



DRAFT SCOPING REPORT
FOR THE CLEARING OF
VEGETATION FOR
EXPANING EXISTING
PIVOTS ON THE
REMAINDER OF THE
FARM TWEEFONTEIN
373 AND PTN 4 (PTN OF
PTN 2 OF THE FARM
KALKFONTEIN 374,
PRIESKA



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BACKGROUND

Digital Soils Africa (Pty) LTD (DSA) was tasked by Temdale Boerdery (Pty) Ltd to conduct environmental investigations and complete the Environmental Authorisation Application for the authorisation of clearing of about 46Ha of vegetation for the expansion of existing pivots on the Remainder of the Farm Tweefontein 373 and Portion 4 (Ptn of Ptn 2) of the Farm Kalkfontein 374, Prieska in the Northern Cape, to establish pecan nut orchard.

In terms of the National Environmental Management Act 107 of 1998 (“NEMA”), environmental authorisation must be obtained before any person can conduct activities that cause damage to the environment.

DSA was appointed by Temdale Boerdery (Pty) Ltd (also referred to as the Applicant) as the independent environmental assessment practitioner (EAP) to undertake the Environmental Authorisation Application for the commencement of a listed activity in terms of the Environmental Impact Assessment Regulations 2014, as amended in 2017.

The proposed project entails the expansion of existing centre pivot irrigation areas by approximately 46 hectares on the Remainder of Farm Tweefontein No. 373 and Portion 4 (portion of Portion 2) of Farm Kalkfontein No. 374 for the establishment of a pecan nut orchard. The properties are currently utilised for irrigated agriculture, with four existing centre pivots already established on the site prior to 1998, comprising a 50 ha and 25 ha pivot on the Kalkfontein property and two 10 ha pivots on the Tweefontein property. The areas proposed for expansion are located predominantly within the undeveloped portions situated between and around the existing pivots, which currently still support indigenous vegetation and remnant outfall areas associated with the existing agricultural layout.

The vegetation assessment identified a combination of disturbed agricultural areas and near-natural Nama Karoo vegetation units on the Tweefontein and Kalkfontein properties. Soil samples were taken and analysed to investigate if the soil is suitable for establishing crops on Tweefontein as the areas between Kalkfontein pivots are old crop lands. The soil study found that the area is predominantly underlain by well-drained Oakleaf soil, which are considered highly favourable for both irrigation and cultivation.

An application to cultivate virgin soil (commonly known as a plough certificate) will also be applied for at the Department of Agriculture to ensure all legal requirements for such a development are met.

The Applicant has existing water use rights and therefore do not require additional applications for a Water Use Right. In the future, they might apply for an increase in usage, however, at this stage, it is not required.

ENVIRONMENTAL STUDIES

The environmental studies for this project will be divided into 2 phases. This Scoping Report is a product of Phase 1 and identifies issues and concerns which are required to be evaluated by specialists and documented in Phase 2.

PHASE 1

- This Environmental Scoping Report aims to identify potential and biophysical impacts associated with the proposed clearing of vegetation and to propose further studies that are required to be undertaken and included within the EIA and EMP report.
- This report acts as a discussion document, and comments from the Department of Agriculture, Environmental Affairs, Rural Development and Land Reform on this report are encouraged.

PHASE 2

- Further investigation and assessment of all potentially significant environmental impacts (social and biophysical) identified in the Environmental Scoping Report. Mitigation measures are to be recommended where required, and the completion of the Environmental Impact Assessment and Environmental Management Report.

INVESTIGATION PROCEDURE

DESK STUDY

The investigation commenced with a desk study of all available information. This provided information on environmental and technical studies that have been conducted and identified potential issues to consider. Historical documentation included all the documents submitted in the previous applications for this area, maps of the area, and land use.

The desk study revealed that this potentially could be a site to develop into orchard, but will depend on the field investigation, which should also include a soil survey and vegetation survey.

FIELD INVESTIGATION

A site visit was conducted on 4 November 2025 to investigate the sensitivity of the site and identify the listed activities that would be triggered for the application for environmental authorisation. The site can be divided into two sections: The Tweefontein Section and the Kalkfontein Section (see Figure 1).



FIGURE 1: DIFFERENT SECTIONS OF THE SITE

During the site visit, it was noted that there are four existing pivots. The existing irrigated footprint currently covers approximately 95 hectares under centre-pivot systems. These pivots were established prior to 2006, at a time when the clearing of vegetation for agricultural crop production did not require Environmental Authorisation.

The Applicant now proposes to expand the irrigated area by incorporating the infill areas between and around the existing pivot circles. This will increase the total irrigated footprint from approximately 95 hectares to 141 hectares, resulting in an additional 46 hectares of vegetation clearance that will require Environmental Authorisation.

The existing pivots are currently utilised for seasonal crops such as maize and wheat. The Applicant however proposes to transition the existing agricultural operation to irrigated pecan nut orchards, which will require the expansion of the cultivated footprint into the infill areas surrounding the existing pivot systems. A soil and irrigation suitability assessment confirms that the majority of the site is underlain by deep, freely drained Oakleaf soils suitable for irrigation and orchard establishment.

The development does not entail the construction of new bulk irrigation infrastructure, as irrigation water will continue to be sourced from the existing lawful water supply system. No new farm buildings are proposed as part of this application.

The operational capacity will increase proportionally to the additional 46 hectares brought under irrigation, contributing to increased pecan nut production once orchards reach maturity.

DETAILS OF THE APPLICANT AND THE LANDOWNER

Temdale Boerdery (Pty) Ltd (1999/023793/07)
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LEGISLATION

Environmental legislation intends to regulate the interaction of human life with the natural environment. The purpose of environmental legislation is to protect and preserve the environment for current and future generations. The following Acts and Regulations apply to the proposed project and a summary of the most relevant environmental legislation is provided in this section.

1. Section 24 of the **Constitution of the Republic of South Africa Act (No 108 of 1996)** states that everyone has the right:
 - (ii) to an environment that is not harmful to their health or well-being;
 - (iii) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources, while promoting justifiable economic and social development.
2. The **National Environmental Management Act (Act No 107 of 1998)**. NEMA is based on the concept of sustainable development and the objective is to provide for co-operative environmental governance, by providing the legal framework for environmental planning and development.

NEMA has basic principles that state:

- That all the principles throughout the Republic apply to the actions of all organs of state that may significantly affect the environment;
 - Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural, and social interests equitably.
 - Development must be socially, environmentally, and economically sustainable.
 - Sustainable development requires consideration of all relevant factors.
 - Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option.
 - There should be equal access to environmental resources, benefits, and services to meet basic human needs and the Government should promote public participation when making decisions about the environment;
 - Decisions must be taken openly and transparently and there must be access to information;
 - Communities must be given environmental education;
 - Workers have the right to refuse to do work that is harmful to their health or the environment;
 - The role of youth and women in environmental management must be recognized;
 - The person or company who pollutes the environment must pay to clean it up;
 - The environment is held in trust by the state for the benefit of all South Africans; and
 - The utmost caution should be taken when permission for new developments is granted.
3. The **Environmental Impact Assessment Regulations**: 324, 325, 326 & 327 of 7 April 2017. The purpose of these Regulations is to regulate the procedure and criteria as contemplated in Chapter 5 of the Act relating to the preparation, evaluation, submission, processing, and consideration of, and decision on, applications for environmental authorizations for the commencements of listed activities, subjected to environmental impact assessment, to avoid or mitigate detrimental impacts on the environment, and to optimize positive environmental impacts, and for matters pertaining thereto.

Duty of Care

Chapter 7 of the NEMA prescribed a general 'duty of care' and the requirement to remediate environmental damage. Section 28(1) of NEMA states:

Every person who causes/has caused, or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing, or recurring, or insofar as such harm to the environment is authorized by law or cannot reasonably be avoided or stopped, to minimize and rectify such pollution or degradation of the environment.

The Duty of Care can, inter alia, be enforced through directives issued by the competent authority.

In terms of 2014 NEMA EIA Regulations, as amended, the activities listed in the below Table (Table 1) will be triggered by the clearing of vegetation, thereby requiring an EA from the Department of Agriculture, Environmental Affairs, Rural Development and Land Reform (DAEARDLR).

TABLE 1: EIA LISTED ACTIVITIES

Government Notice No. R325 Activity No(s):	Details of Activity(ies) requiring a Scoping Report and EIA
GNR 325: Activity 15	The clearance of an area of 20 hectares or more of indigenous vegetation.

4. The **National Water Act (No. 36 of 1998) (NWA)**.

The Upper Western and Upper Eastern Section of the site is situated near the Orange River, with a few drainage lines on the site. Thus, to prevent environmental damage, the clearing of vegetation will not take place within 100m from the drainage line or the Orange River and would therefore also not trigger any listed activity in terms of NEMA or NWA (Section 21 (c)&(i)).

The landowner does have existing water use rights for irrigation, therefore at this stage, a Section 21 (a) application in terms of the NWA is not required.

5. The **National Environmental Management: Biodiversity Act**:

The act provides the framework for: i) the management and conservation of biological diversity within the Republic and the components of such biological diversity; ii) the use of indigenous biological resources in a sustainable manner; and iii) the fair and equitable sharing among stakeholders of benefits arising from bioprospecting involving indigenous biological resources.

The act also provides for co-operative governance in biodiversity management and by establishing a South African National Biodiversity Institute, the objectives of the Act can be achieved.

Three Regulations are applicable: 1) Threatened and Endangered Ecosystems, 2) ToPs (2008) (Threatened or Protected species), and 3) AIS (Alien and Invasive Species).

6. The **National Environmental Management: Protected Areas Act:**

The Protected Areas Act provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. It provides for the establishment of a national register of all national, provincial and local protected areas and the management of those areas. The Act also provides for the governance and functions of South African National Parks and matters in connection therewith.

7. The **National Forests Act No. 84 of 1998 (NFA) & List of Protected Tree Species under the National Forest Act, 1998 (Act No. 84 of 1998).**

The purposes of this Act are to promote the sustainable management and development of forests for the benefit of all. The Act also provides special measures for the protection of certain forests and trees and promotes the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes.

According to the Act, a natural forest is defined as a group of indigenous trees whose crowns are largely contiguous or which have been declared by the Minister to be a natural forest under section 7(2). No person may cut, disturb, damage or destroy any indigenous tree in a natural forest; or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any tree, or any forest product derived from a tree within a natural forest.

The principals of the Act indicate that:

- a) Natural forests must not be destroyed save in exceptional circumstances where, in the opinion of the Minister, proposed new land use is preferable in terms of its economic, social or environmental benefits;
- b) A minimum area of each woodland type should be conserved; and
- c) Forests must be developed and managed so as to-
 - conserve biological diversity, ecosystems and habitats;
 - sustain the potential yield of their economic, social and environmental benefits;
 - promote the fair distribution of their economic, social, health and environmental benefits;
 - promote their health and vitality;
 - conserve natural resources, especially soil and water;
 - conserve heritage resources and promote aesthetic, cultural and spiritual values; and

- advance persons or categories of persons disadvantaged by unfair discrimination. Page 15 of 82 (4) The Minister must determine the minimum area of each woodland type to be conserved in terms of subsection (3)(b) based on scientific advice.

The protected trees that commonly occur in this region are *Acacia erioloba* and *Boscia albitrunca*. The presence of these trees on site will be confirmed as part of the Ecological Impact Assessment.

8. Conservation of Agricultural Resources Act (Act 43 of 1983):

The objectives of the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA) are to provide for the conservation of the natural agricultural resources of South Africa by the:

- Maintenance of the production potential of land;
- Combating and prevention of erosion and weakening or destruction of the water sources; and
- Protection of the vegetation and the combating of weeds and invader plants.

The CARA states that no land user shall utilise the vegetation of wetlands (a watercourse or pans) in a manner that will cause its deterioration or damage. This includes cultivation, overgrazing, diverting water run-off and other developments that damage the water resource.

The CARA includes regulations on alien invasive plants. According to the amended regulations (GN R280 of March 2001), declared weeds and invader plants are divided into three categories:

- Category 1 may not be grown and must be eradicated and controlled,
- Category 2 may only be grown in an area demarcated for commercial cultivation purposes and for which a permit has been issued, and must be controlled, and
- Category 3 plants may no longer be planted and existing plants may remain as long as their spread is prevented, except within the flood line of watercourses and wetlands.

It is the legal duty of the land user or landowner to control invasive alien plants occurring on the land under their control. Should alien plant species occur within the study area; this will be managed in line with the EMPr.

9. Bio-regional Plans:

In terms of the provincial and local protected areas, the area under application is situated within an area that has been identified as other natural areas according to the BGIS of the Northern Cape Biodiversity Conservation Plan and does fall within a critically biodiversity area 1&2. The Siyathemba Municipality Spatial Development Framework (SDF) identified areas within the Municipality

The purpose of the SDF is:

- To guide spatial planning, land development, and land use management in the local municipal area. More specifically, to geographically detail land use.
- To give strategic direction in terms of investment in the local Municipal area to the private sector and community investors concerning the levels, locations, types, and forms of investment that need to be made and that will be supported by the Local Municipality.
- The SDF identified impacts associated with mixed farming (crops and livestock) as:
 - The destruction of biodiversity;
 - Indigenous flora being substituted with exotic species;
 - The loss of herbaceous annuals;
 - Exposure of bare soil and subsequent erosion;
 - Areas are homogenized and ecosystem functioning on cultivated land is essentially simplified to the production of bio-mass;
 - Depletion and degradation of soils may lead to unproductive soils.

The Siyathemba Municipality has mapped the environmental sensitivity of the municipal area in the SDF. The sensitivity is rated from 0-6 (0 being no sensitivity, 1 being low sensitivity, 6 being high sensitivity). According to the SDF, the site falls within an environmental area that is rated 2 and thus has low sensitivity.

A vegetation survey was conducted to verify the sensitivity of the site from a botanical and ecological point of view.

10. Northern Cape Nature Conservation (Act 09 of 2009):

The objective of the Act is to provide for the sustainable utilisation of wild animals, aquatic biota, and plants, to provide for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, to provide for offences and penalties for contravention of the Act, to provide for the appointment of nature conservators to implement the provisions of the Act, to provide for the issuing of permits and other authorisations, and to provide for matters connected therewith.

This Act aims at improving sustainability in terms of balancing natural resource usage and protection or conservation thereof. It includes six schedules, as follows:

- Schedule 1 - Specially Protected species;
- Schedule 2 - Protected species;
- Schedule 3 - Common indigenous species;
- Schedule 4 - Damage causing animal species;
- Schedule 5 - Pet species; and

- Schedule 6 - Invasive Species.

With regards to protected flora, the Northern Cape Nature Conservation Act includes a list of protected flora. The plant species potentially present within the proposed project area will be identified as part of the Flora Impact Assessment specialist study. However, it will be recommended as part of the EMP, that a detailed plant search and rescue operation be conducted before the clearance of vegetation. If any of the listed species are found, the relevant permits should be obtained by the Applicant before their relocation or destruction.

11. The Provincial Spatial Development Framework for the Northern Cape (Office of the Premier of the Northern Cape, 2012):

The Northern Cape Provincial Spatial Development Framework (PSDF) was approved on 22 August 2012 in terms of the Northern Cape Planning and Development Act, 1998. Thereafter, the Spatial Planning and Land Use Management Act, 2013 (Act 16 of 2013) ("SPLUMA") was promulgated and came into operation on 1 July 2015. SPLUMA requires provincial spatial development frameworks to be aligned with its provisions and reviewed periodically. Consequently, the Northern Cape PSDF has undergone and continues to undergo review processes to align with SPLUMA and associated national spatial planning requirements.

The PSDF seeks to address spatial inefficiencies and inequalities, identify areas of opportunity, and ensure the proactive management of natural resources and ecosystems within the Province. In this regard, the PSDF provides a strategic spatial planning framework aimed at guiding sustainable spatial transformation and development within the Province, while SPLUMA provides the legislative framework to support such transformation.

The approval of the PSDF in terms of the Northern Cape Planning and Development Act, 1998 afforded the PSDF statutory status as the common spatial vision and strategy intended to guide and align future development and land use management within the Province.

In terms of land use management, the PSDF identifies six (6) Spatial Planning Categories ("SPCs"), namely:

- Category A: Nature Conservation Areas;
- Category B: Natural Buffer Areas;
- Category C: Agricultural Areas;
- Category D: Urban Related Areas;
- Category E: Industrial Areas; and
- Category F: Surface Infrastructure Areas.

The SPCs do not constitute a zoning scheme or prescribe land use rights. Rather, the SPCs provide a strategic spatial planning framework intended to guide decision-making regarding land use and development at all levels

of planning. The SPC system aims to facilitate coordinated and sustainable development throughout the Province. The designation of SPCs does not replace or amend existing zoning schemes, legislation, or land use rights, but rather serves as a framework to support coherent and informed decision-making.

The land use classification system adopted by the PSDF further incorporates a bioregional planning approach, which broadly provides for:

- a core conservation area (SPC A);
- a conservation-focused buffer area (SPC B); and
- a transition area (SPC C–F).

In terms of this application, the proposed development falls within Spatial Planning Category C (Agricultural Areas), as the Applicant proposes the clearance of vegetation for the establishment of intensive agricultural crop production. The proposed agricultural activities include maize, wheat, lucerne, vineyards and nut tree cultivation.

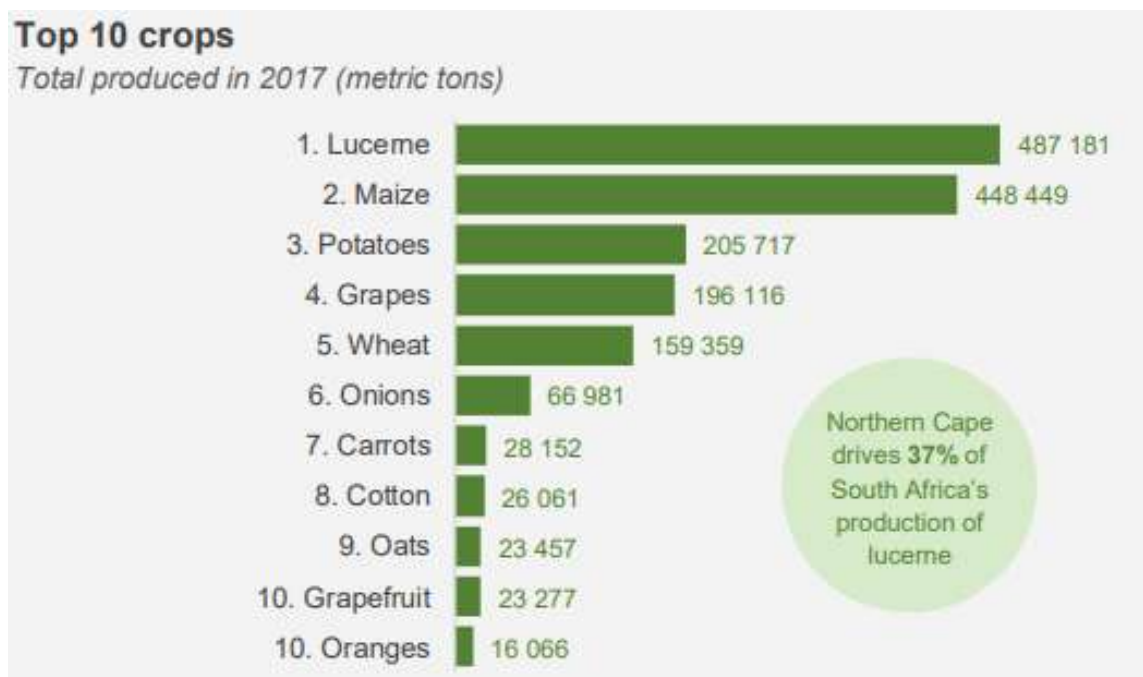


FIGURE 2: TOP 10 CROPS PRODUCED IN NORTHERN CAPE (SOURCE STATS SA, 2020).

The Northern Cape produces about 37% of South Africa lucerne (STATS SA, 2020) and about 9% of South Africa's total maize production (Department of Agriculture, Forestry and Fisheries, 2017), therefore, the Northern Cape plays a significant role in South Africa's agricultural sector, particularly in terms of irrigated agriculture and fodder production. The Province is recognised as a major producer of lucerne and maize under irrigation. The proposed agricultural activities are therefore considered to be aligned with the broader agricultural objectives and economic role of the Province.

In terms of Agricultural Areas within the PSDF Spatial Planning framework, key strategies and interventions include:

- Giving effect to the principles of sustainable development and rural development;
- Promoting the identification and protection of high-potential agricultural land for cultivation and food security purposes;
- Supporting sustainable economic development opportunities within appropriate agricultural areas;
- Encouraging biodiversity conservation and appropriate buffer management approaches where relevant; and
- Encouraging local processing of agricultural products and associated agricultural services to enhance the rural economy and support agricultural viability.

12. The **National Heritage Resources Act (No 25 of 1999)** :

The basic objectives of the National Heritage Resources Act are to set norms and maintain essential national standards and general principles for the governing and management of heritage resources in the Republic and to protect heritage resources of national significance.

The South African Heritage Resources Agency (SAHRA) has been established to coordinate and promote the management of heritage resources at the national level.

The proposed site is situated on agricultural land currently used for grazing, however, a heritage assessment will be completed during the EIA phase.

DETAILS OF THE AUTHOR

Natalie Sharp is the project manager and senior Environmental Assessment Practitioner leading this project and is registered as an Environmental Assessment Practitioner (EAP) with the Certification Board for Environmental Assessment Practitioners of South Africa (EAPSA) (Registration Number: 2020/230) and as a Professional Natural Scientist (Pri.Sci.Nat) with the South African Council for Natural Scientific Professions (SACNASP) (Registration Number: 123443) (see Appendix A). Natalie Sharp has worked in the environmental industry for over twenty years.

CURRICULUM VITAE

NATALIA SHARP

Personal Details

Date of birth: 12 August 1979
Nationality: South African
Identity number: 790812 000 7080
Gender: Female
Languages: English / Afrikaans

Qualifications:

BSc (2000) UFS – Zoology and Botany
BSc Honors (2001) UFS - Limnology
Masters in Environmental Management (2003) UFS - Evaluation of
Phytoplankton as an indicator in a biomonitoring program, with special
reference to the Modder River.

During the 2 years associated with the Centre for Environmental
Management intense training was provided for equipping Natalia Sharp
with adequate knowledge in terms of biomonitoring water systems and
scientific report writing for research done by her through the Centre.
Various scientific contributions were made during these few years which
included formal reports to Bloem Water and seminars providing
management principles for polluted water bodies, thus providing her with
additional regulatory and environmental skills.

Experience (Seventeen years' experience in environmental law and environmental management)

During the 5 years associated with the DME, now changed to the
Department of Mineral Resources (DMR), vast knowledge was gained in
terms mine environmental management, the development,
rehabilitation and closure of mining and prospecting areas.
Environmental Management Programmes, Environmental Performance
Assessment Reports, and Closure Reports were scrutinized continually.
Therefore, adequate expertise was gained to assist the applicants with
relevant environmental and mining advice and providing her with
adequate knowledge to evaluate environmental impacts relating to
mining.

During the 11 years associated with SES (Stellenryck Environmental
Solutions), Natalia Sharp has obtained immense understanding in
completing environmental impact assessments, not only associated with
mining projects, but also for a wide variety of different developing
projects such as Light Industrial developments, Road upgrade projects,
bush clearing for agricultural developments, and applications for
exemptions, and so forth. She has excellent experience in writing
environmental reports, which ranges from Scoping Reports,
Environmental Management Plans, Environmental Awareness Plans,
Mining Work Programs, Closure Plans, Risk Assessments, Performance
Evaluations on projects, and Plan of Study reports. She has also been

involved in performing biomonitoring on river systems associated with some of the projects, completing it by obtaining all the data and writing the Biomonitoring Report for the relevant Department. This is mainly attributed to her Limnology background and she is competently able to add value to this field in her current position.

Previous Employment	Centre for Environmental Management University of the Free State: Lab Assistant [2001 – 2003]
	Mine Environmental Management [2003-2005] at the Department of Mineral Resources: Environmental Officer
	Mine Environmental Management [2005-2008] at the Department of Mineral Resources: Senior Environmental Officer
	Stellenryck Environmental Solutions: Senior Environmental Practitioner [2008-2019]
Current Employment	Digital Soils Africa Pty Ltd: Senior Environmental Practitioner [2020-currently]

Digital Soils Africa Pty Ltd (DSA) is an independent environmental consulting firm that is also soil specialists, focussing on all soil solutions in the agricultural and environmental fields. The specialists are SACNASP registered and recognized leaders in their fields of study.

The soil specialist services provided include soil surveys, soil erosion mitigation, fertilization management, soil and land capability studies, and wetland delineation amongst others, while the fields of specialization are hydropedology and digital soil mapping. Together the directors have 45 years of experience.

Prof. Johan van Tol is a leading researcher on hydropedology. He is a NRF rated researcher, who boasts more than 100 peer reviewed scientific publications and has put his research to work in more than more than 130 consultancy reports. He is a SACNASP registered scientist and a full Professor in soil science at the University of the Free State.

Dr. George van Zijl is Africa's foremost Digital Soil Mapper. For his PhD he developed a DSM protocol for use in southern Africa, and has subsequently improved the methodology to include machine learning such as shown in the mapping of Ntabelanga catchment and City of Joburg Hydropedological mapping. He has served on the scientific committee for international DSM conferences. George has conducted more than 60 consultancy projects and is a SACNASP registered scientist.

Dr. Darren Bouwer boasts 15 years' experience as a soil scientist. His PhD incorporated chemical measurements into hydropedological assessments, which improves flow path determination. He has also completed a post doctorate at Ghent University, Belgium, where he specifically worked on hydropedological modelling. Darren is a SACNASP registered scientist, and has completed more than 45 consultancy reports.

DESCRIPTION OF THE RECEIVING ENVIRONMENT

SITE LOCATION

The site is situated north-east of Prieska in the Northern Cape ($29^{\circ}24'42.00''S$; $23^{\circ}01'36.31''E$) most centre point of the site) on the Remainder of the Farm Tweefontein 373 and Portion 4 (Ptn of Ptn 2) of the Farm Kalkfontein 374, Prieska, within the Siyathemba Municipal area. The site is located on the banks of the Orange River approximately 38km northeast of Prieska and 20 km southeast of Niekerkshoop (Figure 3).

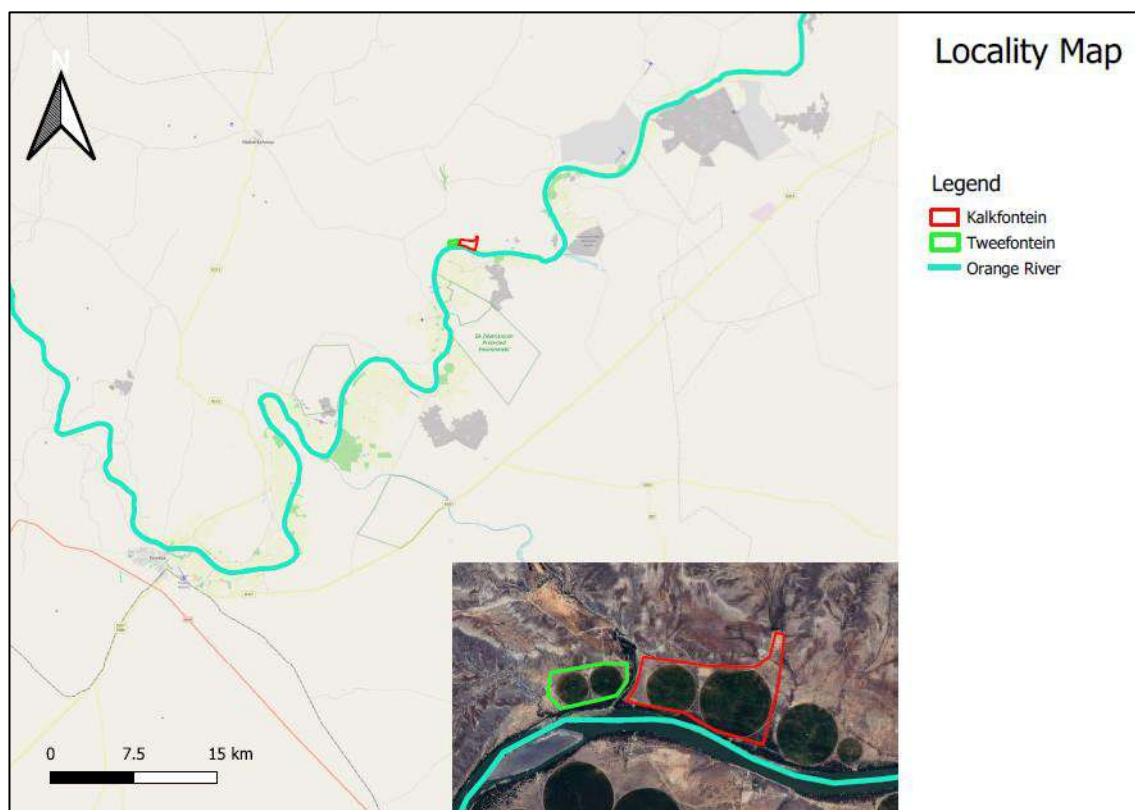


FIGURE 3: SITE LOCATION. THE ORANGE RIVER IS THE BLUE LINE AND THE PROPOSED SITE IS REPRESENTED BY THE RED AND GREEN POLYGONS.

PROJECT DESCRIPTION

In terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), an Environmental Authorisation (EA) must be obtained from the relevant competent authority before commencing with any listed activity that may impact the environment. The Applicant would like to clear more than 20Ha of vegetation between existing central pivots to establish pecan nut orchard for agricultural purposes.

The Applicant already has a Water Use License, for the abstraction of water for irrigation and has a ploughing certificate for cultivating virgin soil from the Directorate Land Use and Soil Management of the Department of Agriculture.

The vegetation assessment identified the site as ecologically important due to the presence of relatively intact Nama Karoo and Upper Gariep Alluvial Vegetation, including natural and near-natural vegetation units associated with the Orange River system. The riparian vegetation units were regarded as having a high conservation priority due to their ecological functioning, habitat diversity and the presence of protected plant species. Additional medium to medium-high sensitivity areas were identified within the natural and karroid shrubland vegetation units, which support indigenous shrubland, scattered trees and several protected succulent and bulb species. Although portions of the site have already been disturbed by existing agricultural activities, pivots and associated infrastructure, the assessment confirms that sections of the site still retain important ecological characteristics and contribute to the broader functioning of the surrounding Nama Karoo ecosystem.

PLANNING PHASE

From an environmental planning perspective, the proposed expansion represents a consolidation of an existing agricultural footprint rather than the establishment of a new, separate 141 ha cultivated area in previously undisturbed veld. Approximately 95 ha has already been transformed under existing centre-pivot irrigation, and the proposed additional 46 ha largely comprises infill areas between and around these established pivots. This approach makes more efficient use of land that is already fragmented by agricultural infrastructure, access tracks, irrigation systems and historic disturbance, and avoids the need to open up a separate, intact area elsewhere on the farms.

The vegetation assessment confirms that the site contains a mix of sensitivities. The riparian vegetation associated with the Orange River is of high conservation importance and should, as far as reasonably practicable, be retained and excluded from clearance because it functions as a corridor for fauna and flora movement and is linked to watercourse functioning. However, several of the areas between existing pivots have already been degraded by agricultural and anthropogenic influences, contain alien invasive and pioneer species, and were assessed as having low to low-medium conservation value / very low biodiversity importance. In this context, concentrating the proposed orchard expansion within the already fragmented pivot landscape is considered environmentally preferable to clearing a new, continuous and less-disturbed 141 ha area elsewhere, even where such an alternative may appear less constrained on a desktop CBA map.

It is acknowledged that some near-natural vegetation units within the proposed infill footprint retain medium to medium-high conservation value and contain protected plant species. The proposed development should therefore not be presented as having no ecological impact. Rather, the impact is considered more acceptable because it is confined to a transformed agricultural landscape, is supported by confirmed soil and irrigation suitability, does not require new bulk irrigation infrastructure or new farm buildings, and allows the higher-value riparian corridor along the Orange River to be retained as the main ecological corridor. Where small, isolated riparian or natural vegetation

fragments occur within the pivot configuration and cannot practically be retained without materially compromising the agricultural layout, their loss is motivated as part of the consolidation of the existing agricultural footprint, subject to the rescue/relocation of protected species, alien invasive plant control, retention of larger protected trees where practicable, and strict exclusion of the main Orange River riparian zone from disturbance.

The soil report and findings were also in favour for development on Tweefontein. No soil suitability study was conducted for Kalkfontein as the pivots existed prior to ploughing certificates being required and historically been used for crop lands.

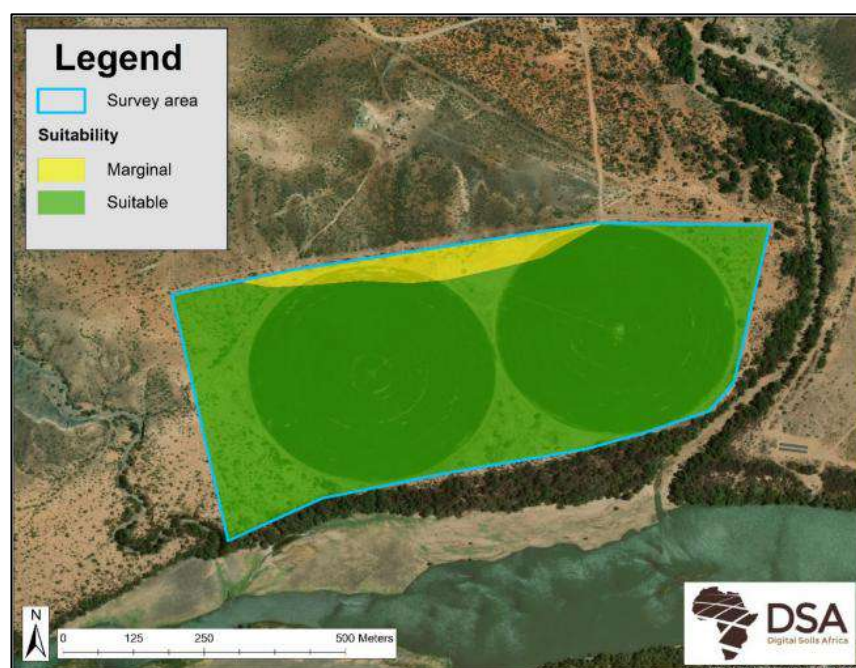


FIGURE 4: SOIL SUITABILITY MAP FROM THE SOIL REPORT

Ultimately, the study area under application is 141 Ha of which 95Ha is already transformed under existing centre-pivot irrigation and the proposed additional 46Ha is the fill-in areas between the existing pivots.

CONSTRUCTION PHASE

The clearance of vegetation will take place immediately if an environmental authorisation has been issued. The construction phase will result in the clearing of natural veld after the seasonal crops have been harvested on the allocated between the existing central pivots. There will thus be a transition from the existing agricultural operation to irrigated pecan nut orchards to be a total of 141Ha.

In terms of the general soil requirements for pecan nut production, the irrigation suitability assessment confirmed that the majority of the site is underlain by deep, freely drained Oakleaf and Ermelo soils which are considered highly suitable for irrigated pecan nut production. The soils exceed 2.5 m in depth, exhibit good drainage characteristics and have favourable physical and chemical properties.

Pecan nut trees grow optimally in fertile, well-drained soils with a moderate to loose structure, while feeder roots generally occur within the upper 40–60 cm of the soil profile. The report states that lime or carbonate-rich horizons should not occur within the upper 60 cm of the soil profile, as elevated pH conditions may reduce the availability of important micro-nutrients.

The Oakleaf soils identified across most of the site were found to contain no lime-rich horizons within the upper 60 cm, with measured pH(KCl) values generally ranging between 6.0 and 6.8, which the specialist considered suitable for pecan nut production.

The soils furthermore contain clay percentages ranging between approximately 22% and 34%, which fall within the acceptable range for pecan nut production and provide suitable drainage and water-holding capacity.

A small northern portion of the site consists of Prieska/Augrabies soils containing free lime and carbonate-rich horizons. These soils were regarded as marginal for pecan nut production due to the potential for reduced micro-nutrient uptake; however, the report states that cultivation of these soils is unlikely to result in soil degradation and that micro-nutrient deficiencies can be managed through foliar applications and appropriate fertility management.

The report further concluded that the soils exhibit acceptable salinity and sodicity levels, with no significant limitations identified for irrigation suitability, provided that appropriate irrigation and fertility management practices are implemented.

Most of the workforce will be sourced locally or provincially.

OPERATIONAL PHASE

Within one year after the commencement of the project the entire 141Ha area applied for should be cleared and the orchard should be established. It will be managed and maintained by the farmer and will be a permanent establishment.

As with the operational phase, the workforce (upkeep of the land) will be sourced locally.

DECOMMISSIONING PHASE

This is a permanent change from natural area between existing pivots and annual crop production to orchard. Should the activity be authorized, it is highly unlikely that the proposed development will be decommissioned.

Should the Applicant elect to decommission the orchard at any point in the future, the necessary authorization must be obtained and the correct decommissioning protocol must be followed. The relevant Government Departments (those applicable at the time of decommissioning) should be consulted before decommissioning.

Following the decommissioning, the site should be rehabilitated back to a predetermined state, e.g. sufficient for grazing or a near-natural state with natural vegetation cover. A qualified botanical specialist should be contacted for more information on rehabilitation techniques.

ALTERNATIVES INVESTIGATED FOR THE PROPOSED DEVELOPMENT

Alternative sites/land use/layout are chosen based on the outcome of the site investigation and proposed activities, which determine the social and environmental impacts. In the process, each environmental parameter and the possible impact of bush clearing is considered and investigated to determine any alternative location/land use/layout or method that could reduce the environmental and social impact and improve the sustainability of the project.

From an alternative site location perspective, no preferable alternative site was identified for the proposed development. The preferred site represents the logical expansion and consolidation of an existing irrigated agricultural footprint already associated with lawful water use infrastructure and suitable soils for pecan nut production. Establishing the proposed orchard in an alternative location elsewhere on the farms would likely require the disturbance of larger areas of intact natural vegetation and the creation of a new agricultural footprint, which from an environmental planning perspective is considered less desirable than concentrating the expansion within the already transformed and fragmented pivot landscape.

Alternative land uses, instead of agriculture will not be considered, since it involves an application for change of land use and the landowner does not wish to change the land use of the property.

In terms of layout alternatives, limited flexibility exists due to the location and configuration of the existing centre-pivot irrigation systems, existing lawful water supply infrastructure, topography and the distribution of suitable soils. The proposed layout therefore follows the logical expansion of the existing pivots by incorporating the infill areas located between and around the current irrigated circles.

The investigation into layout alternatives considered whether portions of the proposed expansion could be shifted or reconfigured to avoid all natural vegetation areas entirely. However, this was found to be impractical as it would either:

- result in fragmented and inefficient orchard blocks;

- compromise the operational functioning of the irrigation systems;
- sterilise otherwise suitable agricultural land between the pivots; or
- shift the development footprint into other undisturbed areas of the property.

From both an agricultural and environmental planning perspective, the preferred layout is therefore regarded as the most practical and least environmentally disruptive option, as it consolidates development within an already transformed and fragmented agricultural landscape rather than creating a separate or disconnected cultivation footprint elsewhere on the property.

The layout has nevertheless been informed by the findings of the vegetation assessment, with the intention of retaining the main riparian corridor associated with the Orange River as far as reasonably practicable and limiting disturbance to the most sensitive vegetation areas where feasible.

In terms of the 'no-go' option; if the site is not developed there will be no change (good or bad) to the status of the site; it will remain as-is: areas that have been severely impacted due to past agricultural practices and areas that are fairly intact and used for grazing. Considering that the proposed study area is directly adjacent to established pivot areas, it will be a continuation of the development on the farm.

From an economic and agricultural point of view, it is better to develop the area and improve the agricultural potential of the land and from a soil management perspective to allow for the best crop production. Therefore, in the EIA no alternative site, no alternative land use, and the 'no-go' option will not be considered or evaluated. The EIA will assess the impacts of the area under application only.

NEED AND DESIRABILITY OF THE PROJECT

The proposed development entails the expansion of an existing irrigated agricultural operation through the incorporation of approximately 46 ha of infill areas located between and around the existing centre-pivot irrigation systems on the farm Tweefontein and Kalkfontein, near Prieska. The proposed development will increase the total irrigated footprint from approximately 95 ha to approximately 141 ha for the establishment of irrigated pecan nut orchards.

From a spatial and environmental planning perspective, the proposal represents the consolidation and optimisation of an existing agricultural footprint rather than the establishment of a new agricultural node within previously undisturbed areas. The proposed expansion area is already associated with existing irrigation infrastructure, lawful water supply, historic agricultural transformation and fragmented agricultural landscapes. The proposed development therefore makes use of existing agricultural infrastructure and confirmed suitable soils, while avoiding the need to establish a separate irrigation area elsewhere on the property.

The Northern Cape Province plays an important role in the South African agricultural sector, particularly along the Orange River irrigation corridor where intensive irrigation agriculture supports the cultivation of table grapes, cereals, cotton, dates and nut crops. The Prieska region is recognised as an established irrigation farming area associated with the Orange River system.

In terms of pecan nut production, the Northern Cape has become one of the most suitable regions in South Africa for the cultivation of pecan nuts due to its hot summers, low humidity and cold winters. Industry information indicates that South African pecan nut production increased from approximately 5 000 tons in 2010 to approximately 10 500 tons in 2015, with continued expansion thereafter as international demand for South African pecan nuts increased.

The South African pecan nut industry continues to expand rapidly, particularly within the Northern Cape Province and areas associated with established irrigation schemes such as the Vaalharts and Orange River irrigation areas.

The soil and irrigation suitability assessment undertaken for the site confirmed that the majority of the proposed expansion area is underlain by deep, freely drained Oakleaf soils regarded as highly suitable for irrigated pecan nut production. The report concluded that the soils exhibit suitable depth, drainage characteristics and acceptable chemical properties for sustainable irrigation agriculture.

The proposed development is furthermore expected to contribute positively to the local rural economy through the creation of additional permanent and seasonal employment opportunities associated with orchard establishment, irrigation maintenance, harvesting, transport and general farming operations. Although the employment opportunities generated by the development may appear limited at a regional scale, they remain important within the local rural context and would contribute to household income generation and local economic activity within the Siyathemba Local Municipality.

The development is also considered desirable from an agricultural land-use perspective because it expands an existing lawful agricultural enterprise within an established irrigation farming area, without requiring additional bulk irrigation infrastructure or new farm buildings. The proposal therefore represents the intensification and optimisation of existing agricultural land use within an area already characterised by irrigation agriculture along the Orange River corridor.

ENVIRONMENTAL IMPACT ASSESSMENT

ENVIRONMENT

Field and desktop studies were completed to establish which impacts might potentially be significant/insignificant and which impacts would require a specialist study.

The environmental parameters are identified and discussed below and potential impacts are classified. A complete Environmental Management Programme (EMP) will be compiled during the EIA process (second phase of the application) to mitigate, manage or eliminate the impacts. As a minimum the EMP document will contain:

1. The environmental impact assessment rating,
2. Specific mitigation measures and guidelines for the development to proceed in the most environmentally sustainable manner,
3. Relevant specialist reports identified during this scoping phase,
4. Maps,
5. Interested and Affected Party comments and objections (if any), and
6. Any additional information required by the DMR.

RECEIVING ENVIRONMENT

REGIONAL CLIMATE

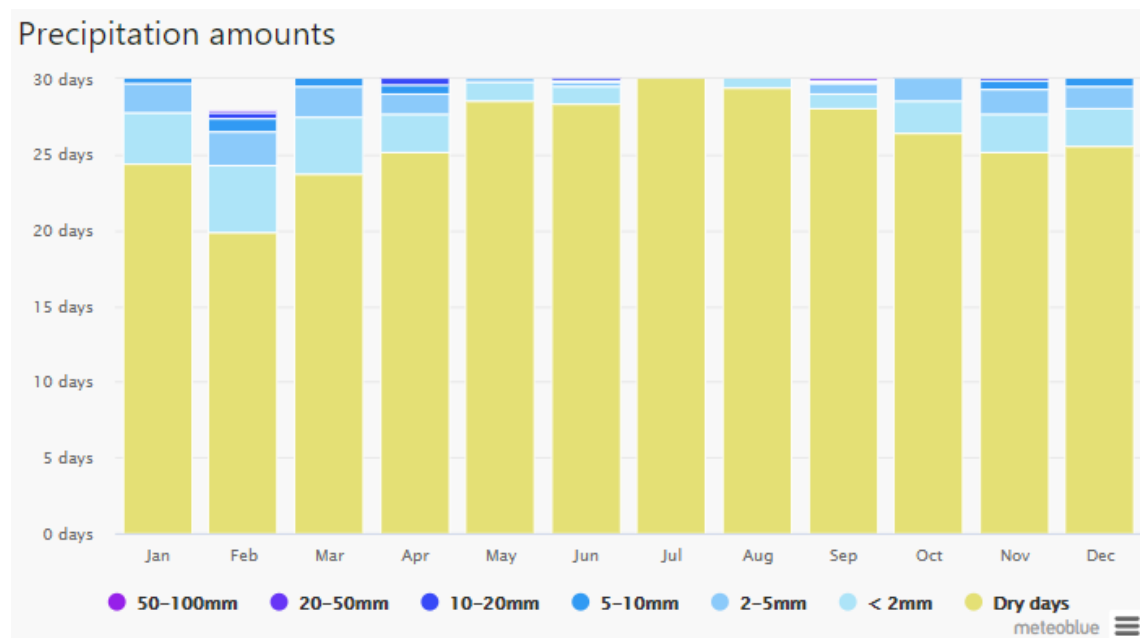
Climatic conditions such as temperature, rainfall, and wind velocity influence for example plant growth, erosion level of disturbed areas, dust generation, and air pollution levels as well as social impact in terms of quality of life. Climatic conditions can, therefore, influence the significance of impacts caused by developments. It is important to understand the role thereof when determining the impacts of specific development and the remedial measures that need to be implemented.

The study site falls within the Hot Desert Climatic (BWh) Region of South Africa, according to the Köppen Climate Classification System. Mild Desert Climate is characterised by warm to hot summers, high evaporation, and dry warm winters.

RAINFALL & TEMPERATURE

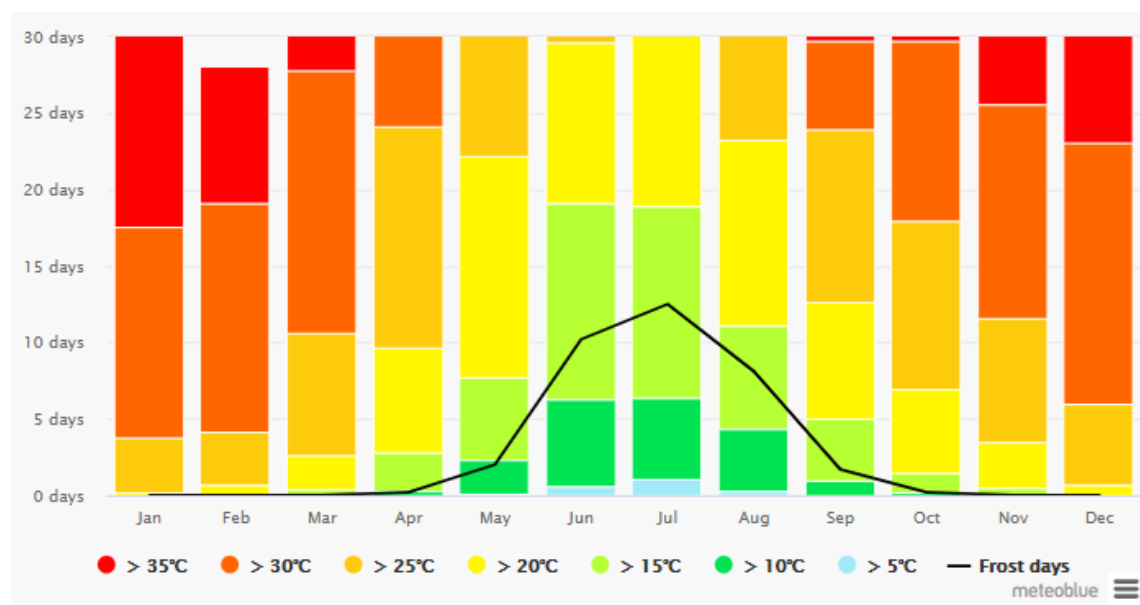
The site is situated in a rainfall area that receives about 201-400mm per annum according to the AGIS Comprehensive Atlas, which is a general classification. Prieska has a summer rainfall between October to May.

TABLE 2: PRECIPITATION AMOUNTS (SOURCE METEOBLUE)



Daily mean maximum temperatures range between 30°C and 35°C and daily mean minimum temperatures between 0.1°C and 2°C. January is the hottest month of the year and July the coldest.

TABLE 3: AVERAGE TEMPERATURES (SOURCE METEOBLUE)



The proposed farm area falls within an area where the annual evaporation is very high, more than 2400mm.

The moisture availability is the ratio of actual to potential evapotranspiration. Evapotranspiration is the process by which water is transferred from the land to the atmosphere by evaporation from the soil, other surfaces (e.g. rivers, dams, wetlands, etc.), and by transpiration from plants. The moisture availability of the area is classified as being very severe. In other words, the evapotranspiration of the area is very high.

This is important for irrigation strategies. The low rainfall combined with the high evapotranspiration rates will result in a higher amount of water required for irrigation per hectare than a farm situated for example in the sub-tropics, where the rainfall is higher and the evapotranspiration is low. The Applicant will consider working out an irrigation scheduling to establish and maintain the orchard.

WIND REGIMES

The prevailing wind directions are predominantly westerlies and north-north-easterlies, with wind speeds, recorded highest during August to October ($>38\text{km/h}$ but $<50\text{km/h}$).

There is a distinct seasonal variation between summer and winter wind direction with predominant winds in summer being westerlies (west and west-south-west) and predominant winds in winter being north-north-easterlies. Generally, wind speeds are also stronger during night-time compared to daytime conditions.

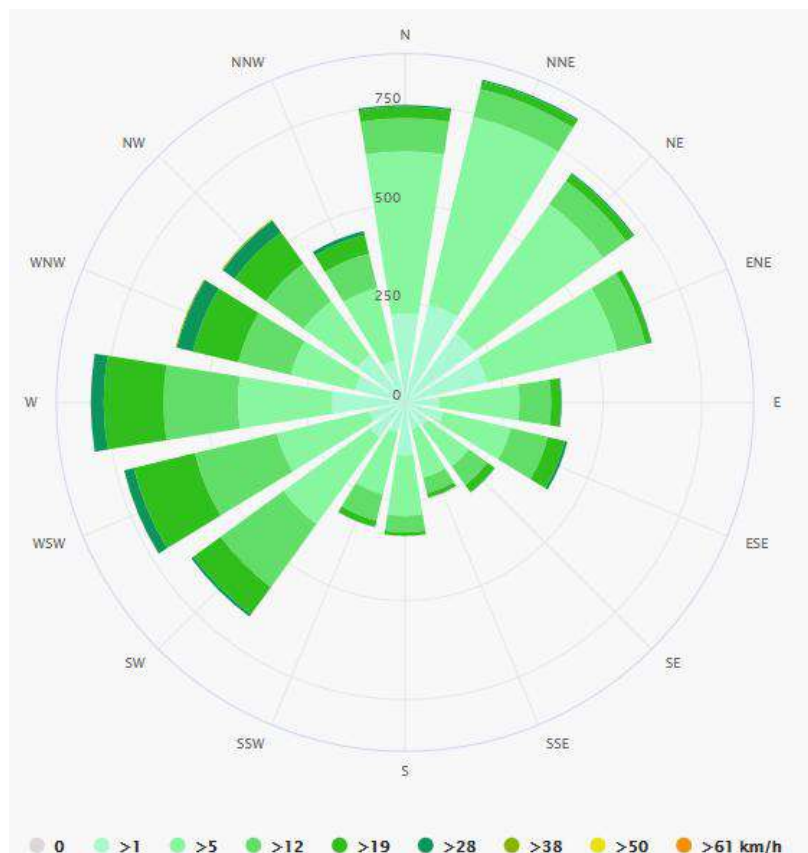
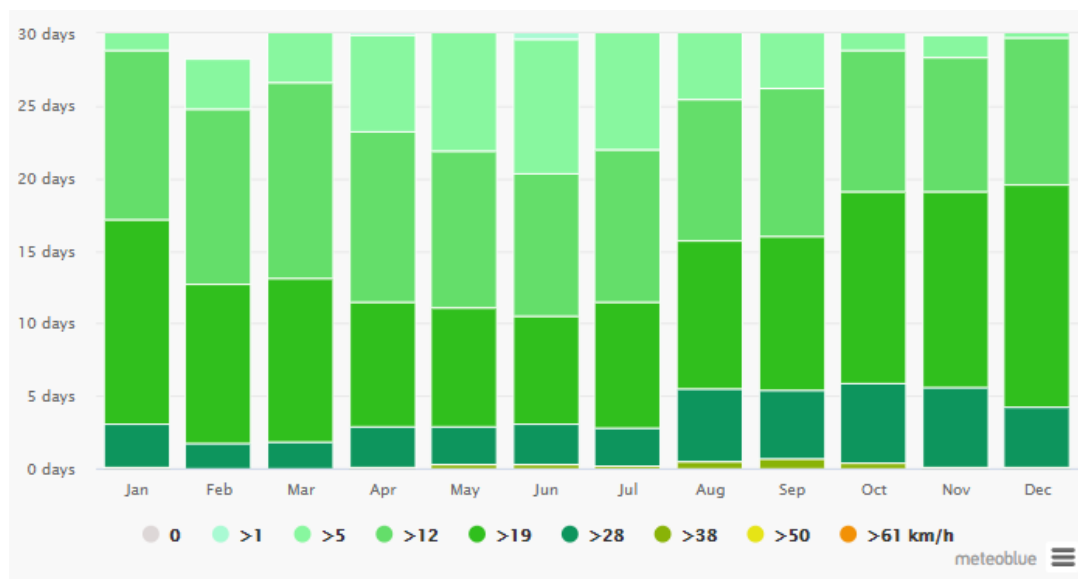


FIGURE 5: WIND ROSE OF PRIESKA AREA (SOURCE METEOBLUE)

TABLE 4: WINDSPEED OF PRIESKA AREA (SOURCE METEOBLUE)



TOPOGRAPHY

Morphology or the Topography of an area can be described as the form and structure of the landscape. The structure is given by the underlying geology and the form is given by erosion factors such as the rivers cutting through the geology to form valleys, or the wind eroding the tops of the mountains and filling in the valleys to form rolling hills and plains.

The site is sloping in a southern direction towards the Orange River.

