APPENDIX 3

BOTANICAL REPORT

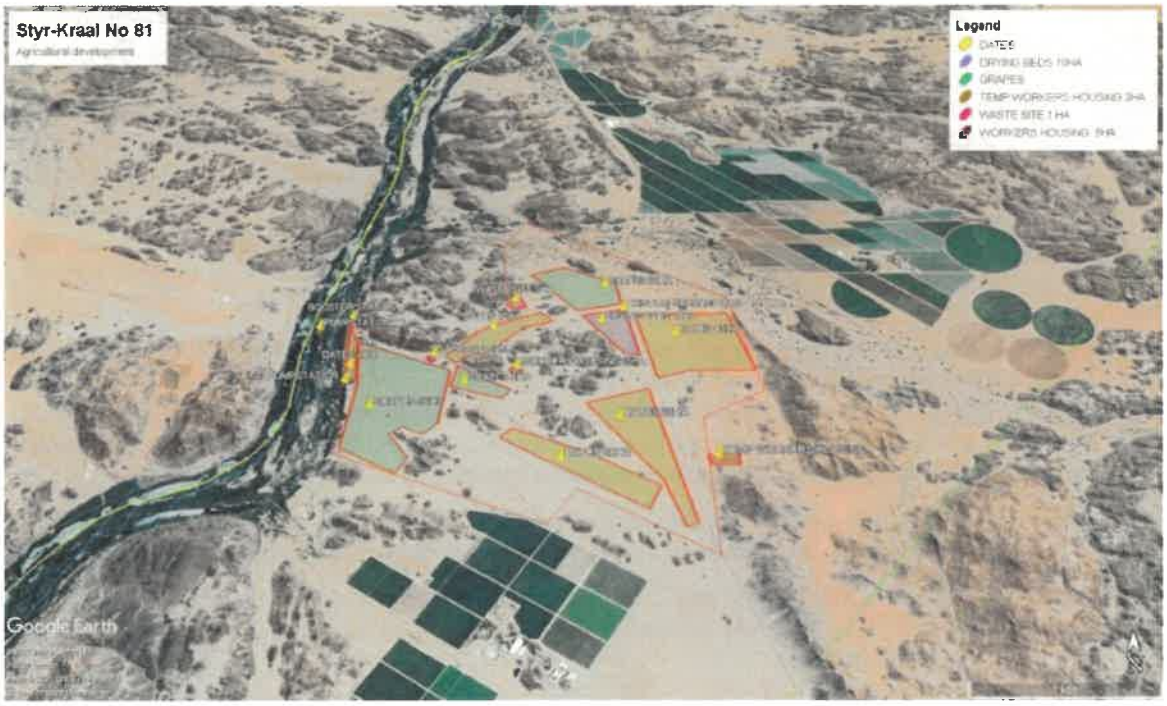
PB CONSULT
ENVIRONMENTAL MANAGEMENT SERVICES

BOTANICAL ASSESSMENT

WITH BIODIVERSITY INPUTS

STYERKRAAL AGRICULTURAL DEVELOPMENT

The proposed development of ±200 ha of new agricultural land on the remainder of farm Styr-Kraal no. 81, Khai-Ma local municipality, Northern Cape Province



24 May 2021

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

Registered Professional Botanical, Environmental and Ecological Scientist

©

22 Buitekant Street
Bredasdorp
7280

Cell: 082 921 5949
Fax: 086 611 0726
Email: peet@pbconsult.co.za

EXECUTIVE SUMMARY

VEGETATION TYPE

Lower Gariep Broken Veld (Figure 5)

Classified as "Least Threatened" (GN 1002, December 2011). More recently the 2018 National Biodiversity Assessment (NBA) was published. Lower Gariep Broken Veld vegetation remains classified as "Least Threatened" in terms of the 2018 NBA.

Lower Gariep Broken Veld is part of the Nama-Karoo Biome, which is not particularly rich in plant species and local endemism is very low. It is too dry in summer for dominance by perennial grasses and the soils generally to shallow and rainfall too low for dominance by trees. But soil type, soil depth and local differences in moisture availability can cause abrupt changes in vegetation structure and composition (e.g. small drainage lines support more plant species than surrounding plains).

VEGETATION ENCOUNTERED

The development will result in the permanent transformation of approximately 200 ha of which about 65% is located on areas previously cultivated. The proposed new development areas are located on the sheet-washed sandy plains between the rocky koppies dominating this part of the Northern Cape. The remaining natural veld can be described as sparse to very sparse vegetation, dominated by low shrubs with larger shrubs or small trees scattered throughout. Species diversity was low and because of the on-going drought very few annuals or bulbs (or even grasses) were observed. However, a great number of protected plants were observed (mainly *Vachellia erioloba* and *Boscia* species).

CONSERVATION PRIORITY AREAS

The NCCBA (Figure 13), shows that the large portions of the proposed development will overlap existing disturbance footprints (white areas), but all of the remainder will impact on proposed CBA's (green in Figure 13). It also indicates that portions of the old agricultural lands (existing disturbance footprint) fall within a previous floodplain area (blue in Figure 13). However, the whole of the remainder of the property falls within a CBA, meaning that any agricultural expansion will impact on the CBA.

According to Van Wyk & Smith (2001), the proposed development is located within the Gariep Centre of endemism. However, it is not expected to have a significant impact on the Gariep Centre as the development will be located on the sheet washed plains and will not impact on the rocky hills (which are more likely to be associated with endemic species) (Refer Section 4.5).

CONNECTIVITY

The new development will be located in between two existing grape farms. 65% of the approximate 200 development will be located on previously cultivated land which will mean that the agricultural activities are concentrated in one area, leaving the remainder of the farm natural. There will be and additional impact on connectivity, but the placement means it will be located in an area already impacted by agricultural activities..

LAND-USE

65% of the approximate 200 development will be located on previously cultivated land. The remaining will be located on natural veld used for livestock grazing by the landowner.

PROTECTED PLANT SPECIES

The Nama-Karoo is not particularly rich in plant species and local endemism is very low. Twenty nine (29) plant species where observed, which include one species listed as an alien invasive plant.

One red-listed plant, 3 plants protected in terms of the National Forest Act (Act 84 of 1998) and 6 plants protected in terms of the Northern Cape Nature Conservation Act (Act 9 of 2009), one of which is a weedy pioneer species, were observed. In terms of botanical significance, the most important aspect of the proposed development is the number of *Vachellia erioloba* trees as well as *Boscia* plants that may be impacted.

MAIN CONCLUSION

The proposed development will result in a permanent (but rehabilitation will be possible) impact on a further approximately 70 ha of natural vegetation (the main footprint ±135 ha, will overlap previously cultivated land) within a CBA and will impact on a number of protected species (especially a number of young *Vachellia erioloba* trees). There is no

alternative location on this property that will not impact the CBA. However, if the recommendations underneath is implemented all the Vachellia trees larger than 5m and most of the young ones will be saved.

Probably the most significant botanical observations made relates to a number of protected plant species observed (refer to Appendix 2) that might be impacted.

The cumulative impact (without mitigation) is expected to be **Medium/Low**, mainly as a result of the potential impact on protected plant species and CBA, but can be reduced to **Low** through mitigation. The No-Go option is not likely to result in a "no-impact" scenario, for it will have a negative socio-economic impact (and slow degradation as a result of further *Prosopis* invasion is very likely).

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

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

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

NO-GO OPTION

The No-Go option is not likely to result in a "no-impact" scenario, for it will have a negative socio-economic impact (and slow degradation as a result of further *Prosopis* invasion is very likely).

COMPLIANCE WITH APPENDIX 6 OF GN. 982 (4 DECEMBER 2014)

Specialist reports

• **A specialist report prepared in terms of these regulations must contain -**	
a) Details of –	**Refer to:**
(i) The specialist who prepared the report; and	Refer to Page iv – v & Appendix 1
(ii) The expertise of the specialist to compile a specialist report including a curriculum vitae;	Refer to Appendix 1
b) A declaration that the specialist is independent in a form as may be specified by the competent authority;	Refer to Page iii & iv
c) An indication of the scope of, and the purpose for which the report was prepared;	Refer to Heading 1.1
d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Refer to Heading 3
e) A description of the methodology adopted in preparing the report or carrying out the specialist process inclusive of equipment and modeling used;	Refer to Heading 3
f) Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructures, inclusive of a site plan identifying site alternatives;	Refer to Headings 4.6, 4.8 & Figure 15 - 17
g) An identification of any areas to be avoided, including buffers;	Refer to Figure 15 - 17
h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Refer to Figure 15 - 17
i) A description of any assumptions made and any uncertainties or gaps of knowledge;	Refer to Heading 3
j) A description of the findings and potential implications of such findings on the impact of the proposed activity, [including identified alternatives on the environment] or activities;	Refer to Heading 6 & 7.1
k) Any mitigation measures for inclusion in the EMPr;	Refer to Heading 7
l) Any conditions for inclusion in the environmental authorization;	Refer to Heading 7.1
m) Any monitoring requirements for inclusion in the EMPr or environmental authorization;	Refer to Heading 7
n) A reasoned opinion -	
(i) [as to] whether the proposed activity, activities or portions thereof should be authorized;	Refer to the "*Main conclusion*" within the executive summary (Page i)
(iA) regarding the acceptability of the proposed activity or activities; and	
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable the closure plan;	Refer to Heading 7
o) A description of any consultation process that was undertaken during the course of preparing the specialist report;	N/a
p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/a
q) Any information requested by the competent authority.	N/a
• **Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.**	

INDEPENDENCE & CONDITIONS

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

RELEVANT QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

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

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

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

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

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

DECLARATION OF INDEPENDENCE

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

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

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

Note: The terms of reference must be attached.

Signature of the specialist:

PB Consult (Sole Proprietor)

Name of company:

24 May 2021

Date:

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ABBREVIATIONS

BGIS	Botanical Geographical Information System
AIP	Alien and invasive plants
AIS	Alien and invasive species
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Critical Biodiversity Areas (Municipal)
DEA	Department of Environmental Affairs
EAP	Environmental assessment practitioner
EIA	Environmental impact assessment
EMF	(Municipal) Environmental Management Framework
EMP	Environmental management plan
NCNCA	Northern Cape Nature Conservation Act, Act 9 of 2009
NEMA	National Environmental Management Act, Act 107 of 1998
NEMAQA	National Environmental Management Air Quality Act 39 of 2004
NEMBA	National Environmental Management Biodiversity Act, Act 10 of 2004
NEMPAA	National Environmental Management Protected Areas Act 57 of 2003
NEMWA	National Environmental Management Waste Act 59 of 2008
NFA	National Forests Act 84 of 1998
NSBA	National Spatial Biodiversity Assessment
NVFFA	National Veld and Forest Fire Act 101 of 1998
NWA	National Water Act 36 of 1998
SABIF	South African Biodiversity Information Facility
SANBI	South African National Biodiversity Institute
SIBIS	SANBI's Integrated Biodiversity Information System
SKEP	Succulent Karoo Ecosystem Project

1. INTRODUCTION

Styerkraal (Remainder of Farm Styr-Kraal no. 81) is located approximately 20 km east of Onseepkans on the banks of the Orange River (the border between South Africa and Namibia) in the Northern Cape Province. The Shamboua Trust proposes to establish a new agricultural development of just more than 200 ha of land on this property. According to the current planning the proposed development will include the establishment of more than 100 ha of date palms, more than 80 ha of table grapes, drying beds, an addition storage dam, worker housing, and an on-site waste disposal site. This is a BEE initiative with the primary objective of promoting economic growth, job creation and economic empowerment, through the agricultural industry.

Styerkraal farm covers an area of approximately 400 ha, and falls within the desert region fringing the north western portion of the Northern Cape Province of South Africa. Agriculture in this desert region is entirely dependent on irrigation from the Orange River. The property is located between two existing vineyard farms.

The proposed project will trigger listed activities in terms of the National Environmental Management Act, 1998 (NEMA) and the Environmental Impact Assessment (EIA) regulations. EnviroAfrica (Pty) Ltd was appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the NEMA EIA application for the proposed development. PB Consult was appointed by EnviroAfrica to conduct a botanical study of the areas that will be impacted by the proposed project.

According to the 2018 Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006), the development falls within the Nama-Karoo Biome and will impact on one broad vegetation type, namely Lower Gariep Broken Veld, which is considered "Least Threatened" (a status which it maintained in the 2018 National Biodiversity Assessment, Skowno, 2019).

About 134.3 ha of the proposed 200 ha development footprint will be located in areas previously cultivated (most of which had not been cultivated for at least the last 10 years meaning it had reverted back to virgin soils in terms of the Conservation of Agricultural Resources Act, Act 43 of 1983). The remaining approximate 67.5 ha will be located on land not previously cultivated. The additional agricultural areas will all be located on the sheet-washed sandy plains between the rocky koppies dominating this part of the Northern Cape. The remaining natural veld can be described as sparse to very sparse vegetation, dominated by low shrubs with larger shrubs or small trees scattered throughout. Species diversity was low and because of the on-going drought very few annuals or bulbs (or even grasses) were observed. From a biodiversity viewpoint the presence of a great number of protected plants (mainly *Vachellia erioloba* and *Boscia* species) was the most significant feature observed.

1.1. TERMS OF REFERENCE

The terms of reference for this appointment were to:

- Evaluate the proposed site(s) in order to determine whether any significant botanical features will be impacted as a result of the proposed development.

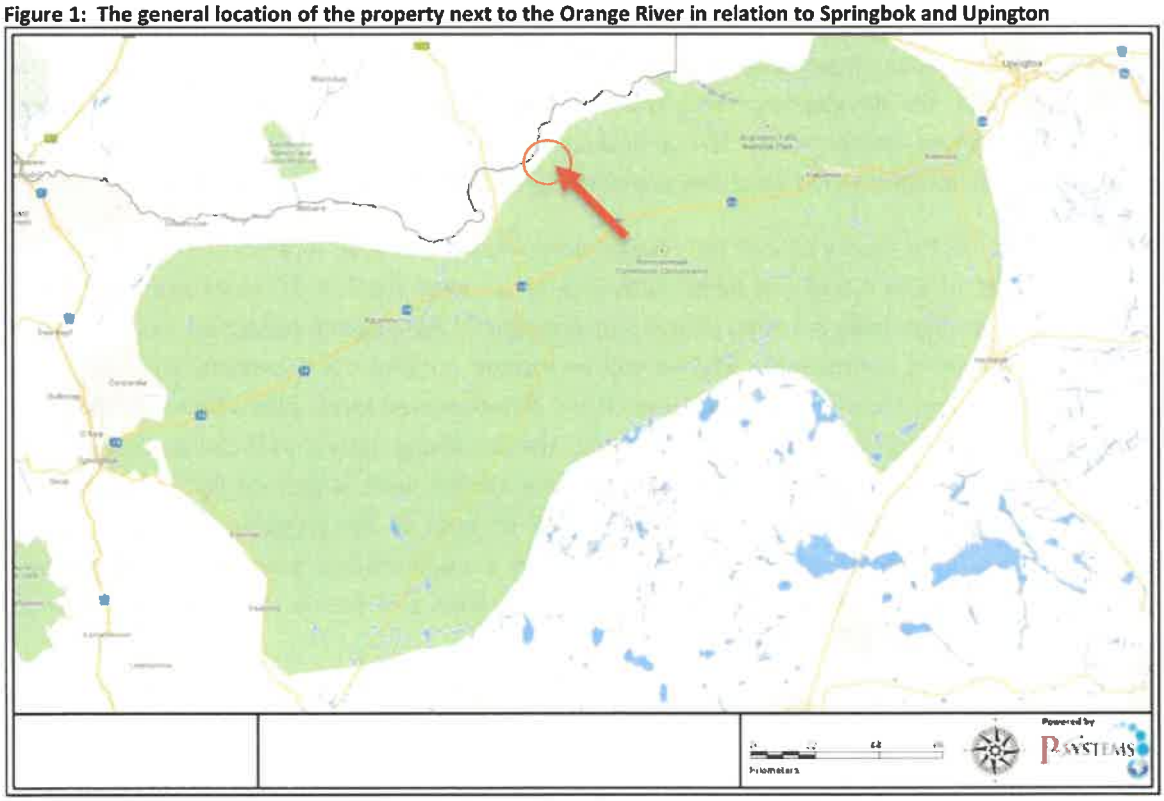
- Determine and record the position of any plant species of special significance (e.g. protected tree species, or rare or endangered plant species) that should be avoided or that may require "search & rescue" intervention.
- Locate and record sensitive areas from a botanical perspective within the proposed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

2. STUDY AREA & BACKGROUND INFORMATION

2.1. LOCATION & LAYOUT

Styerkraal refers to the remainder of the Farm Styr-Kraal no. 81, Onseepkans, located about 20 km east of Onseepkans on the banks of the Orange River in the Khai-Ma Local Municipality (Namakwa District Municipality) of the Northern Cape Province (Figure 1). An area covering approximately 400 ha, of which about 200 ha is proposed for agricultural development was evaluated during this study.

Figure 1: The general location of the property next to the Orange River in relation to Springbok and Upington



The proposed development includes the following infrastructure, with a total footprint of approximately 200 ha (please note the footprint sizes are approximate) (Refer to Figure 2). .

