SCALE	1:3500	DRAWN	J. Pretorius
DESIGNED	M. Pretorius	CHECKED	M. Pretorius

PLAN NUMBER	REVISION NO.	DATE SAVED
U31630C/100/02	A	03 Dec 2014

Sonderwaterkraal.dwg

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APPENDIX 6	PUBLIC PARTICIPATION

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Charl du Plessis

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PO Box 454
Porterville 6810

7 February 2017

Department of Agriculture, Land Reform and Rural Development
PO Box X 18
Springbok, 8240

Attention: Mr Len October

PROPOSED ESTABLISHMENT OF 21 HECTARES, ROOIBOS CULTIVATION LANDS AT ZONDERWATERKRAAL, FARM 951/0, NIEUWOUDTVILLE

NC - Department of Environment and Nature Conservation Ref Nr. NC/BA/01/NAM/HAN/NIE1/2017

Notice is given of a Public Participation Process in terms of the Environmental Assessment Regulation 41(2) van GN No. R.982 of 4 December 2014, promulgated under National Environmental Management Act (NEMA), Act 107 of 1998 as amended. **The Public Participation and commenting period** will start on the **14th February 2017** for the prescribed 30 days and will end on the **16th March 2017.**

Please find the Draft Scoping Report attached for your attention.

Listed Activities: The proposed agricultural development will trigger listed activities in terms of the NEMA EIA Regulations, 2014. In particular Listing Notice 2 (GN No. R. 984 of 4th December 2014) specifically Activity 15.

Locality: The site is situated within the agricultural farm of Zonderwaterkraal Farm 951/0, the site is located at GPS coordinates 31° 51' 35.48" S & 19° 03' 50.78" E. Turn right on the R27 (road between Vanrhysdorp and Calvinia), towards the town of Nieuwoudtville, pass Nieuwoudtville and travel towards the Papkuilsfontein turn off, turn right and follow the dirt road towards Zonderwaterkraal. The farm can be reached after travelling 55 kilometres from Nieuwoudtville.

Applicant: Department of Agriculture, Land Reform and Rural Development.

Environmental Assessment Practitioner: FOOTPRINT Environmental Services.

Regards

K.S Ranger

C.P du Plessis

NOTIFICATION

PROPOSED ESTABLISHMENT OF 21 HECTARES, ROOIBOS CULTIVATION LANDS AT SONDERWATERKRAAL, FARM 951/0, NIEUWOUDTVILLE

DENC Ref Nr. NC/BA/01/NAM/HAN/NIE1/2017

KENNISGEWING

VOORGESTELDE VESTIGING VAN 21 HEKTAAR ROOIBOS TEE LANDERYE OP SONDERWATERKRAAL, PLAAS 951/0 NIEUWOUDTVILLE

DEPT: O&NB VERWYSING NR: NC/BA/01/NAM/HAN/NIE1/2017

Indien u enige kommentaar het en wil registreer as 'n Geïnteresseerde en Geaffekteerde Party, voltooi asseblief die vorm en stuur terug aan ***FOOTPRINT Environmental Services voor of op 16 Maart 2017.***

Should you have any comments and/or would like to register as ad Interested and Affected Party ("I&AP"), please complete this Form and return to ***FOOTPRINT Environmental Services by the 16th March 2017.***

Kontakbesonderhede / Contact details:

Posbus / PO Box 454, Porterville, 6810; 086 6088304 (faks / fax); e-pos / e-mail charlduplessis2@afrihost.co.za

Titel en Naam (Title and Name)	
Adres (Address)	
Tel en Faks (Tel and Fax)	
Sel (Cell)	
E-pos (E-Mail)	

U KOMMENTAAR / YOUR COMMENTS

1. Die volgende kwessies moet aangespreek word in die verslag / The following issues should be addressed in the report.

2. Die volgende kommentaar word gelewer / The following comments are made.

3. Enige persoonlike, besigheid, finansiele of ander belange by die aansoek / Any personal, business, financial or other interests regarding this application.