It is not expected that the proposed development will impact the topography of the site as the clearing of vegetation and establishing of orchard will follow the natural slope of the area.

POSSIBLE MITIGATION MEASURES

The impact on the topography of cleared out will be minimum. Topsoil will be disturbed but the general topography of the site will remain intact. Possible mitigations to prevent topographical scarring could include:

- Clearing of vegetation may not result in excavations, areas where trees might be uprooted must be filled in.
- Clearing of vegetation must follow the same incline as the natural environment.
- Buffer zones should be maintained between the clearing of vegetation and the drainage lines, with at least 32m buffer.

GEOLOGY & PALAEOLOGY

The site is situated on a floodplain margin along the right bank of the Orange River and is underlain by unconsolidated Holocene alluvium and locally reworked aeolian sands associated with a near-level sandy plain. Regionally, the area is underlain by localised Early Permian Dwyka sediments, Late Tertiary to Quaternary calcretes, aeolian sands and other superficial deposits. The Dwyka-aged sediments in the broader region are known to contain evidence of ancient glaciation and may preserve trace fossils, fossil plant material and microfossils. However, the site-specific field assessment confirmed that the development footprint consists predominantly of young, structureless alluvial and sandy deposits that have been extensively reworked by floodplain processes and historical agricultural disturbance. Due to the young age and continuously reworked nature of these sediments, the site was assessed as having low palaeontological sensitivity. No fossils, fossil-bearing horizons, archaeological artefacts, graves or heritage structures older than 60 years were identified during the field investigation, and the site was therefore assigned a Generally Protected C (low significance) palaeontological and archaeological field rating.

POSSIBLE MITIGATION MEASURES

The clearing of vegetation will not impact the geology of the site. No mitigations will be required.

SOILS

Topsoil:

Topsoil is a very precious, non-renewable resource with high conservation importance and is necessary for the production of grapes that the topsoil be protected. The potential of soils to produce crops is dependent on its depth, structure, texture, and sequence of soil horizons.

The opposite of topsoil preservation is topsoil degradation, which involves the removal of soil, and alteration or damage to soil and soil-forming processes, usually due to human activity. Stripping of vegetation will impact negatively soil formation, natural weathering processes, moisture levels, soil stability, humus levels, and biological activity. It is therefore essential that where it occurs, it be preserved and protected or upgraded to improve the agricultural potential of the property.

A soil survey was conducted to determine whether the land would be suitable for irrigating the pecan nut orchard. The soil survey found that the area is predominantly underlain by well-drained Oakleaf soils which are considered highly favourable for both irrigation and cultivation. These soils offer adequate depth, efficient drainage, and favourable chemical characteristics. There is a small section to the north of the site that is covered by Prieska soils. Although cultivation of these soils is unlikely to result in soil degradation, it will probably not be very productive for pecan nut production. Ultimately the soil report concluded that the Prieska soils are marginally suitable.

The impact on soil properties is expected to be rated low if recommendations of the soil report are carried out.

Erosion:

Soil erosion is a natural process that, without disturbance, would balance itself with the formation of new soil. Any development that destroys the natural protective canopy of vegetation speeds up the process of soil erosion. Soil properties determine the erodibility of soils and their ability to support vegetation and this needs to be understood in assessing the potential for erosion and the suitability for the proposed establishment of a crop and pasture. Soils susceptible to water erosion are normally silty, are weakly structured, have low organic contents, and have poor internal drainage.

The erodibility index is determined by combining the effects of slope and soil type, rainfall intensity, and land use. These aspects are represented by terrain morphology (soil and slope), mean annual rainfall, and broad land-use patterns.

According to the soil report, the soil forms have moderate potential for wind erosion and a low potential for water erosion.

The clearing of vegetation will not cause depressions or changes in natural topography and will follow the natural incline of the area, which will reduce the erosion impact. The level of impact and erosion, as a result of the clearance of vegetation, will be investigated further in the EIA phase, but it is expected to be low to low-moderate without mitigation.

POSSIBLE MITIGATION MEASURES

- All topsoil should be preserved as much as possible.
- When the clearance of vegetation is completed, the topsoil should be ploughed.
- Upgrading of topsoil will be investigated during the EIA and EMP phase.
- Any erosion that develops must be filled in and rehabilitated and an erosion control programme must be adopted. The appropriate programme will be investigated during the EIA and EMP phase.
- Hydrocarbon spillages should be prevented by not allowing any storage of fuels, oils & lubricants within the area under application and conducting any repairs within allocated areas at the farm workshop.
- If spills occur, the affected areas must be treated with bio-remedial products and an appropriate response will be stipulated in the EIA and EMP phase.
- The toilet facilities should be well maintained according to Municipal bylaws and the surrounds should not be used as ablutions.

LAND USE AND LAND CAPABILITY

Although land use is not a feature of the environment as such, it does represent the current status of the land surface as a whole, and therefore also reflects the condition of the environment. Land use is reflected by land-use patterns, based on terrain morphological units.

From a land use and land capability perspective, the proposed development does not constitute the establishment of a new agricultural activity within an undeveloped or previously inaccessible landscape, but rather the expansion and optimisation of an existing irrigated agricultural enterprise associated with the Orange River irrigation corridor near Prieska. The proposed development will convert infill areas located between and around existing centre-pivot systems, historically utilised for irrigated annual crop production and grazing, into permanent pecan nut orchards. The proposal therefore represents a change in agricultural crop type and management approach within an already transformed agricultural landscape rather than a change from natural land use to agriculture.

Historically, the broader study area has already been transformed through irrigation agriculture, the establishment of centre pivots, associated irrigation infrastructure, access routes and agricultural disturbance. The proposed

orchard areas occur largely as fragmented and infill portions between existing pivots and are directly associated with an established irrigation footprint. From a land use planning perspective, the proposal therefore represents the consolidation and intensification of an existing lawful agricultural land use rather than outward agricultural expansion into a separate undisturbed area.

Importantly, the proposed transition from annual irrigated cropping systems to permanent pecan nut orchards is considered favourable from a long-term agricultural land capability and soil management perspective. Annual crop systems generally require frequent soil disturbance through repeated ploughing, planting, harvesting and machinery movement, which may increase the risk of soil structure degradation, erosion, compaction and loss of organic matter over time, particularly under irrigated conditions. In contrast, pecan nut orchards constitute a perennial agricultural system where soil disturbance is substantially reduced after establishment. The permanent tree cover and long-term orchard management practices typically promote improved soil stability, reduced erosion risk and more consistent soil moisture management.

The soil suitability assessment undertaken by Digital Soils Africa confirmed that the majority of the proposed expansion area on Tweefontein site is underlain by deep, freely drained Oakleaf and Ermelo soils derived from alluvial deposits associated with the Orange River system. These soils were assessed as highly suitable for irrigation and cultivation due to their depth, drainage characteristics and favourable chemical properties. The report specifically concluded that the Oakleaf soils are “very deep—exceeding 2.5 m” and “freely drained and highly suitable for irrigation.”

The suitability assessment further confirmed that the majority of the site contains soils with sufficient freely drained depth, acceptable clay percentages, favourable pH conditions and low salinity and sodicity risks, all of which are important requirements for sustainable pecan nut production. The agronomical assessment undertaken by Prof. G.M. van Zijl concluded that the soils within the suitable portions of the site exhibit the necessary physical and chemical characteristics for pecan nut production, including:

- freely drained soil depths exceeding 2 m;
- clay percentages between approximately 22% and 34%;
- acceptable pH levels between 6.0 and 6.8;
- suitable fertility levels; and
- low salinity and sodicity risks.

The report furthermore notes that pecan nut trees perform optimally in deep, well-drained soils with moderate textures and that the soils present on the site satisfy these requirements.

Although a limited northern portion of the Tweefontein site contains Prieska soils with carbonate horizons that are regarded as marginal for pecan nut production, the specialist concluded that cultivation within these areas would not result in soil degradation and that the constraints relate primarily to reduced economic productivity and micronutrient uptake management rather than unsustainable land use.

From a land capability perspective, the proposed development therefore aligns with the principle of utilising high-potential irrigable soils for sustainable agricultural production within an already established irrigation corridor. The proposed land use does not sterilise high-potential agricultural land for non-agricultural purposes, but instead maintains and optimises the agricultural capability of the property through a permanent high-value crop system. The proposal also makes use of existing lawful irrigation infrastructure and established water supply systems, thereby limiting the need for additional bulk infrastructure or further agricultural fragmentation elsewhere on the property.

The proposed development is consequently regarded as compatible with the existing agricultural character and land capability of the area and represents the optimisation of already transformed irrigated agricultural land within the Orange River agricultural corridor.

POSSIBLE MITIGATION MEASURES

- Irrigation scheduling and water management

Irrigation must be carefully scheduled and managed to avoid excessive water application, waterlogging and salt accumulation within the soil profile. The soil report specifically notes that sustainable irrigation depends on managing the risks of salinisation and sodicity associated with long-term irrigation practices.

- Maintain adequate leaching fractions

Periodic leaching of soils through controlled irrigation should be undertaken where necessary to prevent the accumulation of dissolved salts within the root zone. The report notes that the soils are freely drained and that excessive sodium is not currently a problem, and that “leaching with excessive water will maintain EC levels within acceptable norms.”

- Ongoing salinity and sodicity monitoring

Regular monitoring of soil Electrical Conductivity (EC), Exchangeable Sodium Percentage (ESP) and Sodium Adsorption Ratio (SAR) should be undertaken as part of the operational management programme to identify early signs of salinity or sodicity build-up associated with irrigation return flows.

- Soil fertility management programme

A soil fertility management programme should be implemented, including periodic soil analysis and fertilisation based on agronomic recommendations. Although the soils were found to have acceptable fertility levels, the report specifically notes that fertility management remains important for optimal pecan production.

- Micronutrient management in marginal areas

The northern marginal areas containing Prieska soils with free lime and elevated carbonate content may experience reduced micronutrient uptake due to higher pH conditions. The agronomical report recommends that foliar micronutrient sprays be applied in these areas to compensate for limited nutrient availability.

- Avoid unnecessary soil disturbance

Following orchard establishment, unnecessary mechanical disturbance, excessive ploughing and repeated heavy machinery movement should be minimised to reduce the risk of soil compaction, structural degradation and erosion.

- Implement erosion prevention measures

Although the site generally exhibits low water erosion potential, exposed areas during orchard establishment should be stabilised through:

- controlled stormwater management;
 - minimising exposed bare soil areas;
 - maintaining vegetation cover between orchard rows where feasible; and
 - preventing concentration of runoff. The soil profiles specifically indicate low water erosion potential but moderate wind erosion potential.
- Wind erosion management

Given the moderate wind erosion potential identified in the report, exposed soil surfaces should be minimised during establishment phases. Measures may include:

- phased clearing;
 - temporary ground cover establishment;
 - mulching;
 - maintaining inter-row vegetation cover; and
 - limiting unnecessary clearing outside orchard footprints.
- Protect soil drainage characteristics

No activities should impede the natural drainage characteristics of the deep Oakleaf soils. The freely drained nature of the soils is one of the key reasons the site is considered highly suitable for irrigation agriculture.

- Irrigation infrastructure maintenance

Irrigation systems should be regularly inspected and maintained to prevent leaks, ponding and localised oversaturation which could contribute to salinity build-up or soil degradation over time.

- Monitoring of marginal soil areas

The smaller northern portions containing Prieska soils should be specifically monitored during operation to ensure that orchard performance, salinity levels and micronutrient deficiencies remain manageable. Although these soils are regarded as marginal for pecan production, the report notes that their cultivation is unlikely to result in soil degradation if appropriately managed.

- Compliance with Department of Agriculture irrigation management principles

Operational management should remain aligned with the Northern Cape Department of Agriculture guidelines for irrigation suitability and sustainable cultivation practices as referenced in the soil suitability assessment.

FLORA

Vegetation plays an important role in maintaining ecosystems, stabilizing soils, maintaining the aesthetics of an area, and providing income for landowners. Therefore, when development is anticipated the vegetation structure needs to be analyzed, and rare or endangered plant species must be identified. Vegetation structure is mostly determined by the geology and climatic factors.

There are an estimated 5 400 plant species in the Northern Cape that occur in six large biomes: the Nama Karoo Biome, Succulent Karoo Biome, Savanna Biome, Grassland Biome, Fynbos Biome, and Desert Biome. More than 30% of the plants found in the Northern Cape are endemic and most of these occur in the Succulent Karoo along the West Coast of South Africa. Many of these plants are rare or threatened, with very limited distribution.

A tree aloe that is a typical landscape feature of the Northern Cape is the kokerboom, or quiver tree (*Aloe dichotoma*). This tree aloe is found growing mainly on the rocky habitat of the hills along the Orange River. In places it occurs in dense “forests”, and good examples of these occur just south of Kenhardt and between Pofadder and Pella. The Doringberg hiking trails near Prieska pass by these gentle aloe giants, and close to 4 000 trees can be seen in the Kokerboom forest on the Kokerboom hiking trail near Kenhardt. Necessitated by the harsh climatic conditions, the kokerboom has adapted to survive. Low air humidity, low soil moisture and intense sunshine levels have made it necessary for it to absorb every available scrap of moisture. It, therefore, has a superficial root system enabling it to absorb moisture quickly (Experiencenortherncape).

A vegetation survey was completed by a SACNASP registered specialist. The site, according to Mucina and Rutherford (2006), host two vegetation types, namely the Upper Gariep Alluvial vegetation (AZa) and the Northern Upper Karoo (NKu3).

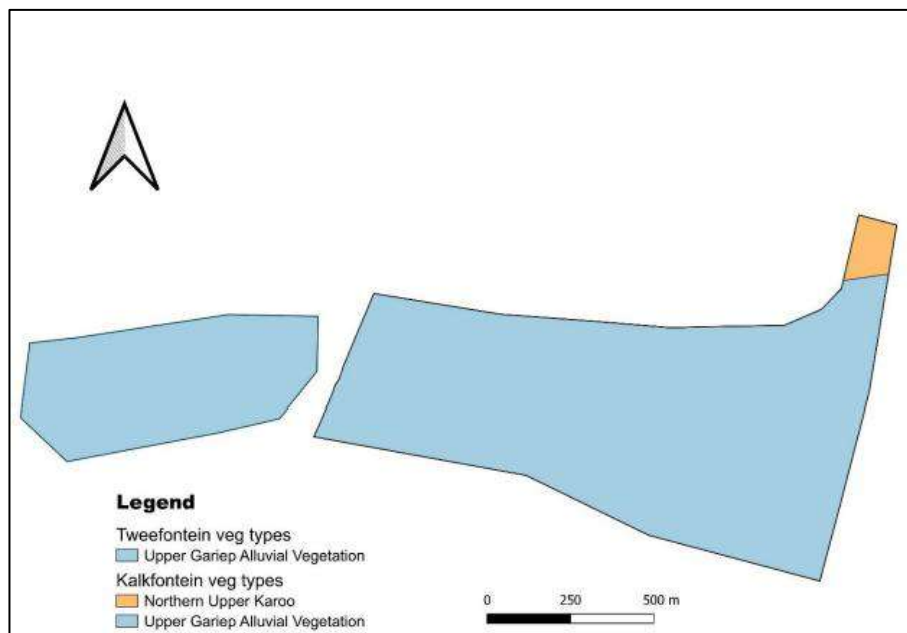


FIGURE 6: THE MAJORITY OF THE STUDY AREA FALLS WITHIN THE UPPER GARIEP ALLUVIAL VEGETATION AND A VERY SMALL CORNER SECTION ON KALKFONTEIN SITE FALLS WITHIN THE NORTHERN UPPER KAROO VEGETATION TYPE (VAN AARDT AND MULLER, 2025).

Upper Gariep Alluvial vegetation (AZa)

In terms of the distribution, the Upper Gariep Alluvial vegetation occurs in the Free State and Northern Cape Provinces: Broad alluvia of the Orange River, lower Caledon as well as lower stretches of the Vaal, Riet and Modder Rivers as far as Groblershoop. These river stretches are surrounded by vegetation units of broad transitional regions between the dry facies of the Savanna and Grassland and northern regions of the Nama-Karoo Biome.

Important Taxa

Riparian thickets Small Trees: *Acacia karroo* (d), *Celtis africana* (d), *Salix mucronata* subsp. *mucronata* (d).

Tall Shrubs: *Diospyros lycioides* (d), *Melianthus comosus* (d), *Rhus pyroides*.

Low Shrubs: *Asparagus setaceus*, *A. suaveolens*.

Woody Climber: *Clematis brachiata*.

Succulent Shrubs: *Lycium arenicola*, *L. hirsutum*.

Herb: *Rubia cordifolia*.

Flooded grasslands & herblands

Graminoid: *Melica decumbens* (d).

Herbs: *Cineraria dregeana*, *C. lobata*.

Conservation Vulnerable. Target 31%. Only about 3% statutorily conserved in Tussen Die Riviere, Gariep Dam and Oviston Nature Reserves. More than 20% transformed for cultivation (vegetables, grapes) and building of dams. Exotic woody species such as *Salix babylonica*, *Eucalyptus camaldulensis*, *E. sideroxylon*, *Prosopis* and *Populus* species have become common dominants in patches of heavily disturbed alluvial vegetation.

Northern Upper Karoo (NKu3)

In terms of the distribution, this vegetation type occurs in the Northern Cape and Free State Provinces: Northern regions of the Upper Karoo plateau from Prieska, Vosburg and Carnarvon in the west to Philipstown, Petrusville and Petrusburg in the east. Bordered in the north by Niekerkshoop, Douglas and Petrusburg and in the south by Carnarvon, Pampoenpoort and De Aar. A few patches occur in Griqualand West.

Important Taxa

Small Trees: *Acacia mellifera* subsp. *detinens*, *Boscia albitrunca*.

Tall Shrubs: *Lycium cinereum* (d), *L. horridum*, *L. oxycarpum*, *L. schizocalyx*, *Rhigozum trichotomum*.

Low Shrubs: *Chrysocoma ciliata* (d), *Gnidia polycephala* (d), *Pentzia calcarea* (d), *P. globosa* (d), *P. incana* (d), *P. spinescens* (d), *Rosenia humilis* (d), *Amphiglossa triflora*, *Aptosimum marlothii*, *A. spinescens*, *Asparagus glaucus*, *Barleria rigida*, *Berkheya annectens*, *Eriocephalus ericoides* subsp. *ericoides*, *E. glandulosus*, *E. spinescens*, *Euryops asparagoides*, *Felicia muricata*, *Helichrysum lucilioides*, *Hermannia spinosa*, *Leucas capensis*, *Limeum aethiopicum*, *Melolobium candicans*, *Microlooma armatum*, *Osteospermum leptolobum*, *O. spinescens*, *Pegolettia retrofracta*, *Pentzia lanata*, *Phyllanthus maderaspatensis*, *Plinthus karooicus*, *Pteronia glauca*, *P. sordida*, *Selago geniculata*, *S. saxatilis*, *Tetragonia arbuscula*, *Zygophyllum lichtensteinianum*. Succulent Shrubs: *Hertia pallens*, *Salsola calluna*, *S. glabrescens*, *S. rabieana*, *S. tuberculata*, *Zygophyllum flexuosum*. Semiparasitic

Shrub: *Thesium hystrix* (d),

Herbs: *Chamaesyce inaequilatera*, *Convolvulus sagittatus*, *Dicoma capensis*, *Gazania krebsiana*, *Hermannia comosa*, *Indigofera alternans*, *Lessertia pauciflora*, *Radyera urens*, *Sesamum capense*, *Sutera pinnatifida*, *Tribulus terrestris*, *Vahlia capensis*.

Succulent Herb: *Psilocaulon coriarium*.

Geophytic Herb: *Moraea pallida*. Graminoids: *Aristida adscensionis* (d), *A. congesta* (d), *A. diffusa* (d), *Enneapogon desvauxii* (d), *Eragrostis lehmanniana* (d), *E. obtusa* (d), *E. truncata* (d), *Sporobolus fimbriatus* (d), *Stipagrostis obtusa* (d), *Eragrostis bicolor*, *E. porosa*, *Fingerhuthia africana*, *Heteropogon contortus*, *Stipagrostis ciliata*, *Themeda triandra*, *Tragus berteronianus*, *T. koelerioides*, *T. racemosus*.

Biogeographically Important Taxa

Herb (western distribution limit): *Convolvulus boedeckerianus*.

Tall Shrub (southern limit of distribution): *Gymnosporia szyszylowiczii* subsp. *namibiensis*.

Endemic Taxa

Succulent Shrubs: *Lithops hookeri*, *Stomatium pluridens*.

Low Shrubs: *Atriplex spongiosa*, *Galenia exigua*.

Herb: *Manulea deserticola*.

Conservation Least threatened. Target 21%. None conserved in statutory conservation areas. About 4% has been cleared for cultivation (the highest proportion of any type in the Nama-Karoo) or irreversibly transformed by building of dams (Houwater, Kalkfontein and Smart Syndicate Dams). Areas of human settlements are increasing in the northeastern part of this vegetation type. Erosion is moderate (46.2%), very low (32%) and low (20%). *Prosopis glandulosa*, regarded as one of the 12 agriculturally most important invasive alien plants in South Africa, is widely distributed in this vegetation type. *Prosopis* occurs in generally isolated patches, with densities ranging from very scattered to medium (associated with the lower Vaal River drainage system and the confluence with the Orange River) to localised closed woodland on the western border of the unit with Bushmanland Basin Shrubland.

According to the vegetation assessment, the site does not have a uniform conservation value, but rather consists of multiple vegetation units with different ecological sensitivities and conservation priorities. The vegetation assessment identified a mosaic of ecological sensitivities across the study area, ranging from Low to High conservation value.

The riparian vegetation units associated with the Orange River were assigned a High conservation value due to their relatively intact ecological functioning, structural diversity and occurrence of protected plant species. These riparian systems are dominated by trees and shrubs including *Vachellia karroo*, *Ziziphus mucronata*, *Searsia lancea*, *Searsia pendulina* and scattered individuals of invasive *Prosopis* species (**Neltuma glandulosa*). The riparian areas also support grasses such as *Phragmites australis* and *Eragrostis lehmanniana* and form important ecological corridors along the Orange River.

Outside of the riparian areas, much of the study area consists of shrubland vegetation characteristic of semi-arid Nama-Karoo systems. The near-natural vegetation units and karroid shrubland units were assessed as Medium-high conservation areas due to the presence of relatively intact indigenous shrubland vegetation and protected species. These vegetation units are dominated by species such as:

- *Senegalia mellifera*;
- *Vachellia karroo*;
- *Pentzia incana*;
- *Roepera pubescens*;
- *Tetraena microcarpa*;
- *Lycium cinereum*;
- *Lycium bosciifolium*; and
- *Eriocephalus ericoides*.

The specialist also identified several protected plant species occurring within the study area, primarily associated with succulent and bulb-forming taxa protected under the Northern Cape Nature Conservation legislation. These include species such as:

- *Mesembryanthemum coriarium*;
- *Mesembryanthemum guerichianum*;
- *Mesembryanthemum noctiflorum*;
- *Mesembryanthemum junceum*;
- *Aizoon plinthoides*;
- *Ammocharis sp.*; and
- *Nerine sp.*

In addition, *Boscia albitrunca* (Shepherd's Tree), which is protected under both the Northern Cape Ordinance and the National Forests Act, was recorded within portions of the natural vegetation units.

A notable characteristic of the study area is the extent of existing disturbance and historical agricultural transformation. The report specifically notes that both Tweefontein and Kalkfontein already contain existing centre pivots, solar infrastructure, agricultural disturbance and old cultivated lands. Large portions of the proposed expansion areas therefore occur within fragmented and disturbed agricultural landscapes rather than intact natural habitat.

The disturbed pivot vegetation units and old field areas were assessed as Low to Low-medium conservation value due to previous transformation, bare soil exposure, invasive species presence and reduced ecological functioning. These disturbed areas are characterised by pioneer and disturbance-associated species such as:

- *Portulaca oleracea*;
- *Salsola kali*;
- *Eragrostis echinochloidea*;
- *Xanthium spinosum*;
- *Datura species*; and
- invasive *Prosopis* (**Neltuma glandulosa*).

Although the vegetation assessment identified the riparian vegetation unit associated with the Orange River as having a High conservation priority due to its ecological functioning, habitat diversity and occurrence of protected species, the proposed development layout has specifically sought to retain the primary riparian corridor along the southern boundary of the property adjacent to the Orange River as far as reasonably practicable.

The retention of this corridor will ensure that the most ecologically functional and continuous portion of the riparian system remains intact and continues to serve as an ecological linkage associated with the Orange River system. However, the narrow sliver of riparian vegetation extending northwards between the two existing pivot areas is already substantially constrained and fragmented by surrounding historical agricultural transformation, existing irrigation infrastructure and the current pivot configuration.

In ecological terms, this narrow remnant does not function as an independent or intact riparian corridor, but rather as an isolated and disturbed extension within an already transformed agricultural matrix. Retaining this isolated fragment would sterilise a central infill portion of the proposed orchard expansion area and result in fragmented and inefficient agricultural blocks between existing pivots, without providing a proportionate ecological benefit relative to the larger riparian corridor that will remain conserved along the southern boundary.

From both a land use planning and agricultural optimisation perspective, the development of this narrow infill section between the pivots is therefore considered justified, particularly as the broader and more functional riparian corridor associated directly with the Orange River will continue to be retained and protected as part of the proposed development layout.

PHOTO RECORD OF THE SITE



FIGURE 7: FALL OUT AREAS BETWEEN PIVOTS ON TWEEFONTEIN SITE



FIGURE 8: VEGETATION IN THE FALL OUT AREAS BETWEEN PIVOTS ON TWEEFONTEIN.



FIGURE 9: VEGETATION IN THE FALL OUT AREAS BETWEEN THE PIVOTS ON TWEEFONTEIN.



FIGURE 10: FALL OUT AREAS ON KALKFONTEIN SITE



FIGURE 11: VEGETATION IN THE FALL OUT AREAS BETWEEN THE PIVOTS ON KALKFONTEIN

POSSIBLE MITIGATION MEASURES

- No vegetation outside the approved area should be removed or damaged.
- All indigenous plant species, that can be transplanted should be removed from the proposed study area.
 - A rehabilitation plan (i.e. relocation of plants that can be transplanted to identify areas outside of the proposed area to be cleared) must be implemented, which will be investigated in the EIA and EMP phase. This must be done in consultation with the botanical specialist.
 - Some of the geophytes must be transplanted into other natural areas.
- Retain the primary riparian corridor associated with the Orange River along the river boundary due to its High conservation status and ecological functioning.
- Alien plant species should be removed and eradicated from the site as a high priority.
 - The spread of alien vegetation must be prevented through an alien vegetation control programme, which will be investigated in the EIA and EMP phase.
- Veld fires should be controlled and prevented.

FAUNA

Animals play an important role in maintaining the functioning of any ecosystem, for example, pollination, spreading of seeds, removing of pests, trimming of vegetation, etc. The largest part of the Northern Cape falls within the Nama-Karoo biome with a vegetation of low shrubland, grass and trees limited to watercourses. The region is typically an arid environment and the terrain and general landscape do not represent much topographical variation. Therefore faunal species are generally widespread across the region, although some key biotopes such as rivers or pans, or the presence of a particular plant species can become an obvious niche for particular animal species that can result in a concentration of species at a certain location.



FIGURE 12: SENSITIVE MAMMAL SPECIES IN THE REGION. THE BLACK ARROW INDICATES THE LOCATION OF THE SITE.

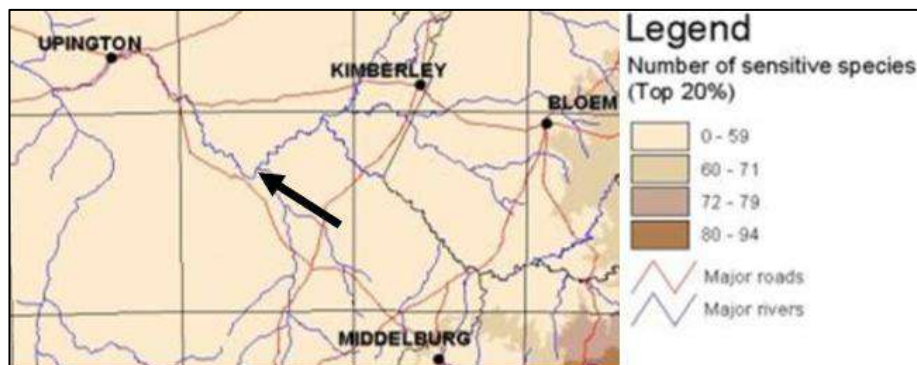


FIGURE 13: SENSITIVE BIRD SPECIES IN THE REGION. THE BLACK ARROW INDICATES THE LOCATION OF THE SITE.

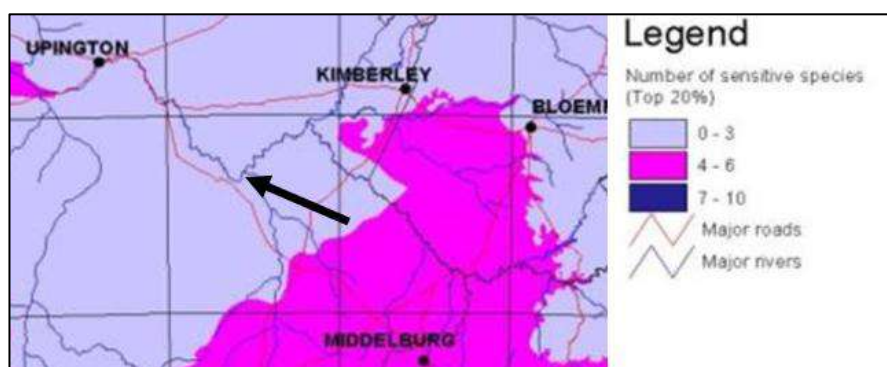


FIGURE 14: SENSITIVE REPTILE SPECIES IN THE REGION. THE BLACK ARROW INDICATES THE LOCATION OF THE SITE.



FIGURE 15: SENSITIVE BUTTERFLY SPECIES IN THE REGION. THE BLACK ARROW INDICATES THE LOCATION OF THE SITE.

The occurrence of faunal species within the proposed area is likely, however, it is farm properties and generally fenced-in camps, which will hinder the mobility of some of the larger wildlife that cannot jump a fence or the smaller wildlife that cannot borrow. Typically, many of the species encountered in the region are species such as the Common

Duiker (*Sylvicapra grimmia*), Springbok (*Antidorcas marsupialis*), Steenbok (*Raphicerus campestris*), Blesbok, (*Damaliscus pygargus phillipsi*), Smiths red rock rabbit (*Pronolagus rupestris*), Scrub Hare (*Lepus saxatilis*), Spring Hare (*Pedetes capensis*), Meerkat (*Suricata suricatta*), Ground Squirrel (*Xerus inauris*), Rock elephant shrew (*Elephantulus myurus*), Suricate or Stokstertmeerkat (*Suricata suricatta*), Rock dassie (*Procavia capensis*), Yellow Mongoose (*Cynictis penicillata*), and Aardvark (*Orycteropus afer*).

Some reptiles can include the Leopard tortoise (*Stigmochelys pardalis*), Cape Cobra (*Naja Nivea*), Puff adder (*Bitis arietans*), Mole snake (*Pseudaspis cana*), Bibron's gecko (*Pachydactylus bibronii*), Southern rock agama (*Agama atra*), Ground agama (*Agama aculeata*), Striped skink (*Plestiodon fasciatus*), Cape skink (*Trachylepis capensis*). Amphibians such as the Common caco (*Cacosternum boettgeri*), Giant bullfrog (*Pyxicephalus adspersus*), Karoo Toad (*Bufo gariepensis*), Common platanna (*Xenopus laevis*) might also occur in the region.

This arid region hosts at least 215 bird species of which 68 species are endemic or near-endemic species, 18 red-listed species, and 5 red-listed endemic species. Several large terrestrial bird and raptor species, of which the most important are Ludwig's Bustard (*Neotis ludwigii*), Kori bustard (*Ardeotis kori*), Secretarybird (*Sagittarius seppentarius*), Karoo Korhaan (*Eupodotis vigorsii*), Verreaux's Eagle (*Aquila verreauxii*), the Tawny eagle (*Aquila rapax*) and Martial Eagle (*Polemaetus bellicosus*), Lanner falcon (*Falco biarmicus*).

The Northern Cape is home to an assemblage of arid sone adapted smaller bird species including larks, such as Spike-heeled Lark (*Chersomanes albofasciata*), sparrow-larks, and others. From a conservation perspective, the Red Lark (*Calendulauda burra*) and Sclater's Lark (*Spizocorys sclateri*), who are both listed as regionally threatened species (vulnerable and near-threatened respectively). They have very restricted ranges. Other species can include the Spotted Eagle-owl (*Bubo africanus*), Martial Eagle (*Polemaetus bellicosus*).

Other potential birds include the Sociable weaver (*Philetarius socius*) which builds huge grass nests to the critical infrastructure of developments which can cause problems.

On the day of site inspection, the following animal species were noted at the site, kudu (*Tragelaphus strepsiceros*), blesbok (*Damaliscus pygargus phillipsi*), gemsbok (*Oryx gazella*) springbok (*Antidorcas marsupialis*), ground squirrel (*Xerus inauris*), guineafowls, falcons, finches, the northern black korhaan (*Afrotis afraoides*) and vervet monkeys (*Chlorocebus pygerythrus*) was within the abutting crop fields, mongoose (*Herpestidae*), and various common birds. A few burrows were noted and diggings out of old termite hills, which could indicate the presence of aardvark (*Orycteropus afer*).

The clearing of vegetation would be restricted to limited areas between existing pivots and the fairly slow clearance rate would provide adequate time for migration of any animals remaining on-site to be sustained in similar adjoining habitats. Also, noise generated by vehicles will cause most animals to vacate the site temporarily. If certain species were to be affected they would simply vacate the proposed cleared areas during the day and return during the night. Since adequate buffer zones will be maintained from drainage line and the Orange River, the clearing of vegetation will not impact amphibian species.

The proposed development entails the conversion of existing irrigated annual crop fields into permanent pecan nut (*Carya illinoensis*) orchards. The establishment of pecan orchards alters the agricultural and ecological characteristics of the site, including the types of pests, pathogens and associated management requirements likely to occur during both the establishment and operational phases.

Unlike annual row crops, pecan nut orchards are long-term perennial systems which may remain productive for several decades. As a result, orchard health management becomes critically important, particularly regarding fungal diseases, wood-boring insects, sap-feeding pests and parasitic plants. The semi-arid climate of the Northern Cape generally reduces the prevalence of severe fungal outbreaks compared to wetter production regions; however, irrigation practices, canopy density, dust accumulation and seasonal rainfall events may still create favourable conditions for certain pathogens and insect infestations.

The most economically significant disease affecting pecan nuts in South Africa is pecan scab, caused by the fungus *Fusicladium effusum* (previously *Cladosporium caryigenum*) (Department of Agriculture, 2000). Scab primarily affects leaves, young shoots and shucks of developing nuts. Initial symptoms include small olive-brown to black lesions which enlarge and merge under favourable environmental conditions. Severe infestations may result in premature leaf drop, reduced nut quality, malformed nuts and decreased yields. The disease spreads through fungal spores transported by wind and rain, particularly during periods of prolonged leaf wetness and high humidity.

The susceptibility of pecan trees to scab varies considerably between cultivars. Cultivars such as Ukulinga, Shoshoni, Moore and Barton are generally regarded as more tolerant, while cultivars including Wichita, Choctaw and Mohawk are considered more susceptible to infection (Department of Agriculture, 2000). Appropriate cultivar selection therefore represents an important preventative management measure for orchard establishment in the Northern Cape environment.

Additional fungal pathogens that may occur within pecan orchards include root rot organisms such as *Phytophthora* spp. and various soil-borne fungi associated with poorly drained or over-irrigated soils. These pathogens may negatively affect root development and tree vigour, particularly in low-lying or waterlogged areas. Proper irrigation scheduling, drainage management and soil monitoring are therefore important mitigation measures during the operational phase.

Various insect pests may also affect pecan production systems. One of the more significant pests recorded in South African pecan orchards is the pecan stem borer. Larvae bore into the trunks and branches of trees, resulting in tunnelling damage which weakens structural integrity and may reduce productivity (Department of Agriculture, 2000). Infestations are often identified by reddish-brown granular excretions around the trunk base or branch unions. Larvae may remain within the tree for extended periods before pupation, making early detection and monitoring important.

The bark borer is another pest associated with pecan orchards. Larvae feed beneath the bark and may eventually penetrate woody tissue, particularly in younger orchards. Feeding damage may lead to ring-barking of branches,

dieback and reduced tree health. Although affected trees do not usually die, long-term infestations may reduce productivity and increase susceptibility to secondary infections.

Sap-feeding insects such as aphids may also periodically occur within pecan orchards. Heavy infestations can reduce photosynthetic efficiency through leaf damage and honeydew accumulation, which may subsequently encourage the development of sooty mould fungi. Mites may furthermore become problematic during prolonged dry and dusty conditions, particularly where dust suppression and vegetation management are inadequate.

Parasitic plants such as bird-lime (*Tapinanthus* spp.) have also been recorded in pecan-producing regions of South Africa. These parasitic species attach to branches and extract nutrients and water from the host tree, reducing tree vigour and productive capacity (Department of Agriculture, 2000). Infestations are generally more visible during winter months and may require manual removal and pruning management.

The proposed conversion from annual crop production to permanent orchards may alter existing pest dynamics on the site. Existing cultivated lands are already transformed and managed agricultural systems; however, perennial orchards create more stable habitats for certain insects and pathogens due to reduced soil disturbance and long-term canopy establishment. Conversely, the removal of annual monoculture crop systems may reduce the prevalence of some seasonal pests historically associated with maize or wheat cultivation.

Integrated Pest Management (IPM) principles should therefore be implemented during the operational phase of the project. Such measures may include:

- Regular orchard monitoring and scouting;
- Selection of disease-tolerant cultivars;
- Appropriate pruning practices to improve airflow through tree canopies;
- Controlled irrigation scheduling to minimise prolonged leaf wetness;
- Removal of infected plant material and orchard sanitation;
- Dust suppression on access roads and disturbed surfaces;
- Biological control measures where feasible;
- Responsible and targeted application of registered fungicides and pesticides when necessary.

The semi-arid climate of the Northern Cape is generally less conducive to severe fungal outbreaks than humid production regions; however, climate variability and occasional high rainfall periods may increase disease susceptibility during certain seasons. Dust generation associated with construction activities, internal farm roads or exposed soils may also contribute to plant stress and increase susceptibility to mites or fungal infections if not appropriately managed.

No unusual or regionally unique pest outbreaks associated with the site are currently known. Since the site is already utilised for intensive irrigated agriculture, the proposed development is not expected to introduce substantially new agricultural pest risks to the broader area. Impacts associated with insects and pathogens are therefore expected to be manageable through the implementation of standard agricultural best-practice measures and an appropriate Environmental Management Programme (EMPr).

The detailed assessment of operational impacts, monitoring requirements and mitigation measures associated with pests, pathogens and agrochemical use will be further assessed and refined during the Environmental Impact Assessment (EIA) and EMP phases.

POSSIBLE MITIGATION MEASURES

- The areas to be cleared should be swept before vegetation is removed and if animals are found, then they should be relocated, without harming, or killing the animal. An expert who holds a Competency Certificate to handle Dangerous and Venomous Reptiles should be contracted to remove such animals. This requirement should be included in the environmental awareness programme that will be provided in the EIA and EMP phase.
- No hunting or snaring should be allowed outside or inside the proposed study area and the Applicant should implement a severe penalty system for people transgressing this requirement.
- Chemical control and genetically modified cultivars must be used by following the prescribed methods.
- Implement an Integrated Pest Management (IPM) approach throughout the operational phase.
- Select scab-tolerant pecan cultivars suitable for the Northern Cape climatic conditions.
- Conduct regular monitoring for signs of fungal infection, borers, aphids, mites and parasitic plants.
- Remove and appropriately dispose of infected plant material where necessary.
- Ensure adequate tree spacing and pruning to improve airflow and reduce humidity within canopies.
- Avoid over-irrigation and waterlogging conditions that may encourage fungal growth.
- Implement dust suppression measures on internal roads and disturbed areas.
- Apply pesticides and fungicides strictly in accordance with registered agricultural guidelines and manufacturer recommendations.
- Restrict indiscriminate chemical application to minimise impacts on beneficial insects and surrounding ecosystems.
- Maintain general orchard sanitation and weed management practices.

SENSITIVE SITES

The National Protected Area Expansion Strategy (NPAES) was developed to expand protected areas in South Africa to increase ecological sustainability and adaptation to climate change. The proposed study area does not fall within any National Protected area, nor is close to any formal or informal protected area. The Gariiep Focus area is about 24km south and about 30km southwest of the proposed site.

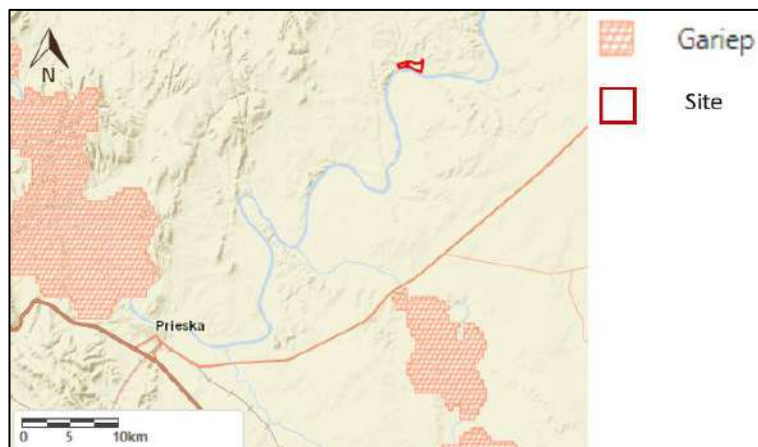


FIGURE 16: THE NATIONAL PROTECTED AREAS EXPANSION STRATEGY (NPAES) INDICATES THAT THE GARIEP FOCUS AREA, IS SITUATED MORE THAN 10KM FROM THE SITE.

The Northern Cape has a full Protected Area Expansion Strategy developed by the Northern Cape Department of Environment with support from the National Department of Environmental Affairs. The PAES priorities are largely a subset of the Critical Biodiversity Areas from the systematic conservation plan that were identified on implementation priority. SANParks priorities were fully included in the provincial PAES.

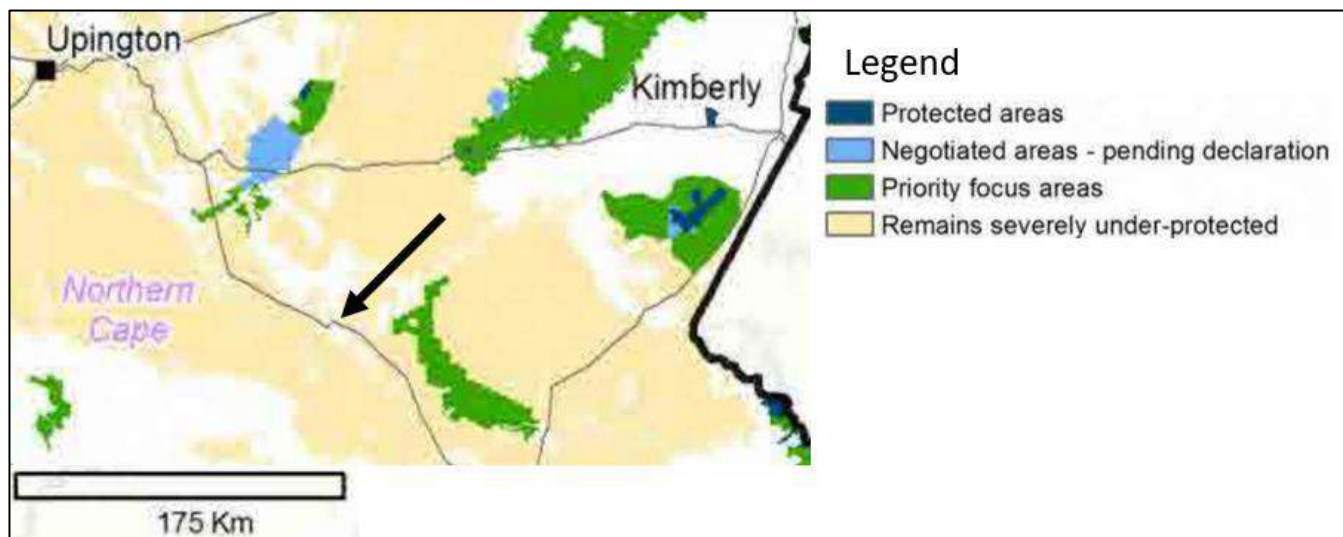


FIGURE 17: PRIORITY AREAS FOR THE PROTECTED AREA EXPANSION IN THE NORTHERN CAPE (BELFOUR ET AL, 2016).

The priority areas in the Northern Cape are in the Succulent Karoo areas of the Namakwa District, Bushmanland, the southern Nama-Karoo as well as in the expansion areas of the existing national parks in the province. The main biodiversity features are the Succulent Karoo and southern Nama-Karoo priorities, as well as river and wetlands. Arid Savanna and some Desert ecosystems are currently not fully included in these priorities. As indicated in the map above, the site does not fall within a focus area.

According to the Northern Cape Biodiversity Conservation Plan, the site falls within a Terrestrial CBA 1 area. Critically Biodiversity Areas (CBA) play an important role in supporting ecological processes. This is particularly the case with riparian areas, some key catchment areas, and key pieces of corridors. CBA areas should preferably not be further developed, no further intensification of land-use activities should be permitted and they should be prioritised for rehabilitation, where possible.

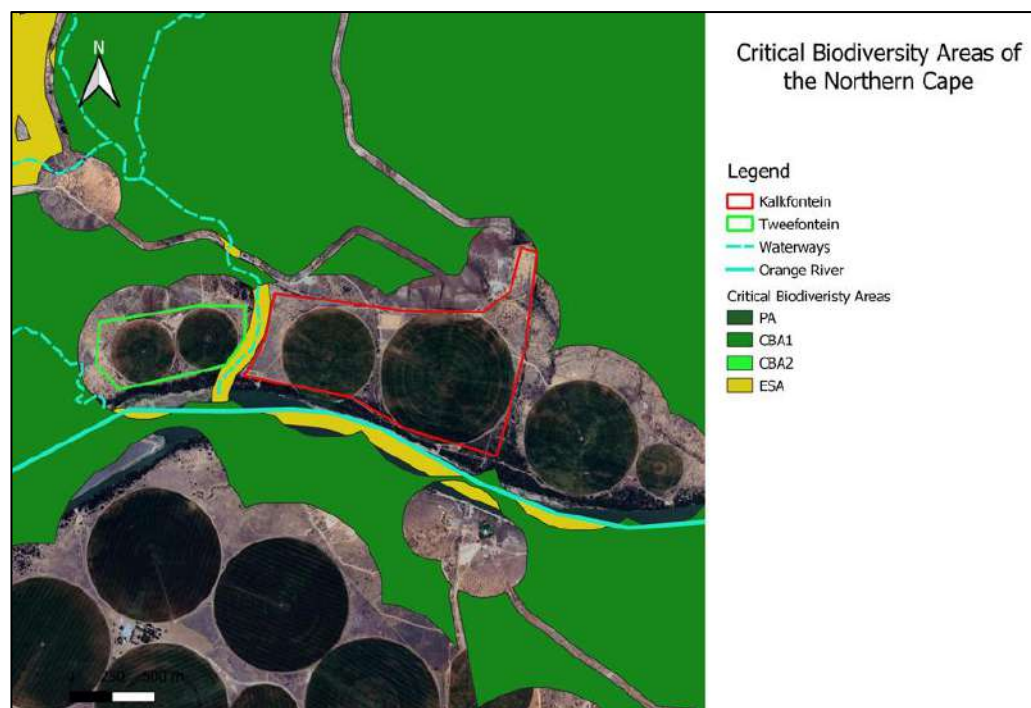


FIGURE 18: THE SITE DOES NOT FALLS WITHIN CBA 1 ACCORDING TO THE BGIS OF THE NORTHERN CAPE BIODIVERSITY CONSERVATION PLAN.

Critical biodiversity areas (CBA) map and guidelines assist in decision-making when considering the biodiversity status of an area and the proposed land-use or development proposal. The overall aim is to avoid loss and degradation of natural habitat in critical biodiversity areas (CBA's), whilst managing sustainable development in other natural areas remaining. Although the CBA maps constitute the best available biodiversity information, they can never replace a site-assessment and are always to be viewed as the biodiversity informant only in the triple bottom line of sustainable development, i.e. social, economic and natural environments (Vromans, D. C et al. 2008).

Since the site does not fall within a CBA it is categorised as a production landscape giving allowance for sustainable utilization of nature.

TABLE 5: CBA CATEGORY AND LAND MANAGEMENT OBJECTIVES

CBA category	Land Management Objective
CBA 1	Natural landscapes: Ecosystems and species fully intact and undisturbed

	• These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met. • These are landscapes that are at or past their limits of acceptable change
CBA 2	Near-natural landscapes: • Ecosystems and species are largely intact and undisturbed. • Areas with intermediate irreplaceability or some flexibility in terms of the area required to meet biodiversity targets. There are options for the loss of some components of biodiversity in these landscapes without compromising the ability to achieve targets. • These are landscapes that are approaching but have not passed their limits of acceptable change.
Ecological Support Areas (ESA)	Functional landscapes: • Ecosystems moderately to significantly disturbed but still able to maintain basic functionality. • Individual species or other biodiversity indicators may be severely disturbed or reduced. • These are areas with low irreplaceability with respect to biodiversity pattern targets only.
ONA (Other Natural Areas) and Transformed	Production landscapes: manage land to optimize sustainable utilization of nature.

According to the Spatial Development Framework, the key issue in the Siyathemba Municipality is the long-term sustainability of all land development practices which is the key factor in the environmental and economic future of this predominantly agricultural region. In terms of land conservation, there are various areas along the Orange River that are well suited for tourism and agricultural development alike. These areas are however sensitive to overutilization and pollution and will have to be protected and conserved to ensure long-term benefits thereof.

The SDF identified amongst others mixed agriculture (livestock & crops), with the following impacts associated with such activities:

- The destruction of biodiversity;
- Indigenous flora being substituted with exotic species;
- The loss of herbaceous annuals;
- Exposure of bare soil and subsequent erosion;

- Areas are homogenized and ecosystem functioning on cultivated land is essentially simplified to the production of bio-mass;
- Depletion and degradation of soils may lead to unproductive soils; or

The Siyathemba Municipality has mapped the environmental sensitivity of the municipal area in the SDF. The sensitivity is rated from 0-6 (0 being no sensitivity, 1 being low sensitivity, 6 being high sensitivity). Unfortunately, the ecological sensitivity map of the SDF is a bit unclear, but it does seem to appear that the site falls within an environmental area that is rated 2 and thus low sensitivity (see Figure 19).

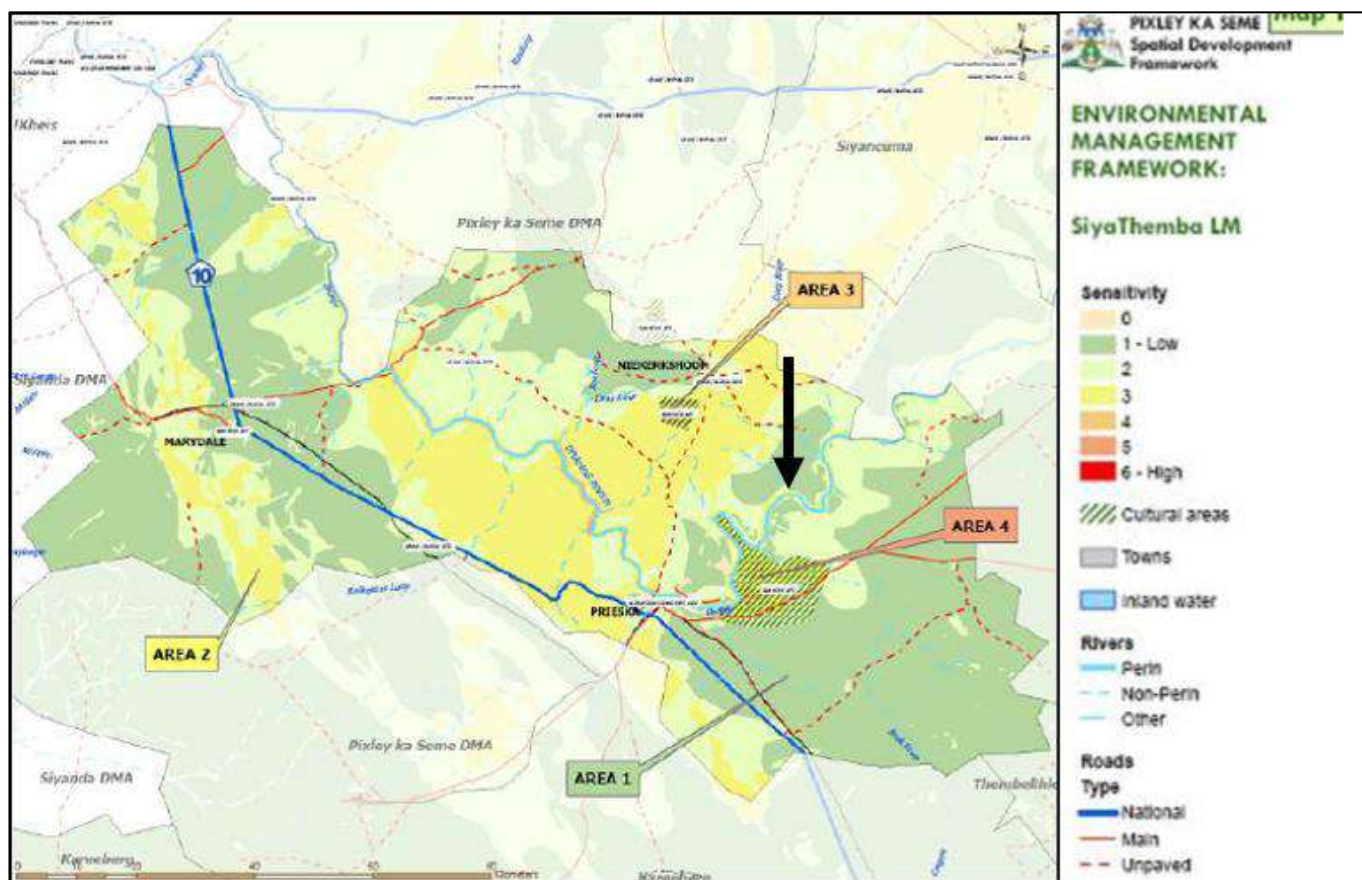


FIGURE 19: SDF OF THE SIYATHEMBA MUNICIPALITY, THE BLACK ARROW INDICATE THE POSITION OF THE SITE.