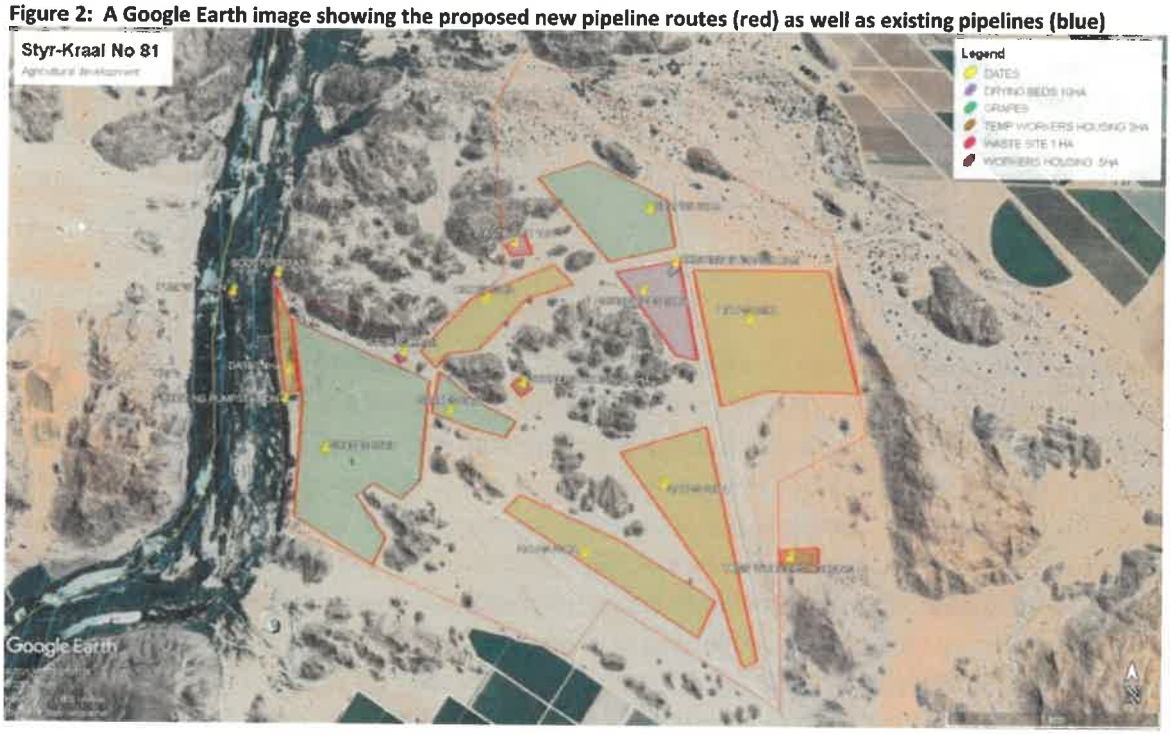
On previously disturbed soils (just less than 146.3 ha):

- Dates: approximately 59 ha on previously disturbed soils;
- Grapes: approximately 77 ha on previously disturbed areas;
- Drying beds: approximately 10 ha on partially disturbed land;
- A new storage dam: approximately 0.3 ha.

On undisturbed land (approximately 55.5 ha):

- Dates: approximately 46 ha;
- Grapes: approximately 6 ha;
- New worker housing: approximately 0.5 ha;
- Temporary workers housing: approximately 2 ha;
- Waste disposal site: approximately 1 ha.

Figure 2: A Google Earth image showing the proposed new pipeline routes (red) as well as existing pipelines (blue)



Co-ordinates for the larger footprint of property are given in Table 1.

Table 1: Broad GPS coordinates for the for the area assessed during the study

Description	GPS Coordinates
South-western corner	S28° 40' 55.5" E19° 29' 47.6"
North-western corner	S28° 40' 14.0" E19° 29' 41.4"
Northern corner	S28° 39' 35.2" E19° 30' 28.9"
Eastern corner	S28° 40' 06.6" E19° 31' 26.4"
South eastern corner	S28° 40' 38.6" E19° 31' 34.7"
Southern corner	S28° 41' 22.5" E19° 31' 16.3"

2.2. LAND-USE AND -COVER

Land use in the majority of the Namakwa District is defined by livestock grazing and mining – the two major economic drivers in the region. Another significant economic factor for the NDM's economy is "flower" tourism that is based on Namaqualand's fantastic annual wildflower displays that cover regions in a kaleidoscope of colour each spring. This is a distinctly seasonal aspect of the economy, lasting only eight to ten weeks, and being highly dependent on the timing and duration of the previous winter rains. However, there are indications that in recent years the regional ecotourism industry is diversifying (e.g., 4x4 and nature tourism) with greater numbers of tourists arriving throughout the year. River rafting is also a big industry on the Orange and Doring Rivers (NDBSP, 2008).

Agriculture in the form of dates and grapes is mainly restricted along the Orange River and is entirely dependent on irrigation from the Orange River. None-the-less the, intensive agriculture is another significant economic contributor of the Northern Cape. Styerkraal is located in between two existing grape farms. Large portions of the land showed signs of previous agriculture. At present the property is used for small scale farming and natural grazing. However, the long term grazing capacity is very low for the Onseepkans area and ranges between 70 ha LSU-1 and 100 ha LSU-1 (Large Stock Unit) (Grazing map, 1993). The proposed development should increase the economic viability of the farming unit considerably.

2.3. TOPOGRAPHY

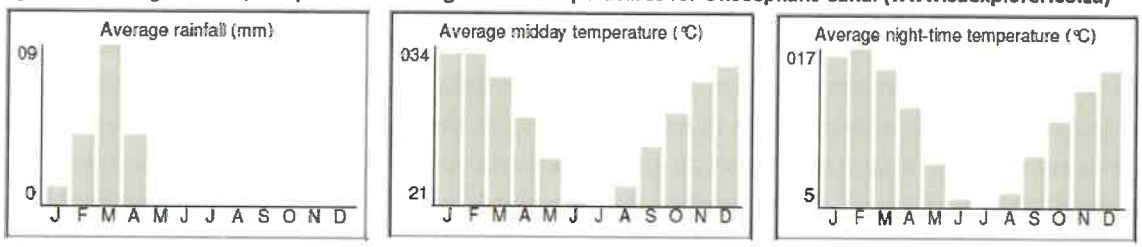
The topography were generally gentle sloping sandy plains in between rocky hills. These higher terraces appear to consist entirely of wind deposited material or alluvial material totally reworked by wind action. As a result the sandy plains have a hummocky micro relief which ranges from fair to severe in other areas. In places, the area can become rocky, possessing a "broken" topography. Elevation increases from approximately 400 m next the river to 510 m at the furthest point away from the river with a gentle average slope of 4.1%. A feature of these sandy plains is the alluvial fans frequently encountered as a result of flash floods (thunderstorm events) which drain the rocky hills onto the plains. Reaching these gentle sloping plains the power of the streams quickly dissipates and become too low to carry the sediment load, which is then dropped onto the sandy plains, resulting in the formation of these alluvial fans. Vary rarely will these drainage from the rocky hills result in the formation of a significant watercourse (e.g. connecting it to another water resource).

2.4. CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. The Onseepkans area falls within the desert biome or hyper-arid region fringing the western South African shoreline, Southern Angola and Namibia. The desert biome is characterised by ecological extremes and of all the biomes in SA it has the lowest amount of and the variability in rainfall. The nearby Onseepkans normally receives about 18 mm of rain per year, with most rainfall occurring mainly during autumn (Figure 3). Figure 3, below (lower left) shows the average rainfall values for Onseepkans per month. It receives the lowest rainfall (0mm) in May and the highest (9mm) in March (also indicating that

Onseepkans falls outside of the winter rainfall area – which is significant in terms of the expectancy of plant species of the Mesembryanthemaceae). The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Onseepkans range from 20.7°C in July to 33.4°C in January. The region is the coldest during July when the mercury drops to 4.7°C on average during the night. Consult the chart below (lower right) for an indication of the monthly variation of average minimum daily temperatures. (www.saexplorer.co.za).

Figure 3: Average rainfall, temperature and night-time temperatures for Onseepkans Canal (www.saexplorer.co.za)



NB: According to the Namakwa District Biodiversity Sector Plan (2008), it is expected that the climate will change drastically over the next millennium. Effects of global climate change lead scientists to the conclusion that the entire Succulent Karoo will most likely experience increased temperatures. It is projected that a 2°C increase in temperature in the area will lead to a 10% reduction in rainfall – a significant loss in an area that is already severely water restricted. This decrease in rainfall is projected to result in a 35% decrease in livestock carrying capacity over the coming 200 years. These projections point to the need for the development of alternative economic opportunities in the area, in order to successfully cope with the changes that are already underway.

2.5. GEOLOGY AND SOILS

According to Mucina and Rutherford (2006) and the SANBI Biodiversity Geographical Information System, the geology and soils of the alluvial soils next to the river are mostly recent alluvial deposits of the Orange River supporting soil forms such as Dundee and Oakleaf. The river cuts through a great variety of Precambrian metamorphic rocks (Ia land type). As it name suggests the flood plains are subject to floods, especially in summer, caused by high precipitation on the Highveld.

According to the agricultural feasibility study done by the Department of Agriculture (July 2014), the Onseepkans area (with similar soils), it is characterized by gneissic rock and course grained metamorphic rocks from the Little Namaqualand Suite of the O'Kiep Group. This is interspersed by sedimentary material from the Korannaland Sequence which includes conglomerates, quartzite, schists and mica. Due to the dominant soil properties, inter alia, (i) topsoil horizons (ii) clay content (iii) effective root depth (iv) dominant soil form and series, it was concluded that the soils have low to high potential for irrigated agriculture. However, it also states that although the area cannot be considered as prime land (prime land being defined as the best land available) from national perspective. However, this area can be defined as unique agricultural land, due to specific combinations of location, climate or soil properties that make it highly suitable for a specific crop,

more especially table grapes, which is made even more suitable due the availability of sufficient volumes of high quality water for permanent irrigation.

2.6. WETLANDS AND WATERCOURSES

Rivers maintain unique biotic resources and are very vulnerable to human mismanagement. Multiple environmental stressors, such as agricultural runoff, pollution and invasive species, threaten rivers that serve the world's population. River corridors are important channels for plant and animal species movement. They are also important as a source of water for human use. Vegetation on riverbanks needs to be maintained in order for rivers themselves to remain healthy, thus the focus is not just on rivers themselves but on riverine corridors. In the study area, the Orange River is the main watercourse of importance although alluvial fans and even small seasonal drainage lines were observed in the study area. It is imperative that the remaining corridor of natural vegetation along the Orange River is protected and that alien species are systematically removed from this corridor.

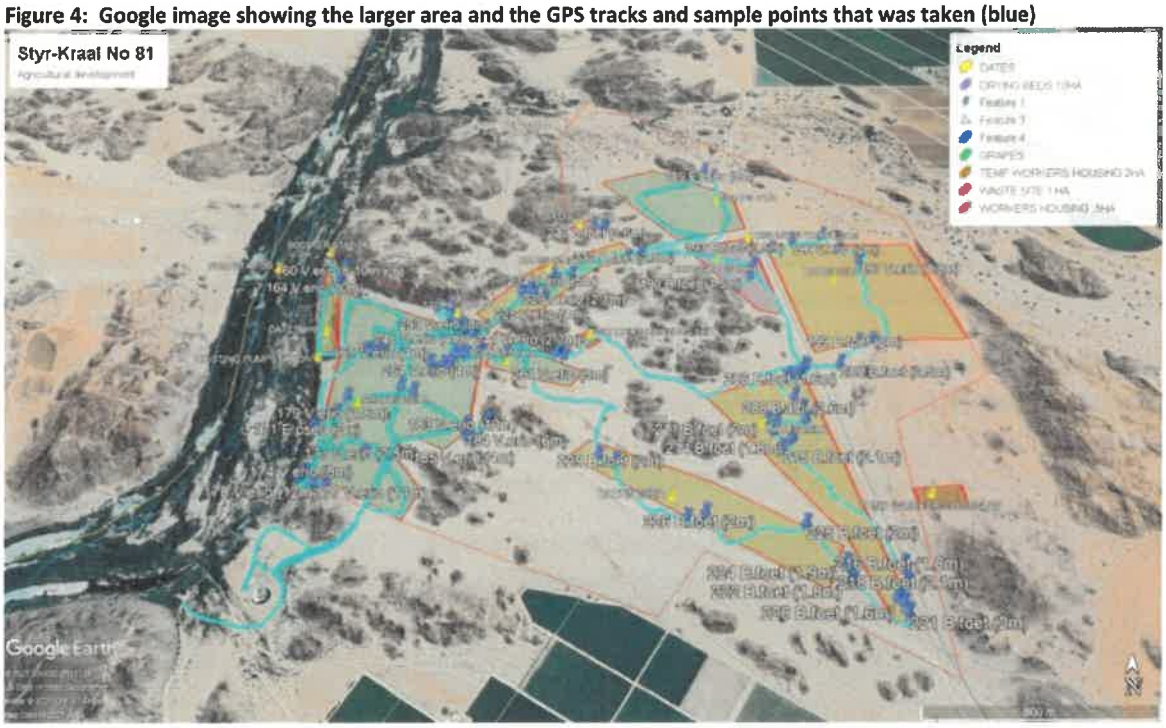
Most of the proposed agricultural areas are located on open sheet washed plains commonly found between the rocky hills of the Eastern Gariep desert. These plains contains the alluvial fans which developed from drainage channels emerging out of the hills (driven by flash floods during thunder storm events) and opening up on the gently sloping pediment where the power of the streams become too low and the sediment loads are dropped so that the drainage lines dissipate onto the sandy plains. This is the case in this instance as well. Apart from the Orange River no other significant perennial watercourses or wetlands were observed on any of the proposed sites, although a few seasonal drainage lines were observed in the proposed expansions to the south east (the 26 ha Dates area). Some of these drainage lines is slightly more prominent and sometimes a larger shrubs or small trees (e.g. *Parkinsonia africana*, *Boscia foetida* or *Boscia albitrunca)* layer are associated with portions of these drainage lines. However, on all of these sites, almost invariably, these drainage lines dissipate onto the sandy plains and does not link up to any water resource.

3. EVALUATION METHOD

The botanical survey was conducted over 2 days during the 18th and 19th of November 2020. The timing of the site visit was reasonable, even though the Northern Cape was still in the midst of a severe drought. Even at the best of times the vegetation on these plains are sparse.

Desktop studies coupled with a site survey were performed. Spatial information from online databases such as SANBI BGIS, CapeFarmMapper and Google Earth were used to evaluate the site in terms of vegetation type(s) expected, potential significant features that might be encountered (e.g. variations in soil type, rocky outcrops etc.) and obvious differences in landscape or vegetation densities, which might indicate differences in plant community or species composition. Expected plant species lists were prepared and species of special significance were flagged (to be used as reference during the site visit).

Figure 4: Google image showing the larger area and the GPS tracks and sample points that was taken (blue)



The following general conclusions were drawn on completion of the desktop assessment:

- The site and surrounding areas still support natural vegetation;
- The vegetation type is expected to be Lower Gariep Broken Veld, considered "*least threatened*" in terms of the National list of threatened terrestrial ecosystems (2011). The more resent 2018 National Spatial Biodiversity Assessment still lists Lower Gariep Broken Veld as "*least threatened*" (Refer to Heading 4).
- According to the 2016 Northern Cape Critical Biodiversity Map (Refer to Heading 4.4), large portions of the proposed development will overlap critical biodiversity areas (CBA) while portions will overlap a floodplain area. But portions of the proposed footprint (including the portion within the floodplain) are recognized as previously developed areas.
- According to Van Wyk & Smith (2001) the site falls within the far eastern corner of the **Gariep Centre of endemism** (Refer to Heading 4.5).

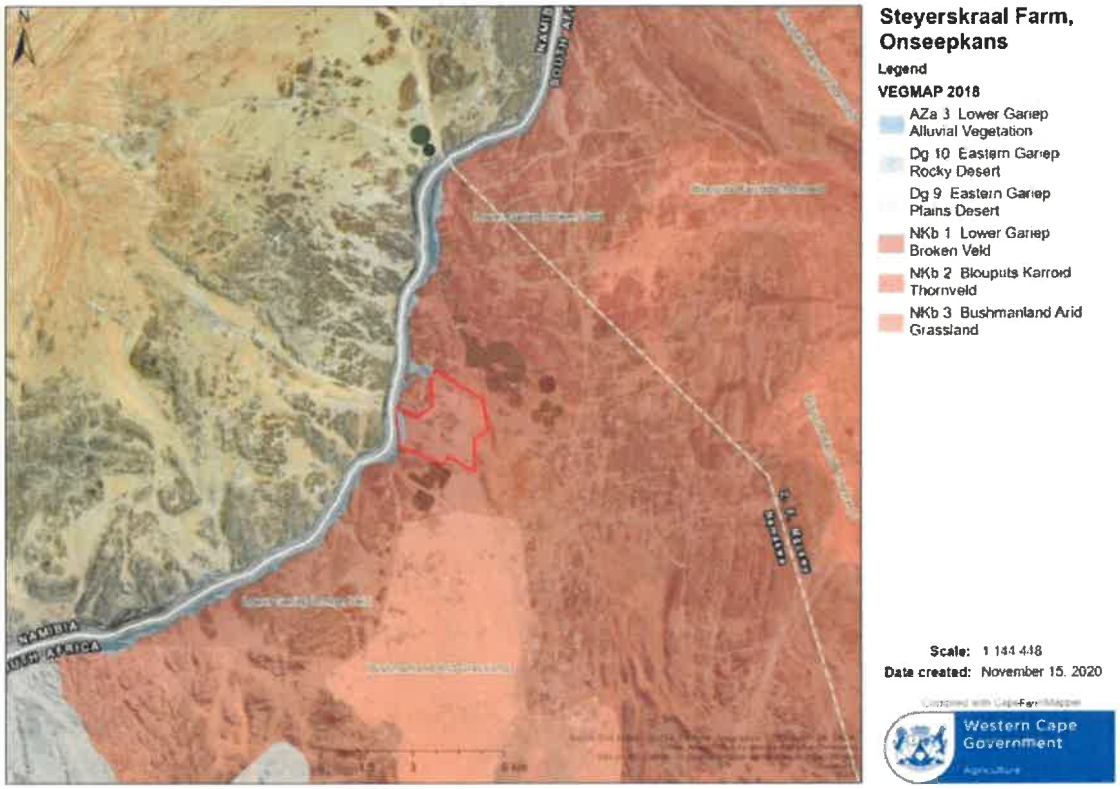
The survey was conducted over 2 days, starting at the reaches of the property and walking and driving each development footprint (mostly on foot). Sampling was done by walking each area and examining, marking and photographing any plant or feature of interest (Refer to Figure 4). A hand-held Garmin GPSMAP 62s was used to track the sampling route and for recording waypoints of locations of specific importance. During the survey notes, together with a photographic record, were compiled for the vegetation and landscape. The author endeavoured to identify and locate all significant biodiversity features, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

4. THE VEGETATION

Lower Gariep Broken Veld corresponds largely with Acock's (1953) Orange River Broken Veld and to Low & Rebello's (1996) Orange River Nama Karoo vegetation types. In accordance with the 2018 Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006), the proposed footprint(s) will mainly impact on one broad vegetation type, namely **Lower Gariep Broken Veld** (Figure 5), a vegetation type classified as "Least Threatened" in terms of the NEM: BA "*national list of ecosystems that are threatened and in need of protection*" (GN 1002, December 2011).