DANKIE VIR U DEELNAME / THANK YOU FOR YOUR PARTICIPATION

PROPOSED ESTABLISHMENT OF 21 HECTARES OF ROOIBOS CULTIVATION LANDS ON SONDERWATERKRAAL, FARM 951/0 NIEUWOUDTVILLE,

HANTAM LOCAL MUNICIPALITY, NAMAKWA DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

DENC REF NR NC/BA/01/NAM/HAN/NIE1/2017

Group	Organisation / Department	Title	Initials	Surname	Postal	Town	Code	Contact number
Authorities	Hantam Municipality	The Municipal Manager			Private bag X 14	Calvinia	8190	municipalmanager@hantam.gov.za
Authorities	Hantam Municipality	The ward councillor - Nieuwoudtville			Private bag X 14	Calvinia	8190	municipalmanager@hantam.gov.za
Authorities	Namakwa District Municipality	The Municipal Manager			PO Box 20	Springbok	8240	info@namakwa-dm.gov.za
Authorities	Department of Agriculture	Mr	L	October	PO Box 18	Springbok	8240	loctober@ncpg.gov.za
Authorities	Department of Water and sanitation	Mr	A	Abrahams	28 Central Road, Beaconsfield	Kimberley	8301	AbrahamsA@dwa.gov.za or Abe@dwa.gov.za
Authorities	Department of Environmental Affairs and Nature Conservation		Onwabile	Ndzumo	Private Bag X 6102	Kimberley	8300	onyndzumo@gmail.com
Authorities	National Department of Agriculture, Forestry and Fisheries. Land-use and Soil Management		Rahab	Maboa	Private Bag X2,	Sanlamhof	7532	RahabM@daff.gov.za
Authorities	Department of Environmental Affairs and Nature Conservation		M	Schumann	P.O.Box 142	Nieuwoudtville	8180	bokkeveld@gmail.com
Owner	Sonderwaterkraal	Mr	G	Koopman	PO Box 79	Clanwilliam	8135	
Neighbour	Zonderwaterkraal	Mr	H	Koopman	P.O.Box 298	Clanwilliam	8135	
Neighbour	Zonderwaterkraal and Landskloof	MS	D	Koopman	Po Box 47	Nieuwoudtville	8180	
Neighbour	Mitarachope	Mr	P	Koopman	168 Cradock St	Graaf Reinet	6280	
Neigbour	Tengiters Kloof	Mr	A	Afrika	PO Box 154	Nieuwoudtville	8180	

Neigbour	Dagbreek							
NGO	Heiveld Co-operative Ltd	The CEO			PO Box 154	Nieuwoudtville	8180	
NGO	Environmental Monitoring Group	Mr	N	Oettle	1 Nethling St	Nieuwoudtville	8180	