Considering all the maps available and data presented, it must be concluded that the NPAES, the Northern Cape PAES, the Northern Cape Biodiversity Map and the Siyathembe SDF all indicate that the proposed site does not fall within any biodiversity-sensitive area. While most of these plans are broad-based, regional/national plans are wide-scale plans and do not consider the land-use of the area and surround or site-specific features and locations. Others are more regionally specific like the Siyathemba Municipality SDF is a localised plan. Thus broad-based, regional/national plans might indicate that a site is not sensitive, but localised plans might indicate otherwise, or *vice versa*.

To assess the sensitivity of the environment the onsite verification is therefore essential. The vegetation assessment undertaken by a SACNASP registered botanist identified a range of vegetation units of varying ecological sensitivity within the broader study area, including high sensitivity riparian vegetation associated with the Orange River, medium to medium-high sensitivity near-natural shrubland vegetation, as well as previously disturbed and transformed areas associated with existing agricultural pivots and old cultivated lands. The proposed development is largely focused on the disturbed “fall-out” areas located between and around the existing pivots, which have already been subjected to historical agricultural disturbance and fragmentation. From an ecological planning perspective, the utilisation of these already transformed and fragmented areas for the establishment of pecan orchards is considered preferable to the clearing of intact natural vegetation in previously undisturbed areas. A SACNASP registered terrestrial fauna specialist has furthermore been appointed to assess the faunal sensitivity and ecological functioning of the site, and the findings of this assessment will be incorporated into the EIA process and EMPr.

Mitigation measures will be detailed in the EIA phase but the impact might range from low-moderate to moderate, but with mitigation, it could be reduced to low or very low.

POSSIBLE MITIGATION MEASURES

- Those mitigation measures listed under the headings ‘Fauna’ and ‘Flora’.

WATER

Surface Water

The proposed site falls within the Orange River Catchment area. The Orange River originates in the Lesotho Highlands and flows in a westerly direction 2 200 km to the west coast where the river discharges into the Atlantic Ocean (ORASECOM, 2007). The Orange River basin is one of the largest river basins south of the Zambezi with a catchment area of approximately 1 million km².

It has been estimated that the natural runoff of the Orange River basin is in the order of 11 300 million m³/a of which approximately 4 000 million m³/a originates in the Lesotho Highlands and approximately 800 million m³/a from the contributing catchment downstream of the Orange/Vaal confluence which includes a small portion in Botswana feeding the Nossob and Molopo rivers. The remaining 6 500 million m³/a originates from the areas contributing to the Vaal, Caledon, Kraai and Middle Orange rivers

The Northern Cape is divided into the following four Water Management Areas:

- Lower Orange;
- Upper Orange;
- Olifants/Droon; and
- Lower Vaal.

More specifically the proposed site falls within Lower Orange Water Management Area, in the D71D. The National Freshwater Ecosystems Priority Areas (NFEPA) identifies important catchments based on the presence of important biota or the degree of riverine degradation.

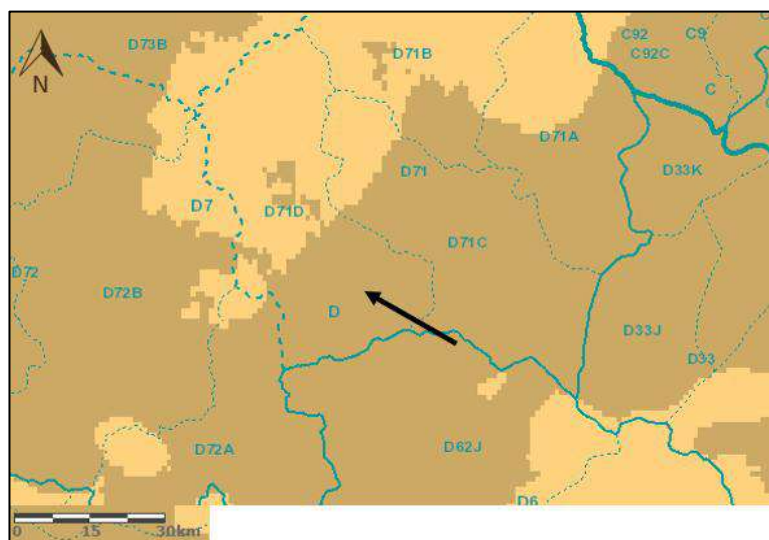


FIGURE 20: QUATERNARY CATCHMENT OF THE SITE IS D71D

TABLE 6: PRESENT ECOLOGICAL STATE CATEGORIES USED TO DESCRIBE THE CURRENT AND DESIRED FUTURE CONDITION OF SOUTH AFRICAN RIVERS, FOR NFEPA, RIVERS IN AN A OR B CATEGORY WERE REGARDED AS BEING IN GOOD CONDITION.

Ecological category	Description
A	Unmodified, natural
B	Largely natural
C	Moderately modified
D	Largely modified
E	Seriously modified
F	Critically/Extremely modified

Fish sanctuaries in a good condition (A or B ecological category) were identified as FEPAs, and the whole associated sub-quaternary catchment is shown in dark green. The remaining fish sanctuaries in lower than an A or B ecological condition were identified as Fish Support Areas, and the associated sub-quaternary catchment is shown in medium green. Fish Support Areas also include sub-quaternary catchments that are important for the migration of threatened or near-threatened fish species – these are not marked with a fish symbol.

The site is located within a Fish Support Area of the *Barbus anoplus*. The back fish symbol on the map (see Figure 21) indicates the presence of vulnerable or near-threatened fish populations. If it was a red fish symbol, it would have indicated that there is at least one 13 population of a critically endangered or endangered fish species within that sub-quaternary catchment. Some fish sanctuaries are FEPAs, with their associated sub-quaternary catchments shown in dark green; others are Fish Support Areas, with their associated sub-quaternary catchments shown in medium green, such as the proposed site.

A goal of NFEPA is to keep further freshwater species from becoming threatened and to prevent those fish species that are already threatened from going extinct. To achieve this, there should be no further deterioration in river condition in fish sanctuaries and no new permits should be issued for stocking invasive alien fish in farm dams in the associated sub-quaternary catchment. Since there is a drainage line or perennial stream that runs between Tweefontein and Kalkfontein sites and the Orange river are situated between 50-100m from the proposed orchard areas, there is a small, but unlikely possibility of impact on the *Barbus anoplus* fish sanctuary.

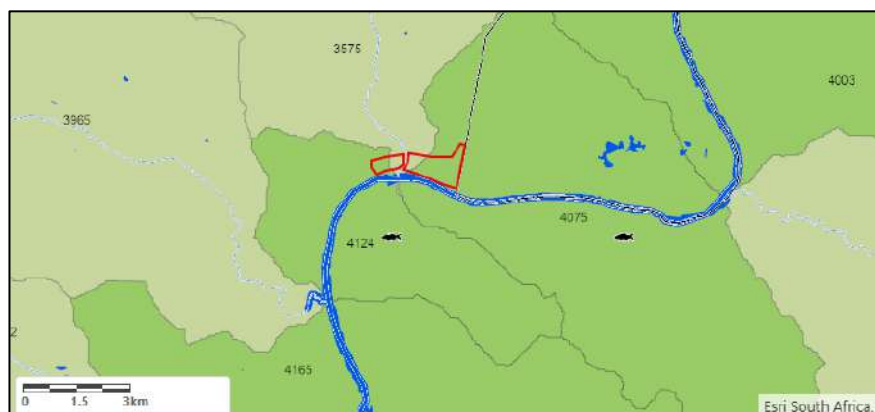


FIGURE 21: THE SITE FALLS WITHIN A FISH SUPPORT AREA

During the EIA and EMP phase, the watercourse attributes will be further investigated, but it is not foreseen that the proposed clearing of vegetation will have an impact on the water sources surrounding the site since the buffer zones will be maintained. The Application already has a Water Use Right, therefore water abstraction has already been accounted for.

POSSIBLE MITIGATION MEASURES

- Clearing of vegetation should be restricted to the proposed footprint and development plan and 32m buffer zone be maintained from all drainage lines/non-perennial streams/ river/etc.
- Water for establishing the orchard will be obtained as per the Water Use Right.
- No foreign or unapproved material/substance should be dumped or stored within the footprint of the study area.
- Refuelling of vehicles (such as the bulldozer) will be done by fuel browser and all vehicles/equipment shall be maintained to a high standard off-site and shall not display any major leaks. Vehicle/machinery inspection should be done regularly and emphasis should be on checking hydraulic hoses and couplings.
- In case of an emergency, repairs on site must be done over a drip pan at least 100m away from any drainage line.
- In case of large, critical spills the Departments of Water Affairs and DMR will be informed immediately for assistance and advice and a competent company conversant with bio-remediation will be appointed immediately to address the possible impacts of such spill. All costs would be for the account of the applicant.
- The applicant accepts the principle of 'polluter pays'.

AIR QUALITY

The air quality of the immediate surroundings is good due to its rural status. During windy periods a limited amount of dust will be deposited into the atmosphere causing a slight rise in air pollution levels during the clearing of vegetation. Since the property involved is still zoned agricultural and rural, it would cause tolerable ambient levels to be higher than those for residential areas. It would on the other hand not exempt the applicant to implement measures to keep disturbed areas as small as possible and to reduce dust generation when and wherever possible.

The amount of dust generated on a site is directly linked to the type of material that is extracted, mechanical processes involved, traffic volumes, wind speed and soil moisture content. The finer the material (more easily airborne) and the higher the clay and silt concentrations, the more severe the impact is. The dryer the soil becomes the more dust it generates therefore the site will be cleared in phases and the crops planted as soon as possible and irrigated. This will reduce the areas exposed to wind and will limit dust generation.

The potential dust generation associated with the proposed pecan nut orchard development will mainly occur during the construction and establishment phase, particularly during vegetation clearing, soil preparation, ripping, levelling, excavation of irrigation infrastructure and the planting of the orchards. Additional temporary dust generation may occur along internal gravel access roads due to construction vehicles and operational farm traffic.

Once the pecan orchards have been established, operational dust generation is expected to decrease substantially compared to annual crop cultivation systems, as permanent tree cover and reduced soil disturbance generally stabilise the soil surface and minimise repeated ploughing activities. Unlike annual rotational crops, pecan orchards do not require continuous seasonal cultivation and large-scale soil preparation once established.

Some localised dust generation may still occur during maintenance activities, harvesting operations, movement of agricultural vehicles and during prolonged dry and windy conditions typical of the Northern Cape. However, since the surrounding area already supports extensive agricultural activities, including existing pivots and cultivated lands,

the proposed development is not expected to result in a significant increase in regional dust levels. During normal climatic conditions, the overall dust impact is anticipated to be low and largely localised in extent.

The overall impact on air quality, without mitigation, is anticipated to be low (calm days) to low-moderate (windy days) only during the construction phase.

POSSIBLE MITIGATION MEASURES

- No cooking fires will be allowed on the property, no chemicals will be stored or disposed off on-site and no waste will be burned on site.
- Waste should not be buried.
- Water will be used to irrigate areas.
- The clearing of vegetation should not impose dust counts of more than 20 mg/m²/per day at any residence or more than 40 mg/m²/per day during abnormal climatic conditions.
- Speed of vehicles should be restricted to 30km/h, which will assist in mitigating dust generated on haul roads.

NOISE

The impact of noise levels generated by farming activities is determined by the type of activity, the time of day, the consistency thereof, distance to people, whether it is a low or high-pitched noise and whether beneficiation is taking place. Noise levels are more intense in the morning and evening than during the rest of the day and are more irritating if it is high-pitched. The more continuous the noise is the higher the impact. In terms of SABS standards, noise levels for rural residential areas are 45dB during the day, 40dB in the early evening, and 35dB at night. Noise impact is rated against the following: 1) The average dB will result in no or sporadic complaints from communities whilst an increase between 5-10dB will result in widespread complaints, 3) An intruding noise is defined by National Noise Regulations as disturbing if it causes the ambient noise levels at the border of the property from which it emanates to increase with 7dB, 4) An average person will perceive such an increase in the ambient noise levels as a doubling of noise levels and very strong response will be expected from communities/residents.

The rural setting of the study area and the extensive agricultural activities characteristics of the area would, under normal circumstances, probably result in the ambient noise levels being between 40 and 45dB during the day. Since the site is more than 16km from the R375, cumulative impact concerning provincial roads will not be a factor.

Noises generated during the construction and operational phase (clearing of vegetation and crops) will generally be low-pitched if earth-moving machinery is well maintained. There is one exception and that is the reverse sirens which produce a high-pitched, irritating noise and could cause some irritation to the applicant's home residence early in the morning or later at night. In terms of residence, the closest resident is more than 4.5km from the site, therefore no impact is expected. Since the fitting of sirens is a requirement of the OHS Act, there is no mitigation possible.

No campsite would be established in the study area, therefore no noise would be generated at night that could become a nuisance.

Management of the human impact during the day could be achieved via the environmental awareness programme. Also, staff and contractors should be sensitized not to engage in unnecessary hooting, shouting, flapping of tailgates, and use of exhaust brakes during operational hours. Maintaining speeds below 40km/h would assist in curbing noise impact.

The expected impact rating on noise is very low to insignificant.

POSSIBLE MITIGATION MEASURES

- Unnecessary hooting, shouting, flapping of tailgates, and use of exhaust brakes should be discouraged as well as the unnecessary idling of vehicles.
- Moving parts of vehicles should be regularly serviced and repair work that involves using grinders and hammers on steel or any other steel on steel activity should be done during the day at the farm workshop.
- This potential impact should be addressed in an environmental awareness programme, which will be completed during the EIA and EMP phase.

WASTE GENERATION

Domestic Waste

The waste stream will consist mainly of small volumes of domestic waste (food, bottles, plastic bags, paper, clothing, rags, etc) and will be deposited in small containers provided in the earth moving vehicles, for this purpose. It can be emptied once a day in a refuse bin at the farmhouse/workshop. Poor control over domestic waste handling could lead to littering the site and abutting properties and must be avoided since it could lead to livestock mortality or impacts on fauna. Due to the limited number of people anticipated on-site, the limited waste stream will have negligible impacts on soils, water vegetation, air quality, and humans.

Clearing of vegetation residue

The geology of the area restricts the type of residue to possible oversize stones, and root mass. The root mass can be worked into the topsoil as organic matter. The cumulative impact on soils, water quality, vegetation and aesthetics is expected to be rated of low significance.

Sewage system

A chemical toilet must be provided. Considering the limited number of people on-site, the effluent stream will be limited to approximately 0,1 m³ per month and no impacts on soils, groundwater, surface water, air and humans are anticipated if it is maintained/serviced properly.

Hydrocarbons

No hydrocarbon storage will take place onsite. Servicing of equipment and vehicles would be done off-site at the farm workshop therefore no hydrocarbon waste such as used oil, lubricants and hydrocarbon-contaminated filters will be generated. Any such material generated during emergency repairs will be removed from the site immediately. No-wash bay or oil trap will be constructed as vehicles will be washed off-site and all hydrocarbon spills will be contained within large drip pans. The impact is anticipated to be a low impact.

POSSIBLE MITIGATION MEASURES

- Any domestic waste produced would be temporarily stored at allocated areas in the farm area and removed continuously to a legal waste facility. Appropriate containers and storage areas will be investigated during the EIA and EMP phase. Easy access to these should be a priority and no waste should be burned or buried on site.
- The site should always remain neat and tidy.
- Any hydrocarbon spills would be cleaned up immediately and vehicles will be maintained to a fuel, oil, or lubricants leak-free status. Vehicles should be parked over drip trays.
- The chemical toilet/s would be regularly serviced and emptied at an approved waste site in Prieska and strict controls will be enforced to ensure that the surrounds are not used as ablutions. This aspect would be included in the environmental awareness programme. Waste from the toilet should be taken to a licensed WWTW.
- The chemical toilet/s can be moved to and from the site as they are needed.
- Residue in the form of oversize stones could be returned to old excavation sites on the farm.

VISUAL IMPACT AND AESTHETIC ACCEPTABILITY

Originally, the landscape would have been described as very attractive and of high aesthetic quality because of the meandering status of the river and the unique riverine environment. However, due to the anthropogenic impacts such as the establishment of cultivation areas, Eskom servitudes, and road infrastructure, the current surrounding

landscape can be viewed as impacted, but with a moderate-high aesthetic quality, due to the location of the site (fairly close to the Orange River) and the tranquillity that farming generally provides to areas.

The landscape itself does not provide valleys and ridges to add to the visual character of the area, and roads, bridges, telephone and power lines, and residences on farms, farm buildings, etc. further reduced the aesthetic value of the surroundings. Onsite assessment of immediate landscapes revealed that the majority of the site under application are transformed due to past and present agricultural activities.

The properties are currently utilised for irrigated agriculture, with four existing centre pivots already established on the site prior to 1998, comprising a 50 ha and 25 ha pivot on the Kalkfontein property and two 10 ha pivots on the Tweefontein property. The Applicant now proposes to expand the irrigated footprint through the cultivation of the infill and fall-out areas located between and around the existing pivot circles for the establishment of pecan nut orchards. This will increase the total irrigated area from approximately 95 hectares to 141 hectares, resulting in approximately 46 hectares of additional vegetation clearance.

Although the establishment of the orchards will introduce a further anthropogenic element to the landscape, the proposed development will remain closely associated with the existing agricultural footprint, its aesthetic sense of place and operational character of the site. As the expansion areas are directly adjacent to the established pivots and occur largely within already fragmented and historically disturbed agricultural areas, the development will largely be perceived as a continuation and consolidation of the existing irrigated farming activities, rather than the introduction of a new or isolated land use into an undisturbed landscape. The visual and aesthetic impact is therefore expected to remain localised and low in extent.

The clearing of vegetation between the pivot areas will temporarily change the texture (vegetated/rough to bare/smooth) and colour (green/brown to whitish-grey) of the cleared out areas and will increase onsite visibility, but as the orchard is established the onsite visuals will be absorbed into the landscape and will fit in with the surrounding land use.

During the EIA phase this procedure will be elaborated on. This visual impact should, however, be temporary and of very low to insignificant significance.

POSSIBLE MITIGATION MEASURES

- No vegetation clearing should take place outside the proposed study area and the visual impact will be reduced through the establishment of the orchard and alien control programme.
- Excessive dust generated by the bulldozer, haul roads, and ploughing machinery, harvesting, etc. that increases visual impact could be reduced through an irrigational plan.

TRANSPORT IMPACT

The existing access roads on the farm and the R357 will be used. During the construction phase (vegetation clearing) a bulldozer will be at the site and will not add heavy vehicle traffic to the national and provincial road system. It is not anticipated that there will be any impact on the farm road infrastructure.

Once operational, the R357 will be used to transport harvest nuts to the relevant markets. It is anticipated that during the harvest time, heavy vehicles will add to the traffic count on the R357, but since this road is built for heavy vehicles, the impact is anticipated to be low.

During the EIA and EMP phase the condition/integrity of the roads will be investigated, but despite the sometimes poor quality of the road, safety risks for motorists would not increase since the proposed development will just be a continuation of existing agricultural activities on the farm. Cyclists and pedestrians will experience a similar risk and truck drivers will be sensitized on the matter and provided with the necessary transport training.

POSSIBLE MITIGATION MEASURES

- All vehicles and earthmoving machinery would be properly maintained and will be road-worthy and all drivers must dispose of applicable driver's licenses.
- Traffic should be observed and necessary road etiquette enforced and this aspect will be included in the environmental awareness programme.
- The appropriate road signage should be erected on both sides of the farm entrance and if needed, a flagman will be appointed at the access point to increase road safety during harvest periods when an increase in trucks are expected on the farm.

SOCIO-ECONOMIC IMPACT

During the construction phase, the development will provide permanent and casual work for a number of people, whether it is renting a bulldozer from a local company, employing workers to 1) remove the vegetation, 2) remove stones, 3) construct the irrigation infrastructure, or 4) fencing/moving fencing the camps, etc. Once in operation and the crops are harvested, it will create job opportunities for harvesters, transport companies, etc. and must be seen as a positive contributor to upliftment of inhabitants of the Siyathemba Municipal area.

Once in operation and the crops are harvested and the pecan nut plantation starts producing nuts, an annual harvesting will create job opportunities for harvesters, transport companies, etc. and must be seen as a positive contributor to upliftment of inhabitants of the Siyathemba Municipal area.

In terms of the socio-economic benefit, it is no secret that South Africa has one of the world's highest unemployment rate, with the IDP of the Siyathemba Municipality indicating that in 2009 the unemployment rate was about 34.7%, which has steadily increased over the past decade. A small portion of workers (10.3%) can be classified as highly skilled, but more than 52% of workers can be regarded as semi- or unskilled workers.

It is thus clear that pecan nut production as proposed by the Applicant, will contribute to economic growth within the Siyathemba Municipal area. This development will not only benefit the Applicant but will also create job opportunities for about 70 staff members, thus assisting the low-income households that will assist in poverty alleviation.

In terms of the negative impacts, it could potentially pose some social impacts on residents in terms of safety and security issues, nuisance factors such as dust & noise generation. However, the Applicant is a farmer and has a close relationship with the local community. Most of the families employed on the farm will be from families that have been on the farm for generations, which is the basis of their mutual trust in each other. The Applicant will therefore employ local community members known to the farming community, which is in line with current farming practices. Farm safety remains a major concern and will be investigated during the EIA and EMP phase.

Based on the above, the overall social-economic impact is expected to be rated positive.

POSSIBLE MITIGATION MEASURES

- If needed, meetings with nearby neighbors should be held to address any unknown impacts.
- Farmworkers may not wander on any area outside the farm and stock theft and poaching should not be tolerated. Any farm worker/contract worker found guilty of these transgressions should be removed from the property, dismissed and handed over to the police for sentencing.
- No wood should be gathered from outside the study area and no plant or crop should be removed by the workforce.
- Landowners will be fully compensated for stock or crop loss.

STRUCTURES OF ARCHAEOLOGICAL AND CULTURAL INTEREST

These sites represent the heritage of communities and are therefore protected in terms of current legislation. In addition, all materials/buildings older than 60 years are protected. The Northern Cape is rich in fossils and archaeological heritage and therefore the area will be subject to a Phase 1 Archaeological and Paleontology Report will be completed by Dr. Lloyd Rossouw who has a BA Hons (SU), MSc (Wits), and PhD (UFS). The full report will be submitted with the EIA and EMP phase. Also, an environmental awareness plan will be compiled to inform the operators of earthmoving equipment of the company's obligation to protect any archaeological or cultural artefacts and to inform management when anything of interest is noted on the site.

POSSIBLE MITIGATION MEASURES

- Recommendations from the Heritage Survey Report will be included in the mitigation measures, which will be completed during the EIA and EMP phase.
- Operators of earthmoving equipment should be informed of the company's obligation to preserve archaeological and historical material and this aspect will be included in the environmental awareness programme.

PUBLIC PARTICIPATION FOR THE SCOPING PHASE

In terms of Regulation 40 of the Schedule published in GNR 326 under NEMA 107 of 1998, interested and affected parties must be consulted as part of the public participation process. To follow 'green' practises, it is proposed that where possible email correspondence will be used as opposed to hard copies of documents. Thus the following steps were taken, following current legislation:

- A Notice Board to inform the public about the application and allow registering as an interested and affected party and time to comment will be placed at the entrance to the property that is accessible to the public.
- An advert will be placed in Die Oewernuus to inform the public about the application and provide an opportunity to register as interested and affected parties to register or raise concerns about the proposed project. The comment period will allow for 30 days to comment, which gives potential I&AP's more time to register.
- All abutting neighbours, Siyathemba Municipal, the Pixle Ka Seme District Municipal, Ward 3 Councilor, the Department of Water and Sanitation, the Department of Agriculture, and all other state departments will be notified to register as interested and affected parties. The comment period will allow for 30 days to comment, which gives potential I&AP's more time to register.
- An application to the South African Resource Agency will be submitted online as per their SAHRIS application format and requirements.

Section 41 (3) of the regulations indicates that the notice, notice board, and advertisement must give details of the application and state if the application is a BAR or an EIA. In addition, the notice must also provide the activities being applied for, the location, where further information on the application can be obtained, and how a person can register as an IAP. According to Section 41 (6)(b) of the regulations, the potential or registered IAPs must have a reasonable opportunity to comment on the application.

The timeframes are very clear in the NEMA Regulations, that IAPs must have 30 days to comment and register as IAPs and the time frames to submit the Scoping Report are very rigid (44 days – of which 10 days could be utilized by the authority to accept/reject the application; 30 days must be provided to IAPs to comment and register, thus leaving 4 days for finalization of the Scoping Report before submitting). This results in the Scoping Report is available to any potential IAP for comment and not just registered IAPs.

The Scoping Report and Plan of Study will be submitted 2-3 days after acceptance of the application is received from the Department of Agriculture, Environmental Affairs, Rural Development and Land Reform and the notice board, advertisement and notification letters will be placed/emailed accordingly. If any IAP wants to comment on the Scoping Report and Plan of Study they can contact Digital Soils Africa (contact information provided in the notice) and enquire regarding the website information where the document is available for public viewing.

The Scoping Report will also be submitted to all organs of the state which have jurisdiction in respect of the activity or any part thereof during the mentioned 30 day period. At the cessation of the 30 day comment period, the Public Participation Report will be finalized and submitted with the Final Scoping Report to the DAEARDLR.

If no comment or written request to be registered as an IAP is received from potential IAPs during this 30 day consultation period, then the public participation process will be concluded and only entities regarded as registered IAPs will be given notice of the EIA.

Proof of consultation during the Scoping Phase is attached in Appendix C – Public Participation.

During the EIA phase, another 30-day comment period on the draft EIA and EMP will be provided to all registered I&AP's.

PLAN OF STUDY

INTRODUCTION

Any activity which is listed in Listing Notice 1 or Listing Notice 2 of these EIA Regulations is subject to environmental authorization. The difference between Listing Notices 1 and 2 is in the process that needs to be followed, with Listing Notice 1 activities being subject to Basic Assessment and those in Listing Notice 2 to Scoping and Impact Assessment. For this application activities listed under Notice 2 were identified, therefore the EIA process has to be followed.

The amendments to the National Environmental Management Act have led to the Plan of Study to be included in the Scoping Report and are no longer a separate document submitted with applications. Since, a detailed description of the components and issues considered, have been included in the Scoping Report, this chapter of the report, therefore, provides the context for the Plan of Study for the Environmental Impact Assessment, supplementary to the Scoping Report.

Therefore this Plan of Study describes how the EIA for the proposed project will proceed and includes proposed specialist studies to be completed for those potential impacts provisionally evaluated to be of significance.

Should the Scoping Report be accepted by the Department of Agriculture, Environmental Affairs, Rural Development, and Land Reform, the application will proceed with the EIA Process as described in the NEMA Regulations of 8 December 2014 as amended in 2017.

OBJECTIVES OF THE EIA

The objective of the assessment of impacts is to identify and assess all the significant impacts that may arise from the undertaking of an activity. The findings of impact assessments are used to inform the competent authority's decision as to whether the activity should be authorized. The objectives of the EIA are:

- To identify issues/concerns that should be included in the scope of the Environmental Impact Assessment process;
- To provide an assessment and rating of the social and biophysical environments affected by the proposed project, to an appropriate level of detail, which will include the physical, biological, and socio-economic components.
- Identify and recommend appropriate mitigation measures for potentially significant environmental impacts;
- To identify possible specialist studies to be conducted to address significant issues;
- To describe/ recommend mitigation measures/ Environmental Management Plan (EMP) to be implemented to address significant aspects/ impacts associated with the proposed development to fall within acceptable levels;
- To inform all stakeholders about the proposed mining development through a public participation process as published in Regulation 41 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended and ensure that IAP's have the opportunity to raise their concerns.

EIA APPROACH

In the EIA, aspects, and impacts (cumulative impacts, degree of impacts, nature of impacts, the degree to which impacts can be reversed), associated with the construction, operational, and closure phases shall be extensively assessed, as determined through site visits and field investigation to determine the baseline environmental parameters. A desktop study will determine:

- Ecological sensitive sites;
- Conservation areas;
- Surface water resources;
- Soil stability; and
- Vegetation sensitivity.

Comprehensive mitigation measures informed by the investigation and specialist reports, as well as consultation with key stakeholders, shall be included in the EIA report and the Draft Environmental Management Plan.

Since this will be a change from grazing land to crop production and the proposed development will have a lifespan of more than 10 years, a closure phase should consist of rehabilitating the site back to a natural veld used for grazing. However, ten years from now, it is most likely that environmental laws would have been amended and requirements might change. Therefore as a condition to guard the long-term sustainability of the project, it is proposed that as a condition of approval, the following be stipulated: should the Applicant decide to cease the crop production, a closure plan must be submitted to the relevant Department for approval.

A DESCRIPTION OF THE ALTERNATIVES TO BE CONSIDERED

In terms of the Environmental Impact Assessment (EIA) Regulations, feasible and reasonable alternatives must be identified and considered for the proposed development. Alternatives were therefore investigated in relation to site location, layout configuration, land use and the “no-go” option. The consideration of alternatives was informed by the findings of the specialist studies available, including the vegetation assessment and irrigation suitability assessment, as well as the existing agricultural context of the site.

Alternative site layout will be investigated since the soil report identified better areas for crop production within the study area and recommends that no more than 10% of unsuitable soil should be included in pivot areas.

ALTERNATIVE SITE

From an alternative site perspective, no preferable alternative site was identified for the proposed development. The proposed expansion area is directly associated with existing lawful irrigated agricultural activities already established on the farms Tweefontein and Kalkfontein prior to 1998. Existing irrigation infrastructure, established centre pivots, confirmed water availability and historically transformed agricultural areas are already present on the site.

The proposed development specifically focuses on the incorporation of the infill and fall-out areas located between and around the existing pivot circles, thereby consolidating and optimising an existing agricultural footprint rather than creating a new agricultural node elsewhere on the properties.

The soil suitability assessment confirmed that the majority of the proposed expansion area is underlain by deep, freely drained Oakleaf and Ermelo soils regarded as highly suitable for irrigated pecan nut production. These soils exhibit suitable depth, drainage and favourable chemical characteristics for sustainable irrigation agriculture. Although limited Prieska/Augrabies soils occur in the northern portions of the Tweefontein site, these areas are relatively small and were identified as marginal rather than unsuitable. The report concluded that cultivation of these soils would not result in soil degradation, although production potential may be lower than within the Oakleaf soils.

From an environmental perspective, the vegetation assessment identified a mosaic of vegetation units ranging from disturbed and transformed agricultural areas to medium-high and high sensitivity natural vegetation. Importantly, the proposed development is largely associated with disturbed pivot vegetation units, old fields and fragmented agricultural landscapes already influenced by historic cultivation and associated infrastructure. The assessment identified the riparian vegetation associated with the Orange River as the most sensitive ecological component of the site, with high conservation importance due to habitat functioning and the occurrence of protected species. Near-natural shrubland vegetation units located toward the northern and western portions of the site were also identified as having medium to medium-high ecological sensitivity.

The establishment of the proposed orchards in an alternative location elsewhere on the farms would likely require the clearing of larger areas of intact natural vegetation and the establishment of new irrigation infrastructure within less disturbed portions of the properties. From both an environmental planning and agricultural perspective, this would be regarded as less desirable than concentrating the proposed expansion within the already fragmented and historically transformed agricultural footprint associated with the existing pivots.

No feasible or environmentally preferable alternative site was therefore identified.

ALTERNATIVE LAYOUT

Alternative layout configurations were investigated during the planning process. However, the extent of layout flexibility is limited due to the location and configuration of the existing centre-pivot irrigation systems, existing lawful water supply infrastructure, topography, soil suitability and the spatial distribution of ecological sensitivities identified during the vegetation assessment.

The preferred layout follows the logical expansion of the existing irrigation footprint through the incorporation of the infill areas located between and around the current pivot circles. This approach allows the Applicant to optimise the use of existing irrigation infrastructure while limiting the need for additional infrastructure corridors or separate agricultural blocks elsewhere on the properties.

The investigation into alternative layouts considered whether the proposed orchards could be shifted or reconfigured to avoid all natural vegetation areas entirely. However, this was found to be impractical for several reasons:

- it would result in fragmented and operationally inefficient orchard blocks;
- it would compromise the functioning and efficiency of the existing irrigation systems;
- it would sterilise otherwise suitable agricultural land located between the pivots;
- it would potentially shift development pressure into more intact and undisturbed areas of the properties; and
- it would require additional disturbance associated with new irrigation infrastructure and access arrangements.

The vegetation assessment nevertheless informed the refinement of the preferred layout. The proposed development intentionally seeks to retain the primary riparian vegetation corridor associated with the Orange River as far as reasonably practicable, due to its high ecological sensitivity and functional importance. Similarly, more sensitive near-natural vegetation areas located toward the northern portions of the site have been considered during layout planning where feasible.

The preferred layout is therefore regarded as the most practical and least environmentally disruptive option, as it consolidates agricultural expansion within an already transformed and fragmented agricultural landscape rather than introducing a separate or disconnected cultivation footprint elsewhere on the properties.

ALTERNATIVE LAND USE

Alternative land uses were considered; however, no feasible or reasonable alternative land use was identified for the site.

The properties are already utilised for irrigated agricultural purposes and form part of an established irrigation farming landscape associated with the Orange River corridor near Prieska. The proposed development therefore does not introduce a new primary land use to the properties, but rather represents the expansion and optimisation of an existing lawful agricultural enterprise.

The soils assessment confirmed that the majority of the site contains soils highly suitable for irrigated pecan nut production, while the broader area is already characterised by intensive irrigation agriculture, including nut production, table grapes and crop cultivation. Existing irrigation infrastructure and agricultural investment are already present on the site.

Alternative non-agricultural land uses would not align with the current agricultural zoning, historic use or the agricultural capability of the land. Furthermore, no industrial, commercial or residential need has been identified for the site, and such land uses would likely introduce a substantially different environmental impact profile and infrastructure requirements.

The proposed pecan nut orchard development is therefore considered the most appropriate land use for the site from both an agricultural capability and land-use planning perspective.

NO DEVELOPMENT OF THE SITE

The “no-go” option refers to the scenario where the proposed development does not proceed.

Under the no-go alternative, the existing agricultural activities associated with the current pivots would continue, while the proposed infill areas between and around the pivots would remain undeveloped. Portions of these areas

currently comprise disturbed and fragmented vegetation associated with historic agricultural activities, while other portions contain near-natural vegetation and riparian habitat.

From an environmental perspective, the no-go option would avoid the direct loss of approximately 46 ha of vegetation associated with the proposed orchard expansion and would maintain the current ecological functioning of the undeveloped portions of the site. Potential impacts associated with vegetation clearance, habitat transformation and operational agricultural activities would therefore not occur.

However, from an agricultural and land-use planning perspective, the no-go option would result in the continued underutilisation of land already situated within an established irrigated agricultural footprint and already associated with existing irrigation infrastructure and lawful agricultural activities. The infill areas between the pivots would remain fragmented and isolated between cultivated areas, despite much of the surrounding landscape already being transformed by irrigation agriculture.

The proposed development represents the consolidation and optimisation of an existing agricultural footprint rather than the expansion of agriculture into a separate undisturbed landscape unit. In this context, the preferred alternative is considered more appropriate than the no-go option, provided that sensitive areas such as the riparian corridor are appropriately managed and retained where feasible, and that mitigation measures identified during the EIA process are implemented through the Environmental Management Programme (EMPr).

ASPECTS TO BE ASSESSED DURING THE EIA PHASE

For the application, a few activities triggered the requirement to apply for environmental authorization. These listed activities include:

Vegetation of clearing

- GNR 325 Activity 15: The clearance of an area of 20 Ha or more of indigenous vegetation.

The above-listed activities will cause direct, indirect, and/or cumulative impacts on the biophysical environment. Therefore each listed activity will be assessed in perspective to the biophysical parameter and the following biophysical parameters will be assessed:

Topographical assessment

Geological & Soil assessment

Land capacity assessment

The vegetation assessment

The fauna assessment

Site Sensitivity assessment

Surface & Ground Water assessment

Air quality assessment
Noise impact assessment
Waste management assessment
Visual impact assessment
Traffic impact assessment
Socio-Economic impact assessment
Archaeological & Palaeontology assessment

Management actions or mitigation measures will be fully described in the Environmental Management Plan (EMP) that forms part of the EIA process. In the above Scoping Report, potential mitigation measures have been discussed, but as the EIA progress, more specific mitigation measures will be prescribed to the proposed project to mitigate specific impacts.

SPECIFIC ISSUES TO BE ADDRESSED IN SPECIALIST STUDIES

The Terms of Reference for each specialist should be outlined, before appointing the specialist, and for each specialist study, the method of assessing the environmental impacts should be similar to the below to ensure uniformity in providing scientific information.

The site visit during the Scoping Phase revealed that the following specialist studies should be completed, also considering the applicable legislation:

- Soil survey – to be completed by Prof. J. van Tol
- Terrestrial Flora survey – to be completed by Dr. A. van Aardt
- Terrestrial Fauna survey - to be completed by Dr. H. Butler
- Heritage and Palaeontology survey – to be completed by Dr. Rossouw

If additional issues are identified by the consulting authorities or through interested and affected parties that must be investigated by a specialist, the additional specialist will be appointed and the studies completed and input from the specialists will be included during the EIA and EMP phase.

METHODOLOGY OF IMPACT ASSESSMENT

The identification and assessment of environmental impacts is a multi-faceted process, which combines quantitative and qualitative analysis and evaluation. It involves the application of scientific measurements and professional judgment to determine the significance of environmental impacts associated with the proposed project.

The assessment of impacts will be based in accordance with Section 3: Assessment of Impacts, in DEAT Guideline 5, June 2006. This identification of potential impacts should include impacts that may occur during the different phases of the operation (construction, operational, and closure phases) and assessment of the impacts should include the direct, indirect, and cumulative impact.

The process of the identification and assessment of impacts must always include the conditions of the current environment so that an environmental baseline is determined from which impacts can be identified and measured. The process must also determine future changes to the environment that will occur if the activity proceeds and the consequences (environmental/social risks as well as the positive and negative consequences).

Different approaches can be adapted to the undertaking of the assessment of impacts, but they should always be based on a methodology that includes:

- A clear process for impact identification, prediction and evaluation;
- Criteria for evaluating the significance of impacts;
- Identifying and assessing the potential impacts associated with a proposed activity and its alternatives (if any) and defining types of impacts (direct, indirect or cumulative);
- Predicting the nature, magnitude, extent and duration of potentially significant impacts;
- The design of mitigation measures to address impacts;
- Evaluating the significance of residual impacts i.e. impacts that remain after taking mitigation measures into account; and
- Specifying uncertainties.

As per the DEAT Guideline, the following methodology is to be applied to the prediction and assessment of impacts. Potential impacts should be rated in terms of direct, indirect, and cumulative:

Direct impacts – are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.

Indirect impacts – are impacts caused as a result of the activity and normally do not manifest immediately when the activity is undertaken or could occur at a different place as a result of the activity.

Cumulative impacts – these are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present, or reasonably foreseeable future activities. Cumulative impacts can include both direct and indirect impacts and can occur from the coactive impacts of individual minor actions over a period of time.

Cumulative Scoring: None, Very Low, Low, Low-Medium, Medium, Medium-High, High, Very High.

Impacts will be assessed according to the criteria listed below:

Criteria	Description	
Spatial Extent	Whether the impact will occur on a scale limited to the immediate site of the proposed activity, local area and immediate communities and settlements, sub-regional (municipal), regional (provincial), or national scale.	None/Insignificant (N) Site Specific (SS) Local (Loc) Sub-Regional (SR) Regional (R)
Duration	Whether the period of the impact will be short term (0-5 years), medium term (5-15 years), long term (> 15 years) or permanent where natural processes or mitigation processes cannot eliminate the impacts.	None (N) Short Term (ST) Medium Term (MT) Long Term (LT) Permanent (P)
Intensity	Whether the size of the impact is low, medium, high, or negligible.	None (N) Very Low (VL) Low (L) Low-Medium (LM) Medium (M) Medium-High (MH) High (H) Very High (VH)
Probability	The probability of the impact occurring as either unlikely, probable, likely or definite.	None (N) Unlikely (Un) Probable (Pr) Likely (Lik) Definite (Def)
Significance	The total level of impact.	Insignificant Very Low Low Low-Moderate Moderate Moderate-High High Very High

These criteria are evaluated in terms of

- *Significance (Insignificant-low-moderate-high)*
- *Status (positive-negative-neutral)*
- *Confidence (based on academic information, specialist knowledge, site evaluations, applicants approach)*
- **Cumulative Impact:** None, Very Low, Low, Low-Medium, Medium, Medium-High, High, Very High

Once the impacts are identified and predicted, the identification and consideration of mitigation measures by implementing the use of a 'mitigation hierarchy', which is a framework for managing the risks and potential negative impacts of development projects when considering the potential environmental, socio-economic, and heritage impacts, is implemented. Preventative measures are considered first and remediation measures are considered last. Offsets are a last resort consideration for possible remediation measures.

After concluding the possible mitigation measures, the significance of the impact on a local, regional or global level is evaluated. The evaluation of the significance of impacts distinguishes between the impact rating before mitigation (significance before) is implemented/considered and the significance rating after (significance after) the recommended mitigation measures are considered.

The significance of the impact on the parameters of the affected environment is rated as:

Low Significance	The project will not cause any major adverse or beneficial changes to the biophysical, social, or economic environment. Impacts experienced will abate almost immediately after cessation of activities and the biophysical, social or economic system should recover and return more or less to the natural state. No expensive mitigating measures will be needed to address any of these impacts. Ecological functions will continue undisturbed and no complaints from Interested and Affected Parties (I&APs) are anticipated. No rare and endangered species or sensitive areas exist in the area.
Moderate Significance	The project will induce moderate short to medium term changes to the biophysical, social, or economic environment. The impact would be induced outside the development area and also possibly on a sub-regional level. Over the medium term the impacts could fade away but the implementation of mitigation measures is normally required to eliminate these impacts. The impacts would be experienced for some time after cessation of activities but would not affect the biophysical, social, or economic environment severely. With mitigation, the biophysical, social, or economic system should recover but the return to the natural state would be very slow and in some instances may not be achieved. I&APs might express some concerns and complaints may be received on an <i>ad hoc</i> basis. Rare and endangered species or sensitive areas may exist in the area and could be marginally affected.
High Significance	The project will induce extensive long-term changes to the biophysical, social, or economic environment. The impact would be induced outside the development area and also possibly on a regional to national level. The possibility of secondary impacts arising from the project is high. Over the long term the impacts could fade away but the implementation of expensive mitigation measures is normally required to eliminate or mitigate these impacts. These impacts would be experienced after cessation of activities and could affect the biophysical, social, or economic environment severely. With mitigation, the biophysical, social, or economic system could recover but the return to the natural state would normally not be achieved. Ecological functions will be permanently disturbed and major

complaints from Interested and Affected Parties (I&APs) could be expected. Rare and endangered species or sensitive areas existing in the area might be critically affected.

Due to the nature of this project, there will not be a closure phase or decommissioning phase, as this is a permanent residential house. For this reason, no decommissioning impacts will be identified or discussed.

TABLE 7: EXAMPLE OF THE IMPACT RATING

	CONSTRUCTION	OPERATIONAL (no mitigation)	OPERATIONAL (with mitigation)	CLOSURE
Extent	Site Specific	Site Specific	Site Specific	Site Specific
Duration	Short Term	Medium Term	Short Term	Short Term
Intensity	Medium-High	High	Medium-High	Medium
Probability	Likely	Definite	Likely	Probable
Cumulative Impact	Very Low	Low	Very Low	None
Status	Negative	Negative	Negative	Negative
Confidence	High	High	High	High
Significance	Low	Moderate	Low	Very Low

In the table, the cumulative impact is presented as surrounding activities (not necessarily agriculture) which can add to the direct or indirect impacts experienced by receptors. Through the scoring system, the weight of the impact is determined and then the impact is categorized.

The definition of indigenous vegetation is defined in the NEMA Regulations as: “vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding 10 years.” Considering that the vegetation and soil of the area under application have not been disturbed, through ploughing or clearing for more than 10 years, the current state of the vegetation is therefore regarded as ‘indigenous vegetation’. This application will also require an application with the Department of Agriculture for cultivating virgin soil or more commonly known as a ploughing certificate.

STAGES OF CONSULTATION WITH DEPARTMENT OF AGRICULTURE, ENVIRONMENTAL AFFAIRS, RURAL DEVELOPMENT AND LAND REFORM

TABLE 8: STAGES OF CONSULTATION WITH THE DEPARTMENT OF AGRICULTURE, ENVIRONMENTAL AFFAIRS, RURAL DEVELOPMENT AND LAND REFORM

DATE	SUBMISSION/CONSULTATION
December 2025 – March 2026	Initiate specialist studies to identify environmentally sensitive areas.
June-July 2026	Submit Environmental Authorisation Application and compile Scoping Report and submit for public review to registered IAPs for 30 day period.
August 2026	Submit Scoping Report to DAEARDLR.
November – December 2026	Compile EIA and EMP and submit for public review to registered IAPs for 30 day period.
February - March 2027	Submit Final EIA and EMP to DAEARDLR.
As per regulations (107 days from, receipt of EIA)	Authority Decision-making period.
As per regulations (5 days from ROD)	Authority to notify the Applicant of the decision or the appeal of the decision from the Applicant, if necessary.
As per regulations (14 days from ROD notification)	Registered IAPs to be notified of the authority's decision and right to appeal.

PUBLIC PARTICIPATION PROCESS DURING THE EIA

As per NEMA Regulations, there is a specific public participation protocol that must be followed:

- A written notice either via email or register post will be given to:
 - the occupiers of the site, if the applicant is not the owner or person in control of the site;
 - the adjacent owners, occupiers or persons in control of such land;
 - the municipal councilor;
 - the applicable Municipality (Local & District);
 - any organ of state that has jurisdiction in respect of any aspect of the activity, including the Department of Agriculture, Environmental Affairs, Rural Development and Land Reform; and
 - any other party as required by the competent authority.
 - all those who registered during the Scoping Phase public participation period as a result of the newspaper advertisement or notice board.

By definition, according to NEMA Regulations, as amended in April 2017, a 'registered interested and affected party', in relation to an application, means an interested and affected party whose name is recorded in the register opened for that application in terms of Regulation 42.

In order for an IAP's name to be placed on a register (and thus become a registered IAP) and according to Regulation 42, it is any person who has submitted written comments or attended public meetings held by the applicant or EAP; or any person requesting, in writing, that their name be placed on the register as a result of the public participation process being conducted in specific timeframes by the EAP.

According to Section 43 (1), a registered IAP is entitled to comment, in writing, on all reports or plans submitted, provided that the IAP discloses any direct business, financial, personal, or other interest(s) which that party may have in the approval or refusal of the application.

Thus, once a person has registered as an IAP, he/she is obligated to disclose his/her matter of interest in the application and as part of the public participation process and will be requested to complete an undertaking under oath, disclosing their interest.

Furthermore, the EAP must submit an undertaking under oath or affirmation that there is a level of agreement between the EAP and the registered IAP on the Plan of Study for undertaking the environmental impact assessment. If no comment is received on the Plan of Study it would therefore be presumed that the IAP does not have any objection and that a level of agreement has been reached.

If Digital Soils Africa (the EAP) receives a comment on the Scoping Report and Plan of Study or receives requests to be placed on the register, then only those parties will be considered registered IAPs for the application process going forward. However, no comment or written request was received from registered IAPs during this 30 day consultation period, thus the public participation process is concluded for the Scoping Phase. Most correspondence will be via email (digital) and only where necessary will hard copies be forwarded, to allow the application to be as 'green friendly' as possible.

The results of the specialist studies will be integrated into the EIA and EMP and the EIA and EMP will be released to the registered IAPs for a 30 day period to review the document and comment. Registered IAPs will be notified via email, telephonically, or registered post, where the EIA and EMP will be available and the timeframes constraint on such a review period.

No public meetings are proposed to be held during this period since it is a rural area with a sparse population. If necessary, one-on-one meetings will take place with registered IAPs upon request and would most likely be virtual. Comments raised by registered IAPs and responses given to the EAP will be captured in a Public Participation Report and will be included in the Final EIA and EMP.

TASKS TO BE UNDERTAKEN FOR THE EIA

1. Soil assessment –

- A specialist will be appointed to conduct the assessment, which should include:
 - A desktop assessment of available literature to identify and describe the soil classification of the affected area;
 - Through soil field investigation.
 - Assess onsite soil properties and characteristics and identify potential constraints imposed on the proposed development of crops.
 - Assess the potential impact in relation to the soil features, as per the prescribed methodology; and
 - Recommend mitigation measures for the management of potential impacts.

2. Land capacity assessment –

- A desktop assessment of available literature and aerial special data will identify the land use/capacity area under application;
- Conduct field investigation and assess the site-specific land use;
- Determine the current economic viability of the land parcel vs the proposed agricultural development;
- Identify potential constraints imposed on the proposed development;
- Identify and assess project-related impacts as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

3. The vegetation assessment –

- A specialist will be appointed to conduct the assessment, which should include:
 - A desktop assessment of available literature to identify and describe the status of the vegetation and ecological/conservational value of the vegetation type;
 - Through the desktop assessment, determine whether the study area falls entirely or partially within a biodiversity area;
 - Conduct field investigation and identification of vegetation found on-site and their relevant ecological status (Least Threatened, Vulnerable, Endangered, Critically Endangered, and Protected);
 - Conduct a floral survey, assess red data list, and assess vegetation maps;
 - Identify and determine alien species present and their distribution within the study area and ecological state of the site, and
 - Recommend mitigation measures for the management of potential impacts.

4. The faunal assessment –

- A specialist will be appointed to conduct the assessment, which should include:

- A desktop assessment of available literature to identify and determine whether the study area falls entirely or partially within the distribution range of species listed as Vulnerable, Endangered, Critically Endangered or Protected;
- Conduct field investigation to identify potentially important or unique faunal habitats on-site;
- Discuss faunal presence with landowners/abutting landowners where necessary;
- Determine activities that could impact the fauna;
- Determine the effectiveness of general remedial measures to prevent activities to impact fauna;
- Determine faunal corridors in the study area and the significance of the corridors;
- Identify and assess project related impact as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

5. The sensitive site assessment –

- A desktop assessment of available literature and aerial special data will identify the ecological sensitivity of the area under application;
- Conduct field investigation and assess the ecological status of the land;
- Compare field investigation findings with desktop assessment and determine the current ecological viability of the area;
- Identify potential constraints imposed on the proposed development;
- Identify and assess project-related impacts as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

6. Surface & Ground Water assessment –

- A desktop assessment of available literature will identify the catchment area and impacts and constraints on the catchment area;
- Identify if an application to the Department of Water and Sanitation must be made;
- Assess possible sensitivity of surface resources;
- Determine sediments and hydro-carbon generating activities and the likelihood of spills reaching surface water and or groundwater;
- Identify and assess project related impact as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

7. Air quality assessment –

- A desktop assessment of available literature to identify and describe the general wind directions, strengths, frequencies, and land uses that can influence the air quality of the surrounding area;
- Determine the population density (number of people to be affected);
- Determine the potential dust generating capacity of various activities that will take place or be used on-site;

- Determine the distances to receptors and how distances from the study area will influence ambient dust levels at receptor areas.
- By doing a site visit, determine how possible topographical and vegetation screens will reduce dust dispersion to receptor areas.
- Identify and assess project related impact as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

8. Noise impact assessment –

- Determine the population density (number of people to be affected);
- Estimate the noise levels of various pieces of equipment/vehicles that will be used on-site;
- Determine the distances to receptors;
- Determine how distances from the study area will influence ambient noise levels at receptor areas;
- Determine how possible topographical and vegetation screens will reduce the propagation of noise waves and ultimately noise levels at receptor areas;
- Determine activities that could result in instant and severe spikes in noise levels;
- Identify and assess project-related impacts as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

9. Waste management assessment –

- Determine the number of people on-site and type/number of ablution facilities and waste receptacles required at the site;
- Determine the possibility of spills and the impact that standard mitigation measures will have;
- Determine the hydrocarbon disposal strategy required to result in limited to zero impact.
- Determine the number of vehicles to be used on-site;
- Determine the distance to water resources and soils with high agricultural potential;
- Identify and assess project related impact as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

10. Visual impact assessment –

- Through a site visit, the following will be determined:
 - Vegetation and topography screens between the study area and receptor areas;
 - The slope and elevation of the affected area in relation to the receptor areas;
 - The distance to receptor areas and sensitivity of receptor areas.
- Assess the influence of remedial action of phase development on the impact in the absence of any natural visual mitigation factors;
- Determine the possibility of dust liberated into higher air columns and its visibility from receptor areas;
- Assess the implementation of dust suppression measures on the impact of dust generation;
- Identify and assess project related impact as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

11. Traffic impact assessment –

- Determine locality of haul roads in relation to distance from receptor areas;
- Assess the possible impact on the wearing course and restrict it to a minimum;
- Determine the production capacity and the hauling density in order to determine the traffic count and the possible impact on traffic volume;
- Identify and assess project related impact as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

12. Socio-Economic impact assessment –

- Determine the value of grazing practices on natural veldt versus crop production;
- Through consultation with the applicant, determine:
 - Whether the development will permanently host employees on-site;
 - the possibility of the theft of stock/wildlife and trespassing;
 - the possibility of fires and the impact of farming in relation to the locality of receptors;
 - the number of jobs created in relation to the available labour pool and the unemployment rates;
 - the possibility of breaching the safety requirements of abutting residences;
- Identify and assess project related impact as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

13. Archaeological and Palaeontology assessment –

- A specialist will be appointed to conduct the assessment which should include:
 - A desktop assessment in order to determine the type and location of artefacts that may be present within the study area
 - Survey the area on foot and record the findings
 - Compile a report and recommendations which must indicate if further Phases 2 or 3 investigations must follow.
- Identify and assess project-related impacts as per the prescribed methodology; and
- Outline mitigation measures for the management of potential impacts.

POSSIBLE MITIGATION MEASURES

Possible mitigation measures to avoid, reverse, mitigate or manage identified impacts were listed under the heading 'Receiving Environment'. During the EIA and EMP phase, the extent of the residual risks that need to be managed and monitored will be identified.

REFERENCES

Agricultural Research Council (ARC). 2014. INTEGRATED PEST MANAGEMENT GUIDELINES FOR SMALL GRAIN CROPS IN SOUTH AFRICA. ARC Small Grain Institute, Bethlehem, South Africa.