More recently the 2018 National Biodiversity Assessment (NBA) was published (Skowno *et al.*, 2019a & Skowno *et al*, 2019b). Although the findings of the 2018 NBA it is not yet formally adopted by NEM: BA in terms of regulations it is important to consider these findings. Lower Gariep Broken Veld vegetation remains classified as "Least Threatened" in terms of the 2018 NBA.

Figure 5: Vegetation map of South Africa (2018), showing the expected vegetation types



It is important to note that even though Lower Gariep Broken Veld is classified as least threatened, it falls within the South African Desert Biome, in this case fringing on the Namibian desert. The Desert Biome is a hyper-arid region of great age and one with extraordinary high diversity of organisms (including many endemics) and adaptions. It includes both winter- and summer rainfall areas, making it one of the most interesting hyper-arid regions of the world. Compared with other desert regions, plant species richness is very high (especially the Richtersveld) and does not differ much from that of the Succulent Karoo (Mucina & Rutherford, 2006). However, not all parts of this biome are equally rich in species diversity. Plant species richness of the western Gariep Lowland Desert

vegetation unit, is thought to be less rich than that of for example the Richtersveld and is described by Mucina & Rutherford (2006) as moderate.

4.1. THE VEGETATION IN CONTEXT

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

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

In contrast with the Succulent Karoo, the Nama-Karoo is not particularly rich in plant species and does not contain any centre of endemism (in contrast with Van Wyk & Smith 2001). Local endemism is very low, which might indicate a relative youthful biome linked to the remarkable geological and environmental homogeneity of the Nama-Karoo. Rainfall seasonality and frequency are too unpredictable and winter temperatures too low to enable leaf succulent dominance (as in the Succulent Karoo). It is too dry in summer for dominance by perennial grasses alone and the soils generally to shallow and rainfall too low for dominance by trees. But soil type, soil depth and local differences in moisture availability can cause abrupt changes in vegetation structure and composition (e.g. small drainage lines support more plant species than surrounding plains) (Mucina *et. al.*, 2006).

4.2. VEGETATION ENCOUNTERED IN EXISTING DISTURBED AREAS

The areas evaluated can be roughly categorized into two different units based on the status of the sites namely (Refer to Figure 6):

- Previously disturbed areas (which includes Block 1, 2, 3, 4, the new storage dam and a portion of the proposed drying beds)
- Undisturbed veld (which includes Block 5, 6, 7, 8, the worker housing, the remainder of the drying beds and the waste disposal site).

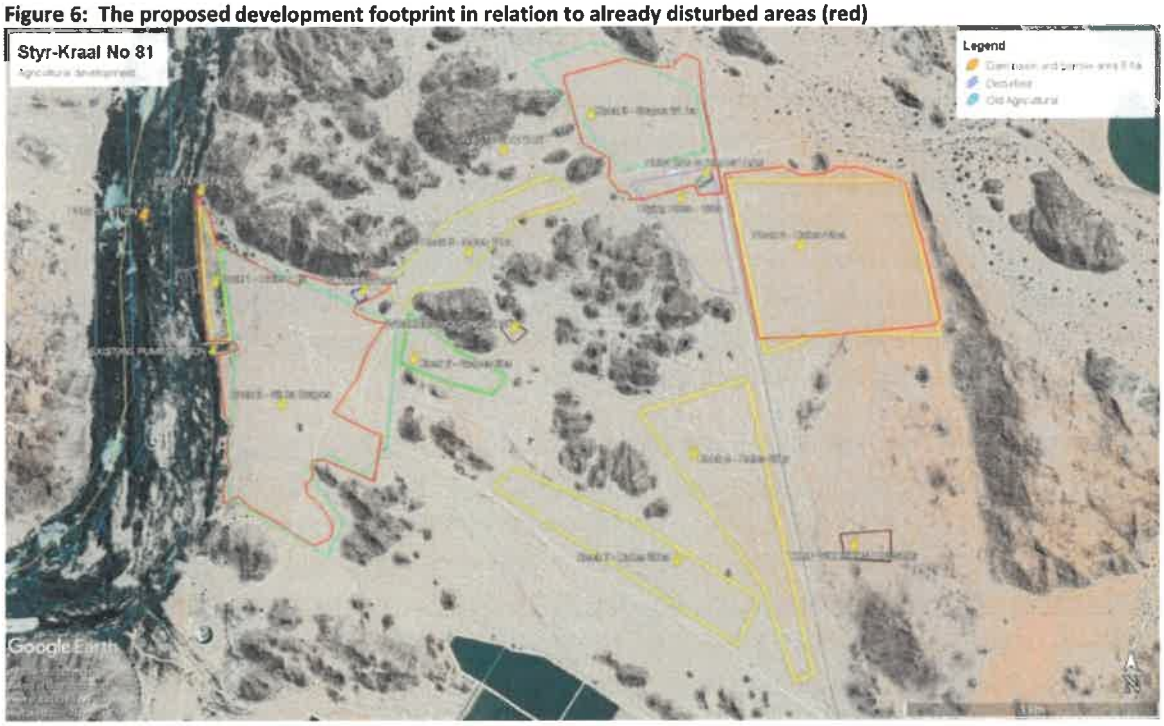
Immediately evident was the great number of Camel thorn trees (*Vachellia erioloba*) as well as the great number of stink bush or false shepherd trees (*Boscia foetida*) encountered on the site. Three

ebony trees (*Euclea pseudebenus*) and two shepherd trees (*Boscia albitrunca*) were also observed near or within the footprint. What was also surprising was the number of relatively young Camel thorn trees that were encountered along the roads and even within the old agricultural land.

Figure 6 give an overview of the proposed development footprint.

- The red areas indicate the existing disturbance footprint (old agricultural land);
- The yellow blocks refer to proposed new date fields;
- The green areas refers to proposed new table grape orchards;
- The purple area refers to the proposed drying beds;
- Proposed worker housing (brown) and a new waste disposal site (purple are also indicated).

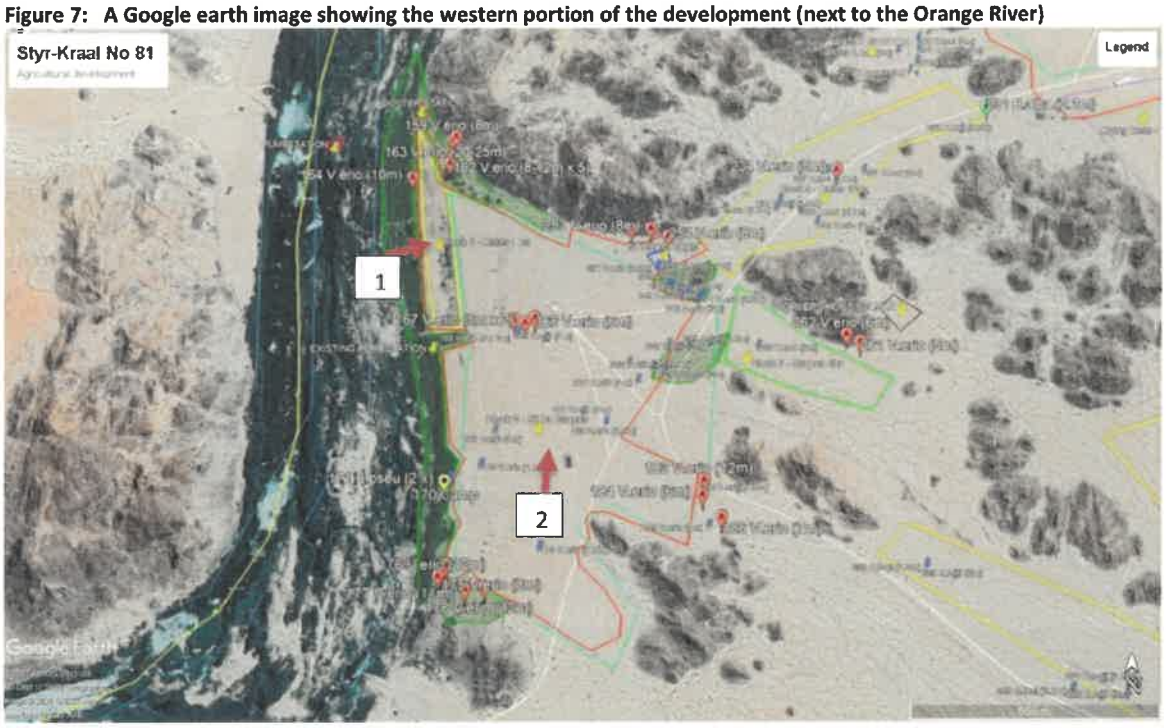
Figure 6: The proposed development footprint in relation to already disturbed areas (red)



4.2.1. Block 1, 2 and the new storage dam area

Block (4ha of Dates) and Block 2 (56 ha of Grapes) as well as the proposed new storage dam will be located almost entirely within the existing agricultural footprint (Figure 7). Both these developments will border on the riparian zone next to the Orange River. According to the CBA maps, it will also partially overlap an old floodplain. The previous land owner had already stepped this land into terraces to lift most of this area out of the flood plain (Photo 1 & Photo 2). The remaining vegetation next to the Orange River will not be impacted by the proposed agricultural land (although the pump stations will have some localised impact). Unfortunately, this vegetation along this section of the river had been all but displaced by dense stands of *Prosopis* trees (Photo 1). However, a number of *Vachellia erioloba, Euclea pseudebenus, Tamarisk usneoides* and *Searsia* species still remain of its original vegetation. A systematic alien eradication program should be implemented in order to systematically remove the alien invasive *Prosopis* trees in order for the natural vegetation to reclaim the river corridor.

Figure 7: A Google earth image showing the western portion of the development (next to the Orange River)



Within the old agricultural area, almost no natural veld remains, apart from *Prosopis* trees starting to invade this area (especially the lower slopes near the Orange River). Along the fringes of the disturbance footprint (Photo 3) and also within the western area of the old agricultural area hardy species such as *Tetraena microcarpa, Sisyndite spartea, Senegalia mellifera (=Acacia mellifera)* and *Codon royenii* (sometimes the only plant dominating portions of the old agricultural areas). Other plants occasionally observed were: *Acanthopsis carduifolia, Phaeoptilum spinosum* and *Petalidium setosum. Euphorbia gregaria* and *Parkinsonia africana* were also observe near a small drainage line to the west of Block 1, but outside of the proposed footprint.

Photo 1: Looking from east to west over the lower terrace that will be planted with Dates (Blok 1). Note the dense stands of Prosopis within the riparian corridor as well as the young Prosopis trees starting to spread throughout the area in the foreground.

It was clear that the area had been disturbed (ploughed) in the past with very few indigenous plants remaining within these disturbed areas (Photo 1, 2 & 3). To the south (outside of the disturbance footprint, but within the proposed expansion area) a slightly denser vegetation cover was observed (Photo 6). But even here the vegetation cover was sparse and species diversity low, with the veld

usually dominated by hardy species such as *Sisyndite spartea* and *Senegalia mellifera*, while *Tetraena microcarpa* becomes more prominent nearer to the Orange River.

Photo 2: Looking over the existing disturbance footprint (from north to south) with Block 1 to be established to the right and Block 2 on the terrace to the left. The Orange River to the right. Note the lack of vegetation and the *Prosopis* trees establishing itself in the background.
The riparian vegetation along the Orange River is also almost replaced by dense stands of *Prosopis* trees.)

Photo 3: *Sisyndite spartea, Tetraena microcarpa, Senegalia mellifera* observed along the fringes of the old land. Note the spread of *Prosopis* even in these areas.

Photo 4: One of the patches of magnificent *Vachellia erioloba* trees observed just east of the proposed Block 1 & 2. These trees must be protected and the surrounding *Prosopis* trees removed.

By far the most significant aspect of this area was the great number of *Vachellia erioloba* trees remaining within the old agricultural area and within the new proposed footprint. In Figure 7, the

red markers indicate *Vachellia erioloba* trees larger than 5m. These markers also represent trees that should not be removed. Twenty eight (28) individual trees larger than 5 m were marked in the immediate vicinity of the proposed Block 1 & 2 and the new storage dam site. Fortunately, only 4 of these trees are within the proposed footprint, and they are located next to an existing road. There should be no reason why any of these trees needs to be removed. Unfortunately, about thirty eight (38) young trees (averaging 2 - 3 m) were also observed, of which 32 falls within the proposed footprint. Quite a number of these are located next to existing roads. All efforts should be made to protected as many of these trees as possible (the minimum aim should be too safe at least 50% of these trees).

Photo 5: A patch of beautiful trees encountered at the camping spot next to the Orange River (next to Block 1). *Vachellia erioloba*, *Euclea pseudebenus* (to the right) and *Tamarisk usneoides* (to the back).

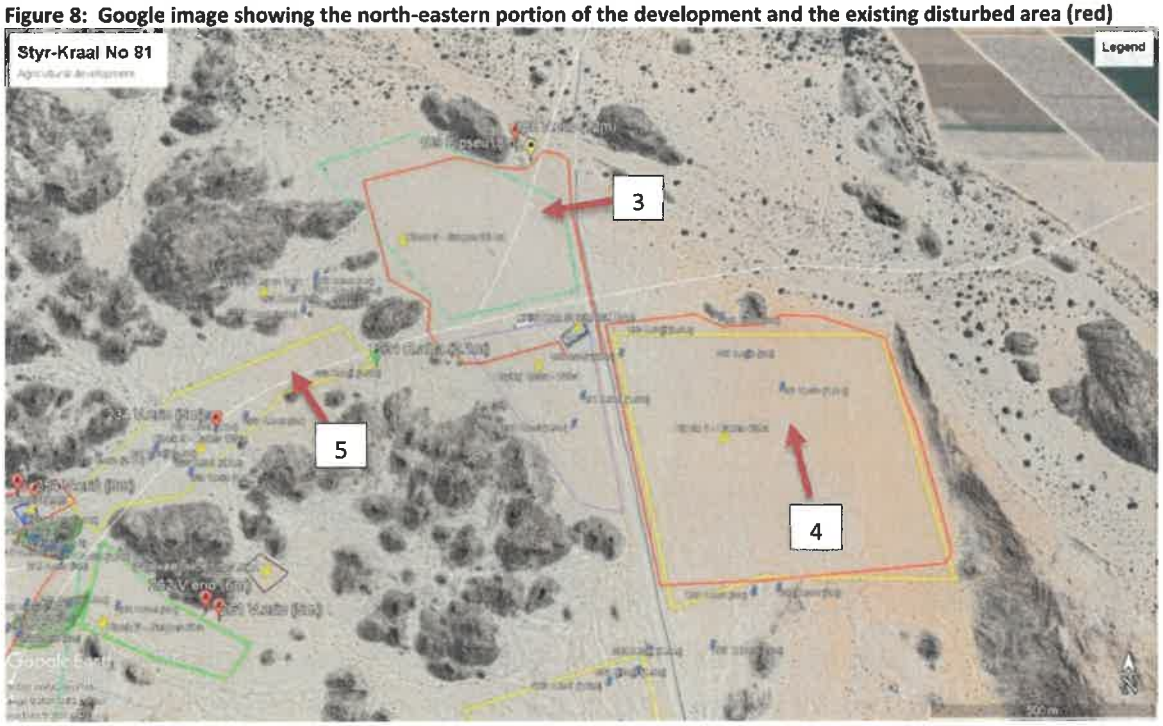
A few *Euclea pseudebenus* (ebony) trees were also observed, on the banks of the Orange River (Photo 5). They will not be impacted by the proposed agricultural development and must be protected.

Photo 6: Remaining natural veld just south of Block 1, giving an indication of how the veld might have looked before it was disturbed. Note the denser stands of *Sisyndite spartea* and *Senegalia mellifera*. In the background two you Camel thorn trees can also be observed.

4.2.2. Block 3 & 4 and Drying beds

Most of the proposed Block 3 & 4 as well as a portion of the drying beds are also located on land that was clearly disturbed in the past (Refer to Photo 7 - Photo 10 and Figure 9). Very little natural veld remains within the previously disturbed areas. All three these areas are slightly further away from the Orange River and the *Vachellia erioloba* trees seems to be replaced by the much smaller *Boscia foetida* (mostly growing as a shrub, but sometimes a becoming a small tree).

Figure 8: Google image showing the north-eastern portion of the development and the existing disturbed area (red)



The evidence of previous agriculture can be clearly seen in both Block 3 (Photo 7) and Block 4 (Photo 8). The general vegetation in and surrounding these two areas is very similar to that described for Block 1 & 2.