VOORGESTELDE VESTIGING VAN 21 HEKTAAR ROOIBOS TEE LANDERYE OP SONDERWATERKRAAL, PLAAS 951/0 NIEUWOUDTVILLE	PROPOSED ESTABLISHMENT OF 21 HECTARES, ROOIBOS CULTIVATION LANDS AT SONDERWATERKRAAL, FARM 951/0, NIEUWOUDTVILLE
DEPT: O&NB VERW. NR: NC/BA/01/NAM/HAN/NIE1/2017	**DENC Ref Nr.** NC/BA/01/NAM/HAN/NIE1/2017
Aansoeker : Departement van Landbou, Grondhervorming en Landelike Ontwikkeling.	**Applicant:** Department of Agriculture, Land reform and Rural Development
Konsultante: FOOTPRINT Environmental Services.	**Consultants:** FOOTPRINT Environmental Services
Kennis vir publieke deelname proses word gegee in terme van die Wet op Nasionale Omgewingsbestuur (WNOB) (Wet nr. 107 van 1998) (soos gewysig) en bepaal in Regulasie 41(2) van Goewerment Kennisgewing Nr. R.982 van 4 Desember 2014.	**Notice is given of a Public Participation Process** in terms of the Environmental Assessment Regulation 41(2) van GN No. R.982 of 4 December 2014, promulgated under National Environmental Management Act (NEMA), Act 107 of 1998 as amended.
Projek ligging: Die voorgestelde vestiging van nuwe Rooibostee lande word beplan vir Sonderwaterkraal, Plaas 951/0, Nieuwoudtville (GPS 31° 51' 35.48" S & 19° 03' 50.78" E.).	**Project location:** The site is situated within the agricultural farm of Sonderwaterkraal Farm 951/0 (GPS coordinates 31° 51' 35.48" S & 19° 03' 50.78" E).
Projek beskrywing: Die aansoeker versoek magtiging om 21 hektaar natuurlike plantegroei te verwyder en te ontwikkel as landerye waarop rooibostee verbou kan word. Die areas sal teen die bestaande windrigting gevestig word om wind erosie te verminder. Stroke van 10m natuurlike plantegroei gaan ook gelaat word ten einde die beweging van natuurlike biota te verseker. 'n Grondanalise studie is reeds onderneem wat die geskiktheid van die area bevestig. Die ontwikkeling poog om finansiële volhoubaarheid van die eienaar te verseker in 'n bedryf wat gekenmerk word deur jaarlikse mark fluktuasies. Die Nieuwoudtville Plato is een van die vernaamste Rooibos produserende areas in die streek.	**Project description**: The applicant wishes to clear 21hectares indigenous vegetation to establish Rooibos Tea. The cultivated areas will be against the prevailing wind direction in order to mitigate the impact of wind erosion. Strips of natural vegetation of at least 10m will be left in order to allow for the movement of natural biota. A soil analyses report has been completed for the sites and indicated that the soil is suitability for Rooibos production. This application will ensure financial sustainability of the landowner in a market that is characterized by significant volatility in price year on year. The Nieuwoudtville Plateau is recognized as one of the best Rooibos tea production areas within the natural distribution area of Rooibos.
Gelyste aktiwiteite: Die beplande ontwikkeling van die rooibostee lande op Sonderwaterkraal is onderworpe aan 'n Bestekopname en Omgewingsimpak Proses. Aansoek word gedoen vir Gelyste Notering 2 van Goewerment Kennisgewing (GK No R. 984) en spesifiek Aktiwiteit 15.	**Listed Activities:** The proposed agricultural development will trigger listed activities in terms of the NEMA EIA Regulations, 2014. In particular Listing Notice 2 (GN No. R. 984 of 4th December 2014) specifically Activity 15.
Registrasie van Geïnteresseerde en Geaffekteerde Partye (GGP) – 'n Konsep Bestekopname verslag sal beskikbaar wees by die Hantam Munisipaliteit kantoor op Nieuwoudtville vanaf 13 Februarie 2017. Alle Geïnteresseerde en Geaffekteerde Partye word vriendelik versoek om kommentaar te lewer oor die voorgestelde ontwikkeling of om kwessies te identifiseer wat u in die verslag wil laat aanspreek. Dui ook asseblief aan van enige direkte sake-, finansiële, persoonlike of ander belang wat u in die aansoek mag hê.	**Registration as Interested and Affected Parties (I&AP)**: The Draft Basic Assessment Report will be available at the Hantam Municipal Offices at Nieuwoudtville from the 13th February 2017. Interested and Affected Parties (I&AP) are hereby requested to provide comments and inputs regarding the proposed development. Please indicate any interest you may have in the project either direct business, financial and personal or any other interest in the proposed development.
Verwys na - DEPT: O&NB Verw. Nr NC/BA/01/NAM/HAN/NIE1/2017	**Always refer to - DENC Ref Nr.** NC/BA/01/NAM/HAN/NIE1/2017
Periode vir kommentaar: 14 Februarie 2017 tot 16 Maart 2017.	**Commenting timeframe: 14 February 2017 – 16th March 2017.**

Sean Ranger

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FOOTPRINT Environmental Services

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APPENDIX 7	ECOLOGICAL & VEGETATION SENSITIVITY MAP

Zonderwaterkraal - Terrestrial & Aquatic Ecosystem Sensitivity Map

Terrestrial.

Zonderwaterkraal has been categorised as CBA 2 - over the full extent of the property. The Land Management Objective for this category is identified as - the maintenance of near natural landscapes with some loss of ecosystem integrity and functioning.

Aquatic

The aquatic ESA should be managed to maintian a near natural landscape with minimal loss of integrity and functioning.

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0 0.25 0.5 1 1.5 2 Kilometers

Property Boundary

Cadastral Boundaries

Ecological Support Area - Aquatic

CBA 2 - Terrestrail

High Sensitivity Area - Botanical

N

W E

S

Zonderwaterkraal - Terrestrial Vegetation Types

Terrestrial.

Zonderwaterkraal has four vegetation units Doringrivier Quartzite Karoo, Kobee Succulent Shribland, Nardouw Sandstone Fynbos and Namaqualand Rivers

Kobee Succulent Shrubland

Nardouw Sandstone Fynbos

Namaqualand Riviere

Doringrivier Quartzite Karoo

Kobee Succulent Shrubland

Doringrivier Quartzite Karoo

Cederberg Sandstone Fynbos

Cederberg Sandstone Fynbos

FOOTPRINT Environmental Services

0 0.25 0.5 1 1.5 2 Kilometers

Property Boundary

Cadastral Boundaries

N W E S