Almond, J. & Pether, J. 2009; SAHRA Palaeotechnical Report. *Palaeontological Heritage of the Northern Cape*. <https://sahris.sahra.org.za/sites/default/files/website/articledocs/NC%20palaeotechnical%20report.pdf>. 29/07/2021, 10:50

Balfour, D., Holness, S., Jackelman, J., Skowno, A., 2016. National Protected Area Expansion Strategy for South Africa. Department of Environmental Affairs. https://www.environment.gov.za/sites/default/files/docs/national_protectedareas_expansionstrategy2016_ofsout_hafrica.pdf. 02/08/2021, 09:32.

Bell, J. 2016. MAIZE PRODUCTION AND PEST MANAGEMENT IN SOUTH AFRICA. Grain SA Production Guidelines.

Botha, L. 2018. Pecan nut farming: high cost, big returns. <https://www.farmersweekly.co.za/crops/fruit-and-nuts/pecan-nut-farming-high-cost-big-returns/>. 29/03/2022, 09:49.

DA (Department of Agriculture) South Africa, 2000. Cultivating Pecan nuts. <https://www.nda.agric.za/docs/pecan/pecan.htm>. 30/03/2022, 10:42.

Department of Agriculture (DA). 2000. PECAN NUTS. Directorate Communication, Department of Agriculture, Forestry and Fisheries, Pretoria, South Africa.

Dean, S. 2017. PECAN PRODUCTION GROWING RAPIDLY IN SA. OFM News, 8 March 2017.

Dugmore, H. 2011. Pecan nut profits. <https://www.farmersweekly.co.za/uncategorized/pecan-nut-profits/#:~:text=Take%20one%20mature%20pecan%20nut,start%20flowing%2C%20writes%20Heather%20Dugmore,> 29/03/2022, 09:44.

Experiencenortherncape, Floral Kingdoms. <https://www.experiencenortherncape.com/visitor/experiences/flora#:~:text=There%20are%20an%20estimated%2005,Fynbos%20Biome%20and%20Desert%20Biome.> 29/07/2021, 15:16.

Global Africa Network, 2020. Agri-Processing an ideal vehicle to drive economic growth in the Northern Cape. <https://www.globalafricanetwork.com/company-news/agri-processing-drives-economic-growth-in-northern-cape-province/>, 29/03/2022, 09:15.

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

Seminis. 2020. THE ROLE OF CROP ROTATION IN MANAGING SOILBORNE DISEASES. Seminis Vegetable Seeds Technical Information Bulletin.

South African Business, 2019/2020. AGRI-PROCESSING AN IDEAL VEHICLE TO DRIVE ECONOMIC GROWTH IN THE NORTHERN CAPE. Northern Cape Business 2019/20.

SouthAfrica.co.za. n.d. PECAN NUTS, SOUTH AFRICA. Available at: <https://southafrica.co.za/pecan-nuts.html?utm> [Accessed 22 May 2026].

South African Pecan Nut Producers Association (SAPPA). n.d. WHO IS SAPPA? Available at: <https://www.sappa.za.org/who-is-sappa/?utm> [Accessed 22 May 2026].

STATS SA, 2016. <http://www.statssa.gov.za/?p=9922>. 05/08/2021, 14:06.

STATS SA, 2020. Census of commercial agricultura CoCA2017. Fact sheets Version 2. <http://www.statssa.gov.za/publications/Report-11-02-01/CoCA%202017%20Fact%20Sheets.pdf>. 30/07/2021, 10:43.

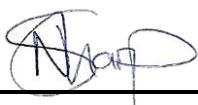
Young, J., 2017. A regional overview of the Northern Cape. <https://www.globalafricanetwork.com/company-news/a-regional-overview-of-the-northern-cape/>. 28/07/2021, 13:44.

UNDERTAKING OF EAP

The EAP herewith confirms

- a) the correctness of the information provided in the reports;
- b) the inclusion of comments and inputs from stakeholders and I&AP's; ☐ (*To be completed with the Final Scoping Report, once the public participation has been completed*).
- c) the inclusion of inputs and recommendations from the specialist reports where relevant; ☒ and
- d) that the information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties are correctly reflected herein. ☐ (*To be completed with the Final Scoping Report, once the public participation has been completed*).

Since this is a Draft Scoping Report and currently under public review for public participation, any comments received will therefore be considered and included in the Final Scoping Report.



Signature of the environmental assessment practitioner(s)

Digital Soils Africa (Pty) Ltd

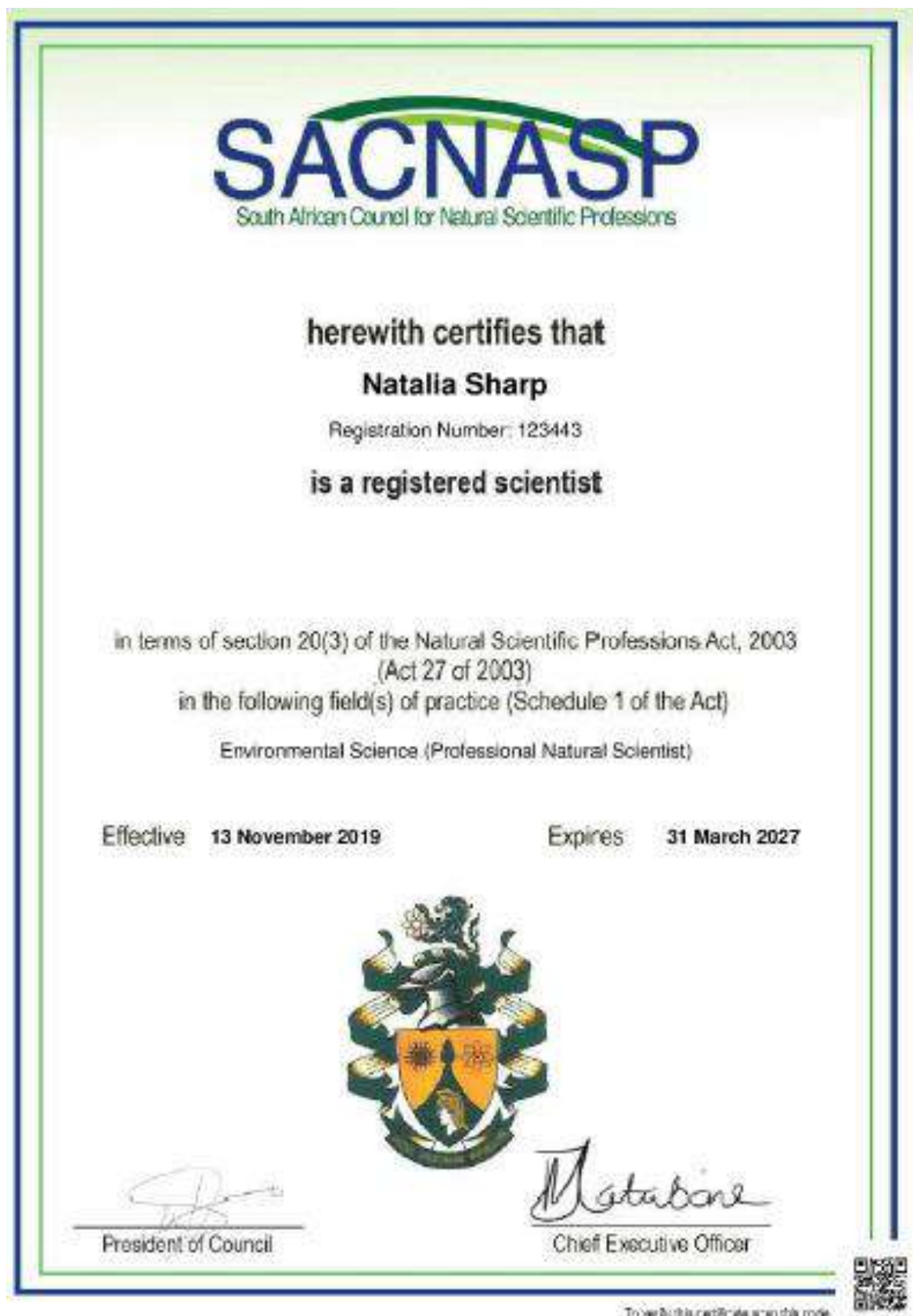
Name of the company

01/06/2026

Date

APPENDIX A – EAP QUALIFICATION







THE UNIVERSITY
OF THE ORANGE
FREE STATE

HIERMET WORD VERKLAARD DAT (DE GRAAD) THIS IS TO CERTIFY THAT THE DEGREE

Baccalaureus Scientiae
Bachelor of Science

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VASSILAKIS, IRENE. CHANCELLOR.

DEPARTMENT

BLUMFORD
2005-03-16
FROM: JRM

SICUTERAIL

I, James M. Smith, do hereby certify that the foregoing is a true and correct copy of the original as the same appears in the records of the County of San Diego, State of California.
 Witness my hand and seal of office this 12/1 day of December, 1929.
 County Clerk of said County.

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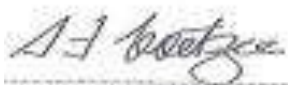
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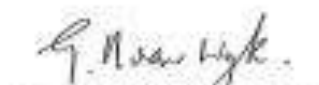
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VICE-CHANCELLOR


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Magister in Omgewingsbestuur Magister in Environmental Management

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VICE-CHANCELLOR


DEAN


REGISTRAR



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APPENDIX B – SITE PLAN



Latitude (S)	Longitude (E)
Tweefontein:	
A: 29°24'36.52"S	23° 0'58.10"E
B: 29°24'33.35"S	23° 1'20.30"E
C: 29°24'33.61"S	23° 1'30.04"E
D: 29°24'39.64"S	23° 1'30.01"E
E: 29°24'44.76"S	23° 1'25.85"E
F: 29°24'49.48"S	23° 1'2.23"E
Kalkfontein:	
G: 29°24'30.96"S	23° 1'36.38"E
H: 29°24'34.43"S	23° 2'22.84"E
I: 29°24'32.80"S	23° 2'26.44"E
J: 29°24'22.44"S	23° 2'30.24"E
K: 29°24'23.36"S	23° 2'34.55"E
L: 29°25'2.99"S	23° 2'25.84"E
M: 29°24'47.00"S	23° 1'29.85"E

APPENDIX C – PUBLIC PARTICIPATION

A Notice Board was erected not along the site boundary because there are no public roads and it would not be visible to any potential I&AP. Therefore the notice was placed at the turnoff to the farm, next to the public gravel road to notify potential I&AP's. Below is an aerial photo indicating the location of placing the board. The red polygon represents the study area under application, while the yellow drop pins represent the location of the board.



FIGURE 22: LOCATION OF THE NOTICE BOARD

Response for potential I&AP's was requested to be submitted within 30 days from notification and those who registered / commented will be recorded in the I&AP registry.

Since this is the draft Scoping Report, public participation is underway. With the submission of the Final Scoping Report, proof of notice board, news paper advertisement and emails/letters sent out will be included.

Example of consultation letter sent to I&AP's during the Scoping Phase

12 June 2026

Dear Interested and Affected Party

Ref: NC/EIA/02/PIX/SIY/PRI1/2026

ENVIRONMENTAL IMPACT APPLICATION IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998, FOR THE CLEARING OF VEGETATION ON THE REMAINDER OF FARM TWEEFONTEIN NO. 373 AND PORTION 4 (PTN OF PTN 2) OF FARM KALKFONTEIN NO. 374, PRIESKA. APPLICANT: TEMDALE BOERDERY (PTY) LTD. Scoping Public Participation Phase.

Temdale Boerdery (Pty) Ltd appointed Digital Soils Africa (Pty) Ltd (DSA) to conduct the necessary environmental impact assessment and public participation for the above-mentioned project.

In terms of Section 41 of NEMA Regulations, you have been identified as an Interested and Affected Party and are invited to participate in the public participation. All written comments will be responded to and forwarded to the relevant departments, in the form of a Public Participation Report.

The purpose of this letter and attached document is therefore to:

- Inform you of the locality of the proposed environmental authorization application.
- Allow you the opportunity to raise concerns or comments in respect of the proposed project detailed in the attached Background Information Document.

Public Participation Process

The purpose of the Background Information Document is to provide you with *basic information* regarding the proposed project and provide the opportunity to register as interested and affected parties and grant you the opportunity to raise any comments you might have on the proposed project.

If you would like to participate in the process, please register as an interested and affected party (I&AP), in writing. Comments/registration must be received **on or before 13 July 2026** no later than 5pm. If no comments are received from you, it will then be regarded that you do not have any comments.

Way Forward

- The outcome of this consultation process will be submitted to the Department of Agriculture, Environmental Affairs, Rural Development and Land Reform as part of the Final Scoping Report.
- Upon completion of the Scoping process, the EIA process will commence.
- The Draft EIA & EMP document and required specialist reports will be subjected to review by all registered I&AP's and relative governmental departments, following the time frames as stipulated in Section 3 (1) & (8) of the NEMA regulations (30 days).

-
- All information received will form part of the public record and may be made available to the public. By submitting comments, you consent to the inclusion of your personal information in public participation records, in accordance with POPIA. Correspondence throughout the remainder of the environmental process will be distributed to registered I&APs only.
 - The outcome of that consultation process will be submitted to the Department of Agriculture, Environmental Affairs, Rural Development and Land Reform as part of the final EIA& EMP.
 - The documents will be made available on the DSA website, www.dsafrica.co.za. Please follow the link to Services, Environmental Services, Documents and choose the Temdale link.
 - All required documents will be submitted to the relevant department for decision-making.
 - If the application is accepted, the relevant department will either issue or reject the Environmental Authorisation.
 - As an I&AP's, you will be notified of the final decision of the relevant departments.

Yours sincerely



Natalie Sharp

Pri.Sci.Nat (Reg nr. 123443)

Reg. EAP (EAPASA)(2020/230)

Member of IAIAAs (7237)

Background Information document sent to all I&AP's as identified during the Scoping Phase.



BACKGROUND INFORMATION
REGARDING CLEARING OF
VEGETATION ON THE
REMAINDER OF THE FARM
TWEEFONTEIN 373 AND PTN
4 (PTN OF PTN 2) OF THE
FARM KALKFONTEIN 374,
PRIESKA

TEMDALE BOERDERY (PTY) LTD

JUNE 2026



DSA
Digital Soils Africa



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Walmer

Port Elizabeth

Directors:

Dr Darren Bouwer

Prof Johan Van Tol

Prof George Van Zijl

PURPOSE OF THIS DOCUMENT

The purpose of this document is to provide all I&AP's with information about the intent of Temdale Boerdery (Pty) Ltd to apply for environmental authorisation to expand existing centre pivot irrigation areas by approximately 46 hectares on the Remainder of Farm Tweefontein No. 373 and Portion 4 (portion of Portion 2) of Farm Kalkfontein No. 374 for the establishment of a pecan nut orchard.

As an identified I&AP, you are invited to register and comment on any aspect related to the proposed development between the 12th of June 2026 and 13th of July 2026.

BRIEF PROJECT DESCRIPTION

The site is situated north-east of Prieska in the Northern Cape (29° 24' 42.00"S; 23° 01' 36.31"E) most centre point of the site) on the Remainder of the Farm Tweefontein 373 and Portion 4 (Ptn of Ptn 2) of the Farm Kalkfontein 374, Prieska, within the Siyathemba Municipal area. The site is located on the banks of the Orange River approximately 38km northeast of Prieska and 20 km southeast of Niekerkshoop.

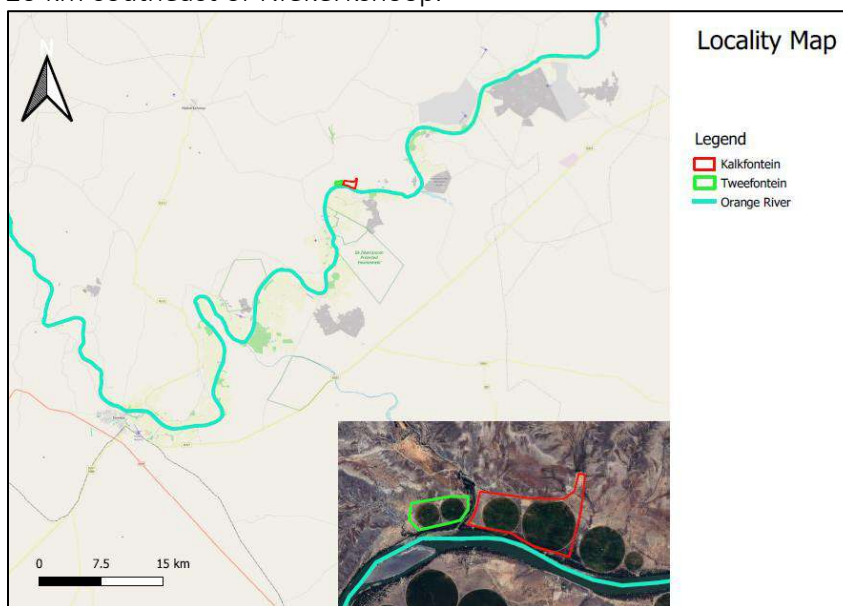


Figure 1: Site location

NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT NO. 107 OF 1998) AS AMENDED

Environmental Assessment

DSA was appointed by Temdale Boerdery (Pty) Ltd as the independent environmental assessment practitioner (EAP) to undertake the Environmental Application and apply for GNR 325 listed activities and the submission of a Scoping Report and Environmental Impact Assessment.

According to the latest Government Notice No. 324; 325 & 327, the following Listed Activities were triggered:

GNR 325 (15): The clearance of an area of 20 hectares or more of indigenous vegetation.	<i>An area of 46 Ha of fall out areas between pivots, but host natural veldt will be cleared to establish pecan nut trees.</i>
--	--

POTENTIAL ENVIRONMENTAL ISSUES

The full impact on all environmental parameters will be concluded in the EIA and EMP phases. For background information, the most important potential environmental issues that will be addressed in the assessment include, but are not limited to:

- The loss of approximately 46 hectares of indigenous vegetation associated with the expansion of existing irrigated agricultural areas;
- Potential impacts on terrestrial biodiversity, including vegetation communities, plant species of conservation concern, and fauna habitat;
- Potential impacts on riparian vegetation and ecological processes associated with the Orange River and nearby drainage features;
- The suitability and sustainable use of agricultural soils for the proposed pecan nut orchards;
- Potential impacts on heritage and palaeontological resources;
- Potential cumulative impacts associated with the expansion of irrigated agriculture in the area;
- Socio-economic benefits associated with increased agricultural production and employment opportunities; and
- The identification of appropriate mitigation measures to avoid, minimise or manage potential environmental impacts.

PUBLIC PARTICIPATION

In terms of the NEMA, public participation forms an integral part of the environmental assessment process. The public participation process provides people who may be affected by the proposed development with an opportunity to provide comments and raise issues of concern about the project or make suggestions that may result in enhanced benefits for the project.

For this application, there will be two phases of public participation.

1. Scoping Phase

2. EIA Phase.

This is the first phase, and during the **Scoping Phase**, *potential* interested and affected parties (I&APs) are given notice via a notice board and local newspaper advertisement informing the public of the application. The *registered* I&APs are considered directly abutting neighbours and organs of state that have jurisdiction over the area, e.g. the Municipality, Ward counsellor, etc. and would be provided with a Background Information Document and given access to a digital copy of the Scoping Report on Digital Soils website for comment.

Comments and issues raised during the Scoping Phase of the public participation process will be captured, evaluated, and included in a Public Participation Report. These issues will be

addressed and included in the final Scoping Report, which will be submitted to the Department of Agriculture, Environmental Affairs, Rural Development, and Land Reform.

During the **EIA Phase** (which is the second phase) of public participation, only those I&AP's that are registered would be given notice and access to a digital copy of the Environmental Impact Assessment Report on Digital Soils website for comment.

Comments and issues raised during the EIA Phase of the public participation process will be captured, evaluated, and included in a Public Participation Report. These issues will be addressed and included in the final EIA Report, which will be submitted to the Department of Agriculture, Environmental Affairs, Rural Development, and Land Reform.

To register and/or submit a comment as an Interested and Affected Party, please respond in writing to the following email: natalie@dsafrica.co.za on or before **13 July 2026** no later than 5pm.

Alternatively, a copy of the Draft Scoping Report is also available on the DSA website at www.dsafrica.co.za. Please follow the link to Services, Environmental Services, Documents and choose the Temdale link.

If you have any other questions or inquiries, please do not hesitate to contact the office at 067 622 5687. If no comments are received from you, it will then be regarded that you do not have any comments.

APPENDIX D – SCREENING TOOL REPORT

**SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS
REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE
ENVIRONMENTAL SENSITIVITY**

EIA Reference number: 000

Project name: Expanding of irrigation crops

Project title: Tweefontein No. 373 & Kalkfontein No 374

Date screening report generated: 12/02/2026 12:55:14

Applicant: Temdale Boerdery (Pty) Ltd

Compiler: Digital Soils Africa (Pty) Ltd

Compiler signature:



Application Category: Transformation of land | Indigenous vegetation



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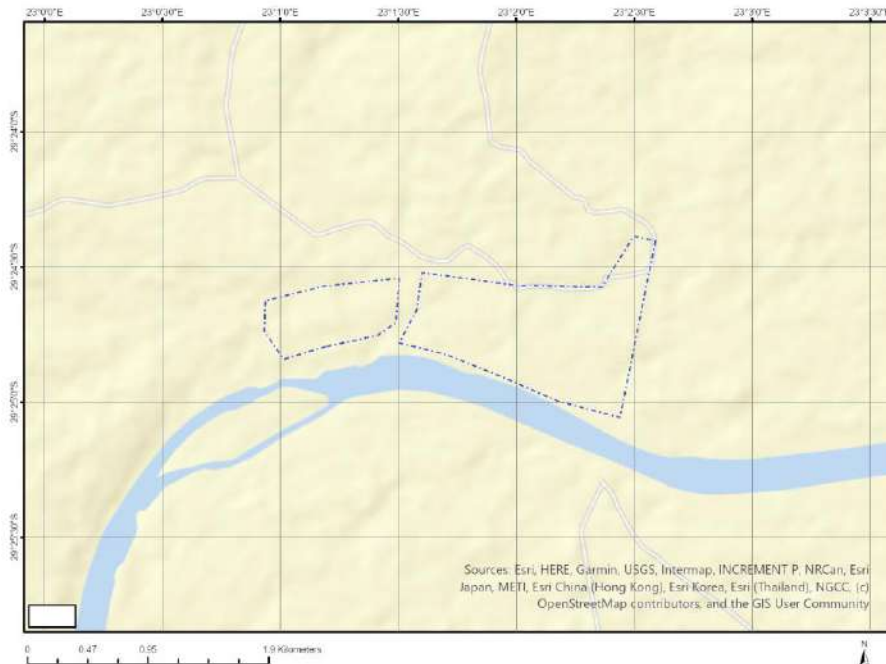
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Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area	4
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Proposed Project Location

Orientation map 1: General location



Map of proposed site and relevant area(s)



Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	TWEEFONTEIN	373	0	29°25'17.23S	22°58'28.98E	Farm
2	KALKFONTEIN	374	0	29°23'15.68S	22°58'1.24E	Farm
3	TWEEFONTEIN	373	0	29°24'47.14S	23°0'5.98E	Farm Portion
4	TWEEFONTEIN	373	0	29°25'18.15S	22°58'28.04E	Farm Portion
5	KALKFONTEIN	374	4	29°24'28.3S	23°2'16.55E	Farm Portion

Development footprint¹ vertices:

No development footprint(s) specified.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	14/12/16/3/3/2/313	Solar PV	Approved	17.1
2	12/12/20/2645/AM2	Solar PV	Approved	28.2
3	14/12/16/3/3/2/627	Solar PV	Approved	21.2

¹ "development footprint", means the area within the site on which the development will take place and includes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

4	12/12/20/2645/2	Solar PV	Approved	28.2
5	12/12/20/2645/AM3	Solar PV	Approved	28.2
6	12/12/20/2645	Solar PV	Approved	28.2
7	14/12/16/3/3/1/484	Solar PV	Approved	28.2
8	12/12/20/1942	Solar PV	Approved	25.5

Environmental Management Frameworks relevant to the application

No intersections with EMF areas found.

Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development site as well as the most environmental sensitive features on the site based on the site sensitivity screening results for the application classification that was selected. The application classification selected for this report is:

Transformation of land | Indigenous vegetation.

Relevant development incentives, restrictions, exclusions or prohibitions

The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this site are indicated below.

No intersection with any development zones found.

Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme	X			
Animal Species Theme		X		
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme				X
Defence Theme				X
Paleontology Theme			X	
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

Based on the selected classification, and the known impacts associated with the proposed development, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the

assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

No	Specialist assessment	Assessment Protocol
1	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
2	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/GuidanceforHIA.pdf
3	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/GuidanceforPIA.pdf
4	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
5	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
6	Socio-Economic Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
7	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
8	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY

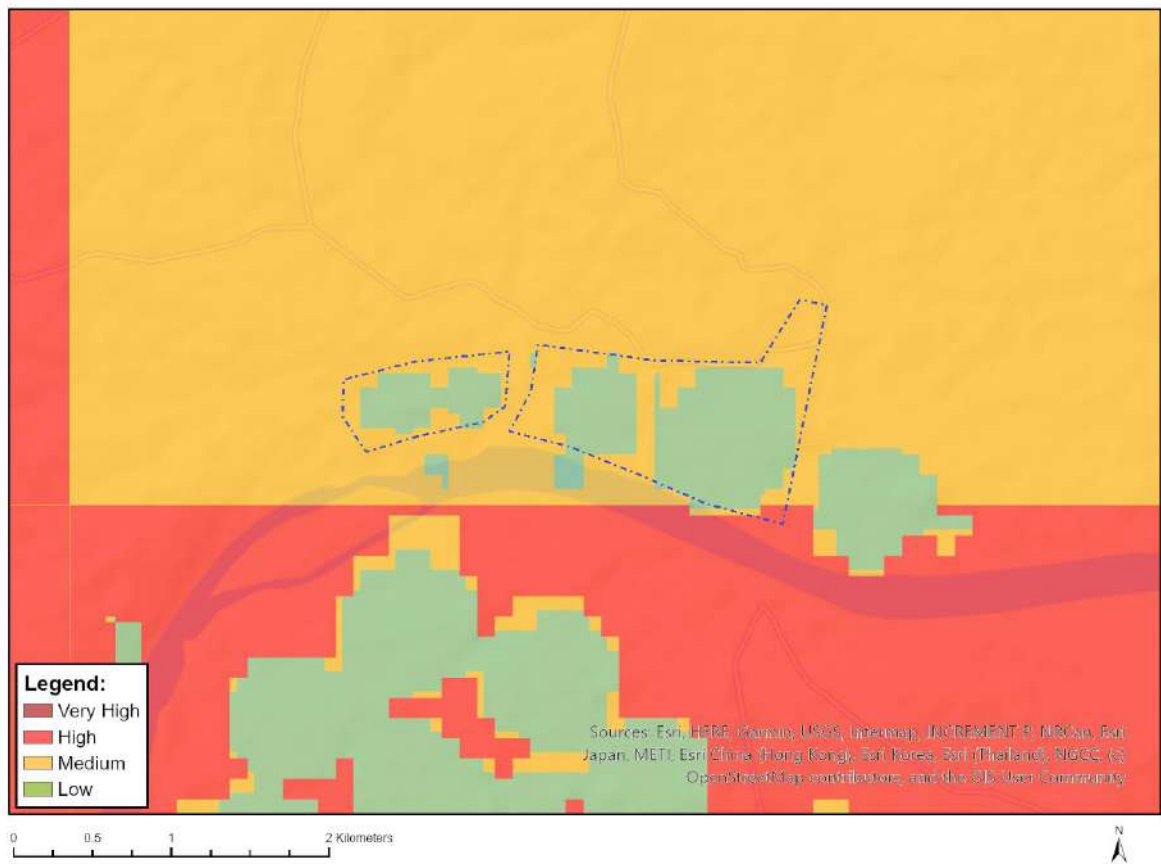


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
High	Rainfed Annual Crop Cultivation / Planted Pastures
Low	03. Low-Very low
Low	04. Low-Very low
Low	05. Low
Medium	06. Low-Moderate
Medium	07. Low-Moderate
Very High	Pivot_Irrigation
Very High	Prieska PAA

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



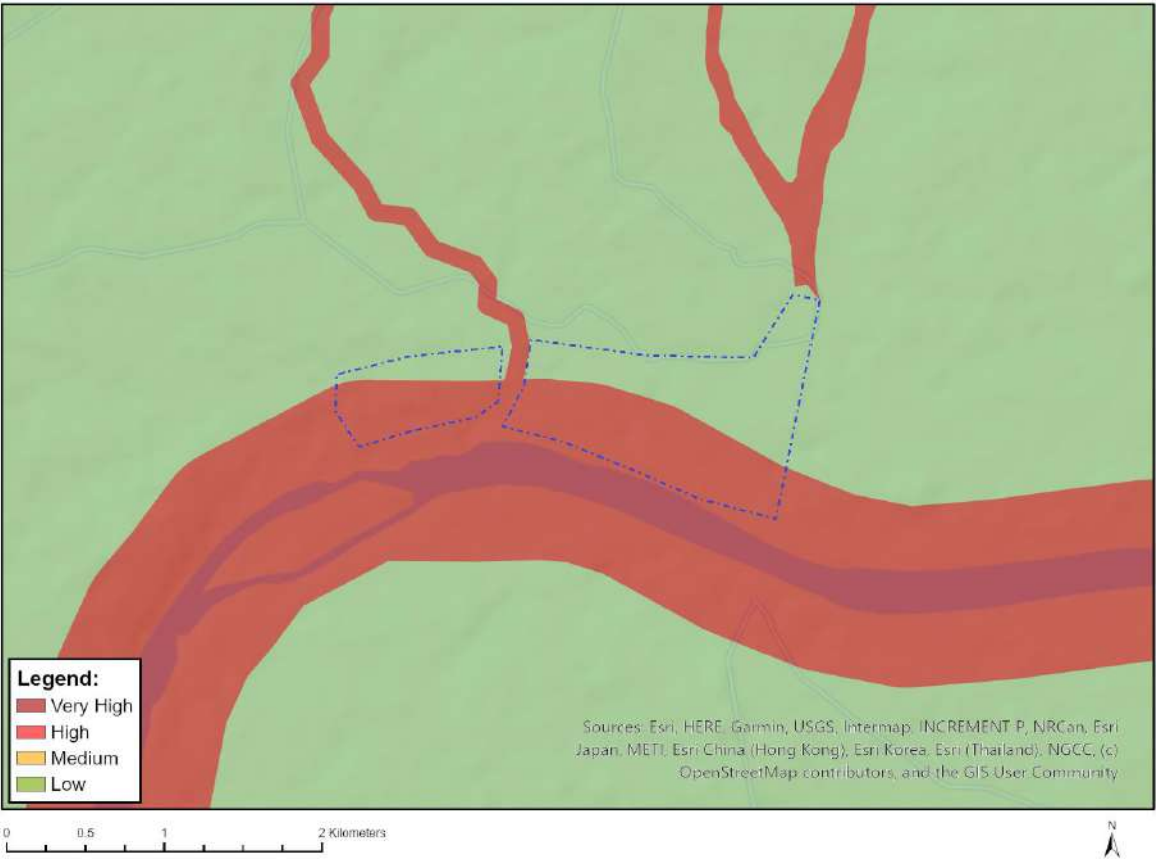
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Neotis ludwigii
Low	Subject to confirmation
Medium	Aves-Hydroprogne caspia
Medium	Aves-Aquila rapax
Medium	Aves-Neotis ludwigii

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

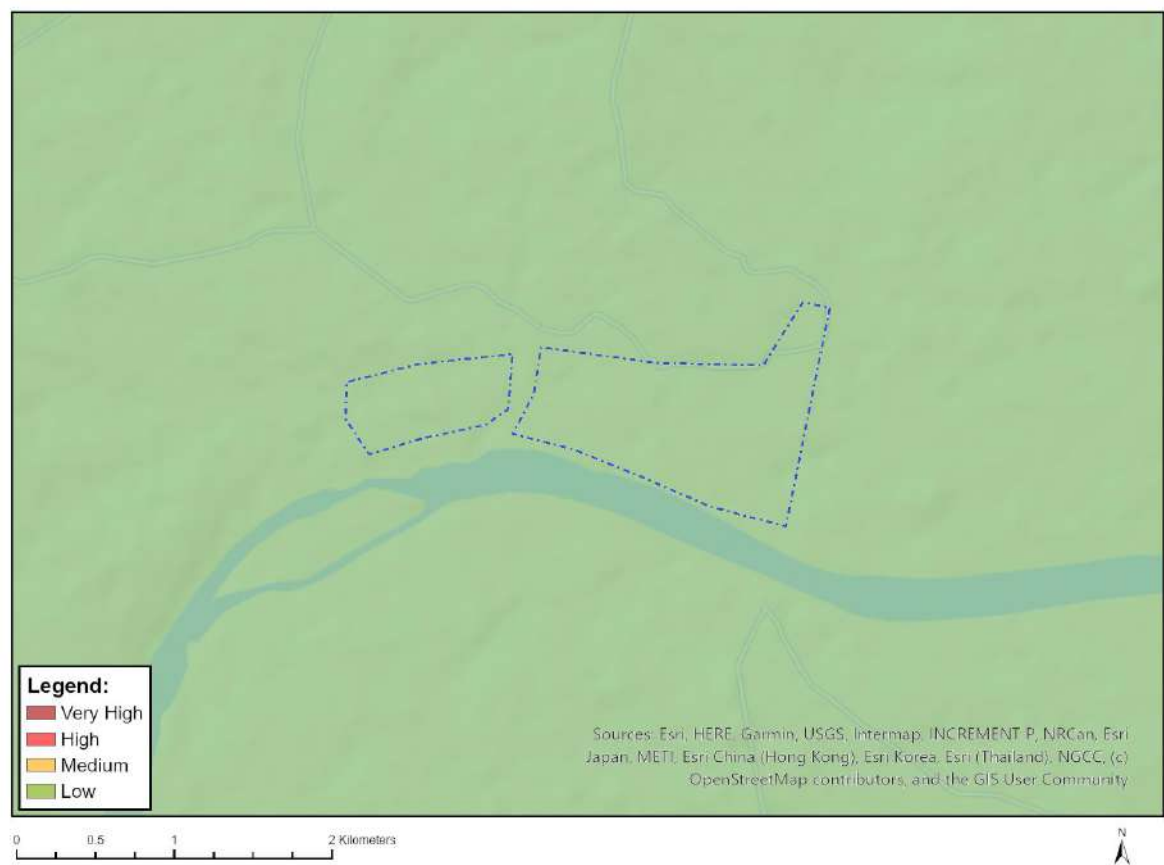


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	Wetlands_River
Very High	Rivers

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

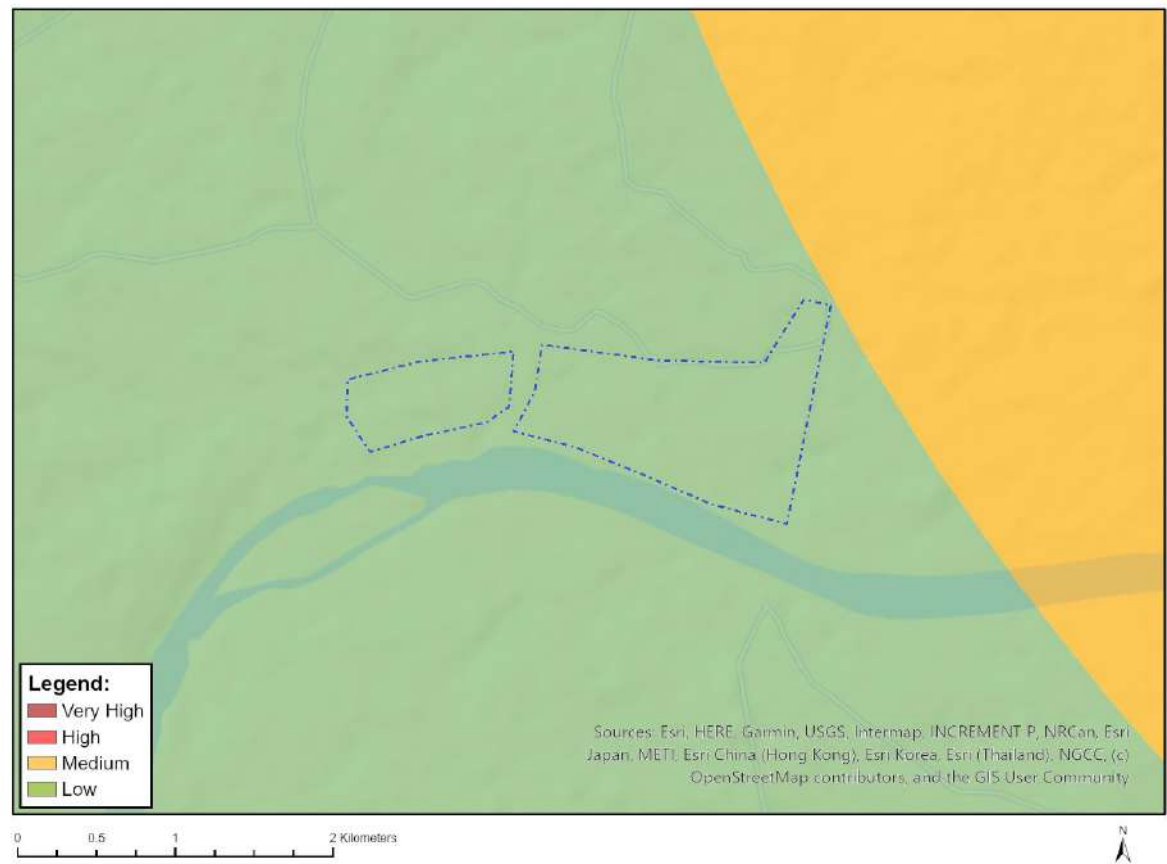


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

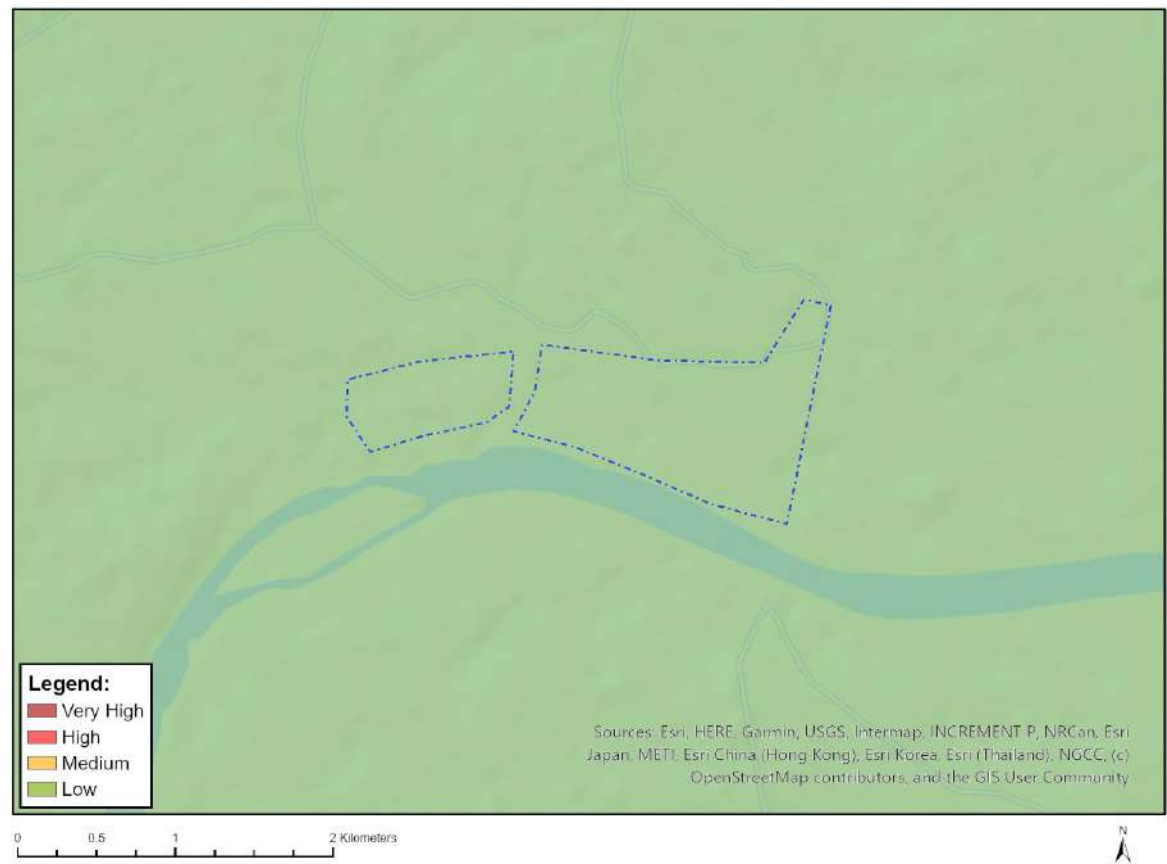


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

MAP OF RELATIVE DEFENCE THEME SENSITIVITY

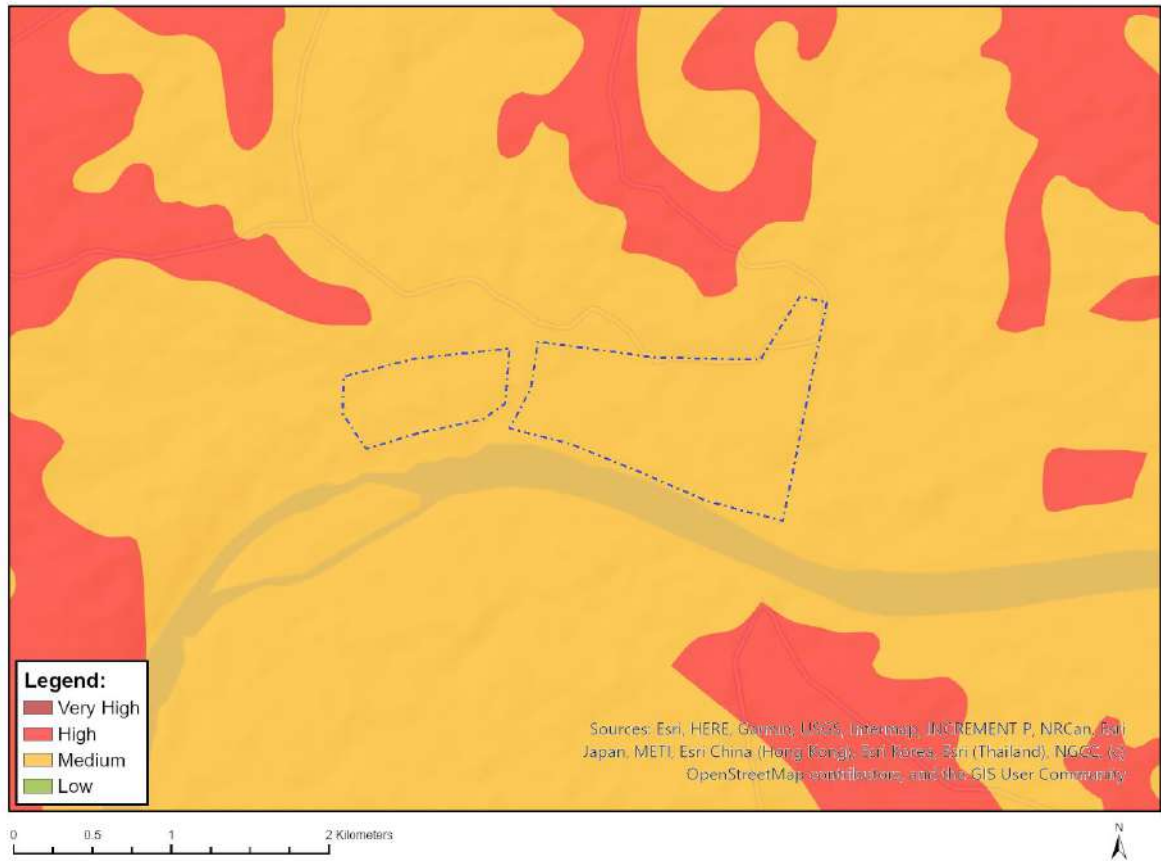


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY

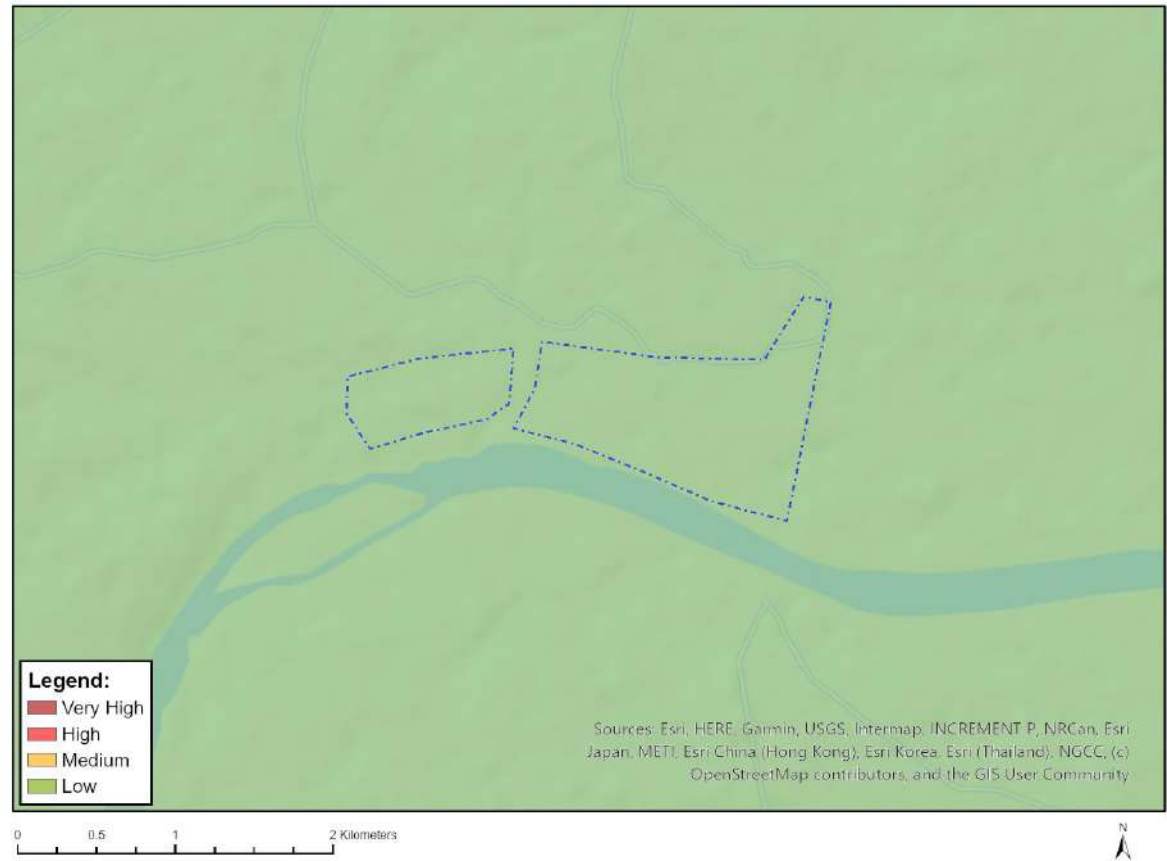


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	CBA 1
Very High	ESA

APPENDIX E – SITE VERIFICATION REPORT



APPENDIX E

SITE VERIFICATION REPORT

For the

Application for Environmental Authorisation for the
clearing of vegetation on the Remainder of the farm
Tweefontein 373 and Ptn 4 (Ptn of Ptn 2 of the farm
Kalkfontein 374, Prieska

Prepared for

TEMDALE BOERDERY (PTY) LTD

JUNE 2026



DSA
Digital Soils Africa



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Port Elizabeth

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Prof Johan Van Tol

Prof George Van Zijl

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BACKGROUND

Digital Soils Africa (Pty) LTD (DSA) was tasked by Temdale Boerdery (Pty) Ltd to conduct environmental investigations and complete the Environmental Authorisation Application for the authorisation of clearing of vegetation between existing pivot areas for peacan nut orchard establishment.

The proposed project entails the expansion of existing centre pivot irrigation areas by approximately 46 hectares on the Remainder of Farm Tweefontein No. 373 and Portion 4 (Portion of Portion 2) of Farm Kalkfontein No. 374 for the establishment of a pecan nut orchard. The properties are currently utilised for irrigated agriculture, with four existing centre pivots already established on the site prior to 1998, comprising a 50 ha and 25 ha pivot on the Kalkfontein property and two 10 ha pivots on the Tweefontein property. The areas proposed for expansion are located predominantly within the undeveloped portions situated between and around the existing pivots, which currently still support indigenous vegetation and remnant outfall areas associated with the existing agricultural layout.

In terms of the National Environmental Management Act 107 of 1998 (“NEMA”), environmental authorisation must be obtained before any person can conduct activities that cause damage to the environment.

DSA was appointed by Temdale Boerdery (Pty) Ltd as the independent environmental assessment practitioner (EAP) to undertake the Environmental Authorisation Application for the commencement of a listed activity in terms of the Environmental Impact Assessment Regulations 2014, as amended in 2017.

PURPOSE

This Site Sensitivity Verification Report has been prepared in support of the Environmental Impact Assessment process and serves to verify the environmental sensitivities identified by the National Web-based Environmental Screening Tool. The report is based on site inspections, the Draft Scoping Report, the Soil Suitability Assessment, the Palaeontological and Heritage Impact Assessment, and the Vegetation Assessment. A terrestrial fauna assessment has reportedly been completed but was not available at the time of compilation.

LOCATION

The site is situated north-east of Prieska in the Northern Cape ($29^{\circ} 24' 42.00''\text{S}$; $23^{\circ} 01' 36.31''\text{E}$) most centre point of the site) on the Remainder of the Farm Tweefontein 373 and Portion 4 (Ptn of Ptn 2) of the Farm Kalkfontein 374, Prieska, within the Siyathemba Municipal area. The site is located on the banks of the Orange River approximately 38km northeast of Prieska and 20 km southeast of Niekerkshoop.

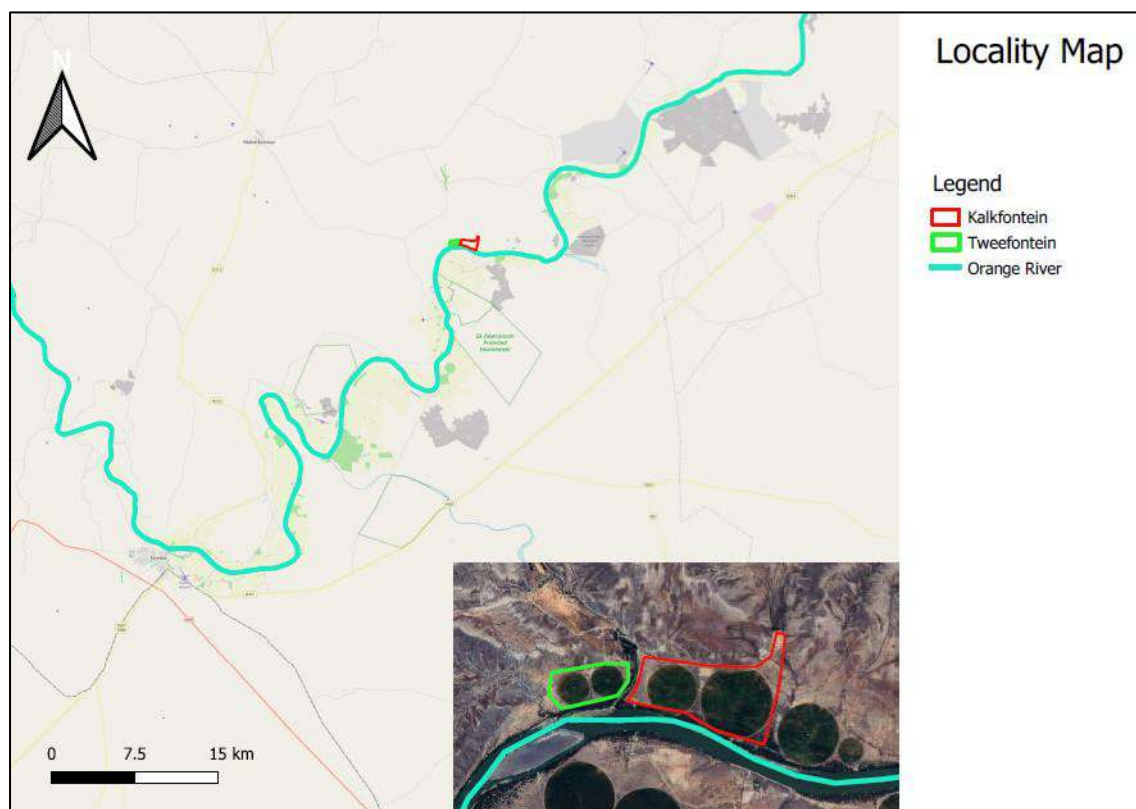


FIGURE 1: SITE LOCATION. THE ORANGE RIVER IS THE BLUE LINE AND THE PROPOSED SITE IS REPRESENTED BY THE RED AND GREEN POLYGONS.

SITE INSPECTION

The site was visited on 4 November 2025, it was clear that there are portions that have been severely impacted due to historic cultivation and other areas that host more intact vegetation.

Only the fall-out areas between existing pivots is considered to extend the existing crop footprint.

PHOTO RECORD

Kalkfontein:





TwEEfontein:





VERIFICATION OF ENVIRONMENTAL THEMES

The Screening Tool Report identified certain environmental sensitivity themes and depending on the level of scoring (High, Medium, or Low) will determine what protocol criteria for specialist assessments and minimum report content should be provided.

The Screening Tool Report has been generated for the proposed development. According to the screening tool report, the following themes were considered:

TABLE 1: ENVIRONMENTAL SENSITIVITY ACCORDING TO THE SCREENING TOOL REPORT

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme	X			
Animal Species Theme		X		
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme				X
Defence Theme				X
Paleontology Theme			X	
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

In terms of specialist assessments, the Screening Tool Report identified the following:

1. Landscape/Visual Impact Assessment;
2. Archaeological and Heritage Impact Assessment;
3. Palaeontological Impact Assessment;
4. Terrestrial Biodiversity Impact Assessment;
5. Aquatic Biodiversity Impact Assessment;

6. Socio-Economic Assessment;
7. Plant Species Assessment; and
8. Animal Species Assessment.

AGRICULTURAL THEME

The Agricultural Theme was given a very high sensitivity score for the site. Considering the activity, and clearing of vegetation to establish crops, the soil must be evaluated to conclude whether it is suitable for 1) irrigation and 2) the proposed crops to be planted. If the soil survey indicates that one of these is not feasible, the clearing of vegetation would be futile and the impact a highly negative result. In the Northern Cape, ploughing and irrigating soil can lead to serious degradation of soils.