Photo 7: Looking from south to north over Block 3. Note the clear evidence of past agriculture. *Tetraena decumbens* dominant in the foreground with *Prosopis* invading in the background.

As mentioned, *Vachellia* erioloba was less common and *Tetraena microcarpa* seems to have been replaced by *Tetraena decumbens.*

However, the surrounding (more natural) veld remains dominated by *Sisyndite spartea* and *Senegalia mellifera*, while the following species were observed in the disturbed areas: *Boscia foetida, Cleome foliosa, Codon royenii, Euphorbia gariepina, Petalidium setosum, Phaeoptilum spinosum, Rhigozum trichotomum, Rogeria longiflora, Tetraena decumbens* (mostly along the edges of the old agricultural areas).

An individual tree of *Euclea pseudebenus* as well as a large *Vachellia erioloba,* one *Commiphora gracilifrondosa* (in the rocks) was observed to north of Block 3 and 4, but not within the footprint. However, two young *Vachellia erioloba* (less than 2m in height) trees as well as two Boscia foetida shrubs were observed within the proposed footprint for Block 4. Young *Prosopis* trees were again commonly observed as it slowly starts to spread through the whole area.

Photo 8: Looking from south-west to north-east over Block 4. The evidence of past agriculture is again clearly visible. *Codon royenii* in the foreground.

Photo 9: Looking from south to north over the area proposed for the drying beds. Most of this area had also been disturbed in the past (but not as recent as Block 1 – 4). Note the slightly denser vegetation associated with the alluvial fan in this area and the Senegalia mellifera to the back.

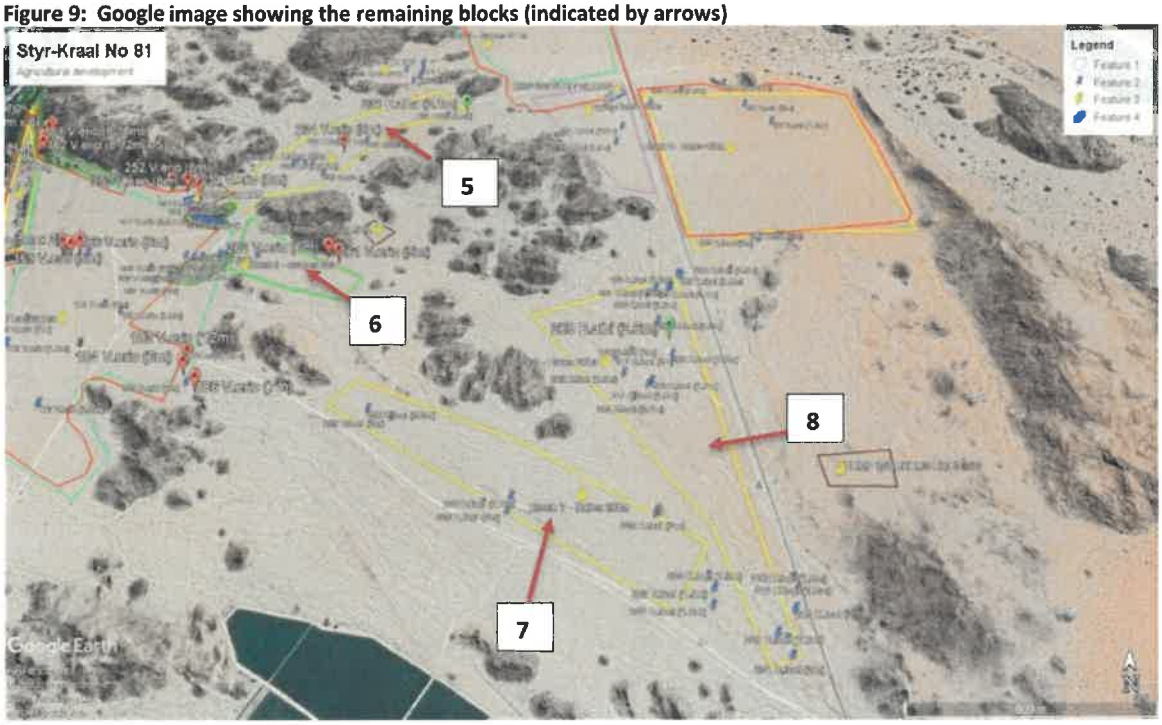
The area proposed for the drying beds are characterised by slightly higher vegetation as a result of the alluvial fan (seasonal water) in the area (Photo 9 & Photo 10). Although still a sparse shrubland the vegetation is dominated by *Senegalia mellifera, Tetraena decumbens Sisyndite spartea* and *Euphorbia gariepina*. *Aptosimum spinescens, Phaeoptilum spinosum* and *Rhigozum trichotomum* were also observed.

Photo 10: Looking from south-west to north-east over the Drying Bed area. Note the relative large *Boscia foetida* to the right of picture.

4.3. THE VEGETATION ENCOUNTERED IN UNDISTURBED AREAS

All of the remaining new developments will be located in natural veld. The sites are all located on the sheet washed sandy plains between the koppies. Since the vegetation was very similar, they will be discussed they will be discusses together. There were only slight differences in soil depth (rocky patches) and drainage lines, which will be highlighted for each section. The remaining blocks refers to Block 5 (12ha of Dates), Block 6 (6ha of Grapes), Block 7 (20ha of Dates), Block 8 (26ha of Dates), the waste disposal site (Refer to Figure 9).

Figure 9: Google image showing the remaining blocks (indicated by arrows)



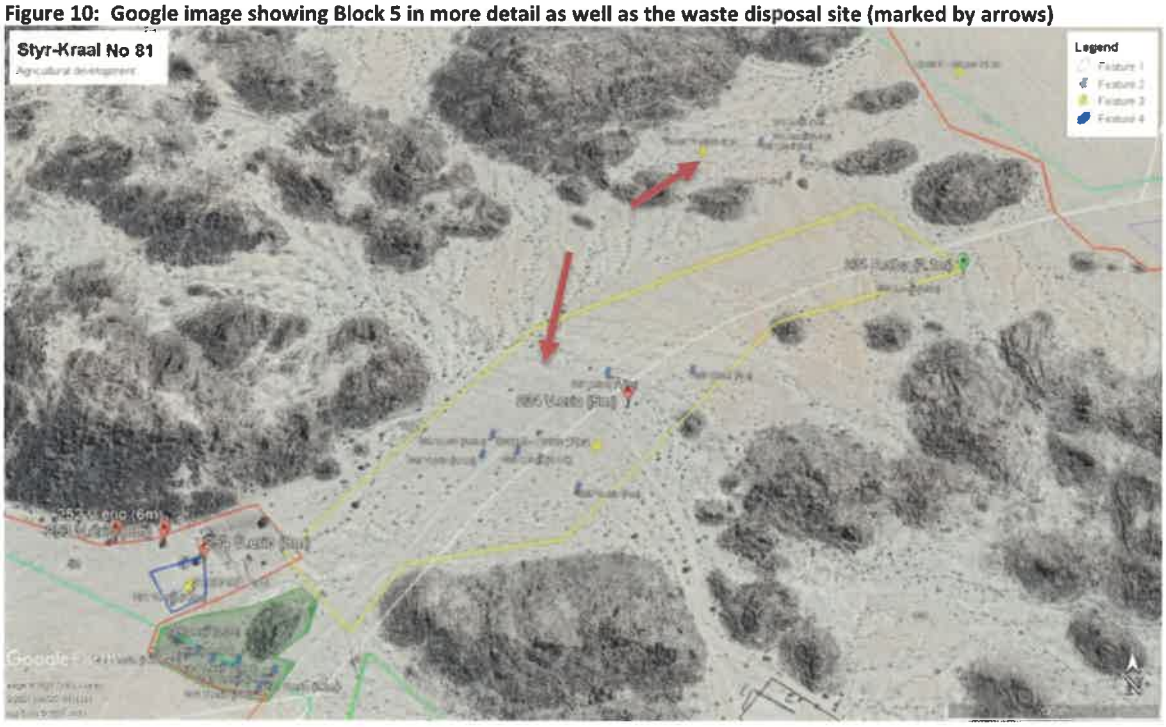
The natural veld on all of these sites can be described as sparse to very sparse vegetation, dominated by low shrubs with larger shrubs or small trees scattered throughout. In deeper soils *Vachellia erioloba* were sometimes encountered, while *Boscia foetida* were much more prominent in

rocky areas or shallower soils. Because of the on-going drought in the Northern Cape, annuals and grasses were not as often observed as expected. Species diversity remained very low. All of the areas were generally dominated by *Senegalia mellifera* in combination with *Sisyndite spartea*, various *Euphorbia* species and/or *Tetraena decumbens*. In rocky areas or near drainage lines, *Boscia foetida* can be locally dominant, together with species like *Parkinsonia africana, Phaeoptilum spinosum*. Other species observed include: *Adenolobus garipensis* (once observed), *Aptosimum spinescens* (occasionally), *Calicorema capitata, Cleome foliosa* (occasionally), *Codon royenii, Euphorbia gariepina, E. gregaria, Galenia africana, Hermannia* cf. *spinosa Lycium cinereum, Petalidium setosum* (Namib petal-bush), *Rogeria longiflora* and *Rhigozum trichotomum.*

4.3.1. Block 5 and the waste disposal site

Block 5 will be located almost in the middle of the location with the proposed waste disposal site nearby (Figure 10). The vegetation was typically as described above, with *Senegalia mellifera, Sisyndite spartea* and *Tetraena decumbens* prominent (Photo 11 & Photo 12). Aptosimum spinescens and Cleome foliosa were also observed occasionally.

Figure 10: Google image showing Block 5 in more detail as well as the waste disposal site (marked by arrows)



The drainage lines were typically dominated by *Senegalia mellifera* together with a mix of *Boscia foetida, Phaeoptilum spinosum, Parkinsonia africana.*

From a botanical viewpoint the most significant plants observed were one large *Vachellia erioloba* (refer to the red dot in Figure 10) as well as one Boscia albitrunca (green dot in Figure 10). Four *Boscia foetida* (of which three were within the footprint) and two smaller *Vachellia erioloba* trees (averaging 2m) and one larger Vachellia erioloba (4m in height) near the southern boundary of the site. It is recommended that at least the larger *Vachellia* and the *Boscia albitrunca* (on the edge of the proposed development) are protected.

Photo 11: The vegetation encountered in Block 5, viewed from east to west. Note the slightly denser vegetation associated with the small drainage line towards the back. Dried out remains of *Tetraena* in the foreground.

Photo 12: One of the *Boscia* individuals observed in the valley (Block 5).

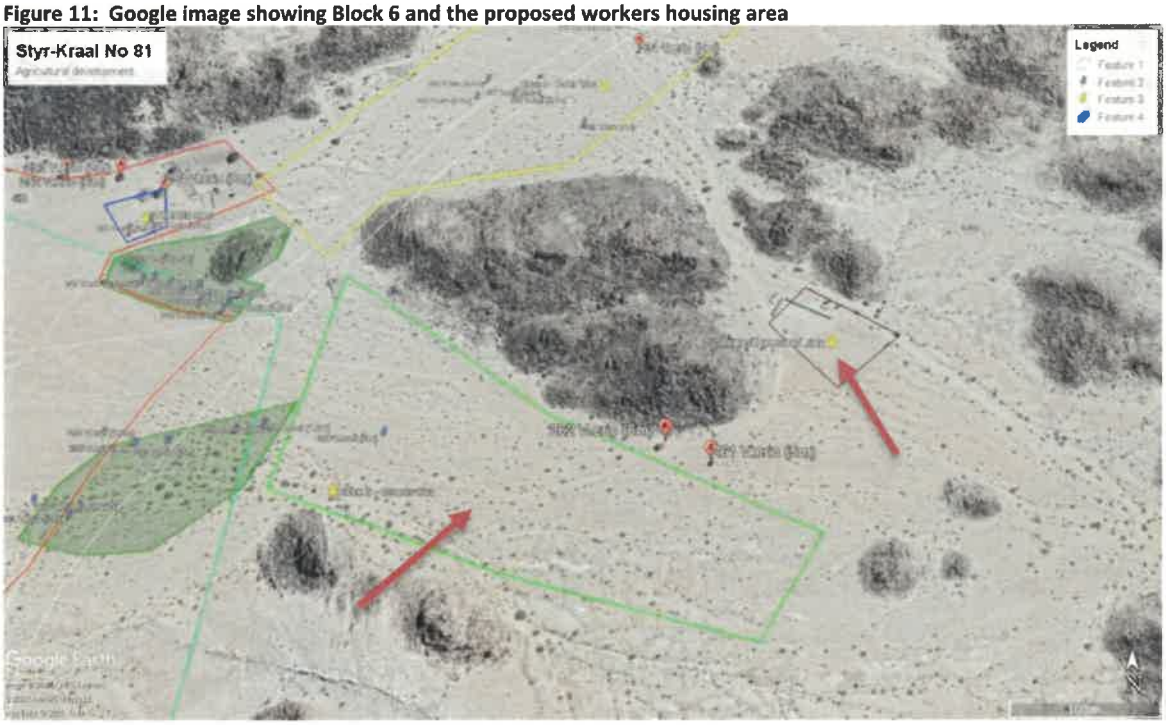
Photo 13: The proposed waste disposal site. A number of Boscia foetida individuals was observed to the east of the proposed site.

The only feature of significance at the proposed waste disposal site was 5 *Boscia foetida* individuals located just east of the proposed site (three of which was quite big plants). It is recommended that all of them are protected as there should be no reason to include them within the footprint.

4.3.2. Block 6 and worker housing areas

Block 6 is located between two rocky outcrops (koppies). The south-western portion of the site was more rocky and uneven than Block 5 and the soils seem to be generally shallower. The vegetation was slightly denser in these rocky areas (with its drainage lines), with *Senegalia mellifera* tending to be more prominent in these areas (Photo 14). The proposed worker housing will be located on an area already disturbed and previously used for housing as well.

Figure 11: Google image showing Block 6 and the proposed workers housing area



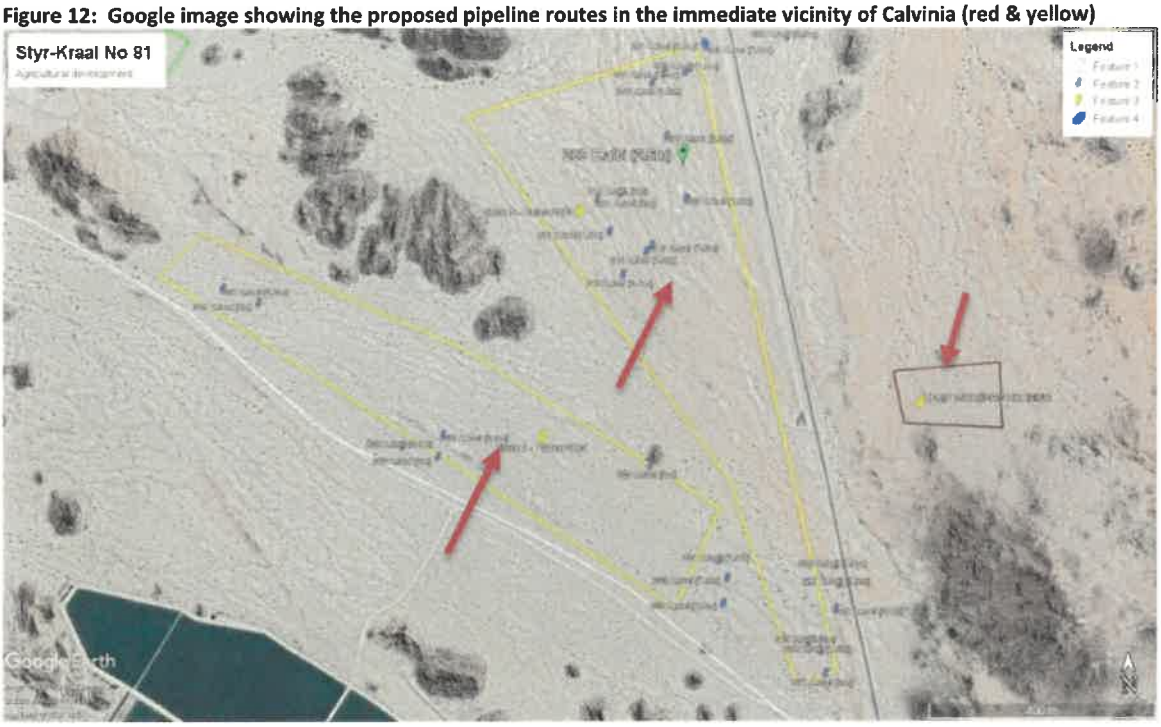
From a botanical viewpoint the only features of special significance were two larger *Vachellia erioloba* trees, located outside of the development footprint and one Boscia foetida (2m height) within the footprint. The Camel thorn trees must be protected.

Photo 14: Block 6, looking from south-east to north-east over the site. Note the shallower soils with *Senegalia mellifera* prominent.

4.3.3. Block 7, 8 and temporary workers housing

Block 7 and 8 is located towards the south or the entrance to the farm, while the temporary workers housing will be located just east of the entrance road (across from Block 8) (Figure 12).

Figure 12: Google image showing the proposed pipeline routes in the immediate vicinity of Calvinia (red & yellow)



Block 7 is located on an open sandy plain with occasional rocky outcrops. The vegetation differs slightly from that described in Block 5 with *Vachellia erioloba* now absent. *Euphorbia gregaria* is much more prominent (especially in the southern rocky section of this block), together with *Tetraena decumbens Phaeoptilum spinosum* and *Petalidium setosum*.

Photo 15: Typical vegetation encountered in Block 7. Note the *Tetraena* and *Petalidium* in the foreground with *Euphorbia gregaria* in the middle of the photo.

The most significant plants encountered within Block 7 were about 9 *Boscia foetida* individuals of which 6 will probably be impacted by the proposed development.

The vegetation in block 8 was slightly more interesting as there were more seasonal drainage lines (alluvial fans) and the western and northern sections were rockier (Photo 16 and Photo 17). These rockier sections were often dominated by *Euphorbia gregaria*, with *Boscia foetida* and *Parkinsonia africana* also closely associated with the many drainage lines. Apart from Block 1 with its many *Vachellia erioloba* trees, this area might be considered one the more sensitive sites, purely because of the number of *Boscia* individuals (including one *Boscia albitrunca*) encountered within the site. The site was again dominated by a combination of *Senegalia mellifera*, *Tetraena decumbens* and *Petalidium setosum*. *Blepharis mitrata*, *Calicorema capitata*, *Euphorbia gariepina*, *Phaeoptilum spinosum*, *Rhigozum trichotomum* and *Aptosimum spinescens* were also observed.

Photo 16: Typical vegetation encountered in Block 8, looking from east to west over the southern portion of the site. Note the rocky outcrops and the dense *Euphorbia gregaria* stands in the background.

Photo 17: Block 8, looking from north to south over the site. Note the two small *Boscia foetida* plants in the middle of picture.

Interestingly only one individual of *Aloidendron dichotomum* was observed within the whole area evaluated, which was in northern half of this block. Unfortunately, this young quiver tree seems to have succumbed to the drought (Photo 18).

From a botanical perspective the most interesting aspect of Block 8 is the great number of *Boscia foetida* species observed (of the 20 plants observed, 15 falls within the footprint). Fortunately, Boscia foetida seems to be quite common on the remainder of the property as well.

One relatively large (2.6 m) Boscia albitrunca was also observed within the footprint.

Photo 18: The only *Aloidendron dichotomum* (quiver tree) observed within any of the proposed footprints.

The area that will be impacted by the proposed temporary worker housing (Photo 19) shows similar vegetation as found in Block 8, but no *Boscia* or *Vachellia* plants will be impacted. The only protected species being a small number of *Euphorbia gariepina* plants.

Photo 19: A view over the area that will be impacted by the temporary housing, looking from north-west to south-east.

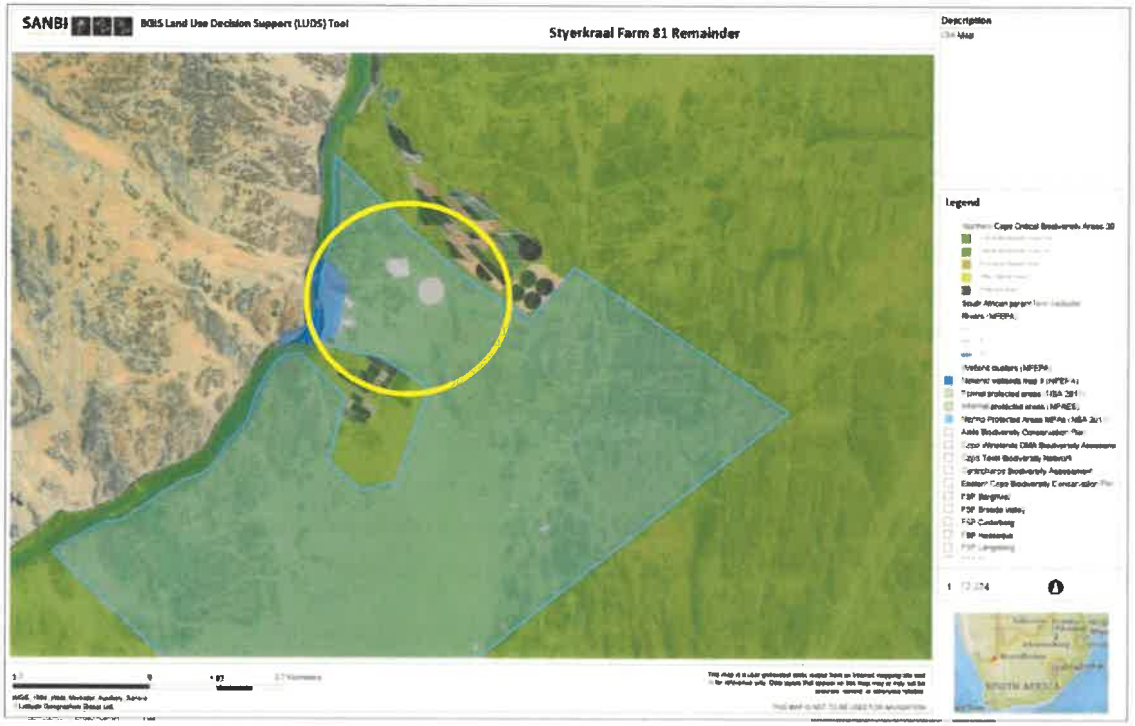
4.4. CRITICAL BIODIVERSITY AREAS MAPS

The 2016 Northern Cape CBA Map (NCCBA) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole (Holness & Oosthuysen, 2016). The 2016 Northern Cape Critical Biodiversity Area (CBA) Map updates, revises and replaces all older systematic biodiversity plans and associated products for the province (including the Namakwa District Biodiversity Sector Plan, 2008). Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes.

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

- **Critical biodiversity areas (CBA's)** are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.
- **Ecological support areas (ESA's)** are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

Figure 13: Northern Cape Critical Biodiversity Areas Map (2016) showing the proposed development area (SANBI BGIS)



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

- For CBA's the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat).

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

The NCCBA (Figure 13), shows that the large portions of the proposed development will overlap existing disturbance footprints (white areas), but all of the remainder will impact on proposed CBA's (green in Figure 13). It also indicates that portions of the old agricultural lands (existing disturbance footprint) fall within a previous floodplain area (blue in Figure 13). However, the whole of the remainder of the property falls within a CBA, meaning that any agricultural expansion will impact on the CBA.

The proposed location might be considered a good compromise because:

- It will utilize existing disturb areas;
- it will minimise future energy cost (since the expansions complement the existing disturbance footprint);
- it is located between two existing agricultural areas (the neighbouring farms), which will mean that the agricultural activities are concentrated in one area, leaving the remainder of the farm natural – thus minimising the impact on connectivity to a degree.

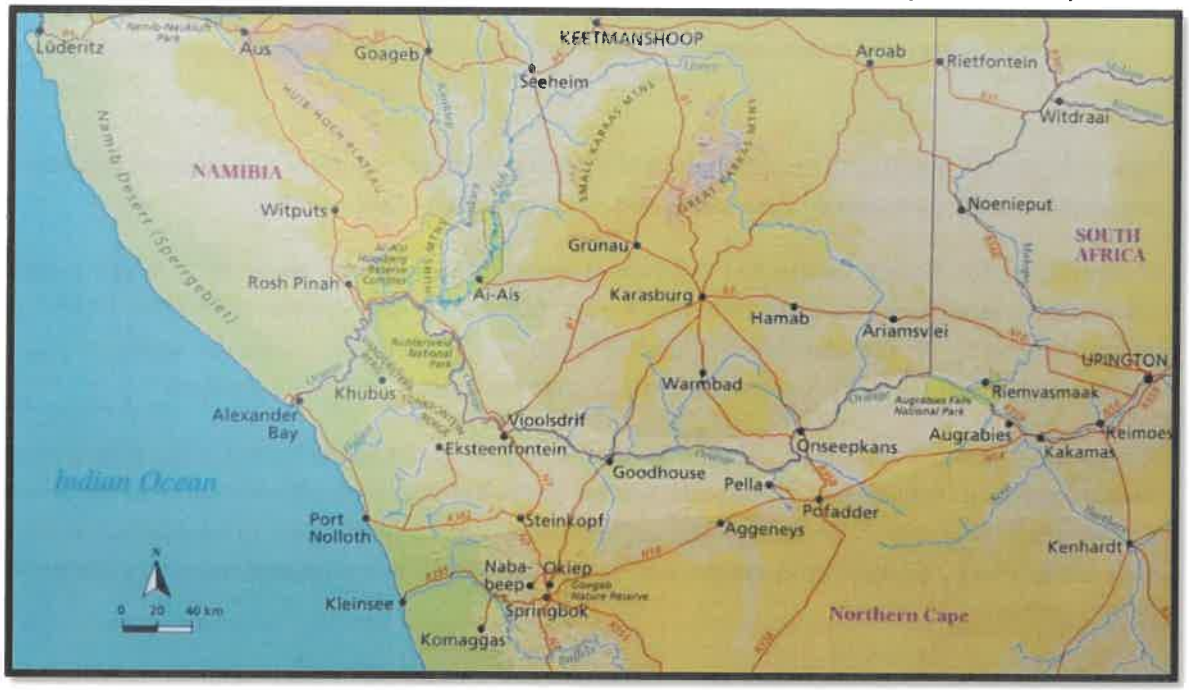
4.5. GARIEP CENTRE OF ENDEMISM

"Gariep" is the Khoekhoe name for the Orange River, which means the "Great River". The lower Orange River cuts right through the core of the Gariep Centre of endemism (GC) and also forms the international border between South Africa and Namibia (Refer to **Figure 14**). The GC, with the Richtersveld as its core is part of the Succulent Karoo Region and is considered a region of high floristic endemism. It is located in the north-western corner of the Northern Cape and the adjacent south-western corner of Namibia (Van Wyk & Smith, 2001). Van Wyk & Smith (2001) describes the GC as more or less L-shaped and within South Africa it is bounded by Port Nolloth (and north to include the Richtersveld), Steinkopf, Pofadder and on the Augrabies Falls to the south and east and by the Orange River in the north (note that it also extends into Namibia).

The GC, as described by Van Wyk & Smith (2001) includes several local foci of endemism, some of which comprise distinct sub-centres. The topography of the GC can varies significantly and includes, sandy plains and dunes (along the coast and inland), rugged inselbergs, gravel plains, dry river beds, steep rock-strewn mountains and deep gorges. The Orange River is the only permanent watercourse within this region. The climate is harsh, the weather unpredictable and with very little rainfall (predominantly in winter, but to the east it moves into the summer rainfall zone). Geologically the GC is very complex and exceeds by far the other centres of endemism in South Africa (Van Wyk & Smith, 2001). Soils are usually alkaline, sandy, shallow and stony, but clayey soils can occur and large areas are covered by aeolian sands.

Vegetation within the GC is mainly xerophytic semi-desert shrubland with a predominance of succulents. However, succulents are less prominent towards the east (as it moves out of the winter rainfall zone into the summer rainfall zone). Vegetation is intimately related to the geomorphology, geology and climate of the region. Trees and shrubs are very rare and mostly confined to rocky mountainous areas, dry watercourses, springs and banks of the Orange River. Within the Richtersveld and Port Nolloth area, most the rare and endangered plant species are concentrated on the higher mountain ranges and other high lying areas.

Figure 14: The Gariep Centre (highlighted) with the Richtersveld as its core (taken from Van Wyk & Smith, 2001)



The GC has the richest variety of succulents on earth with a very high level of endemism associated with these species. However, there is also a number of non-succulents endemic species within the GC (Van Wyk & Smith, 2001). According to Van Wyk & Smith (2001), this remarkable succulent endemism can be attributed to:

- The diverse geology (especially the quartzitic Gariep Supergroup, which is exposed only in the GC) especially in connection with the exposed mountains which provide diverse habitats and facilitate interception of moisture from clouds and fog (coupled with a unique climate). In the Richtersveld diversity is clearly associated with areas with high fog condensation and rainfall, while quartzitic substrates also show a propensity for harbouring endemics.
- The Orange River and its precursor have a significant influence on the geomorphological evolution of this region, being the principal conduit transporting sediments from the interior. The deep valleys associated with the river also create important passages for moist air to penetrate eastwards (from the sea) and also providing a frost-free refuge during colder periods.
- The cold Benguela Current and the South Atlantic Anticyclone initiated an increasing aridification of the region. The Benguela Current ensures a narrow zone of high humidity and low temperatures along the coast which is responsible for the fog which in turn is an extremely important additional source of moisture within the GC.

- Cyclonic rains in winter and close proximity to the summer-rainfall region would have favoured the development of the leaf succulents, while the interface between the rainfall systems would have allowed for the capture of some tropical floristic elements in the GC. Variability in annual rainfall within winter rainfall deserts is also much lower (again favouring the development of succulents).
- The right taxa, at the right place, at the right time (especially concerning the Mesembryanthemaceae).
- The rapid population turn-over associated with perennial shrubs (mainly Mesembryanthemaceae) within the GC would have minimised competitive interaction and would have been conducive to rapid speciation and diversification of especially perennial taxa.

Threats to the GC includes strip mining along the coast, extensive overgrazing in many of the inland mountainous areas, invasion by alien plants and illegal collecting of succulents.

In summary: The **Gariep Centre has the richest variety of succulents on earth** of which a **high percentage are endemic or near endemic.** A soft, but regular and therefore effective rainfall is mainly responsible for this abundance of plant life. Many of the endemic plants are limited to small areas, mostly on mountains where the rainfall is higher and habitat diversity is greatest.

The proposed development is located within the Gariep Centre of endemism, but is not expected to have a significant impact on endemic plant species as the development will be located on the sheet washed plains and will not impact on the rocky hills (which are more likely to be associated with endemic species). No red listed species were observed within the proposed footprints (Refer to Table 2 and Section 4.7.

4.6. FLORA ENCOUNTERED

Table 2 gives a list of the plant species encountered during this study. Because of the limitations (single site visit and on-going drought) it is likely that a number of annuals and geophytes might have been missed, but the author is confident that a good understanding of the vegetation was achieved and confidence in the findings is high.

Species diversity was very low and only twenty nine (29) different plant species where observed, which include one species listed as an alien invasive plant. One red-listed plant, 3 plants protected in terms of the National Forest Act (Act 84 of 1998) and 6 plants protected in terms of the Northern Cape Nature Conservation Act (Act 9 of 2009), one of which is a weedy pioneer species, were observed.

Table 2: Species checklist of flora observed within the study areas

NO.	SPECIES NAME	FAMILY	STATUS	ADDITIONAL NOTES
1.	*Aloidendron dichotomum*	ASPODELACEAE	VU NCNCA, Schedule 1 Protected	**Apply for a NCNCA Flora permit (DENC)**
2.	*Acanthopsis carduifolia*	ACANTHACEAE	LC	

NO.	SPECIES NAME	FAMILY	STATUS	ADDITIONAL NOTES
3.	*Adenolobus garipensis*	FABACEAE	LC	
4.	*Aptosimum spinescens*	SCROPHULARIACEAE	LC	
5.	*Blepharis mitrata*	ACANTHACEAE	LC	
6.	*Boscia albitrunca*	BRASSICACEAE (CAPPARACEAE)	LC NFA protected species NCNCA, Schedule 2 Protected (all species of Boscia)	**Apply for a NFA Tree permit (DAFF)** **Apply for a NCNCA Flora permit (DENC)**
7.	*Boscia foetida*	BRASSICACEAE (CAPPARACEAE)	LC NCNCA, Schedule 2 Protected (all species of Boscia)	**Apply for a NCNCA Flora permit (DENC)**
8.	*Calicorema capitata*	AMARANTHACEAE	LC	
9.	*Cleome foliosa*	CLEOMACEAE	LC	
10.	*Codon royenii*	BORAGINACEAE	LC	
11.	*Commiphora gracilifrondosa*	BURSERACEAE	LC	
12.	*Euclea pseudebenus*	EBENACEAE	LC NFA protected species	**None will be impacted by the proposed development**
13.	*Euphorbia gariepina*	EUPHORBIACEAE	LC NCNCA, Schedule 2 Protected (all species in this Genus)	**Apply for a NCNCA Flora permit (DENC)**
14.	*Euphorbia gregaria*	EUPHORBIACEAE	LC NCNCA, Schedule 2 Protected (all species in this Genus)	**Apply for a NCNCA Flora permit (DENC)**
15.	*Galenia africana*	AIZOACEAE (MESEMBRYANTHEMACEAE)	LC Protected in terms of schedule 2 of the NCNCA	**This is a common weedy pioneer.**
16.	*Hermannia* cf. *spinosa*	MALVACEAE	LC	
17.	*Lycium cinereum*	SOLANANEACEAE	LC	
18.	*Parkinsonia africana*	FABACEAE	LC	
19.	*Petalidium setosum*	ACANTHACEAE	LC	
20.	*Phaeoptilum spinosum*	NYCTAGINACEAE	LC	
21.	*Prosopis species*	FABACEAE	Invasive alien plant: CARA Category 2; NEMBA Category 3	**Implement a comprehensive Alien clearing program**
22.	*Rhigozum trichotomum*	BIGNONIACEAE	LC	
23.	*Rogeria longiflora*	PEDALIACEAE	LC	
24.	*Senegalia mellifera (=Acacia mellifera)*	FABACEAE	LC	
25.	*Sisyndite spartea*	ZYGOPHYLLACEAE	LC	
26.	*Tamarisk usneoides*	TAMARICACEAE	LC	
27.	*Tetraena decumbens (=Zygophyllum decumbens)*	ZYGOPHYLLACEAE	LC	
28.	*Tetraena microcarpa (=Zygophyllum microcarpum)*	ZYGOPHYLLACEAE	LC	
29.	*Vachellia erioloba*	FABACEAE	LC NFA protected species	**Apply for a NFA Tree permit (DAFF)**

4.7. THREATENED AND PROTECTED PLANT SPECIES

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

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

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

4.7.1. Red list of South African plant species

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

- One red-listed species was observed, namely *Aloidendron dichotomum* (Refer to Table 2). Only one individual observed which seems to have succumbed to the drought. Should any further plants be impacted by the proposed development, they must be replanted to the surrounding natural veld (with a watering program implemented until it has re-established itself).