The soil survey must aim to determine which areas would be suitable for irrigation. When land is irrigated it is necessary to understand the risks of waterlogging, chemical changes, and salinization for it to be sustainable. It is for this reason that the properties of soil must be evaluated. The study area was thus investigated by a SACNASP registered soil scientist, to investigate the sustainability of the soil properties as well as areas where irrigation would be manageable whilst being sustainable.

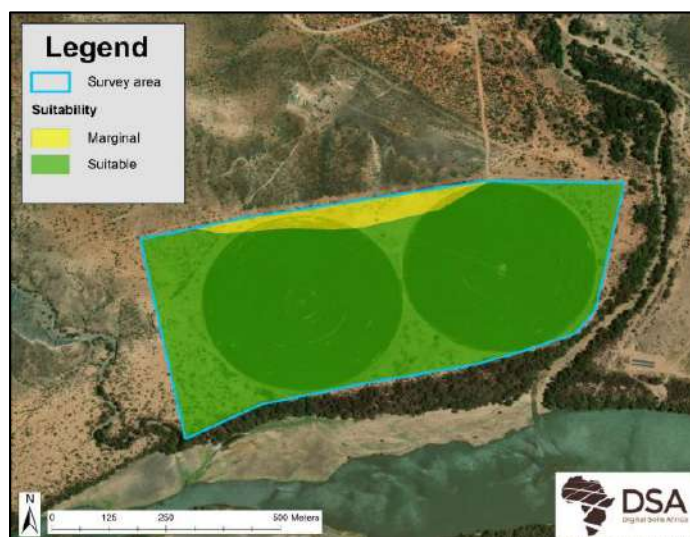


FIGURE 2: SOIL SUITABILITY CLASSES FOR IRRIGATION

Agricultural Theme: VERIFIED. The soil assessment found that the majority of the proposed expansion area is underlain by deep, freely drained Oakleaf soils with favourable chemical and

physical characteristics suitable for irrigation and pecan production. Agricultural sensitivity is therefore confirmed as high from an agricultural resource perspective.

It is the EAP's professional opinion that the specialist's survey and assessment will be sufficient. It is recommended that the impact on soil be discussed in the EIA.

AQUATIC BIODIVERSITY THEME

The Aquatic Theme was given a very high sensitivity score for the site. The proposed site falls within the Orange River Catchment area. More specifically the proposed site falls within Lower Orange Water Management Area, in the D71D.

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

There is a drainage line or perennial stream that runs between the Tweefontein and Kalkfontein sites and the Orange river are situated between 50-100m from the proposed orchard areas. The buffer zones will be kept and clearing of vegetation will not take place within the buffer zones.

The site is located within a Fish Support Area of the *Barbus anoplus*. The black fish symbol on the map (see Figure 3) indicates the presence of vulnerable or near-threatened fish populations. If it was a red fish symbol, it would have indicated that there is at least one 13 population of a critically endangered or endangered fish species within that sub-quaternary catchment. Some fish sanctuaries are FEPAs, with their associated sub-quaternary catchments shown in dark green; others are Fish Support Areas, with their associated sub-quaternary catchments shown in medium green, such as the proposed site.

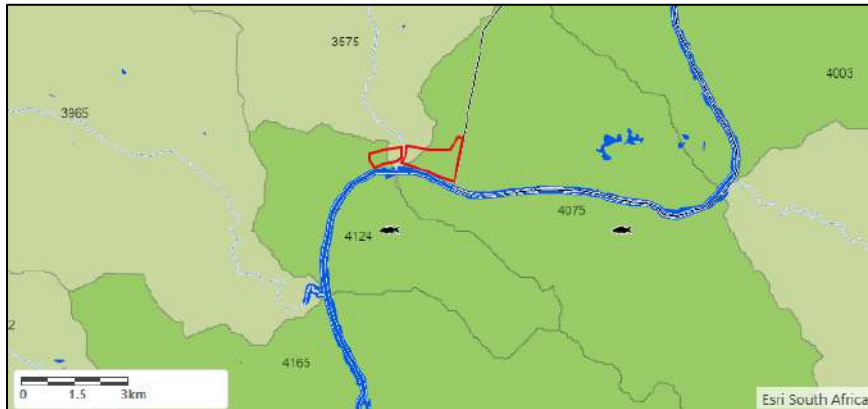


FIGURE 3: THE SITE FALLS WITHIN A FISH SUPPORT AREA

A goal of NFEPA is to keep further freshwater species from becoming threatened and to prevent those fish species that are already threatened from going extinct. To achieve this, there should be no further deterioration in river condition in fish sanctuaries and no new permits should be issued for stocking invasive alien fish in farm dams in the associated sub-quaternary catchment. Since there is a drainage line within 50m from the two sites and the Orange river are situated between 50-100m from some of the proposed orchard area, there is a small possibility of an impact on the *Barbus anoplus* fish sanctuary.

Aquatic Biodiversity Theme: PARTIALLY VERIFIED. The Orange River and associated riparian habitats remain highly sensitive ecological features. However, the proposed vegetation clearance footprint is located outside the riparian corridor and approximately 32 m from the drainage features and river edge. No aquatic biodiversity assessment was undertaken. Based on the vegetation assessment, the high sensitivity is primarily associated with the riparian vegetation and river corridor rather than the proposed cultivation footprint. The riparian vegetation along the Orange River will be left intact and a minimum of 32m distance between clearing of vegetation and the drainage line and Orange river will be maintained. With mitigation the potential impact on the *Barbus anoplus* fish sanctuary can be reduced.

In conclusion, due consideration has been given to the potential impact of the proposed development on the aquatic environment. It is the opinion of the EAP that all factors regarding the aquatic theme were taken into account in this sensitivity verification report. Therefore, it is not required for an Aquatic Biodiversity Compliance Statement to be compiled, although the impact on surface water must still be discussed in the EIA.

ANIMAL SPECIES THEME

The Animal Species Theme was given a high sensitivity score for the site. Animals play an important role in maintaining the functioning of any ecosystem, for example, pollination, spreading of seeds, removing of pests, trimming of vegetation, etc. The largest part of the Northern Cape falls within the Nama-Karoo biome with a vegetation of low shrubland, grass and trees limited to watercourses. The region is typically an arid environment and the terrain and general landscape do not represent much topographical variation. Therefore faunal species are generally widespread across the region, although some key biotopes such as rivers or pans, or the presence of a particular plant species can become an obvious niche for particular animal species that can result in a concentration of species at a certain location.

Micro habitats are shaped by factors other than vegetation, such as topography, land use, food sources and man-made factors and to determine which bird species are more likely to occur on the proposed site, it is important to understand the habitats available to birds. This arid region hosts at least 215 bird species of which 68 species are endemic or near-endemic species, 18 red-listed species, and 5 red-listed endemic species. Several large terrestrial bird and raptor species, of which the most important are Ludwig's Bustard (*Neotis ludwigii*), which was listed on the Screening Tool as a possibility of being present on the site, Kori bustard (*Ardeotis kori*), Secretarybird (*Sagittarius seppentarius*), Karoo Korhaan (*Eupodotis vigorsii*), Verreaux's Eagle (*Aquila verreauxii*) which was also listed on the Screening Tool as a possibility of being present on the site, the Tawny eagle (*Aquila rapax*) and Martial Eagle (*Polemaetus bellicosus*), Lanner falcon (*Falco biarmicus*).

The Northern Cape is home to an assemblage of arid zone adapted smaller bird species including larks, such as Spike-heeled Lark (*Chersomanes albofasciata*), sparrow-larks, and others. From a conservation perspective, the Red Lark (*Calendulauda burra*) and Sclater's Lark (*Spizocorys sclateri*), who are both listed as regionally threatened species (vulnerable and near-threatened respectively). They have very restricted ranges. Other species can include the Spotted Eagle-owl (*Bubo africanus*), Martial Eagle (*Polemaetus bellicosus*).

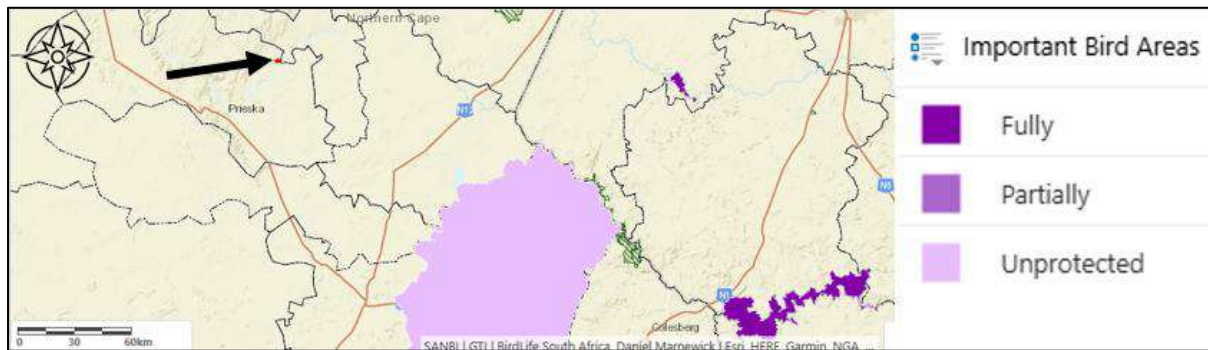


FIGURE 4: IMPORTANT BIRD AREAS ACCORDING TO BGIS

The site does not fall within an important bird area according to BGIS. The farm is impacted by agricultural activities but also hosts intact habitat, and it is not to say that important bird species are not present at the site.

It must be noted that with the high mobility of avifauna, the slow clearing of vegetation, would not endanger any individual specie. The natural vegetation in the surrounding areas will provide adequate nutrition and shelter for displaced species once construction commences.

This is not a project where wind turbines or structures would be erected that could affect the flight paths of migrating birds, or cause displacement. It is the EAP's professional opinion that the proposed development will have a very limited impact on the avifauna and that most factors have been taken into account in this site sensitivity verification report.

In terms of the other faunal species. On the day of site inspection, the following animal species were noted at the site, kudu (*Tragelaphus strepsiceros*), blesbok (*Damaliscus pygargus phillipsi*), gemsbok (*Oryx gazella*) springbok (*Antidorcas marsupialis*), ground squirrel (*Xerus inauris*), guinea fowls, falcons, finches, the northern black korhaan (*Afrotis afraoides*) and vervet monkeys (*Chlorocebus pygerythrus*) was within the abutting crop fields, mongoose (*Herpestidae*), and various common birds. A few burrows were noted and diggings out of old termite hills, which could indicate the presence of aardvark (*Orycteropus afer*).

The clearing of vegetation would be restricted to limited areas and the fairly slow clearance rate would provide adequate time for migration of any animals remaining on-site to be sustained in similar adjoining habitats. Also, noise generated by vehicles will cause most animals to vacate the site temporarily. If certain species were to be affected they would simply vacate the proposed cleared areas during the day and return during the night. Since adequate buffer zones will be maintained from drainage lines, the clearing of vegetation will not impact amphibian species.

The Animal Species Theme was given a very high sensitivity score for the site.

Animal Species Theme: VERIFIED. The screening tool identified elevated faunal sensitivity. A specialist fauna assessment was commissioned and should be used to verify species-specific sensitivities and mitigation requirements.

TERRESTRIAL BIODIVERSITY AND PLANT THEME

The Terrestrial Biodiversity Theme was given a very high sensitivity score for the site. Terrestrial Biodiversity can be defined as the variety of life on land that includes the fauna, flora, and habitat connectivity of an area. High biodiversity is often used as an indication of ecosystem health.

Desktop studies must be completed and the site must be plotted against various biodiversity plans, Province or Local related biodiversity plans, and maps. Thereafter, the onsite assessment must be completed to either confirm or refute the findings of the desktop studies.

In terms of this project, the locality of the proposed area was cross-referenced with the following conservation plans: The National Protected Area Expansion Strategy (NPAES); the Northern Cape Protected Area Expansion Strategy (NCPAES); the Northern Cape Biodiversity Conservation Plan, and the Spatial Development Framework of the Siyathemba Municipality.

The National Protected Area Expansion Strategy (NPAES) was developed to expand protected areas in South Africa to increase ecological sustainability and adaptation to climate change. The proposed study area does not fall within any National Protected area, nor is close to any formal or informal protected area. The Gariep Focus area is about 24km south and about 30km southwest of the proposed site.

With regards to the Northern Cape Protected Area Expansion Strategy (NCPAES), the site does not fall within any priory or protected area.

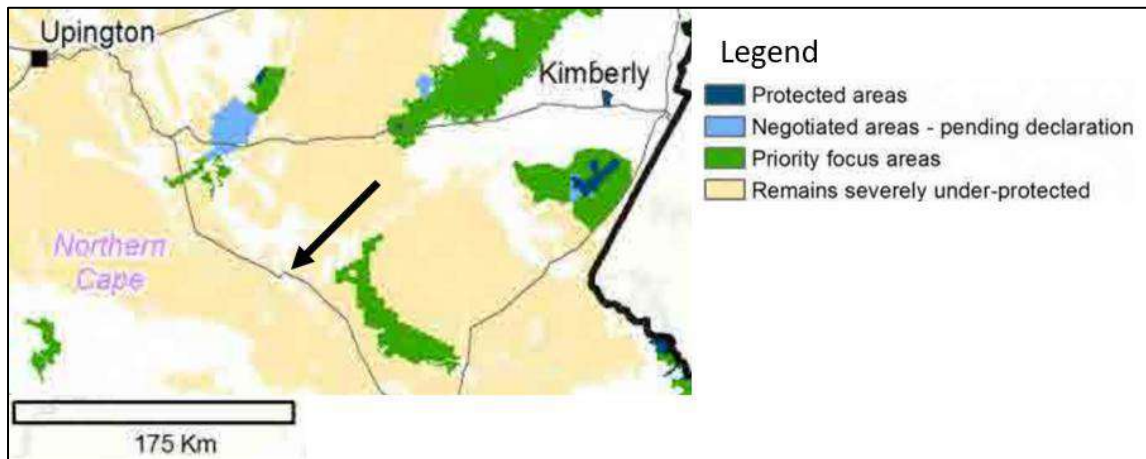


FIGURE 5: PRIORITY AREAS FOR THE PROTECTED AREA EXPANSION IN THE NORTHERN CAPE (BELFOUR ET AL, 2016).

According to the Northern Cape Biodiversity Conservation Plan, the site does not fall within a Terrestrial CBA.



FIGURE 6: THE SITE FALLS WITHIN CBA 1 ACCORDING TO THE BGIS OF THE NORTHERN CAPE BIODIVERSITY CONSERVATION PLAN.

The Siyathemba Municipality has mapped the environmental sensitivity of the municipal area in the SDF. The sensitivity is rated from 0-6 (0 being no sensitivity, 1 being low sensitivity, 6 being high sensitivity). Unfortunately, the ecological sensitivity map of the SDF is a bit unclear, but it does seem to appear that the site falls within an environmental area that is rated 2 and thus low sensitivity.

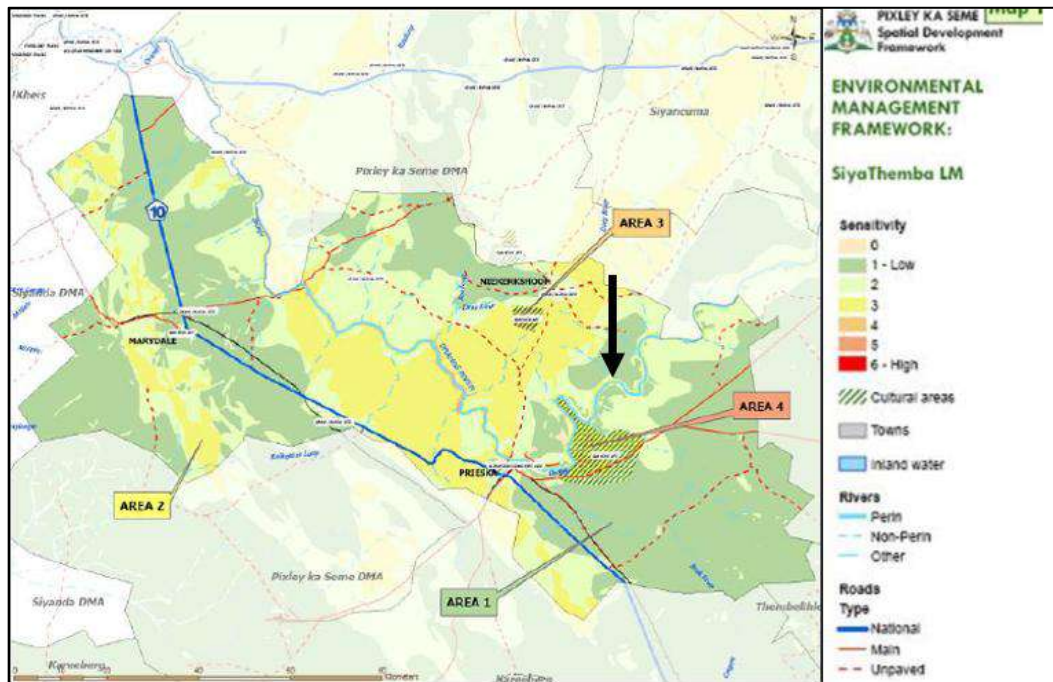


FIGURE 7: SDF OF THE SIYATHEMBA MUNICIPALITY, THE BLACK ARROW INDICATE THE POSITION OF THE SITE.

In terms of the site environmental sensitivity (Screening Tool Report) with regards to terrestrial, the report allocated a very high sensitivity to the theme.

However, one must consider site-specific parameters and the surrounding land use and conservation value to determine the biodiversity importance of a site, and not just rely on desktop studies. To assess the sensitivity of the environment onsite verification is therefore essential. The preliminary onsite investigation indicated that the site does not host sensitive fauna or flora, and could be preliminarily aligned with the Siyathemba Municipality environmental sensitivity map.

From a terrestrial biodiversity aspect, the location of the site has rendered it to be an extension of existing development areas, as most of the area east of the proposed development is transformed due to agricultural activities.

Terrestrial Biodiversity Theme: VERIFIED. Critical Biodiversity Area and Ecological Support Area mapping does not intersect the site. However, the vegetation assessment demonstrated that some proposed expansion areas comprise previously disturbed vegetation with reduced ecological integrity, while riparian vegetation remains highly sensitive and should be retained where feasible.

The Plant Species Theme was given a low sensitivity score for the site. In terms of the flora or habitat representation of the site, a Botanical evaluation of the proposed development site will be conducted by a SACNASP registered scientist, to assess if any natural vegetation is present on the proposed development site. The report would suffice to consider the impact on the ecology from a flora point of view, but will also be indicative of the ecological state and sensitivity, which was regarded as severely impacted. This will then be regarded as the localised plan and evaluation of onsite conditions.

The Orange River and associated riparian vegetation south of the site, do provide continuity with undisturbed areas. It is a farm, thus camps have been fenced off. The site is not regarded as a site of ecological importance when studying the vegetation nor does the site have any high conservation value.

However, a vegetation report will provide better insight into the condition of the veld and connectivity potential. The site, according to Mucina and Rutherford (2006), host two vegetation types, namely the Upper Gariep Alluvial vegetation (AZa) and the Northern Upper Karoo (NKu3).

Plant Species Theme: MODIFIED. The screening tool identified low sensitivity; however, field verification identified distinct vegetation units, including high conservation value riparian vegetation and lower sensitivity disturbed and old-field areas. Sensitivity is therefore site-specific rather than uniformly low.

ARCHAEOLOGICAL & HERITAGE IMPACT AND PALAEOONTOLOGICAL THEME

The Palaeontological Theme was given a medium sensitivity score for the site, but low sensitivity for the archaeological and heritage sensitivity. The Northern Cape is rich in fossils and archaeological heritage and therefore the area will be subject to a Phase 1 Archaeological and Paleontology Report will be completed by Dr. Lloyd Rossouw who has a BA Hons (SU), MSc (Wits), and PhD (UFS) and is ASAPA registered.

An impact on the Palaeontological Heritage will only take place should any fossils be disturbed, damaged, destroyed, or permanently sealed-in at or below the ground surface and then no longer be available for scientific study.

Palaeontology Theme: VERIFIED. The specialist assessment concluded that the site is underlain by young alluvial deposits with low palaeontological significance and low risk.

Archaeological and Cultural Heritage Theme: VERIFIED. No archaeological sites, graves, historical structures, or significant heritage resources were identified within the assessed footprint.

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

CIVIL AVIATION THEME

The Prieska airstrip is about 35km southwest of the proposed site and is most likely the reason the Screening Tool categorized civil aviation impact as 'low'. The proposed activity does not involve the construction of wind turbines, solar panels, high buildings/towers, or infrastructure. It is the development of crops. There will be no industrial factories that might cause air emissions to impair the vision of flight. The clearing of vegetation and the establishment of pecan nut orchards will not restrict the airspace.

It is the opinion of the EAP that the development will not have any impact on civil aviation and therefore it is proposed that no further assessment is made.

Civil Aviation Theme: LOW SENSITIVITY VERIFIED.

DEFENCE THEME

There are no navy- or army bases, airforce bases, or special forces in or near Prieska. According to the Defence Theme Protocol, if the sensitivity is regarded as 'low', it is therefore proposed that no further assessment is required.

Defence Theme: LOW SENSITIVITY VERIFIED.

SPECIALIST ASSESSMENTS IDENTIFIED

Based on the selected classification and the environmental sensitivities of the proposed development footprint, the following list of specialist assessments has been identified for inclusion in the assessment report, according to the Screening Tool Report. However, it is the responsibility of the EAP to confirm the list and to motivate with reason, for not including any of the identified specialists' studies in the report.

TABLE 2: ASSESSMENT OF SPECIALIST STUDIES IDENTIFIED BY THE ENVIRONMENTAL SCREENING TOOL

Screening Tool Recommendation	Site Verification Outcome	Recommendation
Landscape/Visual	Site comprises existing agricultural landscape with no identified visual receptors of high sensitivity	Not required
Archaeology/Heritage	Verified Low sensitivity	HIA to be submitted to SAHRIS
Palaeontology	Verified Medium sensitivity	PIA to be submitted to SAHRIS
Terrestrial Biodiversity	Portions verified as natural vegetation/CBA	Full Assessment
Aquatic Biodiversity	Based on available information, the proposed cultivation areas avoid the Orange River riparian corridor and associated drainage features.	Not required
Socio-Economic	Not triggered by protocol	Not required
Plant Species	Natural vegetation present	Full Assessment
Animal Species	Suitable habitat present	Full Assessment

Although not triggered by protocol, as discussed in detail under the heading 'Agricultural Theme', it was identified that a soil report must be completed and was done by a SACNASP registered soil scientist. This specialist assessment will therefore be included in the EIA.

CONCLUSION OF SITE SENSITIVITY VERIFICATION REPORT

The site verification process confirms that the highest environmental sensitivities are associated with the Orange River and associated riparian habitats. The proposed expansion areas are largely situated within previously modified agricultural landscapes and on soils

suitable for cultivation. Subject to the avoidance of riparian vegetation and incorporation of specialist recommendations, the environmental sensitivities identified by the screening tool have been adequately verified for purposes of the EIA process.

REFERENCES

Comprehensive Atlas Ver. 2.1. http://daffarcgis.nda.agric.za/Comp_Atlas_v2/. 08/04/2022, 09:30.

SANBI Northern Cape Biodiversity Plan, 2016. http://bgisviewer.sanbi.org/Html5Viewer/Index.html?configBase=http://bgisviewer.sanbi.org/Geocortex/Essentials/REST/sites/2016_NorthernCape_CBA/viewers/Northern_Cape/virtualdirectory/Resources/Config/Default&user=&extent=&layerTheme= 08/04/2022, 10:45

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

APPENDIX F – SPECIALIST REPORTS

APPENDIX F1 – PALAONTOLOGY AND HERITAGE REPORT

PALAEONTOLOGICAL AND HERITAGE IMPACT
ASSESSMENT FOR A SECTION 24G RECTIFICATION
APPLICATION: FARMS TWEEFONTEIN 373 & KALKFONTEIN
374, PRIESKA, SIYATHEMBA LM, NORTHERN CAPE
PROVINCE.



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Specialist Info

Lloyd Rossouw previously led the Archaeology and Florisbad Quaternary Research Departments at the National Museum in Bloemfontein and has more than 30 years of fieldwork experience in South African archaeology and Quaternary palaeontology. He earned a BA degree in Archaeology, completed an Honours programme in Stone Age Archaeology at the University of Stellenbosch, and received training in osteology and Quaternary palaeontology for his MSc at the Bernard Price Institute of Palaeontology (Wits). He also undertook instruction in human anatomy at Duke University in Durham, North Carolina, USA. For his PhD at the University of the Free State, he developed a palaeobotanical method that uses plant silica remains to reconstruct past environmental conditions. His fieldwork includes participation in various excavations and surveys, such as historical built environments and farmsteads (including Keerweder, Zomerlust, Boekenhoutskloof, Bien Donne, Sterhuis, Fredericksberg, Aurora), rock art surveys (Ceres, Vanrhynsdorp, Clanwilliam, Piketberg), industrial projects (coastal section for Moss gas Pipeline Project, Molenaars River crossing for Du Toitskloof Pass Tunnel Project), Stone Age sites (Hoedjiespunt, Klasies River Mouth, Erfkroon, Damvlei, Thyspunt, Sunnyside, Baden Baden, Florisbad, Cornelia), and palaeontological localities (Langebaanweg, Zwartklip, Besaansklip, Boesmansfontein, Spitskop, Cango Valley, Braamhoek, Gladysvale, Taung). He has surveyed and mapped multiple open sites in the central interior region, including the northern Karoo, lower Orange, Vaal, Modder, Vet and Sand River basins as well as the central Makgadikgadi basin.

Declaration of Independence

Paleo Field Services remains financially independent, with no vested interest in project activities or outcomes except for professional fees. Its sole remuneration comes from agreed-upon services for each project. Paleo Field Services accepts client-provided information as accurate.

Yours truly,

A handwritten signature in blue ink, appearing to read "L Rossouw".

April 2026

SUMMARY

A Phase 1 Palaeontological and Heritage Impact Assessment (PIA/HIA) was undertaken in support of a Section 24G rectification application in terms of the National Environmental Management Act (NEMA) for the existing cultivation of irrigated crops under adjoining mechanised centre-pivot systems on the farms Tweefontein 373 and Kalkfontein 374, located approximately 38 km north-east of Prieska along the right bank of the Orange River. The assessment indicates that the residual palaeontological and archaeological risk associated with the existing centre-pivot cultivation is low. The study area is situated on a floodplain-margin landform underlain by Holocene alluvium and locally reworked aeolian sand, forming a near-level sandy plain. Such deposits are widely regarded as having low palaeontological sensitivity, as they are geologically young and subject to frequent reworking, conditions that are generally unfavourable for the accumulation or preservation of fossil material. This interpretation is supported by field observations, which recorded no fossil material in inspected exposures or cuttings across the affected areas. The field survey also recorded no *in situ* Stone Age artefacts or artefact scatters, no visible graves or burial grounds, and no historical structures or infrastructure older than 60 years within the demarcated development footprints. Within the context of a Section 24G application, it is noted that the affected areas have already been subjected to substantial prior surface disturbance associated with the establishment and ongoing operation of the existing centre-pivot infrastructure. Any archaeological impacts have therefore largely already occurred and are confined to reworked surface contexts. On this basis, the continuation of the existing agricultural activity is unlikely to result in any additional loss of unique, significant, or scientifically irreplaceable palaeontological or archaeological resources. The centre-pivot areas on both farms are accordingly assigned a Generally Protected C (low significance) rating, on condition that future activities do not involve deeper ground disturbance beyond the already impacted footprint.

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INTRODUCTION

A Phase 1 Palaeontological and Heritage Impact Assessment (PIA/HIA) was undertaken as part of a Section 24G rectification application in terms of the National Environmental Management Act (NEMA) for the existing cultivation of irrigated crops under adjoining mechanised centre-pivot systems on the farms Tweefontein 373 & Kalkfontein 374. The sites lie on the right bank of the Orange River, about 38 km directly north-east of Prieska (**Fig. 1 & 2**).

Map Reference: 1:50 000 scale topographic map 2923AC Nieuwejaarskraal and 1:250 000 scale geological map 2922 Prieska.

Farm Reference: Remainder of the Farm Tweefontein 373 & Portion 4 (Ptn of Ptn 2) of the Farm Kalkfontein 374.

Centroid Coordinates

Tweefontein Pivots: 29°24'40.09"S 23° 1'14.41"E (~31 hectares)

Kalkfontein Pivots: 29°24'44.11"S 23° 2'2.84"E (~104 hectares)



Figure 2. General view of the study area.

LEGAL FRAMEWORK

The assessment is required as a prerequisite for new development in terms of the National Heritage Resources Act (NHRA) 25 of 1999. The NHRA identifies what is defined as a heritage resource, the criteria for establishing its significance and lists specific activities for which a heritage specialist study may be required. The NHRA prescribes a system of grading of places/objects via Section 7 and makes provision for the general protection of heritage resources via Sections 34, 35, 36, and 37 (in respect of the built environment, archaeology/palaeontology, burial grounds/graves and monuments/memorials, respectively), while

Section 38 sets out guidelines under which heritage impact assessments are required when new developments may impact upon heritage resources.

Section 38(1) applies when a development triggers heritage assessment requirements but does not require an environmental authorisation from another regulatory authority, including:

1. Construction of a road, powerline or pipeline, canal or other similar form of linear development or barrier longer than 300m.
2. Construction of a bridge or similar structure exceeding 50 m.
3. Development exceeding 5,000 m².
4. Rezoning of land exceeding 10,000 m², or
5. Any development that may impact recognized heritage resources (e.g., archaeological sites, graves, buildings older than 60 years).

Section 38(3) of the NHRA sets the minimum information requirements for a Heritage Impact Assessment report: the responsible heritage resources authority must ensure that any report submitted includes, at least, the core elements listed in Section 38(3)(a)–(g), namely identification and mapping of heritage resources, significance assessment, impact assessment, evaluation against socio-economic benefits, consultation outcomes, consideration of alternatives (where impacts occur), and mitigation planning.

DISCLAIMER, ASSUMPTIONS AND LIMITATIONS

Information provided by the Client and/or Environmental Assessment Practitioner (EAP) was assumed to be accurate and complete for the purposes of this assessment. Observations presented in this report are based solely on aboveground visibility of features and outcrops as encountered during field survey. The reliability and completeness of these observations are subject to several inherent limitations:

- Fossiliferous outcrops are often limited to exposed lithologies and may be obscured by colluvium, vegetation, or soil mantling; the degree of weathering affects the preservation and visibility of fossil material, with heavily weathered surfaces potentially masking fossil content or fragmenting specimens; stratigraphic context is inferred from visible lithologies only; subsurface fossil-bearing horizons may remain undetected without trenching or coring; access limitations may restrict inspection of

key geological exposures, particularly in rugged terrain or areas with restricted land access.

- The surface visibility of archaeological remains is variable and may be significantly reduced by vegetation cover, soil accumulation, or recent land disturbance (e.g., ploughing, erosion, construction); subsurface archaeological remains (e.g., buried structures, features, or artefact scatters) may not be detectable without excavation or remote sensing; weathering and exposure can obscure diagnostic features such as stone alignments, midden deposits, or low-relief structures, especially in areas with high sedimentation or seasonal vegetation growth; accessibility constraints (e.g., fenced properties, steep terrain, or dense bush) may prevent systematic coverage, resulting in partial or biased spatial data.

METHODOLOGY

The site assessment was carried out in line with the National Heritage Resources Act (Act No. 25 of 1999) and the 2007 SAHRA Minimum Standards for Archaeological and Palaeontological Impact Assessments. Initial site ratings were based on existing field data, relevant databases, and published literature. Topographic, aerial and geological maps were used for illustrative purposes and to identify potential fossil-bearing formations. Fieldwork involved direct observation through foot surveys, with vehicle access where possible. A Garmin Etrex Vista handheld GPS (set to the WGS 84 datum) and a digital camera were used to record spatial and visual data throughout the survey. GPS coordinates are presented in *Degrees, Minutes, Seconds* format in the report.

TERMS OF REFERENCE

The Terms of Reference outlines the scope and objectives for assessing potential impacts on heritage resources—both tangible and intangible—arising from the proposed development, in accordance with relevant legislative standards.

1. Conduct site investigation for a Heritage *Impact Assessment (HIA)* to identify and map heritage sites and occurrences in the affected area(s) and provide an assessment of

their significance. This must be done regardless of the sensitivity indicated on the *DESTEA National Web Based Environmental Screening Tool*, as the Department of Environmental Affairs and its entities make no warranty—express or implied—regarding the accuracy, reliability, usefulness, or completeness of the *archaeological and cultural heritage theme layer*.



Figure 3. Study area marked by yellow polygons on portion of SAHRIS palaeosensitivity map.

2. Conduct a site investigation for a Palaeontological Impact Assessment (PIA) using the SAHRIS PalaeoSensitivity Map (**Fig. 3**), regardless of the sensitivity indicated on the *DESTEA National Web Based Environmental Screening Tool*. Identify and map fossils or exposures in the area and assess their significance. This is required as the Department of Environmental Affairs does not guarantee the accuracy or completeness of the *palaeontology theme layer*.
3. Assess impacts of the proposed development on heritage resources relative to the sustainable social and economic benefits to be derived from the development *if planned impacts will result in the loss of any resources*.
4. Provide a system of grading of places and objects which form part of the national estate, and which distinguishes between at least the categories as prescribed under Section 7 of the NHRA (**Table 1**).

Table 1. Description of Field Rating categories as prescribed in Section 7(1) of the NHRA where SAHRA must by regulation establish a system of grading of places and objects which form part of the national estate, and which distinguishes between at least the categories— (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance; (b) Grade 2: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; (c) Grade 3: Heritage resources which can be considered to have special qualities which make them locally significant; and Generally Protected: Other heritage resources which may require mitigation before destruction.

Field Rating	Grade (NHRA No. 25 of 1999, Section 7)	Significance	Mitigation
National Significance (NS)	Grade 1	-	Conservation: national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation: provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation: mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A	-	High/medium significance	Mitigation before destruction
Generally Protected B	-	Medium significance	Recording before destruction
Generally Protected C	-	Low significance	Destruction

PALAEONTOLOGICAL BACKGROUND

From oldest to youngest, the study area and immediate surrounds are underlain by localised Early Permian Dwyka sediments (C-Pd), widespread Late Tertiary to Quaternary calcretes (T-Qc), aeolian sand (Qs) and other superficial deposits (**Fig. 4**).

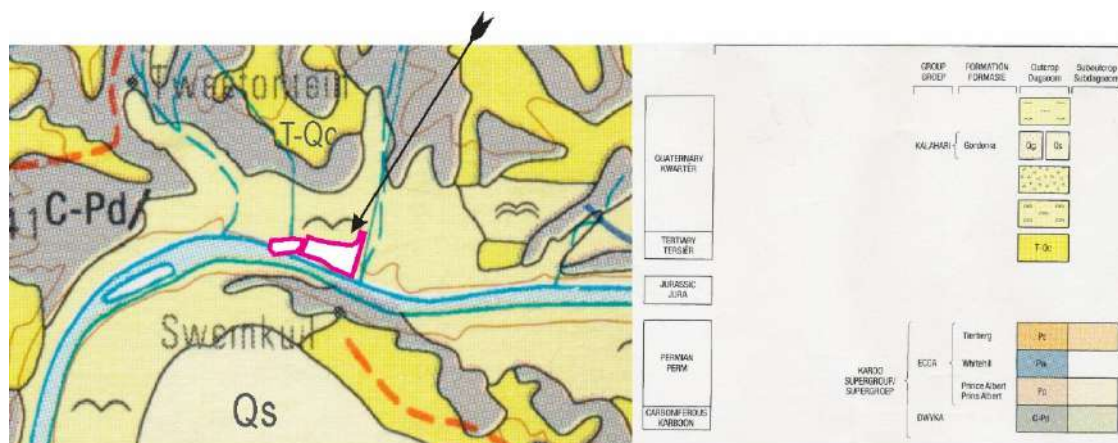


Figure 4. According to the 1:250 000 scale geological map 2922 Prieska the site and surrounding areas are underlain by Early Permian Dwyka sediments (C-Pd) and widespread Late Tertiary to Quaternary calcretes (T-Qc), aeolian sands (Qs) and alluvium.

Localised Dwyka-aged palaeovalleys preserve evidence of glaciation, including glaciated pavements with polished, striated basement surfaces, tillites and Dwyka mudrocks are noted as having yielded trace fossils (including fish and invertebrate trackways), microfossil remains (foraminifera, bryozoans, sponge spicules and radiolaria), and fossil plant material including lycopods, Glossopterids, fossilised wood and plant micro-remains (spores and pollen). In younger deposits, Late Cenozoic duricrusts and eluvium include calcretes (T–Qc), surface gravels and reworked calcretes, aeolian sand. Rare Florisian-type vertebrate fossil remains are known from old calcrete quarries in the area.

FIELD ASSESSMENT – PALAEONTOLOGY

The study area is situated on a floodplain margin along the right bank of the Orange River and is underlain by unconsolidated alluvium and locally reworked aeolian sand characterised by a near-level sandy plain (**Fig. 5**). Exposed riverbank sections show discontinuous gravel lags where finer sediments have been deflated or washed out. The areas indicate substantial deposits of fine- to medium-grained, structureless sand, which contain scattered small

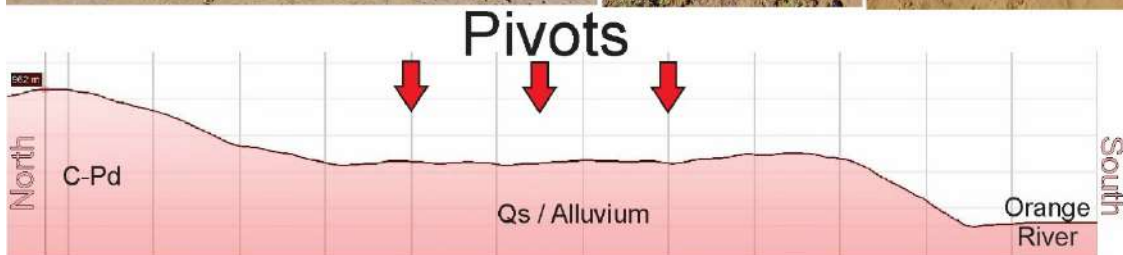


Figure 5. The study area is situated on a floodplain margin along the right bank of the Orange River and is underlain by unconsolidated alluvium and locally reworked aeolian sand characterised by a near-level sandy plain where the pivots are situated (elevation profile, below)

pebbles and cobbles, including subrounded lithic clasts characteristic of river-derived bedload, as well as occasional calcrete nodules (**Fig. 6**). Overall, the terrain reflects an episodically active depositional setting which is most plausibly Holocene in age where it forms part of the active floodplain. Holocene alluvial deposits, which are generally too young and too frequently reworked to accumulate and preserve fossil material are widely regarded as having low palaeontological sensitivity, and this expectation is corroborated by the absence of fossils in inspected exposures and cuttings at the site. Consequently, both the Kalkfontein and Tweefontein sites are assigned a Generally Protected C (low) palaeontological field rating (**Table 1**).

PALAEONTOLOGICAL IMPACT AND RECOMMENDATIONS (NHRA SECTION 38(3))

The results of the site investigation are presented under the minimum information requirements set out in Section 38(3)(a)–(g) of the National Heritage Resources Act (NHRA):



Figure 6. Exposed riverbank sections show discontinuous gravel lags where finer sediments have been deflated or washed out. The areas indicate substantial deposits of fine- to medium-grained, structureless sand, which contain scattered small pebbles and cobbles, including subrounded lithic clasts characteristic of river-derived bedloads, as well as occasional calcrete nodules. Scale 1 = 10 cm.

a) Identification and mapping of all heritage resources

A desktop and field-based palaeontological assessment was undertaken using geological mapping (1:250 000 scale), regional palaeontological literature, the SAHRIS PalaeoSensitivity Map, aerial imagery, and on-site inspection. The study area was confirmed to be positioned on a floodplain margin that is underlain by unconsolidated alluvium (Qs / alluvium) with locally reworked aeolian sand. Exposures comprise fine- to medium-grained, structureless sandy overbank deposits with discontinuous gravel lags and occasional calcrete nodules. No fossil material or fossil-bearing horizons were observed at surface or within inspected cuttings/exposures.

b) Assessment of the significance of identified heritage resources

No fossils/fossil localities were identified. The affected sediments are interpreted as a geologically young active floodplain and are assigned Generally Protected C (low) palaeontological field rating for both the Kalkfontein and Tweefontein sites.

c) Assessment of the nature and extent of potential impacts

Potential impacts are limited to the disturbance/removal of near-surface sandy alluvium during typical agricultural activities (e.g., ploughing, harvesting). Given that the deposits are loose, structureless, and actively reworked overbank/alluvial sands, the likelihood of impacting scientifically significant fossil material is very low, and no fossils were observed in exposed sections.

d) Evaluation of impacts in relation to the anticipated social and economic benefits of the proposed development

Given the absence of palaeontological resources and the negligible level of impact, the continuation of agricultural activities presents no conflict with palaeontological conservation objectives.

e) Consultation with interested and affected parties regarding potential impacts on heritage resources

No objections or concerns relating to palaeontological heritage were raised during EAP consultation processes.

f) Consideration of feasible alternatives where heritage resources may be adversely affected, including alternative layouts or development options.

Due to the lack of palaeontological resources and the low sensitivity of Holocene overbank and alluvial sands, there are no palaeontological constraints that necessitate alternative layouts or cessation of operations.

g) Mitigation measures to avoid, minimise, or manage adverse impacts on heritage resources during construction, operation, and post-completion phases of the development.

No mitigation or monitoring is required. The study area is assigned a **Generally Protected C** rating for palaeontology under Section 35 of the NHRA, conditional on future activities remaining within the scope of existing shallow disturbance.

ARCHAEOLOGICAL BACKGROUND

The wider Prieska region preserves a well-defined Stone Age footprint together with historical period remains, with Early, Middle and Later Stone Age sites recorded particularly in association with pan and mountain plateau environments, while open plains are generally characterised by low-density surface scatters. Isolated ESA and MSA artefact scatters are also recorded within Orange River overbank sediments between Douglas and Prieska, with named occurrences including Marksdrift, Kliphuis, Elswater, Brakfontein, Holsloot and Nuwejaarskraal, and stone tool surface scatters have been recorded in the Prieska Townlands to the southwest. Rock art occurs along the steep slopes of the Asbes and Doringberge to the north and south of Prieska, with noted examples including Wonderdraai, Omdraaisvlei and Sandfontein, and rock engravings have been recorded in younger valley fills along steeper slopes at Sandfontein north of Prieska. Archaeological and historical accounts describe precolonial occupation by Bushman hunter-gatherers and Khoi pastoralists, with early travellers encountering Koranna, Griqua and Bushman groups in the region, and the place-

name “Prieska” is derived from a Koranna term meaning “place of the lost she-goat”; the Middle Orange River context is further described in terms of Khoikhoi group distributions and later movements of Xhosa-speaking groups into the Pramberg and Karreeberg regions south of Prieska.

Historical-period heritage includes remnants dating to the Anglo-Boer War and its aftermath, including a stone fort on top of the Prieska Koppie overlooking the town, and other listed historical buildings and burial places in Prieska (including the Dutch Reformed Church in Church Street and an old graveyard near the Prieska Golf Club). The regional historical landscape also includes ruins and graveyards linked to the early 20th-century asbestos mining industry at multiple localities north and south of Prieska, including occurrences associated with Karabee and Keikams Poort, as well as Kliphuis on the Orange River northwest of Prieska, and wider distributions of stone-walled ruins on farms in the surrounding district.

FIELD ASSESSMENT - ARCHAEOLOGY

Both the Kalkfontein and Tweefontein sites are situated on a floodplain margin separated by a right bank tributary (drainage line) of the Orange River and is underlain by unconsolidated sandy sediments (alluvium and reworked aeolian sand). No heritage resources were identified within the project footprint during the Phase 1 field survey. The field survey reports no *in situ* Stone Age artefacts or scatters, no aboveground signs of graves/burial grounds, and no historical structures or infrastructure older than 60 years within the demarcated development footprints. Within the context of a Section 24G application, it is noted that the affected areas are already subject to existing agricultural pivot infrastructure and associated surface disturbance. Impacts to archaeological resources have therefore largely already occurred and are confined to reworked surface contexts. As such, the *continuation* of the existing agricultural activity is unlikely to result in additional loss of unique or scientifically irreplaceable archaeological resources. The overall archaeological impact associated with the existing pivots is accordingly assessed as low, and the pivots are assigned a site rating of Generally Protected C (**Table 1**), provided that future activities do not involve deeper ground disturbance beyond the currently impacted areas.

ARCHAEOLOGICAL IMPACT & RECOMMENDATIONS (NHRA S38(3))

The results of the site investigation are presented under the minimum information requirements set out in Section 38(3)(a)–(g) of the National Heritage Resources Act (NHRA):

a) Identification and mapping of all heritage resources

A desktop and field-based palaeontological assessment was undertaken using geological mapping (1:250 000 scale), regional archaeological literature, aerial imagery, and on-site inspection. The affected area comprises a near-level **sandy floodplain-margin surface** on Orange River alluvium with local gravel lags and minor calcrete nodules. Within the areas inspected, **no archaeological material or features** (e.g., stone artefact scatters, structures, kraals, midden material, graves) were identified on the surface or in visible cuttings.

b) Assessment of the significance of identified heritage resources

As **no archaeological resources** were identified, the archaeological significance of the affected footprint is assessed as **low**, subject to the limitation that **buried or obscured materials** can occur unpredictably in alluvial settings

c) Assessment of the nature and extent of potential impacts

In this floodplain-margin context the probability of encountering intact archaeological horizons in the loose, structureless sand is assessed as **low**, and no surface indicators were observed. Any likely impacts to archaeological resources have already occurred and are confined to reworked surface contexts.

d) Evaluation of impacts in relation to the anticipated social and economic benefits of the proposed development

The residual archaeological impact is expected to be **low** when weighed against the anticipated economic benefits of the proposed development.

e) Consultation with interested and affected parties regarding potential impacts on heritage resources

No objections or concerns relating to archaeological heritage were raised during EAP consultation processes

f) Consideration of feasible alternatives where heritage resources may be adversely affected, including alternative layouts or development options.

Due to the lack of archaeological resources, there are no archaeological constraints that necessitate alternative layouts or cessation of operations.

g) Mitigation measures to avoid, minimise, or manage adverse impacts on heritage resources during construction, operation, and post-completion phases of the development.

No mitigation or monitoring is required. The study area is assigned a **Generally Protected C** rating for archaeology under Section 35 of the NHRA, conditional on future activities remaining within the scope of existing shallow disturbance.

REFERENCES

- Beaumont, P.B., Smith, A.B. & Vogel, J.C. 1995. Before the Einiqua: the archaeology of the frontier zone. In: Smith, A.B. (ed.) Einiqualand: studies of the Orange River frontier: 236-264. Cape Town: University of Cape Town Press.
- Beaumont, P.B., Van Zinderen Bakker, E.M., Vogel, J.C., 1984. Environmental changes since 32,000 BP at Kathu Pan, Northern Cape. In: Vogel, J.C. (Ed.), Late Cenozoic Palaeoclimates of the Southern Hemisphere. Balkema, Rotterdam, pp. 329-338.
- Brink, J.S., de Bruijn, H., Rademeyer, L.B. and van der Weisthuizen, W.A. 1995. A new *Megalotragus priscus* (Alcelaphini, Bovidae) from the central Karoo, South Africa. *Palaeontologia africana* 32: 17-22
- Burchell W.J. 1824. Travels in the interior of southern Africa. Vol II. Longman and Green. London.
- Kiberd, P. 2006. Bundu Farm: a report on archaeological and palaeoenvironmental assemblages from a pan site in Bushmanland, Northern Cape, South Africa. *South African Archaeological Bulletin* 61: 189-201.
- Humphreys, A.J.B. 1982. Cultural Material from Burials on the Farm St. Clair, Douglas Area, Northern Cape. *South African Archaeological Bulletin*, 37 (136) 68-70.
- Johnson, M.R. et. al. 2006. Sedimentary Rocks of the Karoo Supergroup. In: M.R. Johnson, et. al. (eds). *The Geology of South Africa*. Geological Society of South Africa.

- Kallaway, P. 1982. Danster and the Xhosa Of the Gariep: Towards a Political Economy of the Cape Frontier 1790-1820. *African Studies* 41:143-160.
- Kiberd, P. 2006. Bundu Farm: a report on archaeological and palaeoenvironmental assemblages from a pan site in Bushmanland, Northern Cape, South Africa. *South African Archaeological Bulletin* 61: 189-201.
- Maglio, V.J. and Cooke, H.B.S. 1978. Evolution of African Mammals. Cambridge, Mass. Harvard University Press.
- Malherbe, S.J. & Moen, H.F.G., 1996. 1:250 000 scale geological map 2922 Prieska. Council for Geoscience. Pretoria.
- Partridge, T.C. & Maud, R.R. 2000. The Cenozoic of Southern Africa. Oxford Monographs on Geology and Geophysics No. 40.
- Raper 1984. Dictionary of South African Place Names. Onomastic Research Centre, HSRC. Pretoria.
- Skead, C. J. 2009. Historical plant incidence in southern Africa. A collection of early travel records in southern Africa. Pretoria: South African National Biodiversity Institute.
- Van Riet Lowe, C. 1941. Prehistoric art in SA. Archaeological Series No. 5. Bureau of Archaeology. Dept. Of the Interior, Pretoria.
- Visser, J.N.J., Looock, J.C. et al. 1977-78. The Dwyka Formation and Eccca Group, Karoo sequence in the northern Karoo Basin, Kimberley-Britstown area. *Annals of the Geographical Survey of South Africa* 12: 143 – 176.
- Von Brunn, V. & Visser, J.N.J. 1999. Lithostratigraphy of the Mbizane Formation (Dwyka group). South African Committee for Stratigraphy, Lithostratigraphic Series No. 32, 10 pp. Council for Geoscience, Pretoria.

APPENDIX F2 – SOIL SUITABILITY REPORT



CULTIVATION AND IRRIGATION SUITABILITY OF THE FARM TWEEFONTEIN, NEAR PRIESKA, NORTHERN CAPE

PREPARED FOR
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EXECUTIVE SUMMARY

A soil assessment was carried out on the Tweefontein farm, located near Prieska in the Northern Cape, on behalf of Jaco Gous (Temdale). The investigation covered an area of approximately 34 ha. The objective was to evaluate the suitability of the land for establishing a pecan nut orchard.

Findings from the survey indicate that the area is predominantly underlain by well-drained Oakleaf soils, which are considered highly favourable for both irrigation and cultivation. These soils offer adequate depth, efficient drainage, and favourable chemical characteristics. A small section to the north of the site is covered by Prieska soils. Although cultivation of these soils is unlikely to result in soil degradation, it will probably not be very productive for pecan nut production. The suitability is depicted in Figure A.

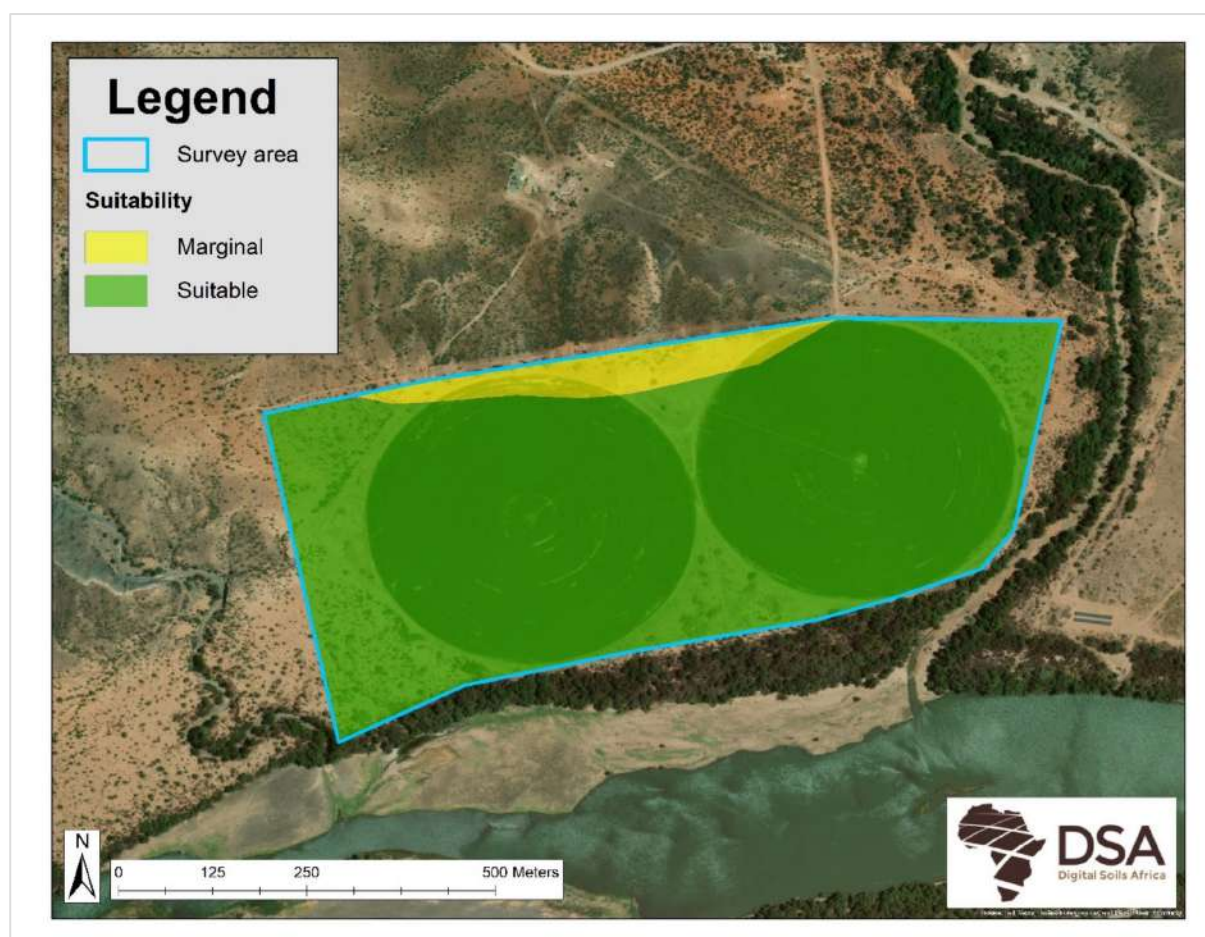


Figure A: Suitability classes for irrigation on portions of the farm Tweefontein near Prieska.