4.7.2. NEM: BA protected plant species

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

- No NEM: BA protected species was observed (Refer to Table 2).

4.7.3. NFA Protected plant species

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

- Three NFA protected species were observed (Refer to Table 2) namely:
  - *Boscia albitrunca* – two individuals observed, of which one might be impacted.
  - *Euclea pseudebenus* – a small number of individuals observed, but none will be impacted by the proposed development.
  - *Vachellia erioloba* – A large number of individuals observed. Refer to the site specific mitigating measures recommendations (Par. 7.1).

4.7.4. NCNCA protected plant species

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

- **Six (6) species protected in terms of the NCNCA were encountered** (Refer to Table 2) of which one is considered a weedy pioneer plant.
- Refer to the site specific mitigating measures recommendations (Par. 7.1).

4.8. FAUNA AND AVI-FAUNA

Please note that no fauna screening was done as part of this study and the following is based on observations made during the site visit and the general status of the study area.

Animal species found in the Desert biomes associated with the Nama-, and Succulent Karoo is adapted to withstand the harsh, arid climate, while some species associated with the denser vegetation bordering the Orange River. Because of its aridity and unpredictable rainfall patterns, the Nama-Karoo region favours free moving herbivores such as ostrich and springbok nomadic birds and invertebrates with variable dormancy cued by rain. Plant defence against herbivores and seed adaption for dispersal by mammals are relatively uncommon, except along rivers and seasonal pans, suggesting the transient nature of herbivores, except near water where they would have lingered longer. However, since the 19th century the vast herds of migratory ungulates indigenous to this biome have been almost completely replaced by domestic stock. Once farmers started fencing their properties into camps (following the Fencing Act of 1912), stock numbers were dramatically increased with dire consequences to plant diversity. Grazing during and immediately after droughts periods is regarded as a major cause of detrimental change in vegetation composition and were ultimately responsible for the decline of large numbers of palatable plants (Mucina *et. al.*, 2006).

In an area, where the carrying capacity of the veld is already very low (70 – 100 ha per larger stock unit), the long term impact of stock grazing (often overgrazing), with their much narrower grazing habits (range of palatable plant species), as opposed to game, had very likely irreversibly impacted on plant species composition as well. As a result large game was almost totally displaced by sheep

and goat farmers and herders in in this part of the Northern Cape. This in turn has affected the food chain and ultimately the density of tertiary predators, particularly mammals and larger birds of prey. Smaller predators and scavengers such as jackal and caracal suffered the same lot and were almost totally eradicated by farmers in fear of their livestock. The use of wire snares and hunting dogs added to the impact on the remaining mammal species such as rabbit and mongooses, which are extremely vulnerable to such hunting methods

Thus, although natural fauna and avi-fauna are still present, it is expected that it would be limited to avi-fauna, insects and reptile's species albeit slightly changed in composition as a result of the changed food chain (loss of game). Because of the long-term impact of human settlement on the larger areas and especially because of the close proximity of the proposed development areas to the existing agricultural enterprises no comprehensive faunal survey was conducted or deemed necessary. The numbers of species given below reflects the potential range of species from literature, but because of the location, the nature and the relative small scale of the proposed development it is not expected that the development can or will pose any significant impact on any specific fauna or avi-fauna species.

4.8.1. Mammals

The site falls within the distribution range of approximately 50 mammal species indicating moderate diversity. Some of the most well-known species still to be expected within the larger communal land includes the Yellow mongoose (*Cynictis penicillata*), scrub hares (*Lepus saxatilis*), South African ground squirrels (*Xerus* inauris), Aardvark (*Orycteropus afer*), Dassie (*Petromus typicus*), Chacma Baboons (*Papio hamadryas*), Velvet Monkey (*Cercopithecus pygerythrus*), Porcupines (*Hysterix africaeaustralis*) and Batt-eared Foxes (*Octocyon megalotis*). Since human activity in the area is medium-high and it is highly unlikely that a fair representation of these mammals will be found on the property. As result the potential impact on mammal species is deemed negligible.

4.8.2. Reptiles

The site falls within the distribution range of approximately 30 reptile species, indicating low diversity. The rocky outcrops surrounding the proposed development areas is much more likely to provide suitable habitat for a much wider range of reptile species than the open sandy plains. Thus although a small number of snakes of snakes, lizards and geckos might be encountered on the open sandy plains (none of which was observed during the site visit), by far the majority of reptile species will be associated with the surrounding rocky hills. As a result is considered highly unlikely that the proposed development will impact on any significant number of reptile species. As such, the impact on reptiles should be negligible.

4.8.3. Avi-fauna

The site falls within the distribution range of approximately 200 bird species known from the broad area. But because of the medium-high human activity and the location of the site (open sandy plains

away from the Orange River) it is not expected that a fair representation of these species will be encountered on site or its immediate vicinity. However, larger indigenous trees can provide suitable habitat for a number of animal species, including avi-fauna, and it remains important that all larger indigenous trees must be protected wherever possible in order to minimise the possible impact (although localised). Thus apart from the potential impact on mature trees the proposed activity is not expected to have a significant impact on avi-fauna.

4.9. ALIEN INVASIVE PLANT SPECIES(AIP)

Alien and invasive plant (AIP) species were introduced into South Africa more than 1 000 years ago *via* trading routes from other countries in southern Africa (Alberts & Moolman, 2013). Since the arrival of settlers from Europe these numbers have increased dramatically. At present, AIPs are encountered on large portions of land in South Africa (10 million hectares) and it is reportedly consuming nearly 330 million cubic meters of water annually, or 7% of the annual run-off. But what is really scary is that this water consumption levels are increasing rapidly and could reach 50% of the mean annual run-off in the not too distant future (Alberts & Moolman, 2013). The aggressive behaviour of the AIPs in their unnatural habitat is a direct threat to the vast wealth of biodiversity in South Africa. South Africa is a relatively small country that comprises only 2% of the total surface of the Earth, but it contains 10% of the plant species, 7% of the vertebrates, and is home to three biodiversity hotspots.

In South Africa, there are currently three pieces of national legislation that relate to the control of Alien and Invasive Species (AIS) namely:

- Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947), administered by the Department of Agriculture, forestry and Fisheries.
- List of weeds and invader plants declared in terms of Regulations 15 and 16 (as Amended, March 2001) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) administered by the Department of Agriculture, Forestry and Fisheries (DAFF);
- Alien and invasive species list 2016 (GN R. 864 of 29 July 2016) promulgated in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental Management, Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA), administered by the Department of Environmental Affairs (DEA).

4.9.1. Conservation of Agricultural Resources Act (CARA)

The **CARA** sets out the regulations (amended March 2001) regarding the control of weeds and invasive plants and provides a list of declared plants. The amended regulations make provision for four groups of invader plants. The first three groups consist of undesirable alien plants and are covered by Regulation 15, namely:

- Category 1 declared weeds (Section 15A of the amended act) are prohibited plants that will no longer be tolerated on land or on water surfaces, neither in rural or urban areas. These plants may no longer be planted or propagated, and all trade in their seeds, cuttings or other

propagative material is prohibited. Plants included in this category because their harmfulness outweighs any useful properties or purpose they may have.

- Category 2 declared plant invaders (Section 15B of the amended act) are plants with a proven potential of becoming invasive, but which nevertheless have certain beneficial properties that warrant their continued presence in certain circumstances. May be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
- Category 3 declared plant invaders (Section 15C of the amended act) are undesirable because they have the proven potential of becoming invasive, but most of them are nevertheless popular ornamentals or shade trees that will take a long time to replace. May no longer be planted. Existing plants may be retained as long as all reasonable steps are taken to prevent the spreading thereof, provided they are not within 30 metres of the 1:50 year flood line of a river, stream, lake or other type of inland water body. The "executive officer" can impose further conditions on Category 3 plants already in existence, which might include removing them if the situation demands it.
- Bush encroachers, which are indigenous plants that require sound management practices to prevent them from becoming problematic, are covered separately by Regulation 16.

4.9.2. National Environmental Management: Biodiversity Act (NEM:BA)

NEMBA aims to provide the framework, norms, and standards for the conservation, sustainable use, and equitable benefit-sharing of South Africa's biological resources. The purpose of NEMBA as it relates to Alien and Invasive Species (AIS) is to prevent the unauthorised introduction and spread of such species to ecosystems and habitats where they do not naturally occur; manage and control such species to prevent or minimise harm to the environment and to biodiversity in particular; and to eradicate alien invasive species from ecosystems and habitats where they may harm such ecosystems or habitats. The Regulations on Alien and Invasive Species, referred to as the **"AIS Regulations"** combine invasive species already listed in the CARA, with two new lists relating to invasive species and prohibited species.

The AIS Regulations list 4 different categories of invasive species that must be managed, controlled or eradicated from areas where they may cause harm to the environment, or that are prohibited to be brought into South Africa, namely:

- **Category** 1a: invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. These species need to be controlled on your property, and officials from the Department of Environmental Affairs must be allowed access to monitor or assist with control.
- Category 1b: invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. Category 1b species are major invaders that may need government assistance to remove. All Category 1b species must be contained, and in many cases they already fall under a government sponsored management programme.
- Category 2: These are invasive species that can remain in your garden, but only with a permit, which is granted under very few circumstances.

- Category 3: These are invasive species that can remain in your garden. However, you cannot propagate or sell these species and must control them in your garden. In riparian zones or wetlands all Category 3 plants become Category 1b plants.

4.9.3. Northern Cape Nature Conservation Act (NCNCA)

Although provinces have a mandate to implement and enforce national legislation (such as CARA or NEM:BA), provincial authorities can also add further to legislation in the form of provincial ordinances, whereby each province can further prohibit certain species should the authorities feel that a species poses a potential risk or threat to the province's ecosystems or biodiversity.

In the Northern Cape Schedule 6 of the Northern Cape Nature Conservation Act, Act 9 of 2009 list additional invasive species that must be controlled. Schedule 6 list includes all species listed as weeds in CARA as well as an additional 36 species (none of which has been observed during this study). *Please note that all species categorized as Category 1 plants in terms of CARA are automatically listed in terms of the NCNCA.*

4.9.4. Alien & invasive plants encountered

The riparian zone associated with the nearby Orange River is heavily infested with the alien invasive *Prosopis* species especially prominent. Away from the river the climate is much harsher and water much less freely available. As a result the number of alien species encountered away from the river corridor reduces dramatically. However, a number of *Prosopis* trees were observed within the various footprints, especially the old floodplain area, most likely the result of its seeds being distributed by livestock. Although their numbers are not high at present, it is important that these plants are removed where-ever they are observed. Removal methods should be based on that used by the Working for Water Program (Bold, 2007) and or the CapeNature alien control guideline (Martens *et. al.,* 2003). Prosopis is listed as an alien invasive plant in terms of both CARA and NEMBA.

In this case all *Prosopis* individuals should be removed from the footprint and its immediate vicinity and a systematic clearing program should be implemented to remove these plants from the river corridor.

5. IMPACT ASSESSMENT METHOD

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

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

5.1. DETERMINING SIGNIFICANCE

Determining impact significance from predictions of the nature of the impact has been a source of debate and will remain a source of debate. The author used a combination of scaling and weighting methods to determine significance based on a simple formula. The formula used is based on the method proposed by Edwards (2011). However, the criteria used were adjusted to suite its use for botanical assessment. In this document significance rating was evaluated using the following criteria (Refer to Table 3).

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

Table 3: Categories and criteria used for the evaluation of the significance of a potential impact

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

5.2. SIGNIFICANCE CATEGORIES

The formal NEMA EIA application process was developed to assess the significance of impacts on the surrounding environment (including socio-economic factors), associated with any specific development proposal in order to allow the competent authority to make informed decisions. Specialist studies must advise the environmental assessment practitioner (EAP) on the significance of impacts in his field of specialty. In order to do this, the specialist must identify all potentially significant environmental impacts, predict the nature of the impact and evaluate the significance of that impact should it occur. Potential significant impacts are evaluated, using the method described above, in order to determine its potential significance. The potential significance is then described in terms of the categories given in Table 4.

Table 4: Categories used to describe significance rating (adjusted from DEAT, 2002)

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

6. DISCUSSING BOTANICAL SENSITIVITY

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

- **Location**: About 134.3 ha of the proposed 200 ha development footprint will be located in areas previously cultivated (most had not been cultivated for at least the last 10 years), some of which overlap old floodplain areas (that had been ridged). The remaining approximate 67.5 ha will be located on land not previously cultivated. The remaining natural veld can be described as sparse to very sparse vegetation, dominated by low shrubs with larger shrubs or small trees scattered throughout. However, a great number of protected plants were observed (mainly *Vachellia erioloba* and *Boscia* species).
- **Activity**: The development will result in the permanent transformation of approximately 200 ha of which about 65% is located on areas previously cultivated. Approximately 70 ha of natural veld will transformed.
- **Geology & Soils**: In general the soils were relatively similar, with only slight differences in soil depth and rocky patches sometimes observed. . In deeper soils *Vachellia erioloba* were more prominent, while *Boscia foetida* were much more prominent in rocky areas or shallower soils.
- **Land use and cover**: 65% of the approximate 200 development will be located on previously cultivated land. The remaining will be located on natural veld used for livestock grazing by the landowner.
- **Vegetation status**: The proposed footprint(s) will only impact on one broad vegetation type, namely Lower Gariep Broken Veld, which is considered "Least Threatened". Lower Gariep Broken Veld is part of the Nama-Karoo Biome. Rainfall is low and unreliable and droughts are unpredictable and often prolonged. The Nama-Karoo is not particularly rich in plant species and does not contain any centre of endemism (in contrast with Van Wyk & Smith 2001). Local endemism is very low. It is too dry in summer for dominance by perennial grasses alone and the soils generally to shallow and rainfall too low for dominance by trees. But soil type, soil depth and local differences in moisture availability can cause abrupt changes in vegetation structure and composition (e.g. small drainage lines support more plant species than surrounding plains).
- **Conservation priority areas**: The NCCBA (Figure 13), shows that the large portions of the proposed development will overlap existing disturbance footprints (white areas), but all of the remainder will impact on proposed CBA's (green in Figure 13). It also indicates that portions of the old agricultural lands (existing disturbance footprint) fall within a previous floodplain area (blue in Figure 13). However, the whole of the remainder of the property falls within a CBA, meaning that any agricultural expansion will impact on the CBA.
  According to Van Wyk & Smith (2001), the proposed development is located within the Gariep Centre of endemism. However, it is not expected to have a significant impact on the Gariep Centre as the development will be located on the sheet washed plains and will not impact on the rocky hills (which are more likely to be associated with endemic species) (Refer Section 4.5).
- **Connectivity**: The new development will be located in between two existing grape farms. 65% of the approximate 200 development will be located on previously cultivated land which will mean that the agricultural activities are concentrated in one area, leaving the remainder of the

farm natural. There will be and additional impact on connectivity, but the placement means it will be located in an area already impacted by agricultural activities.

- **Watercourses and wetlands**: A freshwater specialist was appointed to address this aspect.
- **Protected or endangered plant species**: The Nama-Karoo is not particularly rich in plant species and local endemism is very low. Twenty nine (29) plant species where observed, which include one species listed as an alien invasive plant. One red-listed plant, 3 plants protected in terms of the National Forest Act (Act 84 of 1998) and 6 plants protected in terms of the Northern Cape Nature Conservation Act (Act 9 of 2009), one of which is a weedy pioneer species, were observed. In terms of botanical significance, the most important aspect of the proposed development is the number of *Vachellia erioloba* trees as well as *Boscia* plants that may be impacted.
- **Alien and Invasive Plant species**: The presence of dense stands of *Prosopis* trees next to the river and their slow invasion of the old lands are particularly concerning. A dedicated and systematic alien eradication plan will have to be adopted to eradicate these plants.

Conservation value or habitat sensitivity is based on the irreplaceability of the habitat unit, on observations of the abundance and diversity of floral and faunal species present at the time of the assessment, on the presence of endangered or protected species within the habitat units, on the presence of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) and on the degree of disturbance encountered as a result of historical and current activities.

The terrestrial habitat associated with this project is considered to be of a moderate sensitivity based on the following factors:

- The vegetation type is classified as least threatened;
- However, the portions of the development will impact on a proposed CBA;
- About 65% of the proposed footprint will overlap previously cultivated land the remainder has been impacted, by grazing and agricultural related activities, but still functions well;
- The floral diversity is low and no special habitats were observed;
- One red-listed plant, 3 nationally protected plant species and 6 provincially protected plant species were observed.

6.1. IMPACT ASSESSMENT

Table 5 rates the significance of environmental impacts associated with the proposed development. For each aspect, the worst case scenario (of the combined sites) were taken as *"without mitigation"* with reference to specific mitigation actions given for the specific site mitigation actions required when scoring *"with mitigation"*. It also evaluates the expected accumulative effect of the proposed development as well as the No-Go option.