1. INTRODUCTION

Digital Soils Africa (Pty) Ltd (DSA) was commissioned by Jaco Gous of Temdale to conduct a soil survey on approximately 34 ha of land near Prieska in the Northern Cape. The land, situated on the farm Tweefontein (hereafter referred to as the site or study area), requires a ploughing certificate. The survey was therefore undertaken in accordance with the Northern Cape Department of Agriculture's guidelines for the cultivation of virgin soils.

The objective of the survey was to assess the suitability of the soils for cultivation and irrigation. Sustainable irrigation depends on identifying risks of waterlogging and salinization. When irrigation water is applied, dissolved salts accompany it, but plants primarily remove only the water through transpiration. Over time, this can lead to salt accumulation in the soil, reducing yields and, in severe cases, rendering the soil unproductive. Proper management can mitigate these effects, provided that the soil has suitable physical and chemical characteristics.

Accordingly, the Department of Agriculture specifies minimum standards for soil properties before a ploughing licence can be issued. These include aspects influencing water infiltration, as well as salt and sodium accumulation. The current survey therefore aimed to characterise the soil properties and their spatial distribution across the site to identify areas where irrigation can be managed sustainably.

2. LOCATION

The location of the centre pivot on the farm Tweefontein are shown in Figure 1 with the coordinates of the perimeter in Table 1. The site is located on the banks of the Orange River approximately 38 km northeast of Prieska and 20 southeast of Niekirkshoop (Figure 1). The coordinates of the focus areas are presented in.

Table 1: Coordinates of selected points on the perimeter of the studied area

Number	X	Y	Number	X	Y
1	23.01561	-29.41045	10	23.02428	-29.41218
2	23.01585	-29.41150	11	23.02457	-29.41184
3	23.01617	-29.41292	12	23.02486	-29.41056
4	23.01650	-29.41437	13	23.02514	-29.40934
5	23.01800	-29.41369	14	23.02350	-29.40932
6	23.01932	-29.41342	15	23.02248	-29.40930
7	23.02034	-29.41323	16	23.02110	-29.40950
8	23.02176	-29.41299	17	23.01916	-29.40980
9	23.02310	-29.41266	18	23.01720	-29.41012

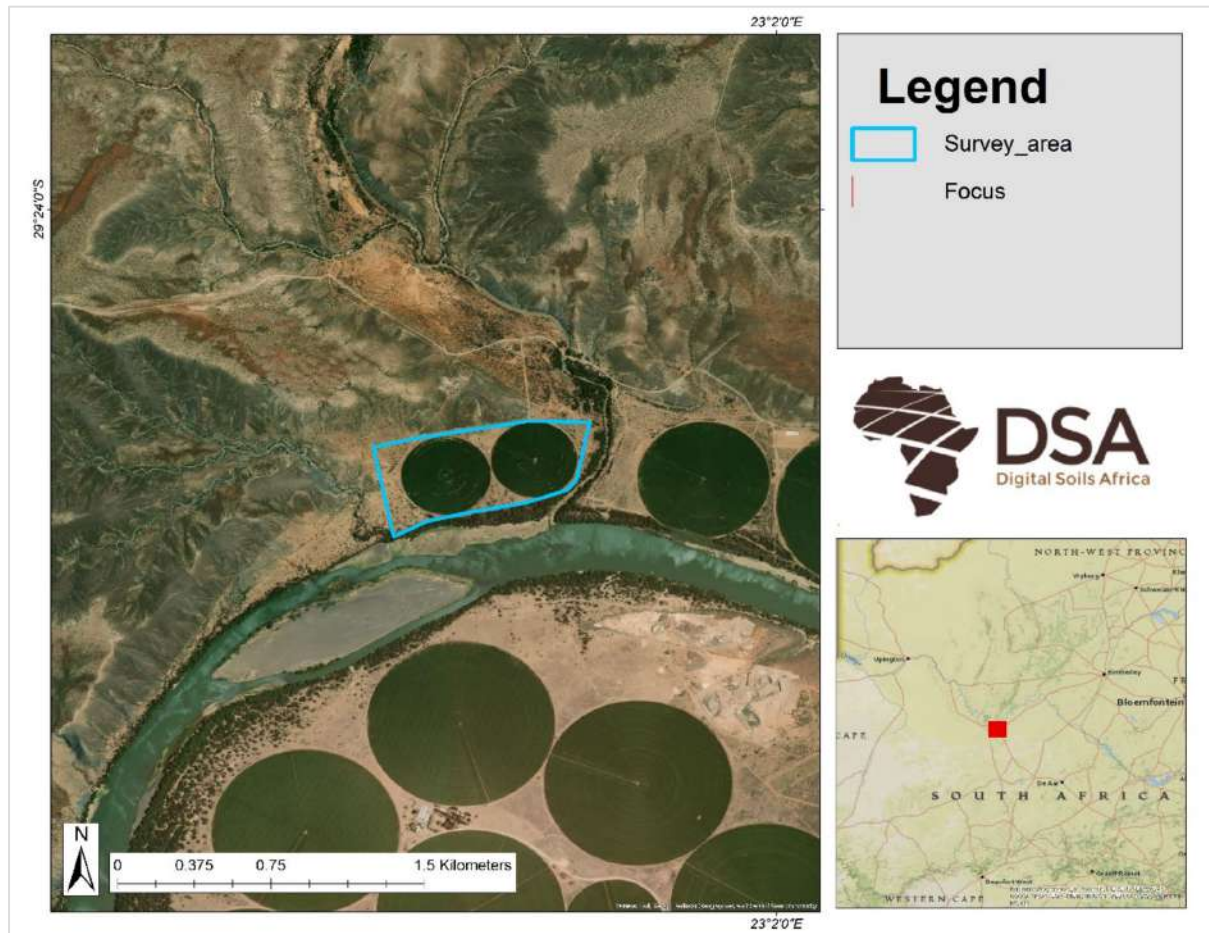


Figure 1: The location of the focus area of this study on the banks of the Orange River.

3. METHODOLOGY

A field visit was conducted on the 17th of September 2025. Thirteen soil observations were made using opened profile pits. The location of these observations is presented in Figure 2 with their coordinates in Table 2. The profiles were opened to approximately 2.5 m. Soils were classified according to Soil Classification: A Natural and Anthropogenic System for South Africa (2018) which is now the officially recognised classification system for South African soils. Soil depth, freely drainable depth and limiting material were noted and mapped. Samples of two representative profiles were taken for chemical and physical analysis. A total of six samples were analysed which included three topsoil samples (0 – 0.3 m) and three subsoil samples (0.3 – 0.6 m). Texture was measured with the pipette method, basic cations from a 1:10 NH₄OAc extract (White 2006) and soil pH in a 1:2.5 KCl extract. Phosphorus was measured with Bray I method and selected micro-nutrients with the DTPA method.

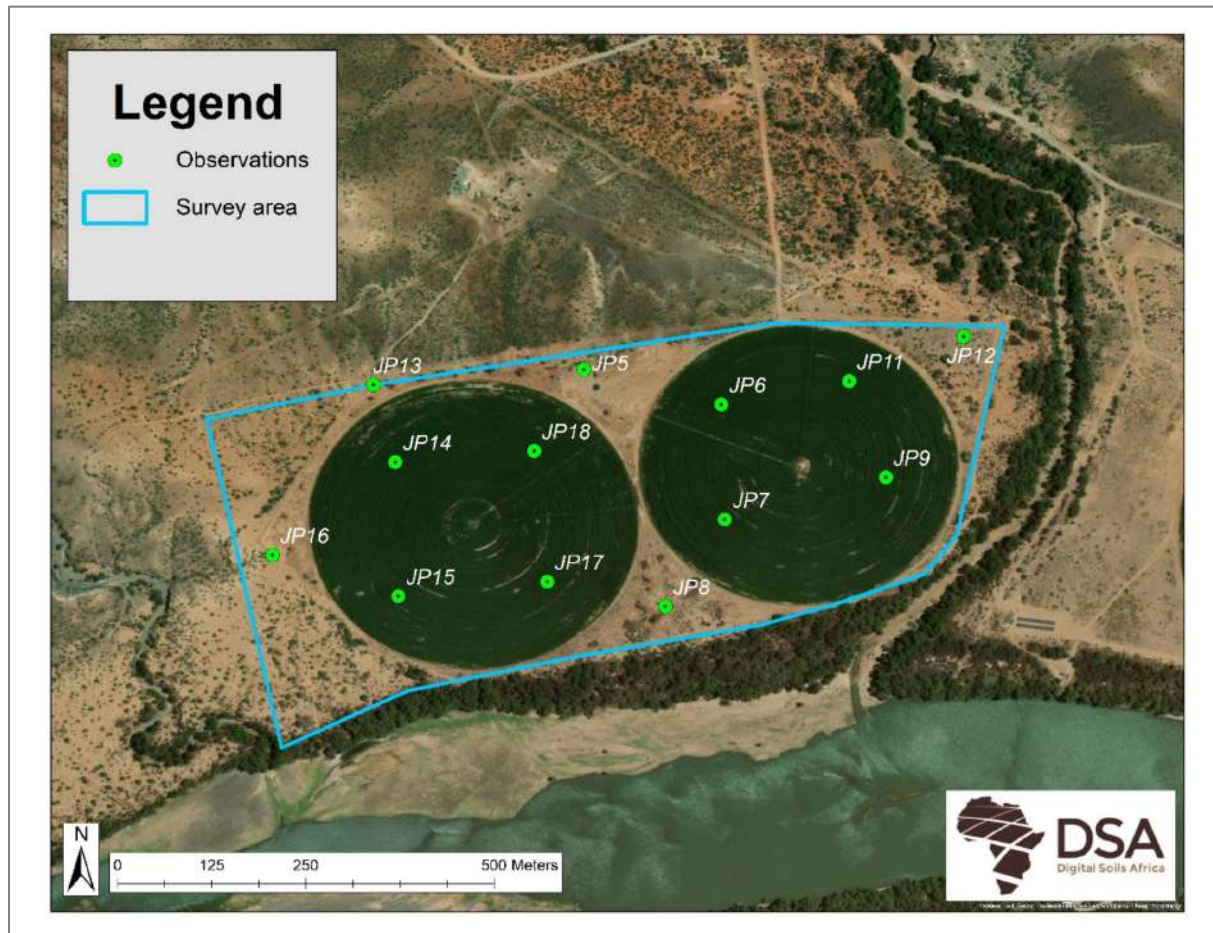


Figure 2: Surveyed area and soil observation locations for the site.

Table 2: Observation locations in study area

Name	X	Y	Name	X	Y
JP5	23.02011	-29.4099	JP13	23.01760	-29.4100
JP6	23.02176	-29.4103	JP14	23.01786	-29.4110
JP7*	23.02180	-29.4116	JP15*	23.01790	-29.4126
JP8	23.02109	-29.4127	JP16	23.01639	-29.4121
JP9	23.02372	-29.4111	JP17	23.01967	-29.4124
JP11*	23.02328	-29.4100	JP18	23.01952	-29.4108
JP12	23.02465	-29.4095			

(observation numbers followed by * were sampled)

4. RESULTS

4.1 SOILS FORM

The site is dominated by very deep soils of the Oakleaf and Ermelo form. To the north of the site a small section of carbonate rich Augrabies and Prieska soils were observed.

AUGRABIES/PRIESKA

The Augrabies and Prieska soils both have an orthic topsoil horizon overlying a neocarbonate subsoil horizon. In the Augrabies soil, no third horizon was observed, whereas in the Prieska soil a hard carbonate horizon occurs at approximately 2.1 m (Figure 3). Given the depth at which this horizon occurs, no drainage problems are expected, although the soils are naturally alkaline. For orchard establishment, these soils are considered marginal, although such development is unlikely to cause soil degradation.



Figure 3: Augrabies (JP5) and Prieska soils (JP13) observed at Tweefontein.

OAKLEAF/ERMELO

The Oakleaf soil form consists of an orthic horizon overlying a deep neocutanic horizon (Figure 4). These soils are very deep—exceeding 2.5 m—and have developed from alluvial deposits. Their morphology indicates that they are freely drained and highly suitable for irrigation. One observation (JP8) was uniformly coloured and very sandy, and was classified as an Ermelo form, which comprises an orthic horizon over a very deep (>2.5 m) yellow-brown apedal horizon. Both the Oakleaf and Ermelo soils are therefore considered highly suitable for irrigation.



Figure 4: Oakleaf soils represented by JP6, JP7 & JP12. A sandy Ermelo soil was observed at JP8.

4.2 SOIL AND SOIL DEPTH MAPS

The majority of the site is covered by Oakleaf/Ermelo soils and small section in the northern part with Augrabies/Prieska soils (Figure 5). The lower boundary of the soils was not reached in the Oakleaf soils but were around 2.1 m in the Prieska soils. Based on this, the soil depth was classified in the 2.51–3.00 m for the Oakleaf and 2.01–2.50 m category for the Prieska soils, respectively, in accordance with the Departmental Guidelines (Figure 6).

The freely drained depth was assumed to be equal to the total soil depth (Figure 7). In all cases, the underlying material could be broken relatively easily; therefore, the drainable depth was also considered equal to the total soil depth, although in practice it may be even deeper (Figure 8). No depth-limiting layers were encountered in the Oakleaf soils whereas the hard carbonate horizon could potentially restrict deep drainage in the Prieska soils (Figure 9).

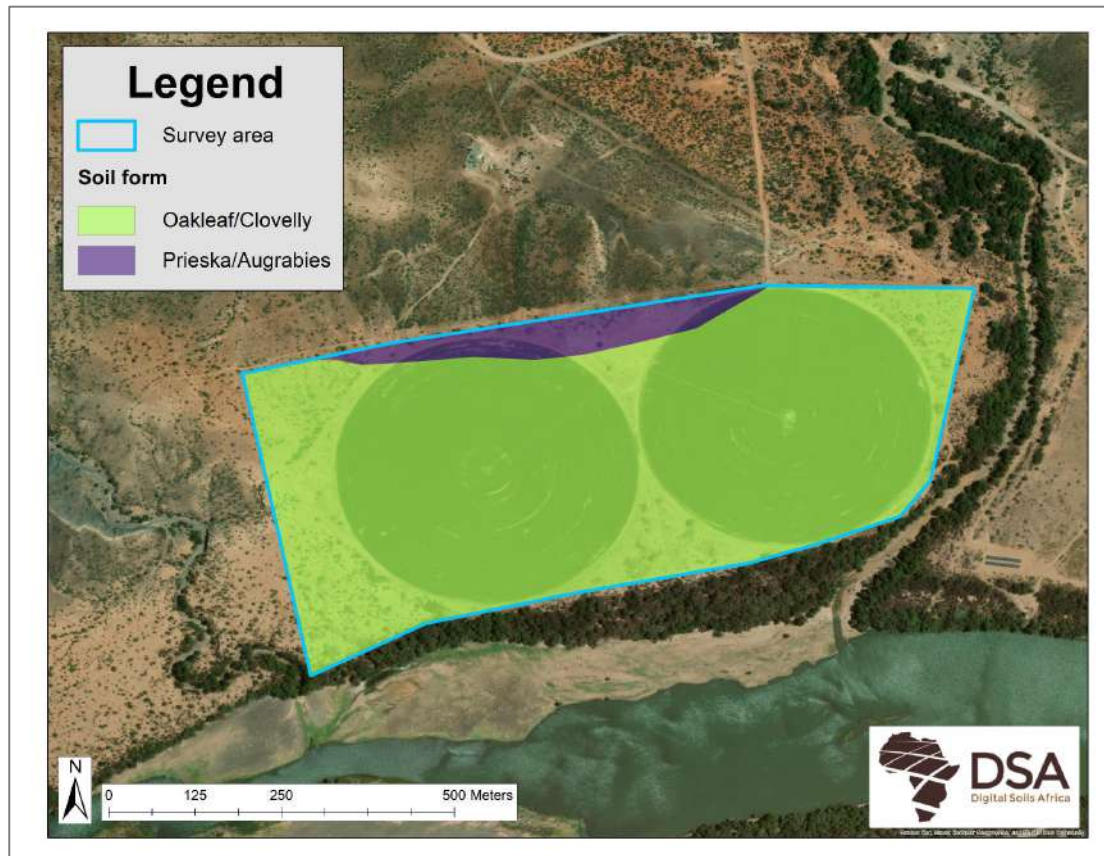


Figure 5: Soil map of the surveyed area.

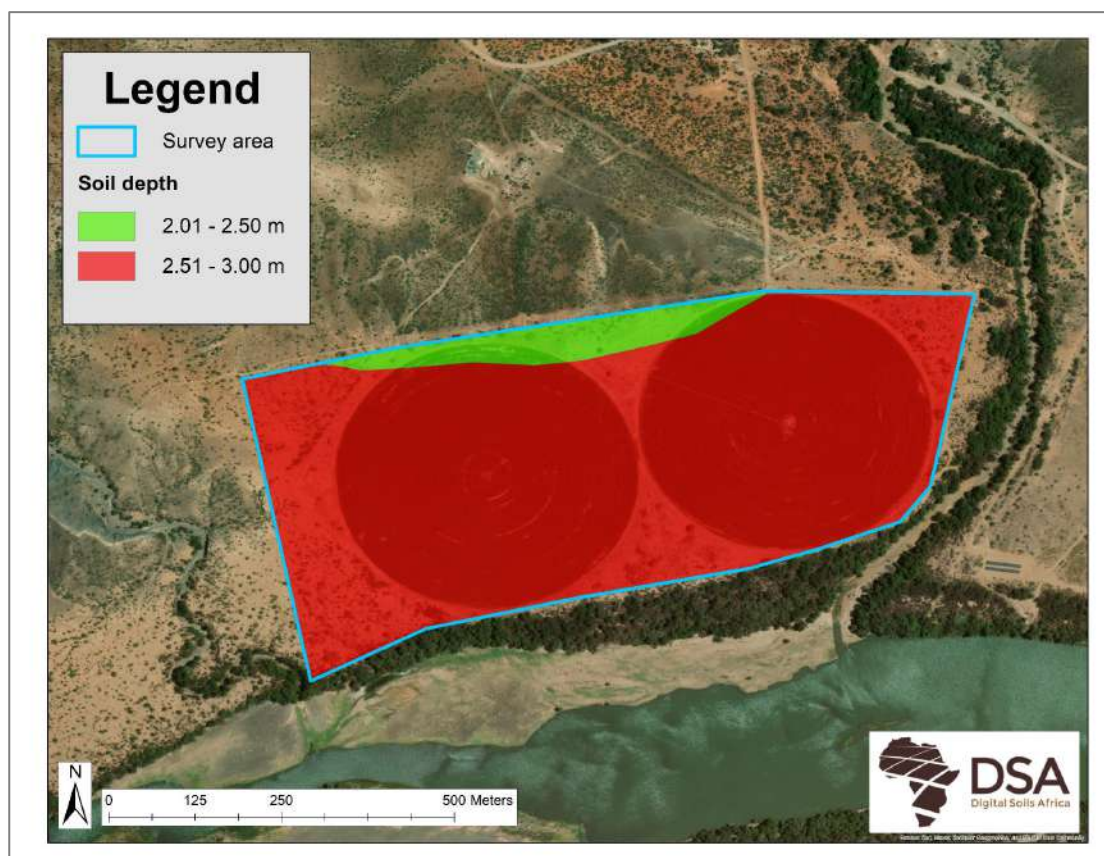


Figure 6: Total soil depth of the surveyed area.

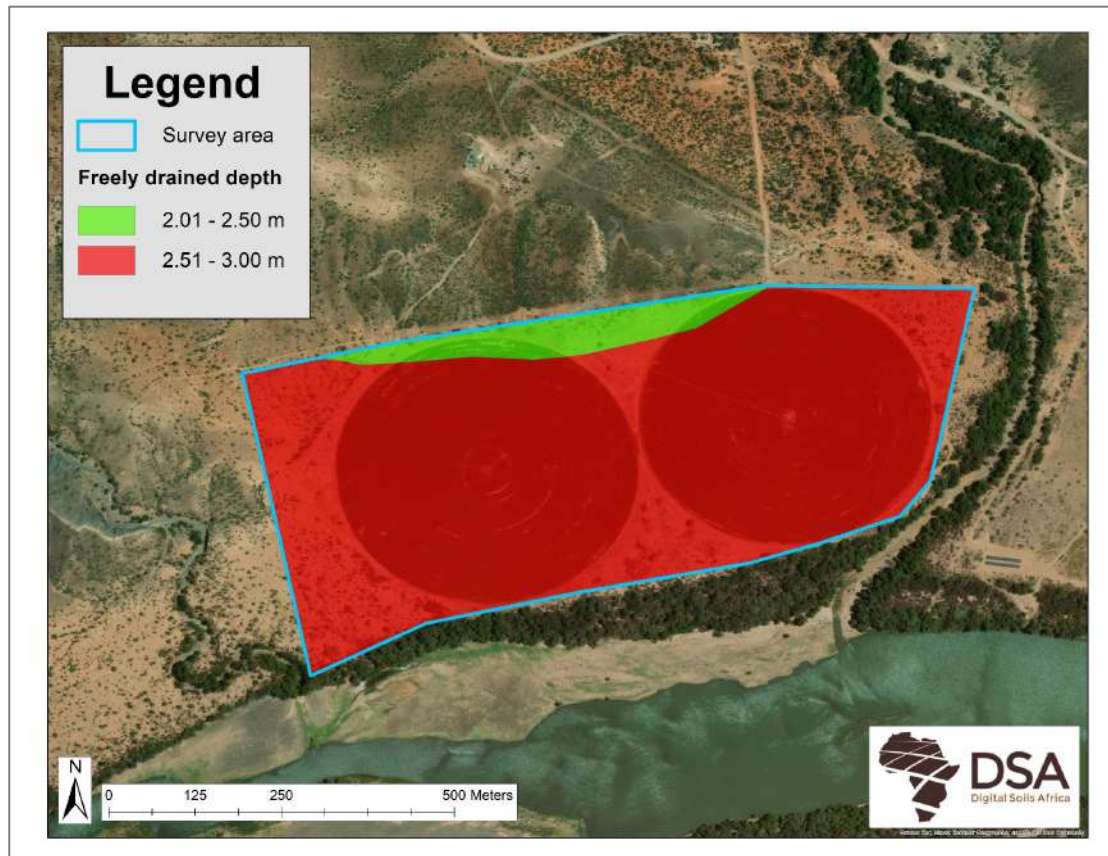


Figure 7: Freely drained depth of the surveyed area.

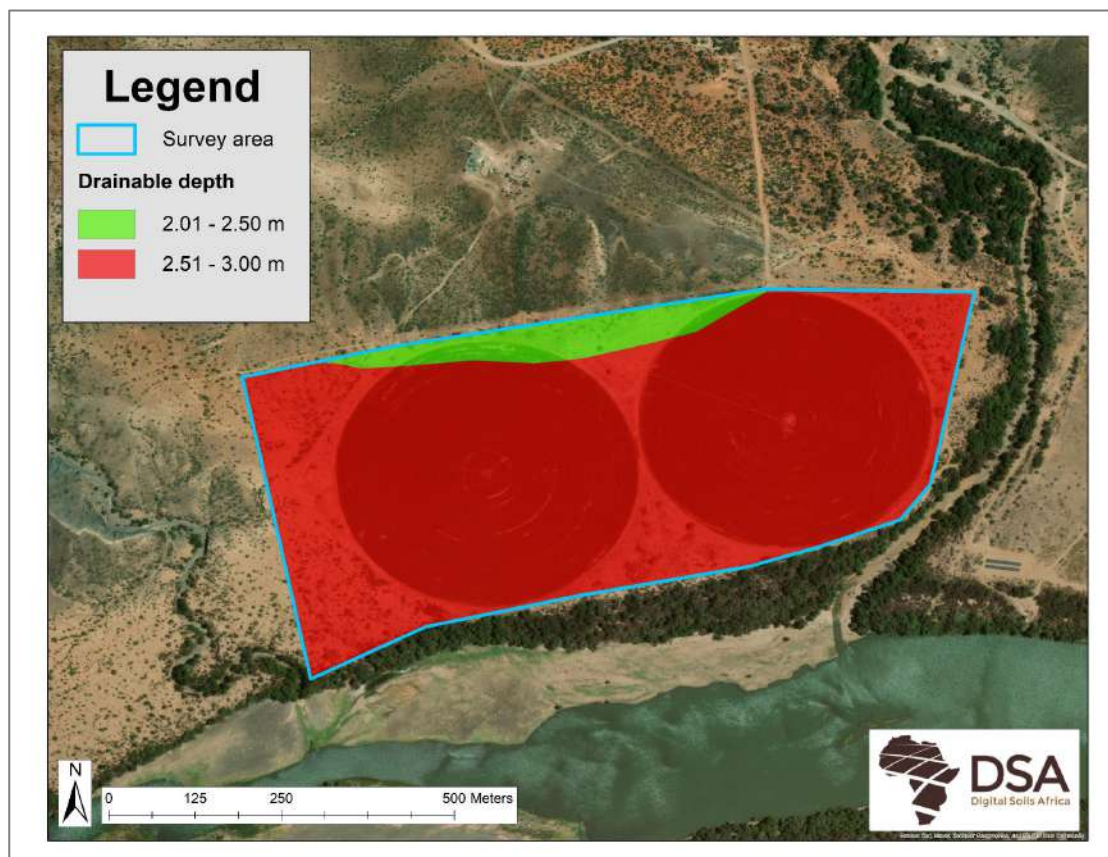


Figure 8: Drainable depth of the surveyed area.

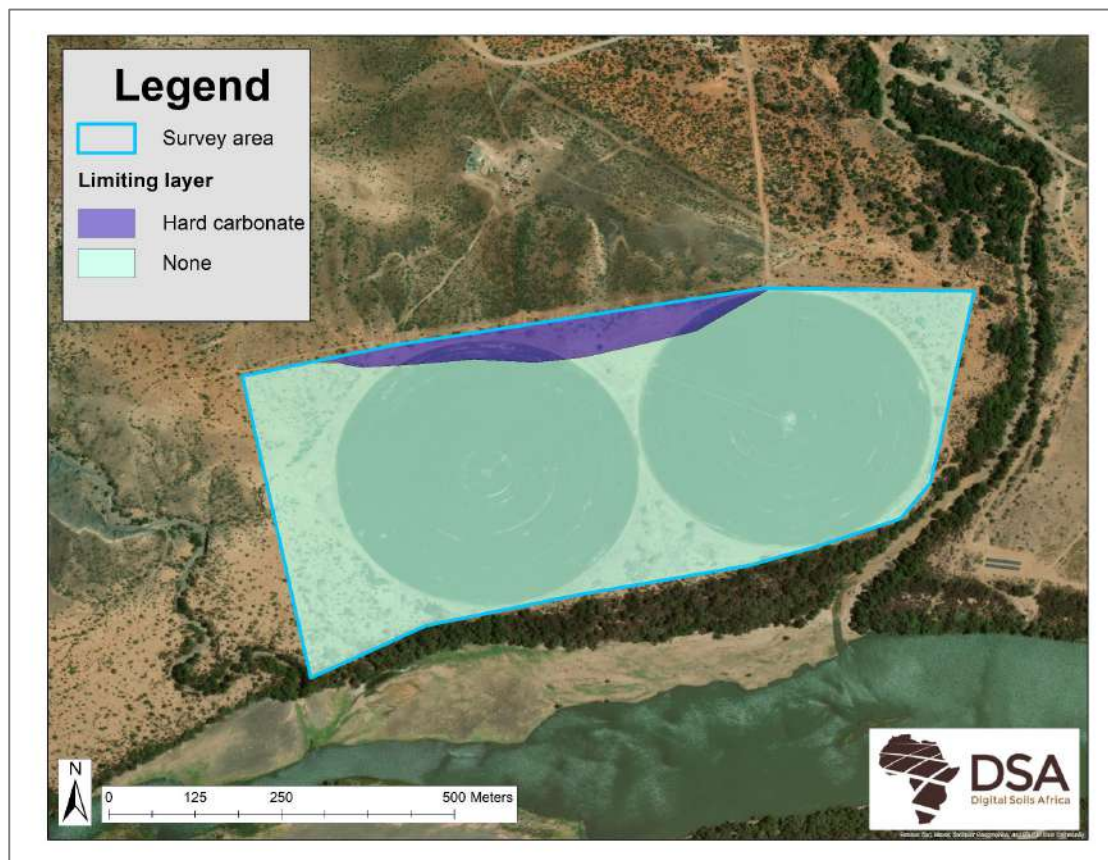


Figure 9: Depth limiting layer of the surveyed area.

4.3 CHEMICAL AND SOIL TEXTURE ANALYSIS

Table 3 (chemical) and Table 4 (texture) present selected soil properties of samples taken from modal profiles.

Based on the chemical analysis, none of the soils exceed the norms in terms of any of the chemical norms for irrigatable soil. Since the soils are freely drained and excessive Na is not a problem leaching with excessive water will maintain EC levels within acceptable norms. Exchangeable Sodium Percentage (ESP) and the Sodium Adsorption Ratio (SAR) are all within the norms for soils to be irrigated. The P content is low but will be elevated when fertiliser is applied.

The clay percentages of all the top and subsoils are all within the recommended ranges of the Department.

Table 3: Selected chemical properties for soil profile observations

Observation	Soil form	Horizon	pH (KCl)	EC	Ca	Mg	Na	K	CEC	ESP	SAR*	S	P
				mS/m	cmol(+)/kg					%		mg/kg	
JP-7A	Oakleaf	Orthic	6.03	48.30	14.25	5.65	0.23	0.32	20.46	1.11	0.07	28.27	17.22
JP-7B		Neocutanic	6.67	54.80	16.36	4.81	0.51	0.16	21.84	2.34	0.16	37.15	2.09
JP-11A	Oakleaf	Orthic	6.66	126.00	11.90	4.96	0.20	1.10	18.16	1.12	0.07	27.87	26.90
JP-11B		Neocutanic	6.75	53.70	21.07	6.81	0.27	0.39	28.54	0.96	0.07	49.46	5.03
JP-15A	Oakleaf	Orthic	6.69	95.30	18.34	3.88	0.22	0.79	23.24	0.93	0.06	42.27	12.93
JP-15B		Neocutanic	6.79	99.50	17.22	4.92	0.75	0.16	23.05	3.27	0.23	41.75	1.98

* SAR – approximated from 1:10 NH₄OA_c extract

Table 4: Particle size distribution of soil observations

Observation	Soil form	Horizon	Sand	Silt	Clay
			%		
JP-7A	Oakleaf	orthic	45.8	22.3	32.6
JP-7B		neocutanic	49.2	23.4	27.4
JP-11A	Oakleaf	orthic	51.7	21.2	27.2
JP-11B		neocutanic	43.3	24.4	32.4
JP-15A	Oakleaf	orthic	61.2	17.2	22.4
JP-15B		neocutanic	42.2	24.2	34.0

4.4 SUITABILITY MAPS

Based on soil morphology and laboratory analysis, the entire surveyed areas are suitable for cultivation and irrigation in accordance with the guidelines of the Northern Cape Department of Agriculture (Figure 10). The Oakleaf soils all very deep (>2.5 m) and show no signs of saturation. The Prieska soils are also deep and the limiting layer only at >2 m. The perimeter coordinates of the final suitability classes for both areas are the same as the surveyed area presented in Table 1. We did highlight in Figure 10 that the Prieska soils might not be ideal for pecan nut production but do not foresee any degradation of the soils when pecans are produced.

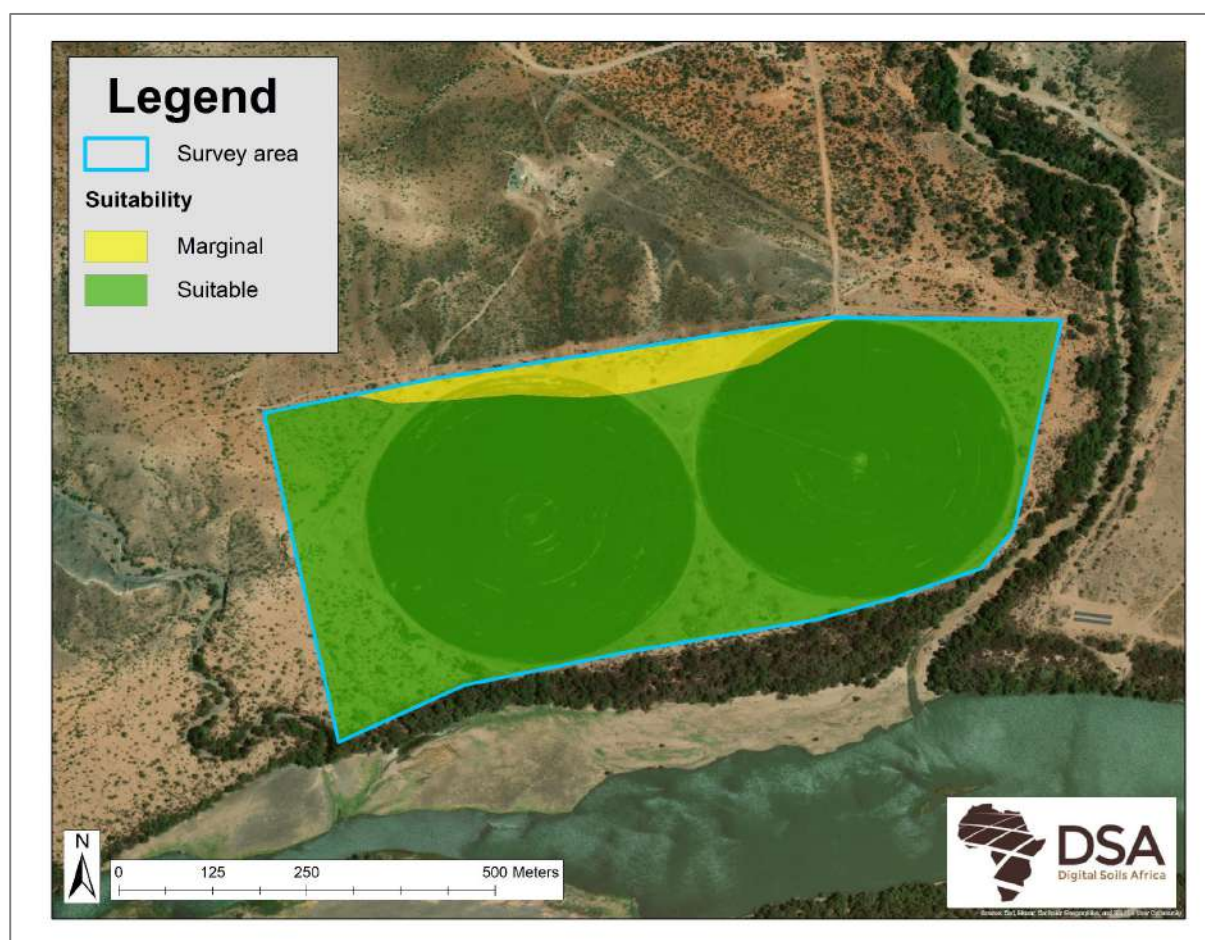


Figure 10: Suitability for cultivation and irrigation of focus area.

5. CONCLUSION

The soil survey conducted on portions of the Tweefontein farm confirms that the area is mostly covered by freely drained Oakleaf soils well-suited for irrigation and cultivation. The area in the north covered by Prieska soils is also suitable, although not as suitable as the Oakleaf soils. All four surveyed portions have soils exhibiting sufficient depth, good drainage characteristics, and

favourable chemical properties. Overall, the land is suitable for irrigation, provided that appropriate management practices are implemented to mitigate potential salinity risks.

6. REFERENCES

- Gee GW and Bauder JW, 1979. Particle size analysis by hydrometer: a simplified method for routine textural analysis and a sensitivity test of measured parameters. Soil Science Society of America Journal 43:1004-1007.
- Soil Classification Working Group, 2018. Soil Classification: A Natural and Anthropogenic System for South Africa.
- White R E, 2006. Principles and Practice of Soil Science: The soil as a Natural Resource. 4th ed. Blackwell Science, Oxford, UK.

7. DISCLAIMER

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

8. APPENDICES

APPENDIX 1: MODAL SOIL PROFILE DESCRIPTION

General Information

Site:	Tweefontein JP7			Soil form:	Oakleaf
Map/Photo example:	Figure 4			Soil family:	2110
GPS Position:	23,0218; -29,4416			Colour	Chromic
Surface stones:	0%			Occurrence of flooding:	None
Altitude:	978 masl			Wind erosion potential:	Moderate
Terrain unit:	Footslope			Water erosion potential:	Low
Slope:	1%			Vegetation/Land use:	Cultivated
Slope shape:	Planform	Straight	Profile	Water table:	Land
Aspect:	None				None
Micro-relief:	None			Described by:	JJ van Tol
Parent material	Alluvial deposits			Date described:	2025-09-17
solum:				Weathering of underlying material:	
Geological group:	Dwyka Formation				

Profile Information

<i>Horizon</i>	<i>Depth (mm)</i>	<i>Diagnostic Horizon</i>	<i>Colour</i>	<i>Structure</i>	<i>Redoximorphic features</i>	<i>Lime</i>	<i>Transition</i>
A	300	Orthic A	Brown	Weak- Moderate, medium, SANBL	None	Absent	Gradual
B1	2500+	Neocutanic	Brown	Weak-moderate, medium, SANBL	None	Absent	Not reached

General Information

Site:	Tweefontein JP15			Soil form:	Oakleaf
Map/Photo example:	Figure 4			Soil family:	2120
GPS Position:	23,01639; -29,4121			Colour	Chromic
Surface stones:	0%			Occurrence of flooding:	None
Altitude:	965 masl			Wind erosion potential:	Moderate
Terrain unit:	Footslope			Water erosion potential:	Low
Slope:	1%			Vegetation/Land use:	Cultivated Land
Slope shape:	Planform	Straight	Profile	Water table:	None
Aspect:	None				
Micro-relief:	None			Described by:	JJ van Tol
Parent material solum:	Alluvial deposits			Date described:	2025-09-17
Geological group:	Dwyka Formation			Weathering of underlying material:	

Profile Information

<i>Horizon</i>	<i>Depth (mm)</i>	<i>Diagnostic Horizon</i>	<i>Colour</i>	<i>Structure</i>	<i>Redoximorphic features</i>	<i>Lime</i>	<i>Transition</i>
A	300	Orthic A	Brown	Weak- Moderate, medium, SANBL	None	Absent	Gradual
B1	2500+	Neocutanic	Brown	Weak-moderate, medium, SANBL	None	Absent	Not reached

APPENDIX 2: AGRONOMICAL REPORT

Compiled by Prof. G.M. van Zijl

Pr.Sci.Nat – Agricultural Science 400065/15

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Agronomical report for the production of pecan nuts on the farm Tweefontein, Prieska, Northern Cape

1. General soil requirements for pecan nut production

Pecan nuts grows optimally in fertile, well drained soils with a moderate to loose structure. In ideal situations the roots can grow as deep as 3 metres, but feeding roots occur only in the top 40-60 cm. No lime should occur in the area where the feeder roots grow (40-60 cm), as a high pH renders micro-nutrients unavailable for uptake by pecan nut roots. Thus neocarbonate, soft carbonate and hard carbonate horizons should not occur within 60 cm of the soil surface. Hard, root impenetrable horizons (indurated or heavy clay soils) should not occur within 60 cm of the soil surface, as pecan nuts require a well-drained soil medium to ensure adequate aeration. Therefore, soils with a clay percentage of 10-40% is preferred for pecan nut production, provided the drainage and aeration is acceptable for pecan nuts. Pecan nuts can grow in soils with a coarse fraction of up to 80%, as long as the medium is loose enough to allow root growth. Irrigation scheduling should be adapted according to the soil properties. A good water holding capacity is desirable, with a clay percentage of above 5%. Soils with a high fertility are preferred, but as fertility can be rectified with a fertilization plan, the other soil prerequisites take precedence over the fertility requirements. The exchangeable sodium percentage (ESP) should not exceed 3%, but can be rectified with chemical and irrigation management.

2. Specific Tweefontein situation.

2.1. Soil Depth

The soil depth for the entire area is freely drained to at least 2 m. Therefore the soil is suitable for pecan nut production.

2.2. *Soil texture*

The soil texture referred to has a clay percentage of between 22 and 34%, which is within the acceptable limits. The soil is well drained, with sufficient water holding capacity.

2.3. pH

For the suitable marked area, no lime containing horizons were found within the top 60 cm of the soil, and the pH for the samples are between 6.0 and 6.8, which is sufficient for pecan nut production. However, the area marked as marginal does contain free lime within the top 60 cm, and pecan nut trees planted here will struggle with micro nutrient uptake. A leaf spray should be administered for micro nutrient fertilization within this area.

2.4. Fertility

The CEC value is between 18 and 23 cmol(+)/kg, which indicates that the soil is sufficiently fertile for pecan nut production. Fertility management does however stay important for optimal production.

2.5. Salinity and sodicity

The electrical conductivity of 48-126 mS/m is below the threshold for pecan nut production (200 mS/m), showing that salts have not accumulated in the soil. The ESP is also below 3, showing that sodicity levels are also in line. With irrigation, salts and sodium will be deposited in the soil, and should be monitored and managed as necessary. However, as the soils are very deep on the largest part of Tweefontein, salinity and sodicity is a small threat, which should easily be managed through irrigation and fertility management.

3. Conclusions

Based on morphological, physical and chemical observations and measurements, the area indicated as suitable is suitable for pecan nut production. The marginal area is indeed marginal, as free lime in the upper 60 cm will hinder micro nutrient uptake which needs to be applied through foliar sprays. However, the issue is economical (cost of foliar sprays vs yield), and panting of pecan nut trees will not lead to soil degradation.

APPENDIX 3 – SPECIALIST CV - JOHAN VAN TOL

Jacobus Johannes van Tol

EDUCATION

Certificate in Environmental Law	University of Pretoria	2017
PhD Soil Science	University of the Free State	2011
M.Sc. Agric Soil Science	University of the Free State	2008
B.Sc. Agric (Hon)	University of the Free State	2007
B.Sc. Agric	University of the Free State	2006

PROFESSIONAL AFFILIATIONS

- SACNASP- Pri Nat Sci 400274/13
- Past-President of the Soil Science Society of South Africa
- Member of the Soil Classification Work Group
- Member of South African Soil Surveyors Organisation

WORK EXPERIENCE

- **University of the Free State** / Professor (full): current
- **Digital Soils Africa** / Soil Scientist: 2015 – Present
- **University of Fort Hare** / Senior Lecturer: 2011 - 2016
- **University of the Free State** / Researcher: 2007 - 2011

RECENT PUBLICATIONS

Total peer reviewed publications: 97 [full list](#)

Total consultancy and research projects: > 120

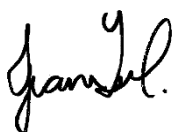
- Van Zijl, G.M. & van Tol, J.J., 2024. Digital soil mapping enables informed decision-making to conserve soils within protected areas. *South African Journal of Plant and Soil*. <https://doi.org/10.1080/02571862.2023.2255158>
- Malongweni, S.O. & van Tol, J.J., 2023. Medium-term interactive effects of herbivores and plant life form on the biochemistry of shallow sandy soils in a protected semi-arid savanna. *Environmental Systems Research*. 12:38 <https://doi.org/10.1186/s40068-023-00320-9>
- Kotze, J.J., Mc Lean, C, van Tol, J.J., 2023. Digitally mapping soil carbon of the uThukela headwater catchment in the Maloti-Drakensberg, a remote Afromontane mountain region. *South African Geographical Journal*. <https://doi.org/10.1080/03736245.2023.2272896>.
- Kotze, J.J. & van Tol, J.J., 2023. Extrapolation of Digital Soil Mapping approaches for soil organic carbon stock predictions in an Afromontane Environment. *Land*, 12, 520. <https://doi.org/10.3390/land12030520>
- Van Tol, J.J. & Bouwer, D., 2024. Hydropedology of South African soil forms and families. *WaterSA*, 50(2), 236 – 245. <https://doi.org/10.17159/wsa/2024.v50.i2.4094>.

- Van Tol, J.J. & van Zijl, G.M., 2022. South Africa needs a hydrological soil map: a case study from the upper uMgeni catchments. *Water SA*, 48(4) 335 – 347. <https://doi.org/10.17159/wsa/2022.v48.i4.3977>.
- Van Tol, J.J., Bieger, K. & Arnold, G., 2021. A Hydropedological approach to simulate streamflow and soil water contents with SWAT+. *Hydrological Processes*. DOI:10.1002/hyp.14242.
- Van Tol, J.J., 2020. Hydropedology in South Africa: advances, applications and research opportunities. *South African Journal of Plant and Soil*. <https://doi.org/10.1080/02571862.2019.1640300>

SPECIALIST DECLARATION

I, Johan van Tol, declare that –

- I act as the independent specialist in this application;
- I regard the information contained in this report to be true and correct;
- I do not have a conflict of interest in this project;
- I will conduct the work relating to the project in an objective manner.

A handwritten signature in black ink, appearing to read 'J. van Tol'.

Prof. Johan van Tol
PhD Soil Science
Pri Nat Sci 400274/13

APPENDIX F3 – TERRESTRIAL FLORA AND ECOLOGICAL REPORT

**AN ECOLOGICAL REPORT ON THE FLORA:
ON THE FOLLOWING FARMS IN THE NORTHERN CAPE:
TWEEFONTEIN: REMAINDER OF FARM TWEEFONTEIN
373, AND
KALKFONTEIN: PORTION 4 (PORTION OF PORTION 2) OF
FARM KALKFONTEIN**

A report commissioned by Digital Soils Africa

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CONDITIONS RELATING TO THIS REPORT

Declaration of interest

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

- Have no vested interest in the property studied, nor is it affiliated with any other person/body involved with the property and/or proposed development.
- Is not a subsidiary, legally or financially, of the proponent.
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act No 107 of 1998) (NEMA).
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- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA.
- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and/or further work in this field.
- Is committed to biodiversity conservation but concomitantly recognise the need for economic development. We reserve the right to form and hold our own opinions within the constraints of our specialities and experience and, therefore, will not submit willingly to the interests of other parties or change our statements to appease them

The study was undertaken by Dr AC van Aardt (PhD UFS) who is registered as a Professional Natural Scientist (Reg. No. 131584 Ecological Sciences and Botanical Sciences) and Mr M Muller (MSc Botany).

She has the following qualifications

SPECIALIST	QUALIFICATION
Dr A.C. van Aardt	PhD – Botany MSc – Botany BSc Hons (Botany) BSc (Botany & Zoology)
M Muller	MSc – Botany BSc Hons Environmental Science BSc (Geography and Environmental Sciences)

Indemnity

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Factors limiting the quality of this report

The formal site visit was undertaken on 18 December 2025. This was during the rainy season which also permits the flowering and growth of plants. Although some plants had flowers, inflorescences and seeds it was not the case for all. Grass identification was particularly challenging since most did not have inflorescences or leaves sufficient for identification. Plants that had flowers or had remnants of flowers at the time of the visit could be identified. Some of the more rare and cryptic species may have been overlooked due to their inconspicuous growth forms. Many of the rare and endangered succulent species can only be distinguished (in the veld) from their very similar relatives on the basis of their reproductive parts. These plants flower during different times of the year. Multiple visits to any site during the different seasons of the year could, therefore, increase the chances to record a larger portion of the total species complex associated with the area. The survey of the study site is, however, considered as successful with a correct identification of the vegetation units and their ecological sensitivity.

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

Approach

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



Dr A.C. van Aardt

Sparaxis Environmental Pty (Ltd)

INTRODUCTION

A complex of extensive plains with dwarf shrubs, grasses, succulents, geophytes and trees along drainage line is a description of the Nama-Karoo. Although the area has a low floristic diversity there is a high diversity of plant life forms. This biome is however known for its low vegetation cover that is associated with aridity. The karoo and karoo-like environments which include Griqualand West, are harsh environments that are unpredictable, with indigenous plants and animals that were selected over hundreds of thousands of years. This area occurs in the north-central parts of South Africa, mainly in the Northern Cape, although it also includes parts of the North-West and the Free State Provinces. The Griqualand West area is semi-arid with a few perennial rivers; however, the most prominent is the Orange River. Associated with water and processes the Orange River is linked to the control of creation, maintenance and development of peculiar habitats. These habitats normally form along flowing and stagnant freshwater bodies where they can be experiencing seasonal or permanent inundation and/or flooding that either occur regularly, irregularly or result in catastrophic events. There is, however, a lack of knowledge in terms of vegetation in the Griqualand West areas, even though it has been known since the mid-20th century that this area has a high floristic diversity. Knowledge of this extraordinary ecosystem will enable better management and decision-making about sustainable development.

Vegetation forms the most obvious external feature on which ecosystems are classified and defined. Uncontrolled and ill-planned development is one of the biggest threats to naturally evolved life on Earth. Development worldwide in the past and at present is responsible for the destruction of various plant and animal species, as well as the habitats in which they occur. The lack of knowledge about the vegetation of the Griqualand West area, therefore, makes it vulnerable to uninformed development. Therefore, a balance needs to be developed between the needs of humans and the conservation of natural habitats or resources. This balance is one of the biggest challenges faced by decision-makers in the country.

Preventing the destruction of any ecosystem requires a need for systematic planning and co-ordination of human activities, and development should be prioritised. The

planning should include studies of the natural environment, which include soil, water, vegetation, animals and cultural as well as historical aspects.

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

AIMS OF THE STUDY

This report aims to present ecological information on the flora that could have been present on the farms Tweefontein and Kalkfontein where pivots have already been erected in the Northern Cape, South Africa (hereafter referred to as the study area).

The objectives of this study were to:

- Identify, describe, and delineate the different vegetation units present on the property
- Compile a map of the vegetation units present in the area
- Indicate the presence of protected plant species or suitable habitat
- Identify alien invasive plant species
- Provide a sensitivity map of the study area (where applicable).

STUDY AREA

Location

The study sites are located north-east of Prieska between the R386 to Niekerkshoop and the R357 to Douglas on the banks of the Orange River (Figure 1). Both farms Tweefontein and Kalkfontein, occur along the Orange River forming their southern boundaries, with natural vegetation to the west and north of Tweefontein. On the eastern boundary, Tweefontein borders Kalkfontein. Kalkfontein only has natural vegetation to the north; the eastern boundary borders another agricultural field.

The study areas fall within the Nama Karoo Biome and the Inland Azonal Vegetation of Mucina and Rutherford (2006). The farm Tweefontein falls within the Inland Azonal

Vegetation known as the Upper Gariep Alluvial Vegetation type (Aza 4). The farm Kalkfontein, falls within two different vegetation types namely the Inland Azonal Vegetation known as the Upper Gariep Alluvial Vegetation (Aza 4) that comprises most of the farm. The north-eastern tip of the farm falls within the least threatened Northern Upper Karoo (NKu 3) of the Nama Karoo Biome. The Inland Azonal Vegetation, known as the Upper Gariep Alluvial Vegetation (Aza 4) that is present on both farms, is regarded as vulnerable (Mucina and Rutherford, 2006). The size of the study areas is approximately 32.7 ha (Magoras) and 106 ha (Kalkfontein).



Figure 1: Locality of the study sites, Tweefontein in blue and Kalkfontein in orange (Source: Google Maps)

Existing impacts on the study site include:

Both Tweefontein and Kalkfontein had existing disturbances in the form of erected pivots, solar panels and farm sheds. We thus only investigated the vegetation surrounding the pivots and the natural vegetation in the surrounding areas.

In order to get an overview of what the natural vegetation looked like, Mucina and Rutherford (2006) were consulted, and the dominant species in each of the vegetation types present in the study areas are listed below.

Upper Gariep Alluvial Vegetation (Aza4) next to the Orange River should include species such as: *Acacia karroo*, *Celtis africana*, *Salix mucronata* subsp. *mucronata*, *Royena lycioides* [*Diospyros lycioides*], *Melianthus comosus* and *Melica decumbens*.

The Northern Upper Karoo (Nku3) that is present in the most northern parts of the Kalkfontein farm should contain dominant species such as: *Lycium cinereum*, *Chrysocoma ciliata*, *Lasiociphon polycephalus* [*Gnidia polycephala*], *Pentzia calcarea*, *Pentzia globosa*, *P. incana*, *P. spinescens*, *Rosenia humilis*, *Thesium hystrix*, *Aristida adscensionis*, *A. congesta*, *A. diffusa*, *Enneapogon desvauxii*, *Eragrostis lehmanniana*, *E. obtusa*, *E. truncata*, *Sporobolus fimbriatus* and *Stipagrostis obtusa*.

METHODS

VEGETATION

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

Data recorded included:

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

Red data and protected species

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

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

Data processing

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

High	Area with natural vegetation with a high species richness and habitat diversity; presence of viable populations of red data plant species OR suitable habitat for such species; presence of unique habitats; less than 5% pioneer/alien plant species present. These areas are ecologically valuable and important for ecosystem functioning. This land should be conserved and managed, and is not suitable for development purposes.
Medium-high	Natural area with a relatively high species richness and diversity; not a threatened or unique ecosystem; moderate habitat diversity; between 5-10% pioneer/alien plant species present; that would need low financial input and management to improve its current condition; and where low-density development could be considered with limited impact on the vegetation / ecosystem. It is

	recommended that larger sections of the vegetation be maintained.
Medium	An area with a relatively natural species composition; not a threatened or unique ecosystem; moderate species diversity; between 11-20% pioneer/alien plant species present; that would need moderate to major financial input to rehabilitate to an improved condition; and where medium density development could be considered with limited impact on the vegetation / ecosystem. Where possible, certain sections of the vegetation could be maintained.
Low-medium	Area with relatively natural vegetation, though a common vegetation type; moderate to low species and habitat diversity; previously or currently degraded or in secondary successional phase; between 20-40% pioneer and/or alien plant species; low ecosystem functioning; low rehabilitation potential.
Low	A totally degraded and transformed area with a low habitat diversity and ecosystem functioning; no viable populations of natural plants; >40% pioneer and/or alien plant species present; very low habitat uniqueness; whose recovery potential is extremely low; and on which development could be supported with little to no impact on the natural vegetation / ecosystem.

RESULTS OF THE VEGETATION SURVEY

Vegetation units at Tweefontein

Two pivots were present at this farm, and the remaining vegetation around it was investigated (Figure 1). The study area can be divided into three different vegetation units (Figure 2) that could be identified. The vegetation in the vicinity of the Orange River was included since the river plays an important role in the ecological functioning of the area.