Table 5: Impact assessment associated with the proposed development

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Geology & soils: Potential impact on special habitats (e.g. true quartz or "heuweltjies")	Without mitigation	2	2	4	1	3	20	Soils were relatively similar, with only slight differences in soil depth and rocky patches. Protected *Vachellia erioloba* trees associated with deeper sandy soils.
	With mitigation	2	2	3	1	1	14	Protect all significant indigenous tree species (and all *Vachellia erioloba* taller than 5m).
Landuse and cover: Potential impact on socio-economic activities.	Without mitigation	2	2	4	1	2	18	65% of the approximate 200 development located on previously cultivated land. The remaining located on natural veld used for livestock grazing by the landowner.
	With mitigation	2	2	3	1	1	14	Potential beneficial socio-economic impact (job opportunities).
Vegetation status: Loss of vulnerable or endangered vegetation and associated habitat.	Without mitigation	2	4	4	2	3	26	Permanent transformation of ±200ha of which 65% was previously disturbed. Remaining veld used for livestock grazing. Many protected trees on site.
	With mitigation	2	2	3	2	2	18	Protect all significant indigenous tree species (and all *Vachellia erioloba* taller than 5m).
Conservation priority: Potential impact on protected areas, CBA's, ESA's or Centre's of Endemism.	Without mitigation	3	4	4	2	3	39	65% of the approximate 200 development located on previously cultivated land (portions within an old floodplain). The remaining will impact on a proposed CBA.
	With mitigation	3	2	3	2	2	27	There is no alternative which will not impact on the CBA. This option will minimise impact on overall connectivity and will concentrate agriculture in one larger area.
Connectivity: Potential loss of ecological migration corridors.	Without mitigation	2	4	4	2	3	26	65% of the approximate 200 development located on previously cultivated land. The remaining located on natural veld used for livestock grazing by the landowner.
	With mitigation	2	3	3	2	2	20	Any expansion will impact connectivity, but the proposed option will minimise the impact on overall connectivity, by concentrating intensive agriculture in one area.
Watercourses and wetlands: Potential impact on natural water courses and it's ecological support areas.	Without mitigation						0	N/a (Refer to the Freshwater specialist report).
	With mitigation						0	
Protected & endangered plant species: Potential impact on	Without mitigation	3	4	4	3	3	42	One red listed and a number of National and Provincial protected plants observed (of which the impact on a number of *Vachellia erioloba* is significant).

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
threatened or protected plant species.	With mitigation	3	3	3	2	2	30	Protect all significant indigenous tree species (and all *Vachellia erioloba* taller than 5m).
Invasive alien plant species: Potential invasive plant infestation as a result of the activities.	Without mitigation	3	3	3	3	4	39	The presence of dense stands of Prosopis trees next to the river and their slow invasion of the old lands are particularly concerning.
	With mitigation	3	2	2	2	2	24	A dedicated and systematic alien eradication plan will have to be adopted to eradicate these plants.
Veld fire risk: Potential risk of veld fires as a result of the activities.	Without mitigation	3	1	2	2	2	21	Veld fire risk low.
	With mitigation	3	1	1	1	1	12	Address fire danger throughout construction.
Cumulative impacts: Cumulative impact associated with proposed activity.	Without mitigation	3	4	4	3	4	45	Permanent transformation of approximately 150ha of natural veld for agriculture (which is likely to lead to job opportunities).
	With mitigation	3	3	3	2	2	30	Refer to all the mitigation recommendations above.
The "No-Go" option: Potential impact associated with the No-Go alternative.	Without mitigation	3	3	3	3	4	39	Degradation of previously cultivated areas as a result of *Prosopis* invasion and no social gain.
	With mitigation						0	

According Table 5, the main impacts associated with the proposed development will be:

- The impact on protected plant species (especially on *Vachellia erioloba*);
- The potential impact of alien infestation if no invasive alien control program is implemented;
- The impact on CBA's and connectivity;

The No-Go option is not likely to result in a "no-impact" scenario, for it will have a negative socio-economic impact (and slow degradation as a result of further *Prosopis* invasion is very likely).

The cumulative impact (without mitigation) is expected to be **Medium/Low**, mainly as a result of the potential impact on protected plant species and CBA, but can be reduced to **Low** through mitigation.

7. IMPACT MINIMISATION RECOMMENDATIONS

The proposed development will result in a permanent (but rehabilitation will be possible) impact on a further approximately 70 ha of natural vegetation (the main footprint ±135 ha, will overlap previously cultivated land) within a CBA and will impact on a number of protected species (especially a number of young *Vachellia erioloba* trees). There is no alternative location on this property that will not impact the CBA. However, if the recommendations underneath is implemented all the Vachellia trees larger than 5m and most of the young ones will be saved.

Probably the most significant botanical observations made relates to a number of protected plant species observed (refer to Appendix 2) that might be impacted.

The cumulative impact (without mitigation) is expected to be **Medium/Low**, mainly as a result of the potential impact on protected plant species and CBA, but can be reduced to **Low** through mitigation. The No-Go option is not likely to result in a "no-impact" scenario, for it will have a negative socio-economic impact (and slow degradation as a result of further *Prosopis* invasion is very likely).

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

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

7.1. SITE SPECIFIC RECOMMENDATIONS

Figure 15 – 17 (underneath) gives a sensitivity map for proposed development, mainly focusing on the protection of larger *Vachellia erioloba*, all *Euclea pseudebenus* trees and *Boscia albitrunca* individuals. The green "sensitive" areas refer to:

1. The protection of the Orange River riparian corridor and a number of larger *Vachellia* & *Euclea* individuals within this corridor as well as to the north and south of Block 1 (Area 1 in Figure 16 – 17).
2. The protection of a clump of young *Vachellia erioloba* trees next to the new proposed storage dam (Refer to trees marked as waypoint "240 V.erio (4m)" to "251 V.erio (2.9m)" in Appendix 3) (Area 2 in Figure 16);
3. The potential protection of as many as possible of the young *Vachellia erioloba* trees marked by waypoint "255 V.erio (1.6m)" - "263 V.erio (2m)" in Appendix 3 (Area 3 in Figure 16 – 17).

- **Block 1: Dates 4 ha (Figure 7):** The Orange River is the main watercourse of importance in the study area. Unfortunately, the riparian zone is heavily infested with the alien invasive *Prosopis* tree. It is imperative that the remaining corridor of natural vegetation along the Orange River is protected and that alien species are removed from this corridor. A number of *Vachellia* erioloba, *Euclea pseudebenus, Tamarisk usneoides* and *Searsia* species still remain of its original vegetation. A

systematic alien eradication program should be implemented in order to systematically remove the alien invasive *Prosopis* trees in order for the natural vegetation to reclaim the river corridor.

- **Block 2: Grapes 56 ha (Figure 7):** By far the most significant aspect observed this area was the great number of *Vachellia erioloba* trees remaining within the old agricultural area and within the new proposed footprint. In Figure 7, the red markers indicate *Vachellia erioloba* trees larger than 5m. These markers also represent trees that should not be removed (refer to Appendix 3 for their GPS locations). Twenty eight (28) individual trees larger than 5 m were marked in the immediate vicinity of the proposed Block 1 & 2 and the new storage dam site. Fortunately, only 4 of these trees are within the proposed footprint, and they are located next to an existing road. There should be no reason why any of these trees needs to be removed. Unfortunately, about thirty eight (38) young trees (averaging 2 - 3 m) were also observed, of which 32 falls within the proposed footprint. Quite a number of these are located next to existing roads. All efforts should be made to protected as many of these trees as possible (the minimum aim should be too safe at least 50% of these trees).

- **Block 3: Grapes 21 ha (Figure 8):** All alien *Prosopis* trees must be removed from the footprint and the areas surrounding the proposed development. The large *Vachellia erioloba* (waypoint 188 in Appendix 2) and *Euclea pseudebenus* (waypoint 189 in Appendix 2) (both outside of the proposed footprint) must be protected.

- **Block 4: Dates 43 ha (Figure 8):** The two young *Vachellia erioloba* trees (waypoints 196 & 197 in Appendix 2) should be considered for protection if possible.

- **Block 5: Dates 12 ha (Figure 10):** The large *Vachellia erioloba* (waypoint 234 in Appendix 2) as well as the *Boscia albitrunca* (waypoint 231 in Appendix 2), on the edge of the proposed footprint should be protected if at all possible.

- **Waste disposal site (Figure 10):** 5 *Boscia foetida* individuals were observed just east of the proposed site (three of which was quite big plants) (refer to waypoints 269 – 273 in Appendix 2) must be protected, as there should be no reason to include them within the footprint.

- **Block 6: Grapes 6 ha (Figure 11):** The two larger *Vachellia erioloba* trees, located outside of the development footprint (waypoint 261 & 262 in Appendix 2) must be protected.

- **Block 7: Dates 20 ha (Figure 12):** 9 *Boscia foetida* (waypoints 222 – 230) were observed, of which 6 falls within the footprint. Protect as many of these plants as possible.

- **Block 8: Dates 26 ha (Figure 12)**: One individual of *Aloidendron dichotomum* was observed. Unfortunately, this young quiver tree seems to have succumbed to the drought (Photo 18). A great number of *Boscia foetida* plants were also observed (of the 20 plants observed, 15 falls within the footprint) and one *Boscia albitrunca*. Fortunately, *Boscia foetida* seems to be quite common on the remainder of the property as well. As many as possible of these plants should be protected where possible.

7.2. GENERAL MITIGATION ACTIONS

The following general mitigation actions should also be implemented:

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must include the recommendations made in this report.

- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase in terms of the EMP and any other conditions pertaining to specialist studies.
- The layout of the development footprint should take the sensitivity map (Figure 15, next page) into account.
- Lay-down areas or construction sites must be located on areas already disturbed;
- No unnecessary clearing of any area outside of the construction footprint may be allowed.
- An integrated waste management approach must be implemented during construction.
    - Construction related general and hazardous waste may only be disposed of at suitably approved waste disposal sites.

Figure 15: Styerkraal sensitivity map: Note the green areas marked as sensitive, the red markers (sensitive *Vachellia erioloba* trees), the yellow markers (*Euclea pseudebenus* trees)

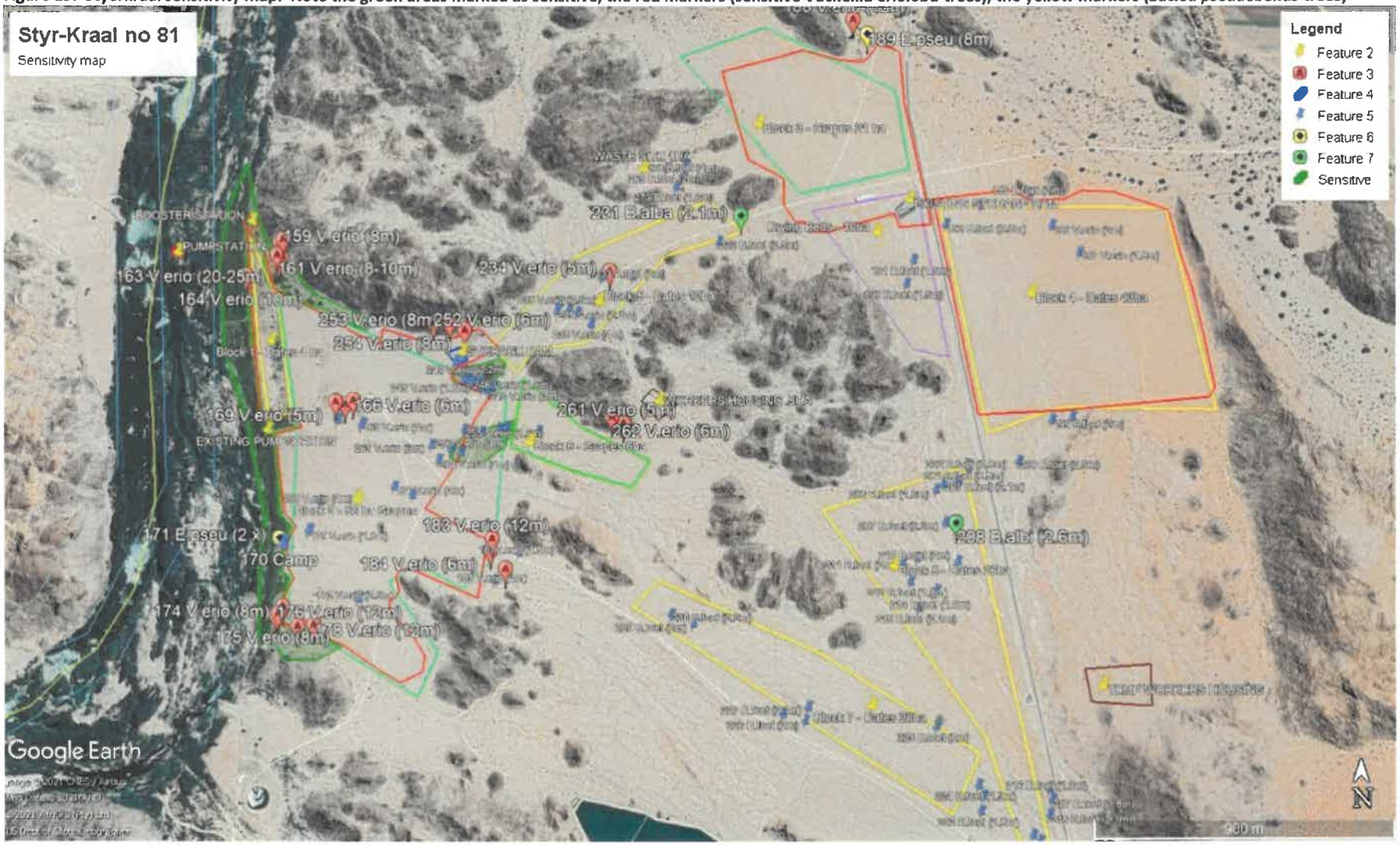


Figure 16: Styerkraal sensitivity map: Showing the upper half of Block 1-2 and the sensitive areas associated with these blocks

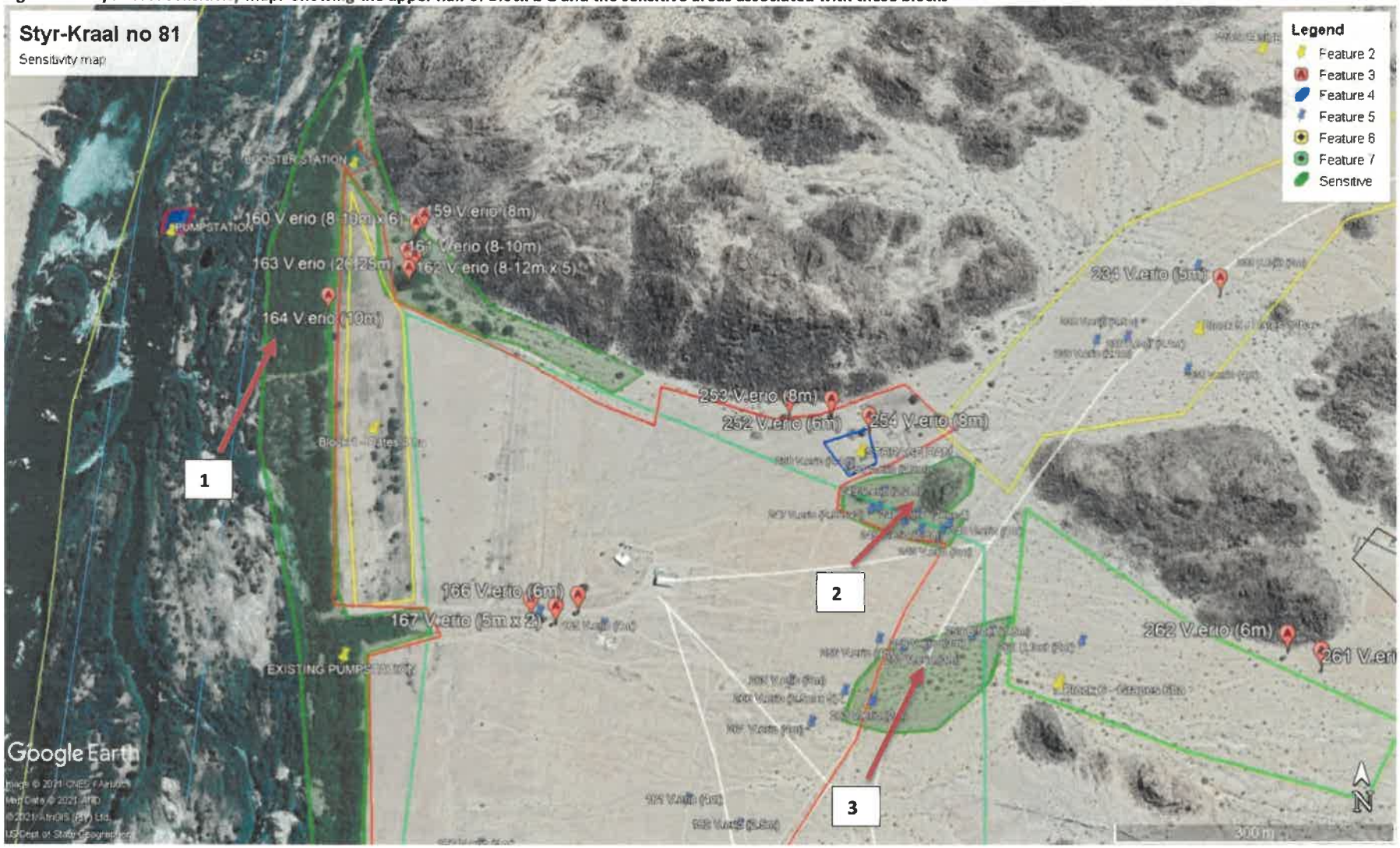
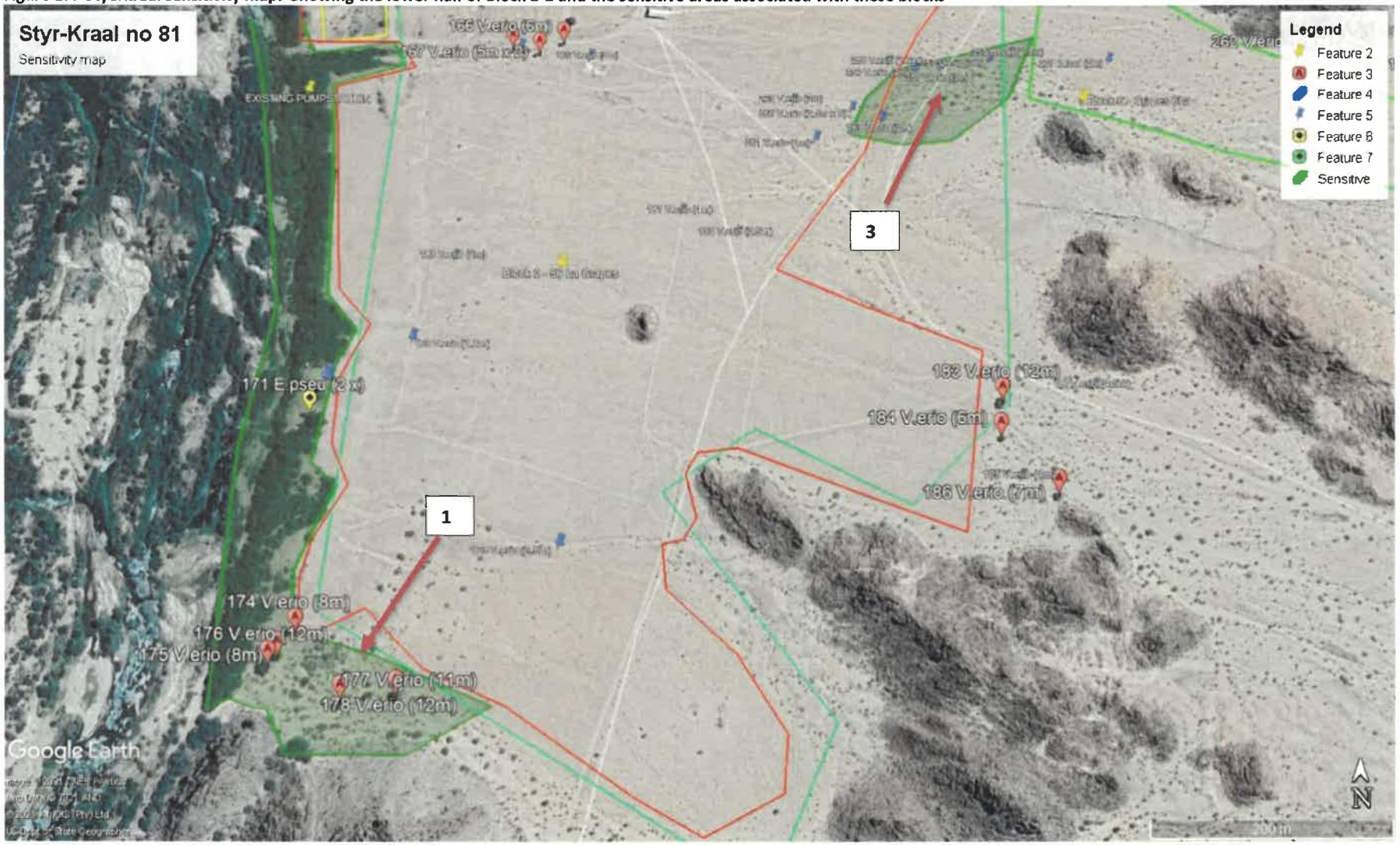