1. Riparian vegetation unit
2. Disturbed pivot vegetation unit
3. Natural vegetation unit

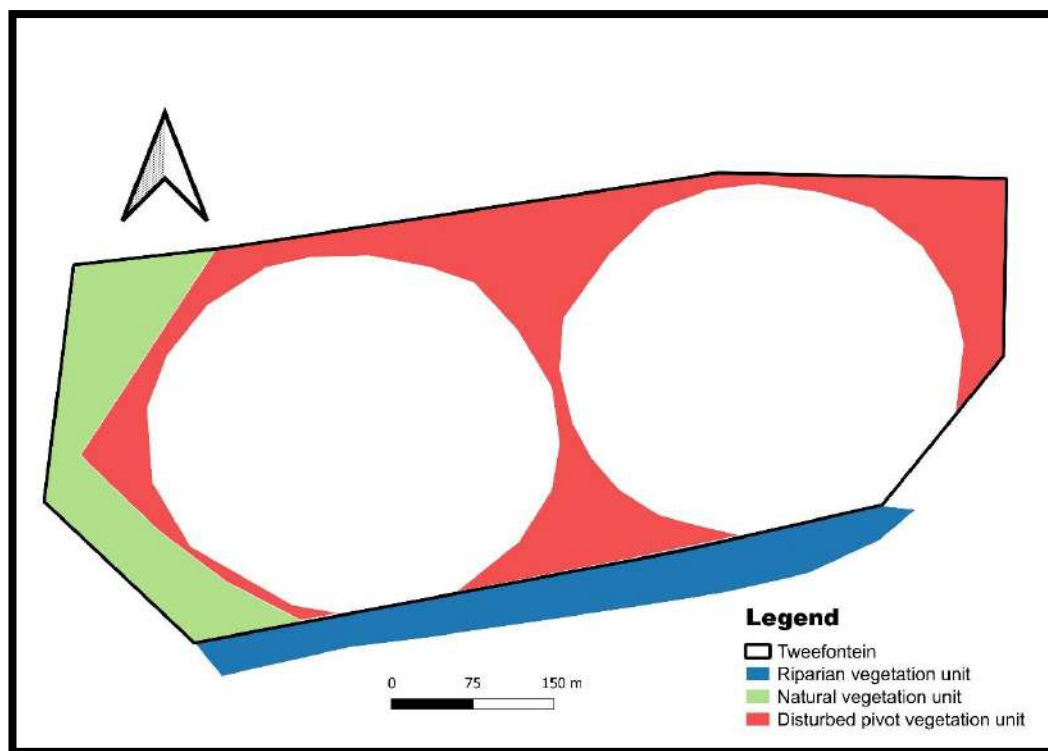


Figure 2: Different vegetation units identified at the Tweefontein farm.

1. Riparian vegetation unit



Figure 3: Riparian vegetation unit indicating the dominance of trees and shrubs that create an impenetrable unit.

Status	Natural with some anthropogenic disturbance
Vegetation structure	The vegetation is composed of trees and shrubs with a few grasses and herbs.
Topography	Sloping in a southern direction towards the Orange River
Rock cover	No rock cover, mostly sandy soils
Conservation priority	High

This vegetation unit (Figure 3) occurs on the southern boundaries of both the farms, Tweefontein (2.94 ha) and Kalkfontein (10.7 ha). The slope of this unit is in a southerly direction towards the Orange River. Protected species include *Mesembryanthemum junceum*, *M. coriarium* and *M. guerichianum* listed under the Northern Cape Ordinance, Schedule 2, because of the families in which they occur.

The vegetation of this area is dominated by trees such as *Vachellia karroo*, *Ziziphus mucronata*, *Searsia lancea*, *Searsia pendulina*, and scattered individuals of **Neltuma glandulosa* [**Prosopis glandulosa*]. Shrubs include *Lycium hirsutum* and *L. cinereum*. Prominent grasses include *Bromus catharticus*, *Eragrostis lehmannina*, *Phragmites australis* and *Setaria verticillata*. The herbs found were mostly alien invasive species.

Protected species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum junceum</i>	Succulent

Invasive Alien plant species

Family	Species	Growth form
Amaranthaceae	<i>*Alternanthera pungens</i>	Herb
Amaranthaceae	<i>Chenopodium *album</i>	Herb
Asteraceae	<i>Bidens *bipinnata</i>	Herb
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Fabaceae	<i>*Neltuma glandulosa</i>	Tree/shrub
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Poaceae	<i>Bromus *catharticus</i>	Graminoid

List of species found during the study:

The following is a list of plant species identified during the survey, where * indicates alien invasive species.

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum junceum</i>	Succulent
Amaranthaceae	* <i>Alternanthera pungens</i>	Herb
Amaranthaceae	<i>Atriplex semibaccata</i>	Dwarf shrub
Amaranthaceae	<i>Chenopodium *album</i>	Herb
Amaranthaceae	<i>Exomis microphyllum</i>	Succulent
Amaranthaceae	<i>Salsola kali</i>	Herb
Anacardiaceae	<i>Searsia lancea</i>	Tree/shrub
Anacardiaceae	<i>Searsia pendulina</i>	Tree shrub
Asparagaceae	<i>Asparagus laricinus</i>	Shrub
Asteraceae	<i>Bidens *bipinnata</i>	Herb
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Asteraceae	<i>Nolletia chrysocomoides</i>	Dwarf shrub
Brassicaceae	<i>Lepidium africanum</i>	Herb
Fabaceae	<i>Vachellia karroo</i>	Tree/shrub
Fabaceae	<i>Senegalia mellifera</i>	Tree/shrub
Fabaceae	* <i>Neltuma glandulosa</i>	Tree/shrub
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Poaceae	<i>Bromus *catharticus</i>	Graminoid
Poaceae	<i>Eragrostis lehmanniana</i>	Graminoid
Poaceae	<i>Phragmites australis</i>	Graminoid
Poaceae	<i>Setaria verticillata</i>	Graminoid
Poaceae	<i>Tragus berteronianus</i>	Graminoid
Portulacaceae	<i>Portulaca oleracea</i>	Succulent
Rhamnaceae	<i>Ziziphus mucronata</i>	Tree/shrub
Solanaceae	<i>Lycium cinereum</i>	Shrub
Solanaceae	<i>Lycium hirsutum</i>	Shrub
Zygophyllaceae	<i>Tribulus terrestris</i>	Herb

2. Disturbed pivot vegetation unit



Figure 4: Disturbed pivot vegetation unit.

Status	Disturbed
Vegetation structure	Vegetation is mostly dominated by succulents with some herbs and scattered shrubs.
Topography	Sloping in a southerly direction towards the Orange River, but seems to be relatively flat.
Rock cover	Small-sized rocks present on sandy soils
Conservation priority	Low-Medium

This vegetation unit (Figure 4) occurs in the immediate vicinity of the pivots on the farm and covers an area of approximately 7.27 ha within the study area. The vegetation unit is relatively flat but slopes slightly in a southern direction towards the Orange River.

The vegetation is mostly dominated by the succulents *Mesembryanthemum guerichianum*, *Portulaca *oleracea*, *Portulaca quadrifida* and *Exomis microphyllum*. Scattered shrubs that are also prominent include *Pentzia incana*, *P. spharocephala*,

Roepera pubescens and *Tetraena microcarpa*. Very few grasses and herbs occur in this vegetation unit, and there are also various bare soil patches. Protected species include *Mesembryanthemum coriarium* and *M. guerichianum* listed under the Northern Cape Ordinance, Schedule 2, because of the families in which they occur. *Boscia albitrunca* is listed as a protected tree under both the Northern Cape Ordinance and the National Forest Act of 1998. Declared alien invasive species that are present in this vegetation unit include **Xanthium spinosum*, **Datura ferox*, **D. innoxia* and **D. stramonium*.

Protected species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Capparaceae	<i>Boscia albitrunca</i>	Tree/shrub

Invasive Alien plant species

Family	Species	Growth form
Amaranthaceae	<i>Salsola kali</i>	Herb
Asteraceae	<i>Erigeron bonariensis</i>	Herb
Asteraceae	<i>*Xanthium spinosum</i>	Herb
Brassicaceae	<i>*Lepidium didymum</i>	Herb
Fabaceae	<i>*Neltuma glandulosa</i>	Tree/shrub
Nyctaginaceae	<i>Boerhavia cordobensis</i>	Herb
Papaveraceae	<i>*Argemone ochroleuca</i>	Herb
Poaceae	<i>Sorghum halepense</i>	Graminoid
Portulacaceae	<i>Portulaca oleracea</i>	Herb
Solanaceae	<i>*Datura ferox</i>	Shrub
Solanaceae	<i>*Datura innoxia</i>	Shrub
Solanaceae	<i>*Datura stramonium</i>	Shrub

List of species found during the study:

The following is a list of plant species identified during the survey, where * indicates alien invasive species.

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Amaranthaceae	<i>Atriplex semibaccata</i>	Dwarf shrub
Amaranthaceae	<i>Exomis microphyllum</i>	Succulent
Amaranthaceae	<i>Salsola kali</i>	Herb
Anacardiaceae	<i>Searsia lancea</i>	Tree/shrub

Family	Species	Growth form
Asparagaceae	<i>Asparagus larycinus</i>	Shrub
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Asteraceae	<i>Pentzia incana</i>	Shrub
Asteraceae	<i>Pentzia sphaerocephala</i>	Shrub
Asteraceae	<i>*Xanthium spinosum</i>	Herb
Brassicaceae	<i>*Lepidium didymum</i>	Herb
Brassicaceae	<i>Lepidium englerianum</i>	Herb
Capparaceae	<i>Boscia albitrunca</i>	Tree/shrub
Celastraceae	<i>Gymnosporia buxifolia</i>	Tree/shrub
Fabaceae	<i>*Neltuma glandulosa</i>	Tree/shrub
Molluginaceae	<i>Kewia salsoloides</i>	Dwarf shrubs
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Papaveraceae	<i>*Argemone ochroleuca</i>	Herb
Poaceae	<i>Eragrostis echinochloidea</i>	Graminoid
Poaceae	<i>Eragrostis lehmanniana</i>	Graminoid
Poaceae	<i>Setaria verticillata</i>	Graminoid
Poaceae	<i>Sorghum *halepense</i>	Graminoid
Portulacaceae	<i>Portulaca *oleracea</i>	Herb
Portulacaceae	<i>Portulaca quadrifida</i>	Succulent
Solanaceae	<i>*Datura ferox</i>	Shrub
Solanaceae	<i>*Datura innoxia</i>	Shrub
Solanaceae	<i>*Datura stramonium</i>	Shrub
Solanaceae	<i>Lycium bosciifolium</i>	Shrub
Solanaceae	<i>Lycium cinereum</i>	Shrub
Zygophyllaceae	<i>Roepera pubesecens</i>	Shrub
Zygophyllaceae	<i>Tetraena microcarpa</i>	Dwarf shrub
Zygophyllaceae	<i>Tribulus terrestris</i>	Herb

3. Natural vegetation unit



Figure 5: Near natural vegetation unit occurring on the western parts of the study area.

Status	Near natural
Vegetation structure	Vegetation is dominated by trees with a very prominent shrub layer. Vegetation cover on the ground is sparse but contains various herbs and grasses.
Topography	This terrain is sloping in various directions and is not even. There is a slight slope to the west – due to a tributary the Orange River occurring in that direction. There is also a slope towards the south, where the Orange River flows. The slope thus depends on where you are in the landscape.
Rock cover	Some areas contain rocks, other is mostly sandy
Conservation priority	Medium-high

This vegetation unit (Figure 5) is located on the western side of the study site and covers approximately 3.11 ha. Depending on your position in the landscape, it might

slope westward towards the tributary of the Orange River or southward towards the Orange River itself.

The vegetation can be regarded as near-natural dominated by *Senegalia mellifera* as either trees or shrubs, while the shrub layer is dominated by *Roepera pubescens*, *Tetraena microcarpa*, *Pentzia incana* and *Aizoon plinthoides*. Grasses and herbs are sparse. Scattered individuals of the protected tree *Boscia albitrunca* (listed as a protected tree under both the Northern Cape Ordinance and the National Forest Act of 1998) is also present in this vegetation unit. Other protected species include *Mesembryanthemum noctiflorum*, *M. guerichianum*, *Aizoon plinthoides* and *Ammocharis* sp., listed under the Northern Cape Ordinance, Schedule 2, because of the families in which they occur.

Protected species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum noctiflorum</i>	Succulent
Aizoaceae	<i>Aizoon plinthoides</i>	Dwarf shrub
Amaryllidaceae	<i>Ammocharis</i> sp.	Bulb
Capparaceae	<i>Boscia albitrunca</i>	Tree/shrub

Invasive Alien plant species

Family	Species	Growth form
Amaranthaceae	<i>Salsola kali</i>	Herb
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb

List of species found during the study:

The following is a list of plant species identified during the survey, where * indicates alien invasive species.

Family	Species	Growth form
Acanthaceae	<i>Pogonospermum divaricatum</i>	Shrub
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum noctiflorum</i>	Succulent
Aizoaceae	<i>Aizoon plinthoides</i>	Dwarf shrub
Amaranthaceae	<i>Atriplex semibacatta</i>	Dwarf shrub
Amaranthaceae	<i>Exomis microphylla</i>	Succulent
Amaranthaceae	<i>Salsola kali</i>	Herb
Amaranthaceae	<i>Salsola tuberculata</i>	Dwarf shrub

Family	Species	Growth form
Amaryllidaceae	<i>Ammocharis</i> sp.	Bulb
Asparagaceae	<i>Asparagus larisinus</i>	Shrub
Asteraceae	<i>Dicoma capensis</i>	Herb
Asteraceae	<i>Pentzia incana</i>	Shrub
Asteraceae	<i>Pentzia sphaerocephala</i>	Shrub
Bigoniaceae	<i>Rhigozum trichotomum</i>	Shrub
Boraginaceae	<i>Ehretia alba</i>	Shrub
Capparaceae	<i>Boscia albitrunca</i>	Tree/shrub
Fabaceae	<i>Vachellia karroo</i>	Tree/shrub
Fabaceae	<i>Senegalia mellifera</i>	Tree/shrub
Fabaceae	<i>Indigofera alternans</i>	Herb
Malvaceae	<i>Hermannia coccocarpa</i>	Herb
Malvaceae	<i>Hermannia spinosa</i>	Herb
Molluginaceae	<i>Kewa salsoloides</i>	Dwarf shrub
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Poaceae	<i>Cenchrus ciliaris</i>	Graminoid
Poaceae	<i>Enneapogon desvauxii</i>	Graminoid
Poaceae	<i>Eragrostis echinochloidea</i>	Graminoid
Poaceae	<i>Stipagrostis ciliata</i>	Graminoid
Poaceae	<i>Stipagrostis obtusa</i>	Graminoid
Poaceae	<i>Tragus berteronianus</i>	Graminoid
Portulacaceae	<i>Portulaca quadrifida</i>	Succulent
Rhamnaceae	<i>Ziziphus mucronata</i>	Tree/shrub
Schrophulariaceae	<i>Aptosimum indivisum</i>	Dwarf shrub
Scrophulariaceae	<i>Peliostomum leucorrhizum</i>	Dwarf shrub
Solanaceae	<i>Lycium cinereum</i>	Shrub
Zygophyllaceae	<i>Roepera pubescens</i>	Shrub
Zygophyllaceae	<i>Tetraena microcarpa</i>	Dwarf shrub

Vegetation units at Kalkfontein

Two actively cultivated pivots and two areas that contained pivots before were present at this farm, and the remaining vegetation around it was investigated (Figure 1). The study area can be divided into five different vegetation units (Figure 6) that were identified. The vegetation in the vicinity of the Orange River was included since the river plays an important role in the ecological functioning of the area.

1. Riparian vegetation unit
2. Succulent shrubland vegetation unit
3. Karroid shrubland vegetation unit
4. Grassy vegetation unit
5. Old fields vegetation unit

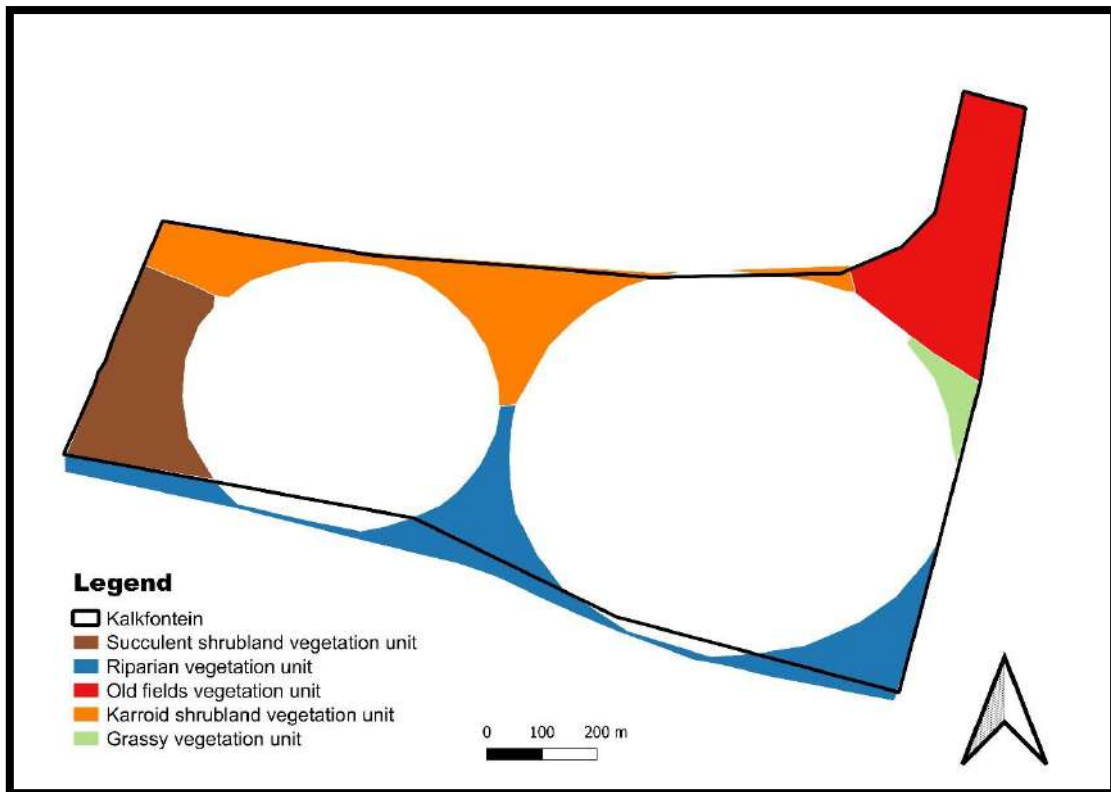


Figure 6: Different vegetation units identified at the Kalkfontein farm.

1. Riparian vegetation unit

This unit is the same as the unit identified on the Tweefontein farm and the content will therefore be a repetition.



Figure 7: Riparian vegetation unit indicating the dominance of trees and shrubs that create an impenetrable unit.

Status	Natural with some anthropogenic disturbance
Vegetation structure	The vegetation is composed of trees and shrubs with a few grasses and herbs.
Topography	Sloping in a southern direction towards the Orange River
Rock cover	No rock cover, mostly sandy soils
Conservation priority	High

This vegetation unit (Figure 7) occurs in the southern boundaries of both the farms, Tweefontein (2.94 ha) and Kalkfontein (10.7 ha). The slope of this unit is in a southerly direction towards the Orange River. Protected species include *Mesembryanthemum junceum*, *M. coriarium* and *M. guerichianum* listed under the Northern Cape Ordinance, Schedule 2, because of the families in which they occur.

The vegetation of this area is dominated by trees such as *Vachellia karroo*, *Ziziphus mucronata*, *Searsia lancea*, *Searsia pendulina*, and scattered individuals of **Neltuma glandulosa* [**Prosopis glandulosa*]. Shrubs include *Lycium hirsutum* and *L. cinereum*. Prominent grasses include *Bromus catharticus*, *Eragrostis lehmannina*, *Phragmites australis* and *Setaria verticillata*. The herbs found were mostly alien invasive species.

Protected species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum junceum</i>	Succulent

Invasive Alien plant species

Family	Species	Growth form
Amaranthaceae	<i>*Alternanthera pungens</i>	Herb
Amaranthaceae	<i>Chenopodium *album</i>	Herb
Asteraceae	<i>Bidens *bipinnata</i>	Herb
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Fabaceae	<i>*Neltuma glandulosa</i>	Tree/shrub
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Poaceae	<i>Bromus *catharticus</i>	Graminoid

List of species found during the study:

The following is a list of plant species identified during the survey, where * indicates alien invasive species.

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum junceum</i>	Succulent
Amaranthaceae	* <i>Alternanthera pungens</i>	Herb
Amaranthaceae	<i>Atriplex semibaccata</i>	Dwarf shrub
Amaranthaceae	<i>Chenopodium *album</i>	Herb
Amaranthaceae	<i>Exomis microphyllum</i>	Succulent
Amaranthaceae	<i>Salsola kali</i>	Herb
Anacardiaceae	<i>Searsia lancea</i>	Tree/shrub
Anacardiaceae	<i>Searsia pendulina</i>	Tree shrub
Asparagaceae	<i>Asparagus laricinus</i>	Shrub
Asteraceae	<i>Bidens *bipinnata</i>	Herb
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Asteraceae	<i>Nolletia chrysocomoides</i>	Dwarf shrub
Brassicaceae	<i>Lepidium africanum</i>	Herb
Fabaceae	<i>Vachellia karroo</i>	Tree/shrub
Fabaceae	<i>Senegalia mellifera</i>	Tree/shrub
Fabaceae	* <i>Neltuma glandulosa</i>	Tree/shrub
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Poaceae	<i>Bromus *catharticus</i>	Graminoid
Poaceae	<i>Eragrostis lehmanniana</i>	Graminoid
Poaceae	<i>Phragmites australis</i>	Graminoid
Poaceae	<i>Setaria verticillata</i>	Graminoid
Poaceae	<i>Tragus berteronianus</i>	Graminoid
Portulacaceae	<i>Portulaca oleracea</i>	Succulent
Rhamnaceae	<i>Ziziphus mucronata</i>	Tree/shrub
Solanaceae	<i>Lycium cinereum</i>	Shrub
Solanaceae	<i>Lycium hirsutum</i>	Shrub
Zygophyllaceae	<i>Tribulus terrestris</i>	Herb

2. Succulent shrubland vegetation unit



Figure 8: Succulent shrubland vegetation unit

Status	Near natural
Vegetation structure	The vegetation is mostly dominated by shrubs that are succulent, and others are woody. Scattered trees also occur in this vegetation unit. While the grass layer are dominated by <i>Cenchrus ciliaris</i> .
Topography	Sloping towards the Orange River in the south or the tributary of the Orange River to the west. It all depends on your position in the landscape.
Rock cover	Limited rocks present, soils were mostly sandy.
Conservation priority	Medium

This vegetation unit (Figure 8) is present in the north-western corner area and covers approximately 6.72 ha of the study area. Within this vegetation unit, there are also solar panels present, which already caused a disturbance in the south-western corner. Shrubs dominate this vegetation unit and are either succulent (*Caroxylon aphyllum* [*Salsola aphylla*], *Mesembryanthemum coriarium* and *Exomis microphylla*) or woody

(*Lycium bosciifolium*, *L. cinereum* and *Pentzia incana*). The scattered tree layer contains individuals of *Vachellia karroo*, *Senegalia mellifera* and *Ziziphus mucronata*. The grass layer is dominated by *Cenchrus ciliaris*. Protected species in this vegetation unit include *Mesembryanthemum coriarium* and *M. guerichianum* both protected under the Northern Cape Ordinance, Schedule 2, because of the families in which they occur.



Figure 9: *Exomis microphylla* dominating certain parts of the Succulent shrubland vegetation unit.

In certain areas of this vegetation unit, *Exomis microphylla* (Figure 9) dominates the vegetation with little to no shrubs and trees present.

Protected species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent

Invasive Alien plant species

Family	Species	Growth form
Amaranthaceae	<i>Chenopodium *album</i>	Herb
Amaranthaceae	<i>Salsola kali</i>	Herb
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Portulacaceae	<i>Portulaca *oleracea</i>	Herb

List of species found during the study:

The following is a list of plant species identified during the survey where * indicates alien invasive species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Amaranthaceae	<i>Chenopodium *album</i>	Herb
Amaranthaceae	<i>Exomis microphylla</i>	Succulent
Amaranthaceae	<i>Caroxylon aphyllum</i>	Succulent
Amaranthaceae	<i>Salsola kali</i>	Herb
Asparagaceae	<i>Asparagus laricinus</i>	Shrub
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Asteraceae	<i>Helichrysum argyrosphaerum</i>	Herb
Asteraceae	<i>Nolettia chrysocomoides</i>	Herb
Asteraceae	<i>Pentzia incana</i>	Shrub
Boraginaceae	<i>Ehretia alba</i>	Shrub
Boraginaceae	<i>Heliotropium lineare</i>	Herb
Brassicaceae	<i>Lepidium englerianum</i>	Herb
Fabaceae	<i>Indigofera alternans</i>	Herb
Fabaceae	<i>Senegalia mellifera</i>	Tree/shrub
Fabaceae	<i>Vachellia karroo</i>	Tree
Limeaceae	<i>Limeum argute-carinatum</i>	Dwarf shrub
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Poaceae	<i>Cenchrus ciliaris</i>	Graminoid
Poaceae	<i>Eragrostis echinocloidea</i>	Graminoid
Poaceae	<i>Eragrostis lehmanniana</i>	Graminoid
Poaceae	<i>Stipagrostis ciliata</i>	Graminoid
Poaceae	<i>Stipagrostis obtusa</i>	Graminoid
Poaceae	<i>Tragus berteronianus</i>	Graminoid
Portulacaceae	<i>Portulaca *oleracea</i>	Herb
Rhamnaceae	<i>Ziziphus mucronata</i>	Tree/shrub
Solanaceae	<i>Lycium bosciifolium</i>	Shrub
Solanaceae	<i>Lycium cinereum</i>	Shrub
Zygophyllaceae	<i>Tribulus terrestris</i>	Herb
Zygophyllaceae	<i>Tribulus zeyheri</i>	Dwarf shrub

3. Karroid shrubland vegetation unit



Figure 10: Karroid shrubland vegetation unit.

Status	Near natural
Vegetation structure	The vegetation is dominated by shrubs with scattered trees. The ground layer is sparsely covered with grasses and herbs.
Topography	Sloping towards the Orange River in the south, however, the pivots prevent natural connections.
Rock cover	Some rocks are present; however, the area is mostly sandy
Conservation priority	Medium-high

This vegetation unit (Figure 10) is present on the northern boundary of the study area, where it borders natural vegetation that is similar. The area covers approximately 9.64 ha. The shrub layer is dominated by various karroid shrubs such as *Lycium cinereum*, *L. bosciifolium*, *Pentzia incana*, *P. sphaerocephala*, *Eriocephalus ericoides*, *Roepera pubescens* and *Tetraena macrocarpa*. Scattered trees such as *Vachellia karroo*,

Senegalia mellifera, *Ziziphus mucronata* and *Searsia pendulina* are also present. The herb and grass layer are sparse; however, the prominent grasses are *Aristida congesta*, *Eragrostis echinocloidea*, *Stipagrostis ciliata* and *Stipagrostis obtusa*.

Mesembryanthemum coriarium, *M. guerichianum*, *M. noctiflorum*, *Aizoon plinthoides* and *Nerine* sp area all protected under the Northern Cape Ordinance, Schedule 2, because of the families in which they occur.

Protected species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum noctiflorum</i>	Succulent
Aizoaceae	<i>Aizoon plinthoides</i>	Dwarf shrub
Amaryllidaceae	<i>Nerine</i> sp.	Bulb

Invasive Alien plant species

Family	Species	Growth form
Amaranthaceae	* <i>Alternanthera pungens</i>	Herb
Amaranthaceae	<i>Salsola kali</i>	Herb
Asteraceae	<i>Erigeron bonariensis</i>	Herb
Nyctaginaceae	<i>Boerhavia cordobensis</i>	Herb
Solanaceae	* <i>Datura ferox</i>	Shrub

List of species found during the study:

The following is a list of plant species identified during the survey, where * indicates alien invasive species:

Family	Species	Growth form
Acanthaceae	<i>Barleria rigida</i>	Dwarf shrub
Acanthaceae	<i>Pogonospermum divaricatum</i>	Herb
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum noctiflorum</i>	Succulent
Aizoaceae	<i>Aizoon plinthoides</i>	Dwarf shrub
Amaranthaceae	* <i>Alternanthera pungens</i>	Herb
Amaranthaceae	<i>Exomis microphylla</i>	Succulent
Amaranthaceae	<i>Caroxylon aphyllum</i>	Succulent
Amaranthaceae	<i>Salsola kali</i>	Herb

Family	Species	Growth form
Amaryllidaceae	<i>Nerine</i> sp.	Bulb
Anacardiaceae	<i>Searsia pendulina</i>	Tree/shrub
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Asteraceae	<i>Eriocephalus ericoides</i>	Shrub
Asteraceae	<i>Pentzia incana</i>	Shrub
Asteraceae	<i>Pentzia sphaerocephala</i>	Shrub
Boraginaceae	<i>Ehretia alba</i>	Shrub
Fabaceae	<i>Vachellia karroo</i>	Tree/shrub
Fabaceae	<i>Senegalia mellifera</i>	Tree/shrub
Fabaceae	<i>Indigofera alternans</i>	Herb
Limeaceae	<i>Limeum argute-carinatum</i>	Dwarf shrub
Malvaceae	<i>Hermannia cococarpa</i>	Herb
Malvaceae	<i>Hermannia spinosa</i>	Dwarf shrub
Molluginaceae	<i>Kewia salsoloides</i>	Dwarf shrub
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Poaceae	<i>Aristida congesta</i>	Graminoid
Poaceae	<i>Cenchrus ciliaris</i>	Graminoid
Poaceae	<i>Eragrostis echinochloidea</i>	Graminoid
Poaceae	<i>Eragrostis lehmanniana</i>	Graminoid
Poaceae	<i>Fingerhutia africana</i>	Graminoid
Poaceae	<i>Stipagrostis ciliata</i>	Graminoid
Poaceae	<i>Stipagrostis obtusa</i>	Graminoid
Portulacaceae	<i>Portulaca quadrifida</i>	Succulent
Rhamnaceae	<i>Ziziphus mucronata</i>	Tree/shrub
Scrophulariaceae	<i>Peliostomum leucorrhizum</i>	Dwarf shrub
Solanaceae	<i>*Datura ferrox</i>	Shrub
Solanaceae	<i>Lycium bosciifolium</i>	Shrub
Solanaceae	<i>Lycium cinereum</i>	Shrub
Zygophyllaceae	<i>Roepera pubescens</i>	Shrub
Zygophyllaceae	<i>Tetraena microcarpa</i>	Dwarf shrub
Zygophyllaceae	<i>Tribulus terrestris</i>	Herb

4. Grassy vegetation unit



Figure 11: The Grassy vegetation unit found at the study area.

Status	Disturbed
Vegetation structure	The vegetation is dominated by grasses. Among the grasses, although not easily visible, are some shrubs that are woody or succulent.
Topography	Sloping towards the Orange River in the south.
Rock cover	Some rocks are present; however, the area is mostly sandy.
Conservation priority	Low

This vegetation unit (Figure 11) is present on the eastern boundary, more or less in the middle of the study area. This vegetation unit is very small and approximately 1.1 ha in size. The vegetation is surrounded by natural vegetation to the east and degraded old lands to the north. The vegetation is dominated by the grass *Eragrostis echinochloideae* a pioneer species. Although the shrubs that are present are not visible, they are the succulent shrubs *Mesembryanthemum coriarium* and *M. junceum*, as well as the woody shrubs **Neltuma glandulosa* [**Prosopis glandulosa*], *Lycium*

cinereum and *L. hirsutum*. *Mesembryanthemum coriarium*, *M. guerichianum*, and *M. noctiflorum* are all protected under the Northern Cape Ordinance, Schedule 2, because of the families in which they occur.

Protected species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum junceum</i>	Succulent

Invasive Alien plant species

Family	Species	Growth form
Amaranthaceae	<i>Chenopodium *album</i>	Herb
Amaranthaceae	<i>Salsola kali</i>	Herb
Fabaceae	<i>*Neltuma glandulosa</i>	Tree/shrub
Papaveraceae	<i>*Argemone ochroleuca</i>	Herb

List of species found during the study:

The following is a list of plant species identified during the survey, where * indicates alien invasive species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Mesembryanthemum junceum</i>	Succulent
Amaranthaceae	<i>Atriplex semibaccata</i>	Dwarf shrub
Amaranthaceae	<i>Chenopodium *album</i>	Herb
Amaranthaceae	<i>Salsola kali</i>	Herb
Asparagaceae	<i>Asparagus larisinus</i>	Shrub
Asteraceae	<i>Nidorella resedifolia</i>	Herb
Brassicaceae	<i>Lepidium englerianum</i>	Herb
Fabaceae	<i>*Neltuma glandulosa</i>	Tree/shrub
Papaveraceae	<i>*Argemone ochroleuca</i>	Herb
Poaceae	<i>Eragrostis echinochloideae</i>	Graminoid
Poaceae	<i>Eragrostis lehmanniana</i>	Graminoid
Poaceae	<i>Stipagrostis obtusa</i>	Graminoid
Solanaceae	<i>Lycium cinereum</i>	Shrub
Solanaceae	<i>Lycium hirsutum</i>	Shrub
Zygophyllaceae	<i>Tribulus terrestris</i>	Herb

5. Old fields vegetation unit



Figure 12: The Old fields vegetation unit.

Status	Disturbed and degraded
Vegetation structure	The vegetation has various open patches of bare soil with other areas containing some grasses or shrubs, while other areas have scattered trees with grasses and herbs as ground cover.
Topography	Sloping towards the Orange River in the south.
Rock cover	Rock presence was minimal, and the soil exhibited significant hardness, potentially due to compaction associated with prior agricultural activities.
Conservation priority	Low-medium

This vegetation unit (Figure 12) is present in the northern corner of the eastern boundary. This vegetation unit occupies approximately 8.98 ha of the study area. It is clear that this area had previously been a cultivated and was completely transformed. No single species dominates the vegetation, which is discontinuous and characterized by multiple patches of bare soil. These patches are highly crusted or compacted.

Although no species dominate the vegetation, one does find remnants of layers similar to the surrounding natural vegetation. These layers include a grass and herb layer, a shrub layer and a tree layer. Protected species under the Northern Cape Ordinance, Schedule 2, because of the families in which they occur are *Mesembryanthemum coriarium*, *M. guerichianum* and *Aizoon plinthoides*.

Protected species:

Family	Species	Growth form
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Aizoon plinthoides</i>	Dwarf shrub

Invasive Alien plant species

Family	Species	Growth form
Amaranthaceae	<i>Salsola kali</i>	Herb
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Papaveraceae	<i>*Argemone ochroleuca</i>	Herb
Solanaceae	<i>*Datura ferox</i>	Shrub

List of species found during the study:

The following is a list of plant species identified during the survey, where * indicates alien invasive species:

Family	Species	Growth form
Acanthaceae	<i>Pogonospermum divaricatum</i>	Herb
Aizoaceae	<i>Mesembryanthemum coriarium</i>	Succulent
Aizoaceae	<i>Mesembryanthemum guerichianum</i>	Succulent
Aizoaceae	<i>Aizoon plinthoides</i>	Dwarf shrub
Amaranthaceae	<i>Atriplex semibaccata</i>	Shrub
Amaranthaceae	<i>Exomis microphylla</i>	Succulent
Amaranthaceae	<i>Salsola kali</i>	Herb
Asteraceae	<i>Erigeron *bonariensis</i>	Herb
Asteraceae	<i>Nidorella resedifolia</i>	Herb
Asteraceae	<i>Pentzia incana</i>	Shrub
Asteraceae	<i>Pentzia sphaerocephala</i>	Shrub
Boraginaceae	<i>Heliotropium lineare</i>	Herb
Brassicaceae	<i>Lepidium englerianum</i>	Herb
Brassicaceae	<i>Lepidium capensis</i>	Herb
Fabaceae	<i>Vachellia karroo</i>	Tree/shrub
Fabaceae	<i>Senegalia mellifera</i>	Tree/shrub

Family	Species	Growth form
Lamiaceae	<i>Leucas capensis</i>	Dwarf shrub
Limeaceae	<i>Limeum argute-carinatum</i>	Dwarf shrub
Malvaceae	<i>Radyera urens</i>	Shrub
Melianthaceae	<i>Melianthus comosus</i>	Tree/shrub
Nyctaginaceae	<i>Boerhavia *cordobensis</i>	Herb
Papaveraceae	<i>*Argemone ochroleuca</i>	Herb
Pedaliaceae	<i>Sesamum triphyllum</i>	Herb
Poaceae	<i>Aristida congesta</i>	Graminoid
Poaceae	<i>Cenchrus ciliaris</i>	Graminoid
Poaceae	<i>Enneapogon desvauxii</i>	Graminoid
Poaceae	<i>Eragrostis echinochloidea</i>	Graminoid
Poaceae	<i>Fingerhutia africana</i>	Graminoid
Poaceae	<i>Pogonarthria squarrosa</i>	Graminoid
Poaceae	<i>Stipagrostis ciliata</i>	Graminoid
Poaceae	<i>Stipagrostis obtusa</i>	Graminoid
Portulacaceae	<i>Portulaca quadrifida</i>	Succulent
Rhamnaceae	<i>Ziziphus mucronata</i>	Tree/shrub
Solanaceae	<i>*Datura ferox</i>	Shrub
Solanaceae	<i>Lycium bosciifolium</i>	Shrub
Solanaceae	<i>Lycium hirsutum</i>	Shrub
Zygophyllaceae	<i>Tetraena microcarpa</i>	Dwarf shrub
Zygophyllaceae	<i>Tribilus terrestris</i>	Herb

DISCUSSION

VEGETATION

Vegetation types

The vegetation types present in the study occur within the Nama Karoo Biome, namely the Northern Upper Karoo (NKu 3) considered as **least threatened**. As well as the Inland Azonal Vegetation known as the Upper Gariep Alluvial Vegetation (Aza 4) (Figure 13) (Mucina and Rutherford, 2006).

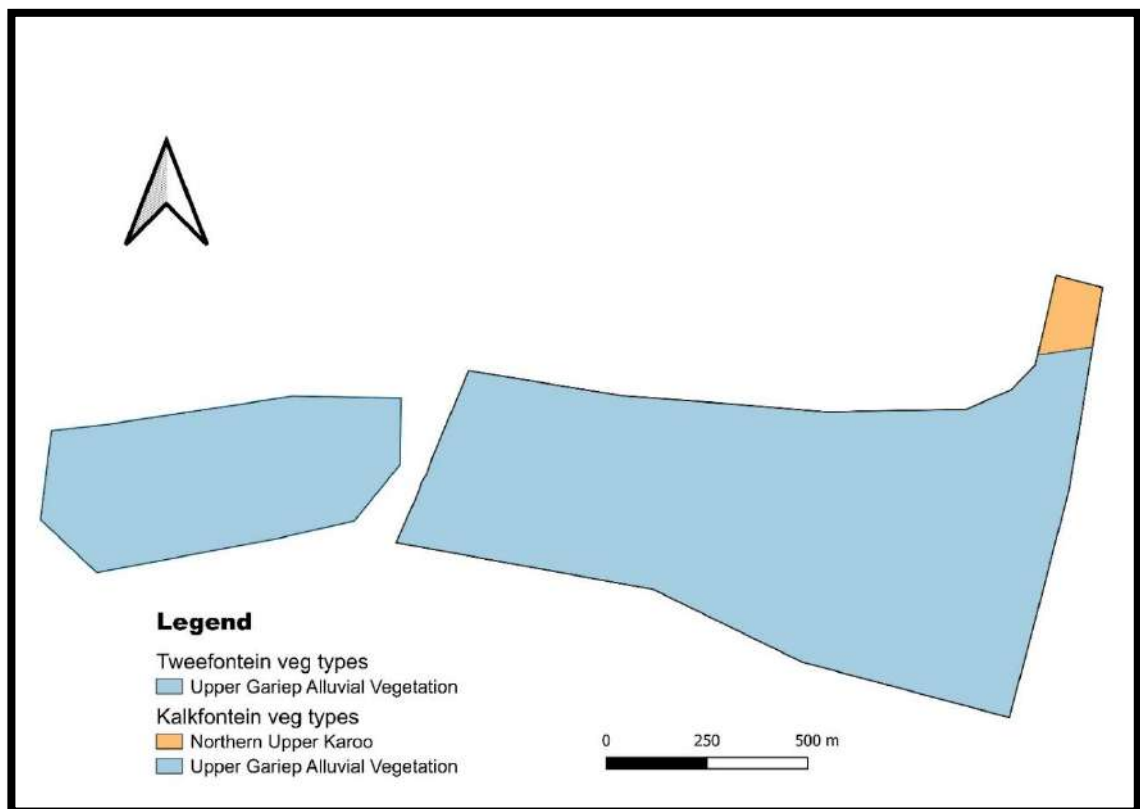


Figure 13: Location of the study area within the Upper Gariep Alluvial Vegetation (AZa 4) and Northern Upper Karoo (NKu 3) vegetation types after Mucina and Rutherford (2006).

Only 3% of the Upper Gariep Alluvial Vegetation (Aza 4) is statutorily conserved in Tussen Die Riviere, Gariep Dam and Oviston Nature Reserves. More than 20% has already been transformed for cultivation and the building of dams.

Important taxa according to Mucina and Rutherford (2006), include Small trees: *Vachellia karroo*, *Celtis africana*, *Salix mucronata* subsp. *mucronata*. Tall shrubs: *Royena lycioides* [*Diospyros lycioides*], *Melianthus comosus*, *Searsia pyroides*. Low Shrubs: *Asparagus setaceus*, *Asparagus suaveolens*. Woody climber: *Clematis*

brachiata. Succulent shrubs: *Lycium arenicola*, *L. hirsutum*. Herbs: *Rubia cordifolia*, *Cineraria dregeana*, *C. lobata*. Graminoids: *Melica decumbens*.

The Northern Upper Karoo (NKu 3) is considered **least threatened**, however there are no statutory conserved areas in this vegetation type. Around 4% has been cleared for cultivation or irreversibly transformed by the building of dams. There is also an increase in human settlements in the northeastern parts of the vegetation type. **Prosopis glandulosa*, one of the 12 agriculturally most important invasive alien plants in South Africa, is widely distributed in this vegetation type.

Important taxa according to Mucina and Rutherford (2006) include Small Trees: *Acacia mellifera* subsp. *detinens*, *Boscia albitrunca*. Tall Shrubs: *Lycium cinereum*, *Lycium horridum*, *L. oxycarpum*, *L. schizocalyx*, *Rhigozum trichotomum*. Low shrubs: *Chrysocoma ciliata*, *Lasiosiphon polycephalus* [*Gnidia polycephala*], *Pentzia calcarea*, *P. globosa*, *P. incana*, *P. spinescens*, *Rosenia humilis*, *Amphiglossa triflora*, *Aptosimum marlothii*, *A. spinescens*, *Asparagus glaucus*, *Barleria rigida*, *Berkheya annectens*, *Eriocephalus ericoides* subsp. *ericoides*, *E. glandulosus*, *E. spinescens*, *Euryops asparagoides*, *Filicia muricata*, *Helichrysum lucilioides*, *Hermannia spinosa*, *Leucas capensis*, *Limeum aethiopicum*, *Melolobium candicans*, *Microlooma armatum*, *Osteospermum leptolobum*, *O. spinescens*, *Pegolettia retrofracta*, *Pentzia lantana*, *Phyllanthus maderaspatensis*, *Aizoon plinthoides* [*Plinthus karooicus*], *Petronia glauca*, *P. sordida*, *Selago geniculata*, *S. saxatilis*, *Tetragonia arbuscula*, *Zygophyllum lichtensteinianum*. Succulent shrubs: *Hertia pallens*, *Salsola calluna*, *S. glabrescens*, *S. rabieana*, *S. tuberculata*, *Zygophyllum flexuosum*. Semiparasitic shrubs: *Thesium hystrix*. Herbs: *Chamaesyce inaequilatera*, *Convolvulus sagittatus*, *Dicoma capensis*, *Gezania krebsiana*, *Hermannia comosa*, *Indigofera alternans*, *Lessertia pauciflora*, *Radyera urens*, *Sesamum capense*, *Sutera pinnatifida*, *Tribulus terrestris*, *Vahlia capensis*. Succulent herb: *Psilocaulon coririum*. Geophytic herb: *Moraea pallida*. Graminoids: *Aristida adscensionis*, *A. congesta*, *A. diffusa*, *Enneapogon desvauxii*, *Eragrostis lehmanniana*, *E. obtusa*, *E. truncata*, *Sporobolus fimbriatus*, *Stipagrostis obtusa*, *Eragrostis bicolor*, *E. porosa*, *Fingerhuthia africana*, *Heteropogon contortus*, *Stipagrostis ciliata*, *Themeda triandra*, *Tragus berteronianus*, *T. koelerioides*, *T. racemosus*.

Biogeographically Important Taxa: Herb: *Convolvulus boedeckerianus*. Tall Shrub: *Gymnosporia szyszyłowiczii* subsp. *namibiensis*.

Endemic Taxa: Succulent shrubs: *Lithops hookeri*, *Stomatium pluridens*. Low shrubs: *Atriplex spongiosa*, *Galenia exigua*. Herb: *Manulea deserticola*

Vegetation units

Vegetation unit 1 (Riverine vegetation unit) occurring on both **TwEEfontein and Kalkfontein farms** has a well-developed tree layer, dominated by *Vachellia karroo*, *Ziziphus mucronata*, *Searsia lancea*, *Searsia pendulina*, and scattered individuals of **Neltuma glandulosa* [**Prosopis glandulosa*]. The shrub layer is mostly dominated by *Lycium hirsutum* and *L. cineureum*. Prominent grasses include *Bromus *catharticus*, *Eragrostis lehmannina*, *Phragmites australis* and *Setaria verticillata*. The herbs are mostly alien invasive species which might be due to disturbance because of flooding along the banks of the Orange River. From an ecological perspective the area has a high conservation value because riverine systems are important corridors connecting ecosystems. At both TwEEfontein and Kalkfontein Farms these areas are minimally disturbed with mainly pumps going into the river, thus these areas still have their ecological integrity. This integrity should be kept intact as this riparian environment plays an important role in the broader environment as a natural corridor for the movement of fauna and flora, as well as the provisioning of water. Various invasive species were found in this vegetation unit, which include: **Alternanthera pungens*, *Chenopodium *album*, *Bidens *bipinnata*, *Erigeron *bonariensis*, **Neltuma glandulosa* [**Prosopis glandulosa*], *Boerhavia *cordobensis* and *Bromus *catharticus*.

Vegetation units at TwEEfontein farm

Vegetation unit 2 (Disturbed pivot vegetation unit) has been affected when the pivots of the area were set up. Although the vegetation does contain components of the surrounding natural vegetation, it is mostly dominated by *Mesembryanthemum guerichianum*, *Portulaca *oleracea*, *Portulaca quadrifida* and *Exomis microphyllum*, which are all succulents. Some scattered shrubs include *Pentzia incana*, *P. sphaerocephala*, *Roepera pubescens* and *Tetraena microcarpa*, however, these are in low numbers. Ecologically, this vegetation unit has previously been degraded and is

currently in a secondary successional phase. There are also various declared alien invasive species present in this vegetation unit, namely **Xanthium spinosum*, **Datura ferox*, **D. innoxia* and **D. stramonium*. It is however surrounded by natural vegetation to the west and north of the study site. An intact individual of the protected *Boscia albitrunca* was also found between the pivots.

Vegetation unit 3 (Natural vegetation unit) is still in a near natural state, dominated by a tree layer mostly composed of *Senegalia mellifera* and a shrub layer that contains species such as *Roepera pubescens*, *Tetraena microcarpa*, *Pentzia incana* and *Aizoon plinthoides*. Grass and herb cover are spares which result in a lot of bare ground that does not have any vegetation cover. Various individuals of the protected *Boscia albitrunca* were present in this vegetation unit. Ecologically, this vegetation unit is still natural with moderate habitat diversity, thus still performing its ecological function in the environment. There is still intact natural vegetation that is similar to this vegetation unit towards the west of the study site. Very limited individuals of the NEMBA declared alien invasive *Salsola kali* were found within this vegetation unit. Another alien invasive species also found here was *Boerhavia *cordobensis*.

Vegetation unit at Kalkfontein farm

Vegetation unit 2 (Succulent shrubland vegetation unit) is seen as natural, although the presence of solar panels in the south-western corner is an indication of disturbance that already exists in this vegetation unit. The vegetation is mostly dominated by succulent shrubs such as *Caroxylon aphyllum* [*Salsola aphylla*], *Mesembryanthemum coriarium* and *Exomis microphylla*; however, there are also some woody shrubs such as *Lycium bosciifolium*, *L. cinereum* and *Pentzia incana*. Scattered trees are also present in this vegetation unit (*Vachellia karroo*, *Senegalia mellifera* and *Ziziphus mucronate*). *Chenchrus ciliaris* is the dominant grass in this vegetation unit. Ecologically, this vegetation unit contains natural species that are not threatened or unique. It still performs its ecological function, however, within the environment studied for both farms, there are no similar vegetation units nearby. Alien invasive plants include *Chenopodium *album*, *Salsola kali* (NEMBA declared alien invasive), *Erigeron *bonariensis*, *Boerhavia *cordobensis* and *Portulaca *oleracea*.

Vegetation unit 3 (Karroid shrubland vegetation unit) has a prominent shrub layer composed of *Lycium cinereum*, *L. bosciifolium*, *Pentzia incana*, *P. sphaerocephala*, *Eriocephalus ericoides*, *Roepera pubescens* and *Tetraena microcarpa*. It also has a prominent but scattered tree layer composed of trees such as *Vachellia karroo*, *Senegalia mellifera*, *Ziziphus mucronata* and *Searsia pendulina*. Although the grass and forb layer spares, prominent grasses include *Aristida congesta*, *Eragrostis echinochloidea*, *Stipagrostis ciliata* and *Stipagrostis obtusa*. Ecologically, this vegetation unit can be seen as near-natural and still performing its function. This vegetation unit is also bordered by similar vegetation to the north of the study site. Furthermore, this vegetation unit has a relatively high richness and diversity with limited alien invasive species such as **Alternanthera pungens*, *Salsola kali* (NEMBA declared alien invasive species), *Erigeron *bonariensis*, *Boerhavia *cordobensis* and **Datura ferox*

Vegetation unit 4 (Grassy vegetation unit) is mostly dominated by the pioneer grass *Eragrostis echinochloideae* which is indicative of previous disturbance in the area. The shrub layer, although not very visible or prominent, is dominated by natural species also found in the surrounding environment and includes *Mesembryanthemum coriarium*, *M. junceum*, *Lycium cinereum* and *L. hirsutum*. The NEMBA declared alien invasive **Neltuma glandulosa* [**Prosopis glandulosa*] also occurs as a shrub in this vegetation unit. Ecologically, this vegetation unit can be regarded as degraded, with a low habitat diversity and ecosystem function, mostly dominated by pioneers. Alien invasives include *Chenopodium *album*, *Salsola kali* (NEMBA declared alien invasive species), **Neltuma glandulosa* and **Argemone ochroleuca*.

Vegetation unit 5 (Old fields vegetation unit) can be seen as disturbed and degraded. It is clear that this area has been cultivated before. There are, however, a lot of species present from the surrounding environment, indicating this vegetation unit is in a secondary successional phase, and the recovery potential is low. Development in this vegetation unit will not impact the natural vegetation / ecosystem since it is already degraded. There is no dominating species in this vegetation unit, nor is the vegetation cover continuous. There are, however, remnants of natural species from the

surrounding vegetation that form various vegetation layers that include grasses, herbs, shrubs and trees.

Declared Alien Invasive Plant Species (AIP's)

Farm			Tweefontein			Kalkfontein				
Vegetation unit			1	2	3	1	2	3	4	5
Family	Species	NEMBA								
Amaranthaceae	Salsola kali	1b		x	x		x	x	x	x
Asteraceae	*Xanthium spinosum	1b		x						
Fabaceae	*Neltuma glandulosa	3	x	x		x			x	
Papaveraceae	*Argemone ochroleuca	1b							x	x
Solanaceae	*Datura ferox	1b		x				x		x
Solanaceae	*Datura innoxia	1b		x						
Solanaceae	*Datura stramonium	1b		x						

Alien species pose a risk to the natural environment, locally as well as in the surrounding areas. These species are indicative of degraded conditions in the areas where they occur. Alien plant species outperform the indigenous plant species in terms of reproduction and establishment; furthermore, they also cause deterioration of the habitat in terms of soil water content, soil pH and erosion. Various species from NEMBA's category 1b were found in the study area. According to section 70(1)(a) of the Act, these species must be controlled or irradiated where possible. Category 3 species is also present and regarded as proven invaders and must be controlled (Henderson, 2020).

Protected and Specially protected species

A list of possible protected species that were recorded in the larger region is listed below.

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

Species	Conservation status	Comments
<i>Nerine</i> sp	Amaryllidaceae family is protected	Found
<i>Ammocharis</i> sp.	Amaryllidaceae family is protected	Found
<i>Boschia albitrunca</i>	Least concern	Found
<i>Aizoon plinthioides</i>	Aizoaceae family is protected	Found

Species	Conservation status	Comments
<i>Mesembryanthemum junceum</i>	Aizoaceae family is protected	Found
<i>Mesembryanthemum coriarium</i>	Aizoaceae family is protected	Found
<i>Mesembryanthemum guerichianum</i>	Aizoaceae family is protected	Found

Ecosystem classification

The study area falls within the greater Griqualand West Centre of Endemism (Frisby, 2016; Frisby et al., 2019; van Staden et al., 2020). The focus areas of the centre of endemism are the core areas with higher numbers of endemic and restricted flora. The core areas include the Northern Ghaap Plateau and Kuruman Hills sub-centre, the Southern Kalahari and the Langeberg sub-centre and the Southern Ghaap Plateau and the Kimberley-Prieska valley sub-centre. The study areas fall within the boundaries of the Griqualand West Centre of Endemism (Frisby, 2016; Frisby et al., 2019; van Staden et al., 2020).

Critical Biodiversity Areas

The study area does not fall within any of the Critical Biodiversity Areas identified by the Northern Cape Biodiversity Spatial Plan of 2024 (Figure 14). The western part of the Kalkfontein farm forms part of the Ecological Support Areas identified in the 2024 Northern Cape Biodiversity Spatial Plan. This forms part of the Succulent shrubland vegetation unit and the Karroid vegetation unit identified during the study.