Figure 17: Styerkraal sensitivity map: Showing the lower half of Block 1-2 and the sensitive areas associated with these blocks



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Curriculum Vitae: Peet JJ Botes

Address: 22 Buitekant Street, Bredasdorp, 7280; **Cell**: 082 921 5949

Nationality:	South African
ID No.:	670329 5028 081
Language:	Afrikaans / English
Profession:	Environmental Consultant & Auditing
Specializations:	Botanical & Biodiversity Impact Assessments
	Environmental Compliance Audits
	Environmental Impact Assessment
	Environmental Management Systems
Qualifications:	**BSc** (Botany & Zoology), with Nature Conservation III & IV as extra subjects; Dept. of Natural Sciences, Stellenbosch University 1989.
	Hons. BSc (Plant Ecology), Stellenbosch University, 1989
	More than 20 years of experience in the Environmental Management Field (Since 1997 to present).
Professional affiliation:	Registered Professional Botanical, Environmental and Ecological Scientist at SACNASP (South African Council for Natural Scientific Professions) since 2005.
SACNAP Reg. No.:	400184/05

BRIEF RESUME OF RELEVANT EXPERIENCE

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

2005-2010: Joined Enviroscientific, as an independent environmental consultant specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming

for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity and environmental legal compliance audits.

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

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

LIST OF MOST RELEVANT BOTANICAL & BIODIVERSITY STUDIES

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Botes, P. 2020(a): Gamakor & Noodkamp Low cost housing – Botanical Assessment of the proposed formalization of the Gamakor and Noodkamp housing development on the remainder and portion 128 of the Farm Kousas No. 459 and Ervin 1470, 1474 and 1480, Gordonia road, Keimoes. Kai !Gariep Local Municipality, Northern Cape Province. 6 February 2020.

Botes, P. 2020(b): Feldspar Prospecting & Mining, Farm Rozynen Bosch 104, Kakamas. Botanical assessment of the proposed prospecting and mining activities on Portion 5 of The Farm Rozynen Bosch No. 104, Kakamas, Khai !Garib Local Municipality, Northern Cape Province. 12 February 2020.

Botes, P. 2020(c): Boegoeberg housing project – Botanical assessment of the proposed formalization and development of 550 new erven on the remainders of farms 142 & 144 and Plot 1890, Boegoeberg settlement, !Kheis Local Municipality, Northern Cape Province. 1 July 2020.

Botes, P. 2020(d): Komaggas Bulk Water supply upgrade – Botanical assessment of the proposed upgrade of the existing Buffelsrivier to Komaggas BWS system, Rem. of Farm 200, Nama Khoi Local Municipality, Northern Cape Province. 8 July 2020.

Botes, P. 2020(e): Grootdrink housing project – Botanical assessment of the proposed formalization and development of 370 new erven on Erf 131, Grootdrink and Plot 2627, Boegoeberg Settlement, next to Grootdrink, !Kheis Local Municipality, Northern Cape Province. 14 July 2020.

Botes, P. 2020(f): Opwag housing project – Botanical assessment of the proposed formalization and development of 730 new erven on Plot 2642, Boegoeberg Settlement and Farm Boegoeberg Settlement NO.48/16, Opwag, !Kheis Local Municipality, Northern Cape Province. 16 July 2020.

Botes, P. 2020(g): Wegdraai housing project – Botanical assessment of the Proposed formalization and development of 360 new erven on Erven 1, 45 & 47, Wegdraai, !Kheis Local Municipality, Northern Cape Province. 17 July 2020.

Botes, P. 2020(h): Topline (Saalskop) housing project – Botanical assessment of the pproposed formalization and development of 248 new erven on Erven 1, 16, 87, Saalskop & Plot 2777, Boegoeberg Settlement, Topline, !Kheis Local Municipality, Northern Cape Province. 18 July 2020.

Botes, P. 2020(i): Gariep housing project – Botanical assessment of the proposed formalization and development of 135 new erven on Plot 113, Gariep Settlement, !Kheis Local Municipality, Northern Cape Province. 20 July 2020.

Botes, P. 2021(a) Schaapkraal Erf 644 – Botanical re-assessment of the proposed residential development on Erf 644, Schaapkraal, Michells Plain, City of Cape Town. Western Cape Province.

Botes, P. 2021(b) Bass Dii Berries – Botanical assessment of the proposed development of a new dam and agricultural land on Portion 12 of the Farm Scherpe Heuvel no. 481. Worcester. Breede Valley Local Municipality, Western Cape Province. 11 February 2021.

Botes, P. 2021(c) Calvinia Bulk Water Supply – Botanical assessment of the proposed development of new boreholes and connecting pipelines along the R355, R27 and a number of minor gravel roads. Hantam Local Municipality, Northern Cape Province. 8 March 2021.

APPENDIX 2: GPS COORDINATES FOR THE PROTECTED TREES OBSERVED

GPS CO-ORDINATES FOR SIGNIFICANT PROTECTED PLANT SPECIES OBSERVED AT STYERKRAAL

In this table the following acronyms refer to the following plant species.

Acronym	Species name	Common name	Recommendations
V.erio	*Vachellia erioloba*	Camel thorn tree (Kameeldoring)	All highlighted plants must be protected. The remainder should be protected where possible.
E.pseu	*Euclea pseudebenus*	Ebony tree quarri (Ebbehout)	
B.foet	*Boscia foetida*	Stink-bush (Noeniebos)	
B.albi	*Boscia albitrunca*	Shepherd's tree (Witgat)	

Waypoint Name	Latitude	Longitude	Comments
"159 V.erio (8m)"	-28.671396989375353	19.496133020147681	To be protected
"160 V.erio (8-10m x 6)"	-28.671479970216751	19.496021037921309	To be protected
"161 V.erio (8-10m)"	-28.671817006543279	19.495917018502951	To be protected
"162 V.erio (8-12m x 5)"	-28.671883977949619	19.496034029871225	To be protected
"163 V.erio (20-25m)"	-28.672040970996022	19.495965968817472	To be protected
"164 V.erio (10m)"	-28.672383036464453	19.494939018040895	To be protected
"165 V.erio (4m)"	-28.675973005592823	19.498630994930863	
"166 V.erio (6m)"	-28.675817018374801	19.49832396581769	To be protected
"167 V.erio (5m x 2)"	-28.675936041399837	19.498062031343579	To be protected
"168 V.erio (2 x 3m)"	-28.675834033638239	19.497862039133906	
"169 V.erio (5m)"	-28.675861023366451	19.497761037200689	To be protected
"171 E.pseu (2 x)"	-28.679643021896482	19.495966974645853	Outside footprint but must be protected.
"173 V.erio (2.5m)"	-28.680797964334488	19.498505014926195	
"174 V.erio (8m)"	-28.681544037535787	19.496073005720973	To be protected
"175 V.erio (8m)"	-28.681735983118415	19.495931016281247	To be protected
"176 V.erio (12m)"	-28.681802032515407	19.49585197493434	To be protected
"177 V.erio (11m)"	-28.682080982252955	19.496559994295239	To be protected
"178 V.erio (12m)"	-28.68204602971673	19.497066009789705	To be protected
"179 V.erio (1.8m)"	-28.678918993100524	19.496937012299895	

Waypoint Name	Latitude	Longitude	Comments
"180 V.erio (4m)"	-28.678117012605071	19.497300032526255	
"181 V.erio (4m)"	-28.677698001265526	19.499645959585905	
"182 V.erio (2.5m)"	-28.677934035658836	19.500225987285376	
"183 V.erio (12m)"	-28.679630029946566	19.502737959846854	To be protected
"184 V.erio (6m)"	-28.679958013817668	19.502685992047191	To be protected
"185 V.erio (4m)"	-28.680290021002293	19.502852037549019	
"186 V.erio (7m)"	-28.680464029312134	19.503165017813444	To be protected
"187V.erio (4.5m)"	-28.679503966122866	19.503623005002737	
"188 V.erio (12m)"	-28.665357995778322	19.514083033427596	To be protected
"189 E.pseu (8m)"	-28.665757980197668	19.514520987868309	Outside footprint but must be protected.
"190 B.foet (1.5m)"	-28.672152031213045	19.515721024945378	
"191 B.foet (1.5m)"	-28.671502014622092	19.515953036025167	
"192 B.foet (0.8m)"	-28.670515967532992	19.516960959881544	
"193 B.foet (0.5m)"	-28.669998971745372	19.51806602999568	
"195 B.foet (2m)"	-28.669666964560747	19.5195949729532	
"196 V.erio (2m)"	-28.670560978353024	19.52025898732245	
"197 V.erio (1.8m)"	-28.671306967735291	19.521108996123075	
"198 B.foet (2m)"	-28.675777958706021	19.520827028900385	
"199 B.foet (2m)"	-28.675857000052929	19.520204002037644	
"200 B.foet (2.5m)"	-28.676991993561387	19.519161963835359	
"201 B.foet (0.8m)"	-28.677085032686591	19.517568983137608	
"202 B.foet (0.8m)"	-28.677145969122648	19.517627991735935	
"203 B.foet (1.8m)"	-28.677523992955685	19.517305037006736	
"204 B.foet (0.5m)"	-28.677586019039154	19.517222978174686	
"205 B.foet (2.1m)"	-28.677589958533645	19.516833974048495	
"206 B.foet (1.6m)"	-28.677757009863853	19.516595005989075	

Waypoint Name	Latitude	Longitude	Comments
"207 B.foet (2.2m)"	-28.678648006170988	19.516874961555004	
"208 B.albi (2.6m)"	-28.679166007786989	19.517176039516926	
"209 B.foet (1.8m)"	-28.679710999131203	19.517238987609744	
"210 B.foet (2m)"	-28.67961997166276	19.516010032966733	
"211 B.foet (2m)"	-28.679720973595977	19.515551961958408	
"212 B.foet (1.8m)"	-28.680261019617319	19.515789002180099	
"213 B.foet (1.6m)"	-28.680493030697107	19.516592994332314	
"214 B.foet (1.8m)"	-28.680584980174899	19.516490986570716	
"215 B.foet (2.1m)"	-28.68097398430109	19.516044985502958	
"216 B.foet (1.8m)"	-28.685771031305194	19.519993029534817	
"217 B.foet (1.8m)"	-28.686062972992659	19.520063018426299	
"218 B.foet (2.1m)"	-28.686471004039049	19.519990012049675	
"219 B.foet (2m)"	-28.687013983726501	19.519490031525493	
"220 B.foet (1.6m)"	-28.687171982601285	19.519703015685081	
"221 B.foet (2m)"	-28.687527040019631	19.519796976819634	
"222 B.foet (1.8m)"	-28.686394980177283	19.517911970615387	
"223 B.foet (1.9m)"	-28.685982003808022	19.51798003166914	
"224 B.foet (1.9m)"	-28.685696013271809	19.517837036401033	
"225 B.foet (2m)"	-28.684139996767044	19.516557035967708	
"226 B.foet (2m)"	-28.684009993448853	19.51252500526607	
"227 B.foet (2.1m)"	-28.683642027899623	19.512622989714146	
"228 B.foet (2.1m)"	-28.683831039816141	19.511853028088808	
"229 B.foet (2m)"	-28.68142400868237	19.509075013920665	
"230 B.foet (2.2m)"	-28.681175988167524	19.508376969024539	
"231 B.alba (2.1m)"	-28.670788966119289	19.51054603792727	
"232 B.foet (2.5m)"	-28.670990969985723	19.509882023558021	

Waypoint Name	Latitude	Longitude	Comments
"233 B.foet (2m)"	-28.671942986547947	19.507192019373178	
"234 V.erio (5m)"	-28.67229200899601	19.506438989192247	
"235 V.erio (4m)"	-28.673221981152892	19.505874970927835	
"236 B.foet (2.1m)"	-28.672913024201989	19.505449002608657	
"237 V.erio (2.5m)"	-28.672816967591643	19.505194025114179	
"238 V.erio (2.5m)"	-28.672642037272453	19.504904011264443	
"239 V.erio (2.1m)"	-28.672857033088803	19.504800997674465	
"240 V.erio (4m)"	-28.67491596378386	19.502793028950691	This Bush clump should be protected if possible.
"241 V.erio (2.2m)"	-28.674988970160484	19.502703007310629	
"242 V.erio (3m)"	-28.675067005679011	19.502656990662217	
"243 V.erio (2.8m)"	-28.674982013180852	19.502445012331009	
"244 V.erio (4m x 2)"	-28.674820996820927	19.502405030652881	
"245 V.erio (1.8m)"	-28.674885034561157	19.502263963222504	
"246 V.erio (1.6m)"	-28.674801969900727	19.502138989046216	
"247 V.erio (2.5m x2)"	-28.674751007929444	19.501865990459919	
"248 V.erio (2m x 4)"	-28.674731981009245	19.501964980736375	
"249 V.erio (2.2m)"	-28.674560990184546	19.502033041790128	
"250 V.erio (2.1m)"	-28.674158994108438	19.501796001568437	
"251 V.erio (2.9m)"	-28.674241974949837	19.50161000713706	
"252 V.erio (6m)"	-28.673707041889429	19.500892013311386	To be protected
"253 V.erio (8m)"	-28.673713998869061	19.501414960250258	To be protected
"254 V.erio (8m)"	-28.673895969986916	19.501877976581454	To be protected
"255 V.erio (1.6m)"	-28.676125975325704	19.501886023208499	This Bush clump should be protected if possible.
"256 V.erio (4m)"	-28.676206022500992	19.502165978774428	
"257 V.erio (3m)"	-28.676189007237554	19.502429002895951	
"258 V.erio (3m)"	-28.676099991425872	19.502977011725307	

Waypoint Name	Latitude	Longitude	Comments
"259 B.foet (1.8m)"	-28.676054980605841	19.503201982006431	
"260 B.foet (2m)"	-28.676161011680961	19.504231028258801	
"261 V.erio (5m)"	-28.676453037187457	19.506877027451992	
"262 V.erio (6m)"	-28.676282968372107	19.506520964205265	
"263 V.erio (2m)"	-28.676751013845205	19.501771023496985	
"264 V.erio (4m)"	-28.676957963034511	19.501067027449608	
"265 V.erio (3m)"	-28.676543980836868	19.500840967521071	
"266 V.erio (2.5m x 5)"	-28.676646994426847	19.50145997107029	
"267 B.foet (2.1m)"	-28.67194902151823	19.506214018911123	
"269 B.foet (2m)"	-28.668953999876976	19.508250989019871	
"270 B.foet (4m)"	-28.668645964935422	19.508826993405819	
"271 B.foet (2.2m)"	-28.668871019035578	19.508844008669257	
"272 B.foet (1.6m)"	-28.669215012341738	19.508768990635872	
"273 B.foet (1.6m)"	-28.669465966522694	19.508559023961425	