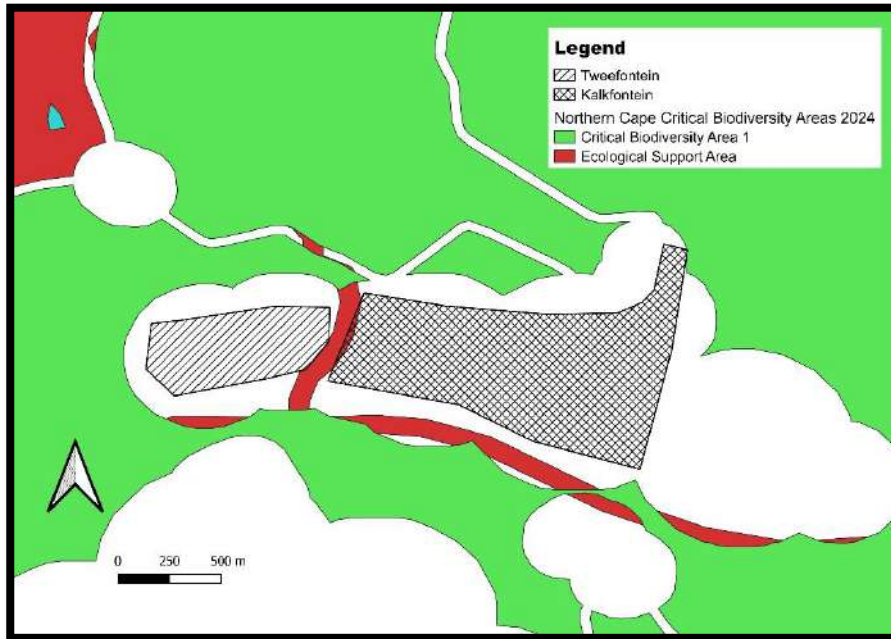


Figure 14: Study area falling within the Critical Biodiversity Areas identified by the Northern Cape in 2024.

However, the 2016 version of the Critical Biodiversity Areas indicated that the study area falls within two of the Critical Biodiversity Areas identified by the Northern Cape. These are Critical Biodiversity Area 1 (TwEEfontein and Kalkfontein) and Critical Biodiversity Area 2 in the most northern parts of the Kalkfontein farm (Figure 15).

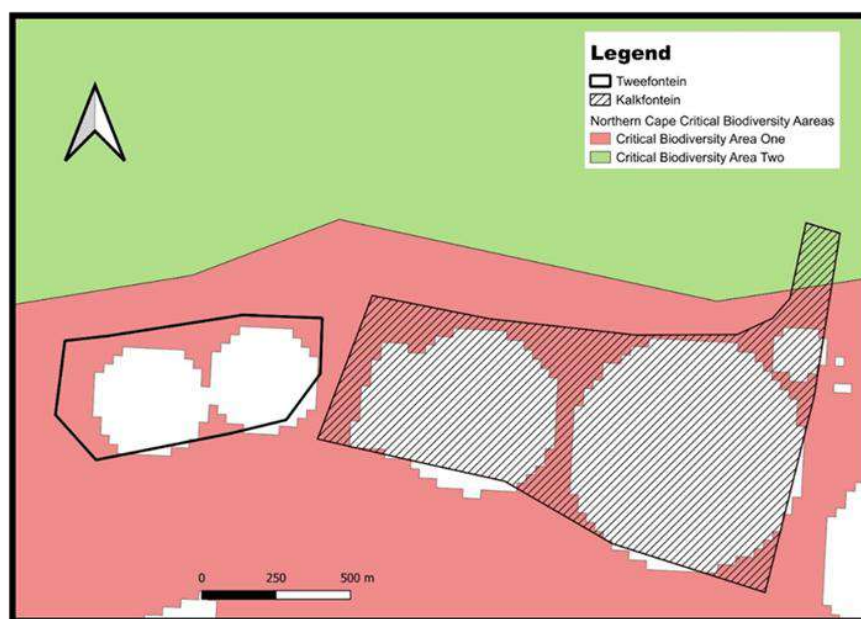


Figure 15: Study area falling within the Critical Biodiversity Areas identified by the Northern Cape in 2016.

Critical Biodiversity Area 1 is areas in a natural condition. These areas are required to meet biodiversity targets for species, ecosystems or ecological processes and infrastructure and must be maintained in a natural or near-natural state with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate. When looking at Critical Biodiversity Area 2, these areas are required to meet biodiversity targets for species, ecosystems or ecological processes and infrastructure. These areas need to be maintained in a functional, natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate. Ecological Support areas are seen as areas that support the Critical Biodiversity and connect core areas that serve as important corridors.

CONCLUSION AND RECOMMENDATIONS

The study is located north-east of Prieska on the banks of the Orange Rivers between the R386 to Niekerkshoop and the R357 to Douglas. Both farms, Tweefontein and Kalkfontein, occur on the northern banks of the Orange River. The western and northern boundaries of Tweefontein are composed of natural vegetation, but to the east, Tweefontein borders Kalkfontein. Kalkfontein only borders on natural vegetation to the north, while the eastern boundary contains agricultural fields in the form of pivots where crops are planted. Various structures such as sheds, pumping stations and solar panels were present at the study sites.

Two farms were studied during this investigation. Both Tweefontein and Klakfontein border on the Orange River and therefore contain the Riparian vegetation unit (Vegetation unit 1 on both farms). These units have some disturbance in the form of access areas to the Orange River for the extraction of water and has thus been affected by anthropogenic influences. These ecosystems play an important role as corridors for the movement of fauna and flora, as well as the provisioning of water and should therefore be considered as areas with a high conservation priority and high sensitivity.

Vegetation units 2 on Tweefontein and 4 and 5 on Kalkfontein can all be seen as disturbed vegetation units with severe anthropogenic impacts in the form of clearing

for the setting up of pivots where crops are currently grown, or areas where crops have been grown in the past (Kalkfontein, vegetation unit 5) and is in the process of recovering naturally at the moment. Vegetation unit 2 on Tweefontein and 5 on Kalkfontein both have a low-medium conservation priority due to the presence of some natural components of the vegetation that are in later successional phases, resulting in them having a low to medium sensitivity as well. However, vegetation unit 4 on Kalkfontein has a low conservation priority and a low sensitivity due to the dominance of mostly pioneer grasses.

Near natural vegetation units were found on Tweefontein (vegetation unit 3) and Kalkfontein (vegetation units 2 and 3). These vegetation units all contain various species indicated by Mucina and Rutherford (20026) that are naturally occurring within the area. Furthermore, these units are also still performing their respective ecological functions. Their conservation priorities vary from medium to medium-high because of their mostly intact vegetation. These vegetation units also have a medium sensitivity.

According to the Northern Cape Biodiversity Spatial Plan (2024) the study areas do not fall within any Critical Biodiversity Areas, but the western boundary of Kalkfontein forms part of an Ecological Support area. From a plant ecological point of view vegetation units 1 of both Tweefontein and Kalkfontein are natural with some human disturbance. Both vegetation units contain protected species as well as the category 3 alien invasive **Neltuma glandulosa* [**Prosopis glandulosa*]. These vegetation units are associated with water courses and can therefore be regarded as having a high biodiversity importance and a medium to high ecological sensitivity.

On Tweefontein vegetation unit 2 occurs between existing pivots that over the years have become degraded due to agricultural and anthropogenic influences. This area contains various category 1 and 3 alien invasive plants such as different species of **Datura*, *Salsola kali*, **Xanthium spinosa*, **Argemone ochroleuca* and **Neltuma glandulosa*. These plant species are indicative of transformed vegetation with low conservation value and species richness. One must however take note of the protected *Boscia albitrunca* individual that is also present within this vegetation unit. This vegetation unit has a very low biodiversity importance value.

Vegetation unit 3 on the Tweefontein farm is regarded as near natural with a moderate species richness consisting of climax and secondary successional species. This vegetation unit is thus regarded as having a high biodiversity importance. There are a few alien invasives such as *Salsola kali* and *Boerhavia*cordobensis* that should be removed as a high priority to prevent further encroachment into the area and the displacement of the native vegetation. The presence of the protected tree, *Boscia albitrunca*, further emphasize the high conservation value of this vegetation type, since there were various individuals found in the area. This vegetation unit is also still connected to natural vegetation on the western side of the study area.

Near natural vegetation were found in vegetation units 2 and 3 on the Kalkfontein farm. This vegetation has a medium to medium high conservation value since it contains various sub-climax and secondary successional species with a moderate species richness. These vegetation units thus have a medium to high diversity importance. There are however various individuals of the category 1 alien invasive species **Datura ferox* and *Salsola kali* present in these vegetation units which should be removed where possible.

Vegetation unit 4 and 5 on Kalkfontein farm are both disturbed with unit 4 having a low conservation value and 5 being disturbed. Vegetation unit 4 occurs between existing pivots and has become degraded over the years. This vegetation unit contains various individuals of the category 1 alien invasive **Argemone ochroleuca* and the category 3 alien invasive **Neltuma glandulosa* [*Prosopis glandulosa*]. These species are indicative of transformed vegetation with a low conservation value and species richness. With regards to vegetation unit 5 there are various open patches indicative of areas that have been cultivated before and left to be reclaimed by nature. There were, however, no attempts at restoration or management of these areas after cultivation stopped. Vegetation unit 5 from a vegetation point of view can be seen as degraded and transformed with a very low conservation value and species richness. Both these vegetation units have a very low biodiversity importance value.

Although no threatened species, nor suitable habitat were found during the vegetation surveys, there are various protected species present in all of the vegetation units found

during this study. Permits must be obtained for the removal of these species from the different vegetation units. These species should be replanted in suitable habitat outside the study area, under the supervision of a qualified plant ecologist. In vegetation units 2 and 3 on Tweefontein, larger individuals of the protected tree *Boscia albitrunca* must be retained as far as practically possible and if not, then permits must be obtained for their removal.

BIBLIOGRAPHY

BROMILOW, C. 2018. *Problem Plants and Alien Weeds of Southern Africa*. Briza Publications, Pretoria, South Africa. Pp 1-464

CONSERVATION OF AGRICULTURAL RESOURCES ACT, 1983 (Act No.43 of 1983).

ENVIRONMENTAL CONSERVATION ACT, 1989 (Act No. 73 of 1989).

ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, 2010 (Gazette No 33306 – Regulation 543).

FISH, L., MASHAU, A.C., MOEHA, M.J. AND NEMBUDANI, M.T. 2015. Identification guide to southern African grasses. An identification manual with keys, descriptions and distributions. *Strelitzia* 36. South African National Biodiversity Institute, Pretoria, South Africa. Pp 1-798.

FRISBY, A.W., SIEBERT, S.J., STRUWIG, M. AND CILLIERS, D.P. 2019. Plant endemism in Griqualand West, South Africa. *South African Journal of Botany*. 124: 127-137.

HENDERSON, L. 2020. *Invasive Alien Plants in South Africa*. Plant Protections Research Institute Handbook No 21. Agricultural Research Council

LE ROUX, P.M., KOTZÉ, C.D., NEL, G.P. AND GLEN, H.F. 1994. *Bossievelde: Grazing plants of the Karoo and karoo-like areas*. Bulletin 428. Pp 1-231.

MUCINA, L. AND RUTHERFORD, M.C. (eds) 2006. *The vegetation of South Africa, Lesotho and Swaziland*, Strelitzia 19. SANBI, Pretoria, South Africa. Pp 325-347.

NATIONAL ENVIRONMENT MANAGEMENT ACT, 1998 (Act No 107 of 1998).

NATIONAL ENVIRONMENTAL MANAGEMENT BIODIVERSITY ACT, 2004 (Act No. 10 of 2004). Government Gazette RSA vol 467, 26436, Cape Town, June 2004.

NATURAL SCIENTIFIC PROFESSIONS ACT, 2003 (Act No. 27 of 2003)

NORTHERN CAPE NATURE CONSERVATION ACT, 2011. (Provincial Gazette No 1566).

OOSTHUYSEN, E. AND GELDENHUYS, L. 2024. Northern Cape Biodiversity Spatial Plan: Technical Report. Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform, Springbok.

SANBI. Red List of South African Plants. <http://redlist.sanbi.org/index.php>.

SANBI. New Plants of southern Africa. Index BRAHMS Online. <https://posa.sanbi.org/sanbi/Explore>

SHEARING, D. AND VAN HEERDEN, K. 2008. *Karoo: South African Wild Flower Guide 6*. Botanical Society of South Africa, Claremont, South Africa. Pp 1-192.

VAN OUDTSHOORN, F. 2018. *Guide to the Grasses of southern Africa*. Briza Publications, Pretoria, South Africa. Pp 1-287.

VAN ROOYEN, N., BEZUIDENHOUT, H. AND DE KOCK, E. 2001. *Blomplante van die Kalahari-duineveld*. Ecotrust BK, Lynwood, Pretoria, South Africa. Pp1-216.

VAN ROOYEN, N. AND VAN ROOYEN, G. 2019. *Flowering Plants of the southern Kalahari*. Published by Authors, Somerset West, South Africa. Pp 1-398.

VAN STADEN, N., SIEBERT, S.J., CILLIERS, D.P., WILSENACHE, D. AND FRISBY, A.W. 2020. Floristic analysis of semi-arid mountain ecosystems of the Griqualand West centre of plant endemism, Northern Cape, South Africa. *Biodiversitas* 21 (5): 1989-2002

APPENDIX F4 – TERRESTRIAL FUANA REPORT



BioBase Environmental Pty Ltd

Reg. No: K2024104397

ANIMAL SPECIES SPECIALIST ASSESSMENT REPORT:

Farm Tweefontein (Erf No. 373) and Kalkfontein (Erf No. 374) for Temdale Boerdery (Pty Ltd),
Siyathemba Local Municipality, Pixley ka Seme District Municipality

Commissioned by Digital Soils Africa

Compiled by:

HJB Butler (PhD, Zoology)

E. Netherlands (PhD, Biology)

BioBase Environmental (Pty) Ltd

14 Eddie de Beer Street

Dan Pienaar

Bloemfontein

9301

DECLARATION OF SPECIALIST INDEPENDENCE

We, Dr Hennie JB Butler and Prof. Edward Netherlands hereby declare that:

- we are acting as independent specialists regarding this application;
- we do not have any interest, hidden or otherwise, in the outcome of this application, apart from financial compensation for the work done to survey the proposed development area and compile this report;
- surveying the site for this faunal compliance statement was done objectively, and that this report and the facts therein contained (regardless of its impact on the application approval process) will not be affected by any outside factors;
- we have the required expertise to perform surveys and produce compliance statements as it pertains to the faunal aspect of this proposed development;
- we will comply with the relevant Acts, regulations and legislation;
- we have not, and will not, engage in conflicting interests while performing our duties for this activity, and have no influence over the decision-making authorities regarding their accepting or rejecting of this proposed development;
- we undertake to disclose to the applicant and competent authority all material and information within my possession that may influence the decision-making process regarding the proposed development;
- all particulars furnished by us in this form are true and correct, and that it is an offense to present a false declaration, and that such a false declaration is punishable in terms of Section 24F of the Act; and that
- this document is to be viewed as a whole and not misquoted out of context.

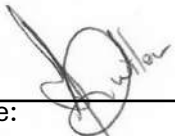
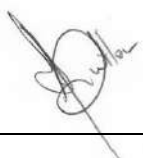
 Date: _____		09 June 2026 Date: _____	
Date	Status	Prepared by	Checked and approved by
09 June 2026	Approved for submission	Dr HJB Butler 	Prof. E Netherlands (SACNASP Registration Nr. 126419) 

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DETAILS OF THE SPECIALISTS

Both specialists that compiled this document have experience in faunal species identification, and the identification of suitable habitats for terrestrial animals including birds, mammals, reptiles and frogs. Their details are in the table below.

Table 1. *The details and experience of the specialists involved with this report.*

Specialist and contact details	Qualifications	SACNASP Registration	Experience
Dr Hennie JB Butler E mail: hennie.butler@gmail.com Mobile: 0827718101	PhD (Zoology) UFS	Not registered	25 Years' experience in faunal ecology and behaviour in both the private and tertiary education sector. Current position: Lecturer in the Department Zoology & Entomology, University of the Free State
Prof. Edward C Netherlands E mail: ec.netherlands@gmail.com Mobile: 0791922833	PhD (Biology) KU Leuven & NWU	126419	More than 10 years' experience in reptiles and amphibians in both the private and tertiary education sector. Current position: Associate professor in the Department Zoology & Entomology, University of the Free State

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1. INTRODUCTION

BioBase Environmental was appointed by Digital Soils Africa to provide Terrestrial Animal Specialist inputs for the proposed establishment of pecan nut orchards under irrigation close to the town Prieska on the farms Tweefontein and Kalkfontein (Siyathemba Local Municipality) in the Pixley ka Seme District Municipality. These orchards will be planted on already existing centre-pivot irrigation systems (approximately 95 hectares) with the expansion of an additional 46 hectares of the infill areas between and around the existing pivot systems. Existing centre-pivot irrigation systems on the farm were installed before 2006 when environmental authorisation was not needed for the removal of vegetation in order to produce agricultural crops. Natural vegetation of large parts of the infill areas is altered and the most northern section of Kalkfontein covers old crop production fields.

1.1 Site location

The study sites are located on the farms Tweefontein (Erf No. 373) and Kalkfontein (Erf No. 374) are located the north-east of Prieska, in the corridor between the R386 road leading to Niekerkshoop and the R357 road leading to Douglas, along the riparian zone of the Orange River (Fig. 1). According to Mucina and Rutherford (2006), the majority the study area falls within the Upper Gariep Alluvial Vegetation (Aza 4) while a small portion of the most northern part of Kalkfontein falls in the Northern Upper Karoo Vegetation (Nku3) (Fig. 2).



Figure 1. Locality of the study area north of the Orange River in the Northern Cape Province of South Africa. (Modified from Google Earth).

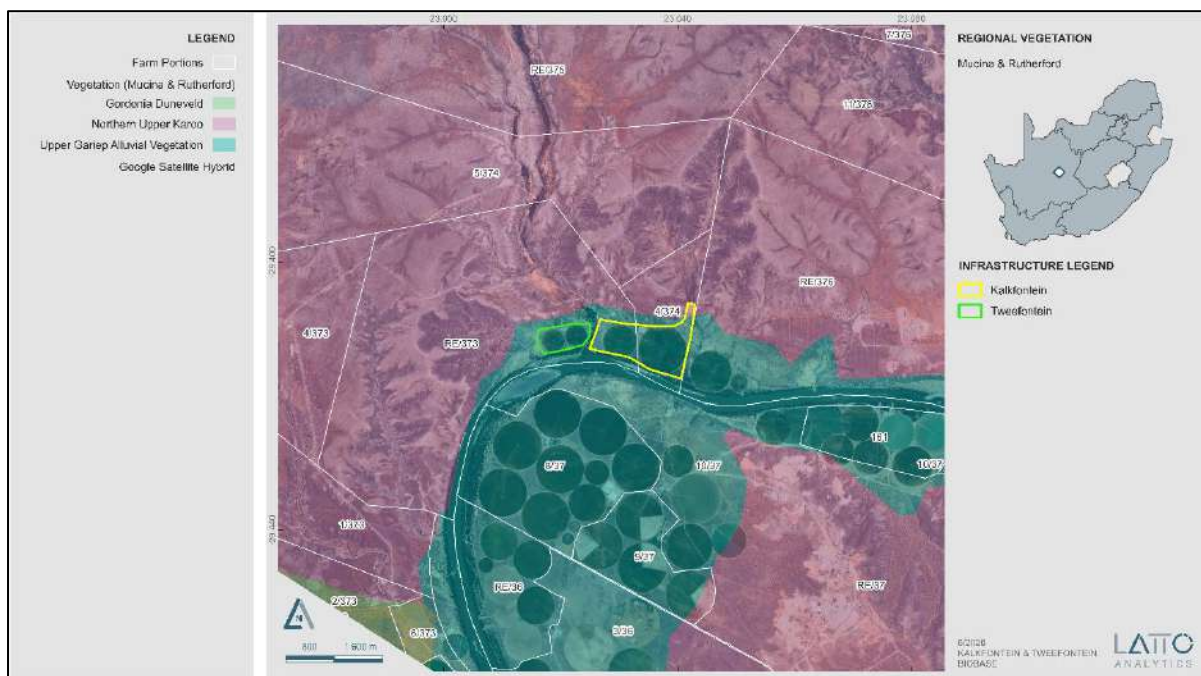


Figure 2. Locality of the study area within the Upper Gariep Alluvial Vegetation and Northern Upper Karoo Vegetation according to Mucina & Rutherford (2006).

1.2 Development Layout

According to the DFFE Screening Tool, the study area is located on the farms Tweefontein and Kalkfontein as listed in Table 2.

Table 2. Cadastral details of Tweefontein and Kalkfontein in the Prieska district (Northern Cape Province, South Africa) according to the DFFE screening tool.

No	Farm Name	Farm/Erf No	Portion	Latitude	Longitude	Property Type
1	TWEEFONTEIN	373	0	29°25'17.23S	22°58'28.98E	Farm
2	KALKFONTEIN	374	0	29°23'15.68S	22°58'1.24E	Farm
3	TWEEFONTEIN	373	0	29°24'47.14S	23°0'5.98E	Farm Portion
4	TWEEFONTEIN	373	0	29°25'18.15S	22°58'28.04E	Farm Portion
5	KALKFONTEIN	374	4	29°24'28.3S	23°2'16.55E	Farm Portion

2 TERMS OF REFERENCE

The objective of this report is to provide ecological information regarding the terrestrial fauna that may be present in the study area on the farms near Prieska in the Northern Cape Province, South Africa (hereafter referred to as the study area). As per the "Protocols for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes" (hereafter called "the Protocols"), as promulgated in Government Gazette Notice 320 (Government Gazette 43110, 20 March 2020), and amended in Government Gazette Notice 3717 (Government Gazette 49028, 28 July 2023), the Protocols must be adhered to for all new applications for Environmental Authorisation.

As per the Protocols, the objectives of this study were to:

- a) identify the SCC which were found, observed or are likely to occur within the study area;
 - b) provide evidence (photographs or sound recordings) of each SCC found or observed within the study area;
 - c) identify the distribution, location, viability and provide a detailed description of the population size of the SCC identified within the study area;
 - d) identify the nature and extent of the potential impact of the development on the population of the SCC located within the study area;
 - e) determine the importance of the conservation of the population of the SCC identified within the study area, based on the information available in national and international databases;
 - f) determine the potential impact of the proposed development on the habitat of the SCC located within the study area;
 - g) include a literature review of the SCC population sizes, the conservation interventions, and any national or provincial management plans for the SCC. This should also indicate whether the development is compliant with the applicable species management plans;
 - h) identify dynamic ecological processes (e.g. fire in fire-prone ecosystems) occurring within the broader landscape that might be disrupted by the development and result in negative impacts on the identified SCC;
 - i) identify any potential impact of ecological connectivity in relation to the broader landscape, resulting in impacts on the identified SCC and its long-term viability;
 - j) determine buffer distances as per the Species Environmental Assessment Guidelines used for the population of each SCC;
 - k) discuss the presence (or likely occurrence) of additional SCC not identified by the screening tool, as well as undescribed species, or roosting and breeding and foraging areas used by migratory species (where these species show significant congregations) occurring in the vicinity;
- and

- l) identify any alternative development footprints within the preferred site that would be of “low” or “medium” sensitivity as identified by the screening tool and verified through site sensitivity verification.
- m) A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

2.1 Screening Tool

Based on the screening tool (performed on 02 February 2026) of The Department of Forestry, Fisheries and the Environment (DFFE), the study sites were identified as having a **Medium sensitivity** for Tweefontein (Erf No. 373) and a **High sensitivity** for Kalkfontein (Erf No. 374) in terms of the animal species theme (Fig. 3). This is due to the possible occurrence of three species of conservation concern (SCC). These SCC (and their associated sensitivities) are listed in Table 3. It must be pointed out that the DFFE Screening tool listed the Ludwig’s Bustard as both **High** and **Medium** for Kalkfontein Erf No.374.

Table 3. Species of Conservation Concern (SCC) as listed by the DFFE Screening Tool.

Class	Common name	Genus & species	Sensitivity	
			Tweefontein	Kalkfontein
Aves	Tawny Eagle	<i>Aquila rapax</i>	Medium	Medium
	Ludwig’s Bustard	<i>Neotis ludwigii</i>	Medium	High / Medium
	Caspian Tern	<i>Hydroprogne caspia</i>	-	Medium

3 ASSESSMENT OF STUDY AREA

The findings of this report are based on:

- 1) a desktop study to determine the potential presence of the SCC identified by the DFFE screening tool report and any SCC not identified in the report at the study site; and
- 2) a site visit to the study area to determine the presence of, and habitat suitability for the SCC highlighted by the DFFE screening tool report, and any SCC not flagged by the screening tool report.

3.1 Methodology

3.1.1 Desktop assessment

A desktop study was undertaken to confirm and/or identify any species of conservation concern (SCC) near the study area. Information of such SCC was extracted from the Global Biodiversity Information Framework (GBIF) and iNaturalist. Bird species recorded in the pentad 2920_2300 as well as 2925_2300, where the study area is located, was obtained from the Southern African Bird Atlas Project 2 (SABAP2) and BirdLife International (The IUCN Red List of Threatened Species 2025). Possible mammal species and the conservation status thereof was obtained from the EWT Regional Mammal Red List (2025). The conservation status of Reptiles was obtained from the Conservation status of the reptiles of South Africa, Eswatini and Lesotho, Suricata 10 (Tolley et al. 2023). The conservation status of frog species was listed according to the assessment of SANBI as well as the South African Frog Re-Assessment Group (SA-FRoG).

3.1.2 Field assessment

A field assessment of both study sites was done on 3 February 2026. On the day, temperatures were hot without any clouds in the sky. The visibility for observations of terrestrial vertebrates was good on both study sites. During the site visits, a walk through the study sites was done. Any live vertebrate observed, sounds of animals, signs including tracks, burrows and even nests of birds were logged onto Fulcrum, a field all-in-one data collection platform to collect accurate, real-time data on mobile devices. Transects that were walked in both study sites as well as the localities of observed vertebrate species are shown in Figure 4. Data recorded on Fulcrum was downloaded and captured in an Excel spreadsheet. Farm animals were not included in the data sheet. In addition to the walk throughs, road kills of vertebrates that were encountered on the R357 road between Douglas and Prieska was also documented. Only road kills that were observed 30 km from the study area in both directions were considered.



Figure 4. Transects walked (yellow line) on the farms Tweefontein (Erf No. 373) and Kalkfontein (Erf No. 374) during the site assessment.

3.2 Assumptions and Limitations

Although public platforms like GBIF, iNaturalist and even SABAP2 can be regarded as reliable platforms of species distribution, these platforms include sightings of vagrant or passing animals upon which an assessment cannot reasonably be based. For example, Kalkfontein (Erf No. 374) falls between two adjacent pentads (2920_2300 and 2925_2300). However, the recorded bird species for these two pentads differ in composition with only 44 bird species that were recorded in pentad 2920_2300 while 79 bird species were recorded in pentad 2925_2300 by SABAP2. Expert interpretation is therefore applied to the full list of SCC identified by the various public platforms and some species are then excluded from further assessment due to the project area clearly lacking suitable habitat or the species clearly representing a vagrant or transient animal outside its normal range. Another limitation to the study is the outdated evaluation of some species. The SCC assessed in this report therefore represent those which may reasonably occur on site. However, some animal species are elusive and difficult to detect even with modern technology while other species have large Areas Of Occupancy (AOO), home ranges or are seasonal migrants and do not occupy such areas constantly. Although active field sampling was done on foot at both Tweefontein and Kalkfontein, and additional data from nine days of camera trapping at a site less than 12 km away from the study area, there is always the possibility that some SCC are overlooked in this process.

3.3 Results

3.3.1 Class Aves

A combined list of bird species that might occur as listed by GBIF, iNaturalist and SABAP2 for pentad 2920_2300 and 2925_2300, as well as the Regional Red Data Book Assessment of each species and species that were observed during the field survey is summarised in Appendix 1, Table A1. Of the 89 bird species that might occur in the study area, a total of only 39 species, 13 at Tweefontein (Erf No. 373) and 26 at Kalkfontein (Erf No. 374), were observed. Eleven bird species were observed at both study sites (Table A1).

None of the three SCC bird species that were listed by the DFFE screening tool, was observed during the assessment of the study area. However, the presence of two bird species of conservation concern was confirmed to be present in the study area. The Lanner Falcon and the Kori Bustard (both listed as **Near Threatened**) was observed during another field assessment in the same area. No photographic record of the Lanner Falcon could be obtained as the bird was viewed from a distance with the aid of binoculars. In addition, a Kori Bustard was observed during another field assessment in the same area and was also captured on one deployed camera trap in the area (Fig. 6) close to the study sites. The record of this species was reported on the iNaturalist website (<https://www.inaturalist.org/observations/351691276>). In addition, a neighbouring farmer (Mr David Muller) did confirm a recent siting of Verreaux's Eagle, listed as **Vulnerable**, in the area (pers.comm). The regional Red List status, habitat requirements as well as breeding and feeding behaviour of the six identified bird SCC (three from the screening tool plus four additional species) is summarised in Table 4. The Regional Red list status of SCC of the class Aves that occurred or might likely occur in the study area, suitability of habitat, likelihood of occurrence as well as reasons for occurrence are listed in Table 5. The habitat of the study area is suitable for all the identified species except for the Caspian Tern (Table 5). No Critically Endangered species were recorded in this pentad.



Figure 5. A Kori Bustard (*Ardeotis kori*) captured on a camera trap in natural veld on the farm Muis Hoek close to the study sites. (<https://www.inaturalist.org/observations/351691276>)

The status of the six SCC that were identified and as listed by SANBI, BirdLife South Africa (2025), IUCN, TOPS (Threatened or Protected Species under NEMBA Act 10 of 2004 (GN R151 of 2008, as amended 2023), CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) as well as their migratory status are listed in Table 6. Only three species, the Verreaux's Eagle, Lanner Falcon and Kori Bustard are listed under Appendix II (international trade regulated by permit) of CITES. All six species are resident to the area (Table 6).

Table 4. The regional Red List status, habitat requirements as well as breeding and feeding behaviour of SCC of the class Aves in the study area.

EN, Endangered; **VU**, Vulnerable; **NT**, Near Threatened.

Species	Regional Red list status	Habitat	Breeding	Feeding
Tawny Eagle (<i>Aquila rapax</i>)	EN	Occupies open and semi-open habitats including woodland savanna, grassland, bushveld, and arid shrubland. Avoids dense forest and heavily transformed agricultural land. In southern Africa favours the dry interior, including the Karoo and Kalahari biomes. Requires large, undisturbed tracts of natural veld with tall trees or rocky outcrops for nesting.	Monogamous and territorial; pairs maintain large home ranges year-round. Breeds from April to September in southern Africa. Constructs a large stick nest (eyrie) in the canopy of a tall tree, occasionally on a power-line pylon. Clutch size is typically 1–2 eggs; incubation lasts approximately 42–44 days. Usually only one chick survives (Cainism). The fledgling period lasts around 70–80 days.	An opportunistic, generalist predator and scavenger. Prey includes small to medium-sized mammals (hares, mongooses, ground squirrels), birds up to the size of francolins, reptiles, and carrion. Known to engage in kleptoparasitism, stealing food from other raptors and vultures. Hunts from a perch or by quartering low over open ground.
Ludwig's Bustard (<i>Neotis ludwigii</i>)	EN	Near-endemic to southern Africa; restricted to arid and semi-arid Karoo shrubland, Namib desert fringes, and Bushmanland. Strongly associated with flat, open gravel plains and sparse low shrubland. Avoids mountainous terrain, dense vegetation, and transformed habitats. Core distribution in the Northern Cape, Namibia, and marginally into the Western Cape and Free State.	Polygynous display system similar to other bustards. Females raise chicks alone. Nests are minimal or absent; eggs are laid directly in a shallow scrape on open ground, often in sparse vegetation. Lays 1–2 eggs. Incubation approximately 24 days. Chicks are precocial. Breeding season spans August to December. Highly sensitive to disturbance at nesting sites.	Omnivorous. Diet consists primarily of large invertebrates (beetles, locusts, termites, caterpillars) and plant material (seeds, berries, flowers). Also takes small lizards, rodents, and other vertebrates opportunistically. Forages by walking through open scrubland. Does not need free water if food moisture is adequate.

Verreaux's Eagle <i>(Aquila verreauxii)</i>	VU	Restricted to mountainous and rocky terrain, particularly kopjes, cliff faces, and rocky gorges with escarpments. Found from sea level to high-altitude ranges. Strongly associated with areas where Rock Hyrax (<i>Procavia capensis</i>) is abundant. Occurs in the Cape Fold Mountains, Drakensberg, and the arid rocky hills of the Karoo and Namaqualand.	Monogamous, with long-term pair bonds. Breeds from April to September. Nests are large stick structures (eyries) built on cliff ledges or in large trees on rocky hillsides; the same nest may be used for many years, growing very large over time. Lays 1–2 eggs (usually 2); incubation takes approximately 45 days. The second chick is almost always killed by the first (Cainism). Fledging occurs at approximately 95–99 days.	Highly specialised predator; Rock Hyrax typically comprises 90% or more of the diet. Will occasionally take other prey including small antelopes (e.g., young klipspringer), hares, dassies, birds, and monitor lizards. Hunts by fast, contour-hugging flight over rocky terrain, surprising hyrax in the open.
Caspian Tern <i>(Hydroprogne caspia)</i>	VU	Associated with large inland water bodies, estuaries, coastal lagoons, and large rivers. Favours open water with exposed sandbars, beaches, or rocky islets for roosting and nesting. In southern Africa found along the coast and at major inland dams and river systems. Largely non-breeding visitor to the interior, including the Northern Cape.	Colonial ground-nester on low-lying islands, sandbanks, and coastal beaches with minimal vegetation and no terrestrial predator access. Breeds in small to large colonies, sometimes mixed with other terns or skimmers. Lays 1–3 eggs in a shallow scrape. Incubation lasts approximately 26–28 days. Chicks are semi-precocial and fledge at approximately 35–45 days. Highly sensitive to disturbance at breeding colonies.	Exclusively piscivorous (fish-eating). Dives from height into open water to catch fish near the surface. Prey fish typically 10–25 cm in length. Will also steal fish from other terns and birds (kleptoparasitism). Forages over open water, often flying with bill angled downward scanning for fish.

Lanner Falcon <i>(Falco biarmicus)</i>	NT	Occupies open to semi-open habitats including arid and semi-arid shrubland, grassland, savanna, farmland, and rocky escarpments. Avoids dense forest. Common across the Karoo, Bushmanland, and Kalahari biomes. Often nests on cliff faces but also uses old stick nests of other large birds on pylons or tall trees. Highly adaptable to a range of arid environments.	Monogamous. Does not build its own nest; uses cliff ledges, old stick nests of other species (eagles, crows), or cavities in rock faces and buildings. Breeds from July to November. Lays 2–5 eggs; incubation lasts approximately 32–35 days. Both sexes incubate and provision chicks. Fledging occurs at approximately 35–40 days. May raise 1–2 broods per season under good conditions.	An agile aerial predator. Prey consists mainly of medium-sized birds (up to the size of doves and francolins), large insects (especially termite alates and beetles), and small mammals and lizards. Hunts by high-speed pursuit in open airspace, often cooperating in pairs to flush and catch prey. Also stoops at prey from height. Foraging activity peaks at dawn and dusk.
Kori Bustard <i>(Ardeotis kori)</i>	NT	Inhabits open arid and semi-arid grassland, Karoo shrubland, open savanna, and lightly wooded areas. Strongly avoids tall, dense vegetation and heavily cultivated land. Favours areas with short to medium grass cover interspersed with bare patches. Common in the Kalahari, Karoo, and dry open savanna of southern and East Africa. Requires large, unfragmented open landscapes.	Polygynous; males display at traditional lekking grounds during the breeding season (August–November). Females perform all parental duties alone. Nests are shallow scrapes in open ground, often with minimal cover. Lays 1–2 eggs; incubation approximately 23–24 days. Chicks are precocial and follow the female shortly after hatching. Juveniles remain with the female for several months.	Omnivorous and opportunistic. Diet includes insects (especially locusts, beetles, grasshoppers, and termite alates), small vertebrates (lizards, snakes, small rodents), plant matter (seeds, berries, flowers, and roots), and carrion. Takes advantage of invertebrate prey flushed by grass fires. Forages by walking slowly and deliberately through open habitat.

Table 5. Habitat suitability and likelihood of occurrence of Species of Conservation Concern of the class Aves that occurred or might likely occur in the study area. **EN**, Endangered; **VU**, Vulnerable; **NT**, Near Threatened.

Species	Regional Red list status	Observed	Suitable habitat	Likelihood of occurrence	Reason
Tawny Eagle (<i>Aquila rapax</i>)	EN	No	Yes	Medium	In southern Africa, it is largely concentrated in protected areas in the north-east and central parts of the region, which is confirmed by more recent SABAP2 data. Although present in the arid areas, the species seems to have disappeared from large parts of the Northern Cape, Free State and Limpopo provinces. A small, sparsely distributed population persists in the grassy Karoo where they have capitalised on powerlines, using pylons as nest structures.
Ludwig's Bustard (<i>Neotis ludwigii</i>)	EN	No	Yes	High	Ludwig's Bustards are likely to be seen in transformed habitats with the preference of these birds to feed on pastures but they also utilise crops, stubbles or ploughed/fallow fields.
Verreaux's Eagle (<i>Aquila verreauxii</i>)	VU	Yes	Yes	Confirmed	This SCC is confirmed to be present by a neighbouring farmer.
Caspian Tern (<i>Hydroprogne caspia</i>)	VU	No	No	Low	This SCC has not been reported to be present in the area between 2007 and 2023.
Lanner Falcon (<i>Falco biarmicus</i>)	NT	Yes	Yes	Confirmed	This SCC is confirmed to be present on a neighbouring farm close to the study area.
Kori Bustard (<i>Ardeotis kori</i>)	NT	Yes	Yes	Confirmed	This SCC is confirmed to be present via camera trap data on a neighbouring farm.

Table 6. Conservation status summary of bird SCC in pentad 2920_2300 and 2925_2300 (Prieska, Northern Cape Province, South Africa). **EN**, Endangered; **VU**, Vulnerable; **NT**, Near Threatened; **LC**, Least Concern; **—**, Not listed.

Common Name / Scientific Name	SANBI Status	BirdLife SA Status (2025)	IUCN Status	TOPS (NEMBA)	CITES	Migratory Status
Tawny Eagle <i>Aquila rapax</i>	EN	EN	VU	EN	App. II	Resident (breeding)
Ludwig's Bustard <i>Neotis ludwigii</i>	EN	EN	EN	EN	—	Resident / nomadic
Verreaux's Eagle <i>Aquila verreauxii</i>	VU	VU	LC	VU	App. II	Resident (breeding)
Caspian Tern <i>Hydroprogne caspia</i>	VU	VU	LC	VU	—	Resident / migrant
Lanner Falcon <i>Falco biarmicus</i>	VU	NT	LC	VU	App. II	Resident (breeding)
Kori Bustard <i>Ardeotis kori</i>	NT	NT	NT	Protected	App. II	Resident (breeding)

Notes: SANBI status reflects the most recent regional Red List assessment from speciesstatus.sanbi.org. BirdLife SA status reflects the 2025 Red Data Book of Birds of South Africa, Lesotho and Eswatini (birdlife.org.za/red-list). IUCN status is the current global assessment (iucnredlist.org); where regional and global statuses differ, the more severe regional status is operative for this assessment. TOPS = Threatened or Protected Species under NEMBA Act 10 of 2004 (GN R151 of 2008, as amended 2023): EN = Endangered; VU = Vulnerable; Protected = Schedule 3 Protected Species. CITES App. II = international trade regulated by permit.

3.3.2 Class Mammalia

No mammal species was listed as a SCC by the DFFE screening tool. However, results from the desktop study revealed the possibility of 64 mammal species that might occur in or on the study area (Appendix 2, Table A2). This includes species from the Order Cetartiodactyla belonging to the families Bovidae and Giraffidae which are “game” species that are not regarded as part of the survey. The Common duiker and Steenbok were however included in the survey. Of 64 possible mammal species, only the Yellow Mongoose and Cape Porcupine were observed at the Tweefontein site while the Slender Mongoose, Suricate, Cape Ground Squirrel and Cape Porcupine were observed at the Kalkfontein site. However, during the same week as the assessment of these study sites, the presence of Black-backed Jackal, Steenbok, Common duiker, Aardvark (camera traps), Bat-eared Fox, Striped Polecat/Zorilla, Southern Small-spotted Genet (road kills), and Vervet Monkey (Road observations) were confirmed to be in the vicinity of the study area.

Of the listed mammal species that might occur in the study area, only six species are of conservational concern. This includes the Black-footed Cat (*Felis nigripes*), Brown Hyaena (*Parahyaena brunnea*), African Striped Weasel (*Poecilogale albinucha*), Damara Horseshoe Bat (*Rhinolophus damarensis*), Southern African Hedgehog (*Atelerix frontalis*), and Aardvark (*Orycteropus afer*). The regional Red list Status, habitat requirements, as well as the breeding and feeding behaviours of these species are listed in Table 7. The habitat suitability and likelihood of occurrence for the mammal SCC is listed in Table 8. Even though the majority of the study area is under centre-pivot irrigation, the areas between these pivots still provides suitable habitat for any of the SCC to be present. Although not in the study area itself, only the Aardvark was confirmed to be present in the area. The only other mammal species that has a high probability of occurrence to be present in the study area is the Southern African Hedgehog which was recorded between the year 2013 and 2024 (Smith & Da Silva, 2025).

Table 7. The regional Red List status, habitat requirements as well as breeding and feeding behaviour of SCC of the class Mammalia in the study area.

VU, Vulnerable; **NT**, Near Threatened.

Species	Regional Red list status	Habitat	Breeding	Feeding
Black-footed Cat (<i>Felis nigripes</i>)	VU	Restricted to arid and semi-arid open habitats in southern Africa, including Karoo shrubland, dry savanna, open grassland with sparse shrub cover, and dry riverbeds. Strongly avoids dense bush and transformed agricultural land. Closely associated with open, flat terrain with short vegetation cover. Found mainly in the Karoo, Kalahari, and adjacent areas of South Africa and Botswana.	Solitary and nocturnal. Females raise kittens alone. Does not construct its own den; uses burrows of aardvark, springhare, or porcupine, and termite mounds. Breeds year-round with peaks in summer. Litter size 1–3 kittens (typically 1–2). Gestation approximately 63–68 days. Kittens begin accompanying their mother on hunts at about 6 weeks; independent at approximately 5–6 months.	The most lethal hunter relative to body size of all wild cats. Diet comprises predominantly small mammals (gerbils, mice, shrews), small birds, reptiles (lizards, skinks), insects, and arachnids. Has been documented killing prey heavier than itself, including Cape Hare. Hunts almost exclusively at night using acute hearing to locate prey in darkness. Requires no free water — all moisture obtained from prey.
Damara Horseshoe Bat (<i>Rhinolophus damarensis</i>)	VU	Restricted to arid and semi-arid environments in northern Namibia and adjacent north-western South Africa (Northern Cape). Found in rocky terrain with caves, mine shafts, and rocky overhangs which serve as roost sites. Associated with sparse dry bushveld and desert-adjacent shrubland. A near-endemic of the arid western subregion.	Colonial rooster; maternity colonies form in caves or abandoned mining tunnels. Gives birth to a single pup once per year, typically in spring or early summer (October–December). Pups are born naked and altricial and cling to the mother until capable of independent flight.	Insectivorous; forages by low, slow flight close to vegetation and rock surfaces, using high-frequency echolocation to detect insects. Prey includes moths, beetles, flies, and other flying and resting invertebrates. Often hunts from a perch (perch-hunting), sallying out to

			Sexual maturity reached at approximately 1–2 years.	catch prey and returning to the same spot.
Brown Hyaena <i>(Parahyaena brunnea)</i>	NT	Occupies a wide range of arid and semi-arid habitats including open Karoo shrubland, desert fringes, dry savanna, grassland, and open woodland. Found throughout much of southern Africa, including the Karoo, Kalahari, and coastal zones. More tolerant of arid conditions than the Spotted Hyaena. Requires access to rocky areas or dense thickets for denning. Avoids densely forested areas.	Solitary or in small family groups (clan sizes much smaller than Spotted Hyaena). Dens typically located in rock crevices, aardvark holes, or dense thicket. Litters of 1–3 cubs born after a gestation of approximately 90–92 days. Cubs remain at or near the den for several months and are nursed for up to 12–16 months. Both parents (in pair-bonded groups) contribute to cub provisioning.	Primarily a scavenger; forages over very large home ranges (up to 1,000 km ²) in search of carcasses. Diet includes carrion of all sizes, supplemented by invertebrates (dung beetles, moths, locusts), wild fruits (especially tsamma melons for moisture), eggs, small vertebrates, and refuse near human habitation. Capable of crushing and digesting bones. Rarely kills large prey but will take small livestock, eggs, and injured animals.
African Striped Weasel <i>(Poecilogale albinucha)</i>	NT	Inhabits grassland, moist savanna, open woodland, and forest edges across eastern and southern Africa. Associated with areas of rank grass cover, reed beds, or dense ground vegetation near water. In South Africa found mainly in KwaZulu-Natal, Mpumalanga, Limpopo, and parts of the Northern Cape. Requires dense ground cover for foraging and shelter. Rarely encountered in open arid environments.	Solitary. Dens in grass clumps, dense vegetation, burrows, or beneath rocks and logs. Litter size 1–3 young, born after a gestation of approximately 32–33 days. Young are altricial (helpless at birth). Eyes open at approximately 6 weeks. Independence reached at about 10–12 weeks. Breeding may occur year-round but peaks in spring and summer.	Almost exclusively a predator of snakes, including venomous species (e.g., mambas, cobras) — one of the very few mammals specialised for this. Also takes lizards, small rodents, frogs, and invertebrates. Kills snakes by delivering a precise bite to the back of the skull. Has some immunity to snake venom. A relentless and ferocious hunter relative to its small body size.

Southern African Hedgehog <i>(Atelerix frontalis)</i>	NT	Occupies a range of habitats including open savanna, semi-arid shrubland, grassland with sparse bush, and mixed bushveld. Avoids dense forest and very arid desert. In South Africa found across the Northern Cape, Northwest, Gauteng, and Limpopo provinces. Requires areas with loose soil for foraging, and access to dense vegetation or rocky outcrops for shelter and hibernation sites.	Solitary; males and females associate only during the brief mating season. Breeds from August to March. Litter size typically 2–6 young after a gestation of approximately 35–40 days. Young are born blind and helpless; the first set of spines (soft, white) emerges within hours of birth beneath a membrane. Eyes open at approximately 18 days. Weaning occurs at 4–6 weeks. Enters torpor or hibernation during cold, dry months.	Omnivorous and opportunistic. Diet includes beetles, termites, crickets, millipedes, worms, caterpillars, small vertebrates (lizards, frogs, small rodents), bird eggs, fungi, and plant material such as seeds and berries. Has limited immunity to some toxins. Forages nocturnally by rooting through leaf litter and soil. Uses a highly developed sense of smell to detect prey.
Aardvark <i>(Orycteropus afer)</i>	NT	Occurs in a wide range of habitats including grassland, savanna, open woodland, bushveld, Karoo shrubland, and semi-arid environments. Avoids dense forest and very rocky terrain that prevents burrowing. Requires areas with suitable sandy or loamy soil for digging burrows and abundant termites and ants as food. Widespread across sub-Saharan Africa wherever suitable soil and ant/termite colonies exist.	Solitary and nocturnal. Breeds year-round, with a peak in spring and summer. Gives birth to a single young (rarely twins) after a gestation of approximately 7 months. The calf is born in the burrow and remains underground for the first few weeks. At approximately 2 weeks it begins to follow the mother on foraging trips. Weaning at 3–4 months; independent at 6 months. The young may share the burrow for up to 6 months after weaning.	Highly specialised ant and termite eater (myrmecophage). Diet consists almost exclusively of ants and termites, particularly harvester ants (<i>Messor</i> spp.) and termites (<i>Trinervitermes</i>, <i>Macrotermes</i>). Uses powerful foreclaws to excavate termite mounds and ant nests, and a long, sticky tongue (up to 30 cm) to extract insects. May consume up to 50,000 ants and termites in a single night. Also eats the wild Aardvark Cucumber (<i>Cucumis humifructus</i>) for water.

Table 8. Habitat suitability and likelihood of occurrence of Species of Conservation Concern of the class Mammalia that occurred or might likely occur in the study area. **VU**, Vulnerable; **NT**, Near Threatened.

Species	Regional Red list status	Observed	Suitable habitat	Likelihood of occurrence	Reason
Black-footed Cat (<i>Felis nigripes</i>)	VU	No	Yes	Low	The Black-footed Cat is a semi-arid specialist inhabiting Nama Karoo, open savannah, and grassland habitats with sparse shrub and tree cover. The last recorded observation of this species in the study area was between 2000 and 2012.
Damara Horseshoe Bat (<i>Rhinolophus damarensis</i>)	VU	No	Yes	Low	The study area falls on the periphery of the Area Of Occupation (AOO) of this species. This species was last recorded in the area before 2000.
Brown Hyaena (<i>Parahyaena brunnea</i>)	NT	No	Yes	Low	Persecution of these animals by stock farmers as well as game farmers, almost exterminated the brown Hyaena from this area.
African Striped Weasel (<i>Poecilogale albinucha</i>)	NT	No	Yes	Low	Although the study area is located on the edge of the distribution of this species, no African Striped Weasel was recently recorded in this area. The Orange River riparian zone adjacent to the study area provides rank grass cover and dense ground vegetation near water, which constitutes suitable habitat for this species.
Southern African Hedgehog (<i>Atelerix frontalis</i>)	NT	No	Yes	High	Records of this species were documented in the area between 2013 and 2024.
Aardvark (<i>Orycteropus afer</i>)	NT	Yes	Yes	Confirmed	This SCC is confirmed to be present in adjacent areas.

A summary of the regional conservation status of mammal SCC in the study area is listed in Table 9. Only the Black-footed Cat, Brown Hyaena and Southern African Hedgehog is listed under the Threatened or Protected Species (TOPS) Regulations (Government Notice R. 151 of 2007, as revised in Government Gazette No. 47984 of 3 February 2023) promulgated under NEMBA (Act 10 of 2004). All three species are listed as **Protected** under **Schedule 3** (Indigenous species facing a high risk of extinction in the wild in the medium-term future). Of the six mammal SCC, only the Black-footed Cat (Appendix I) and Damara Horseshoe Bat (Appendix II) are listed by cites (Table 9). Appendix I prohibits the commercial trade of species while Appendix II permits the commercial trade of species only with valid permits.

Table 9. Summary of the regional conservation status of mammal SCC in the study area (Prieska, Northern Cape Province, South Africa). **VU**, Vulnerable; **NT**, Near Threatened; **LC**, Least Concern.

Common Name / Scientific Name	EWT SA Status (2025)	SANBI Status (2016)	IUCN Status	TOPS (NEMBA)	CITES
Black-footed Cat (<i>Felis nigripes</i>)	VU	VU	VU	Protected (Sch 3)	App I
Damara Horseshoe Bat (<i>Rhinolophus damarensis</i>)	VU	LC	LC	—	App II
Brown Hyaena (<i>Parahyaena brunnea</i>)	NT	NT	NT	Protected (Sch 3)	—
African Striped Weasel (<i>Poecilogale albinucha</i>)	NT	LC	LC	—	—
Southern African Hedgehog (<i>Atelerix frontalis</i>)	NT	NT	LC	Protected (Sch 3)	—
Aardvark (<i>Orycteropus afer</i>)	NT	LC	LC	—	—

Notes: SANBI status reflects speciesstatus.sanbi.org (2016 Regional Red List of Mammals of South Africa — the most recent SANBI mammal assessment prior to the 2025 revision). EWT SA 2025 status reflects the 2025 Regional Mammal Red List coordinated by the Endangered Wildlife Trust and SANBI (ewt.org/2025-red-mammal-list/); '(uplisted)' denotes species whose status worsened in the 2025 revision. IUCN status is the current global assessment. TOPS = Threatened or Protected Species under NEMBA GN R151 of 2007 (as amended 2023); Schedule 3 = Protected Species. CITES listings: *Felis nigripes* = Appendix I (trade prohibited); *Rhinolophus damarensis* = Appendix II (trade regulated through a permit system); '—' = not listed under CITES or TOPS.

3.3.3 Class Reptilia

No reptile species was listed as a SCC by the DFFE screening tool. However, results from the desktop study revealed the possibility of 43 reptile species that might occur in or on the study area (Appendix 3, Table A3). Only two species, the Spotted Sandveld Lizard and Kalahari Tree Skink were observed at both the Tweefontein and Kalkfontein study sites. Two additional reptiles, a Puff Adder and a Cape cobra were however observed as road kills approximately 20 km before Prieska on the R357 road from the town Douglas.

Of the 43 reptile species as listed in Table A3, only the Tent Tortoise (*Psammobates tentorius*) is listed as a SCC. Restricted to South Africa and Namibia, three subspecies are recognised, though their distribution ranges overlap and there remains some uncertainty about their exact limits and therefore, the boundary zones should be treated with some caution in formal assessments. The sub species that is listed is probably *P. t. verroxii* (Northern Tent Tortoise) which has a wide distribution throughout the Nama Karoo in the Northern Cape and penetrates the Western Cape and possibly the Eastern Cape peripherally (Hofmeyr et al. 2023). Its range extends across the Orange River into Namibia, as far north as Mariental. The other two subspecies are unlikely to occur near Prieska: *P. t. tentorius* (Southern Tent Tortoise) occurs considerably further south, ranging through the Eastern Cape and southern Western Cape, well away from Prieska. *P. t. trimeni* (Western Tent Tortoise) is restricted to the Namaqualand Sandveld and Richtersveld to the west (Hofmeyr et al. 2023), a distinctly different habitat and bioregion to the Nama Karoo around Prieska. *P. t. verroxii* is currently assessed as **Least Concern** by both SANBI and the IUCN, making it the lowest-priority taxon in the table. However, it occurs within a population that is part of the broader *P. tentorius* **Near Threatened** species-level assessment, meaning ongoing habitat degradation, overgrazing, road mortality, livestock fence electrocution, and Pied Crow predation in the Prieska area are all relevant threat factors to consider. The species' naturally sparse occurrence and low population densities across the Nama Karoo mean that even localised habitat loss carries proportionate significance.

The habitat requirements as well as breeding and feeding behaviour of the Tent Tortoise is listed in Table 10 and the habitat suitability and likelihood of occurrence as well as a summary of the regional conservation status of the sub-species *Psammobates tentorius verroxii* that occur in the area is listed in Table 11 and Table 12 respectively.

Table 10. The regional Red List status, habitat requirements as well as breeding and feeding behaviour of reptile SCC in the study area.

NT, Near Threatened

Species	Regional Red list status	Habitat	Breeding	Feeding
Tent Tortoise (<i>Psammobates tentorius</i>)	NT (species)	Restricted to the arid and semi-arid succulent Karoo and Nama Karoo of South Africa (Northern Cape, Western Cape, Eastern Cape) and marginally into southern Namibia. Inhabits low succulent shrubland, quartz gravel plains, and open Karoo flats. Requires areas with abundant low-growing succulents. Three subspecies recognised, each occupying slightly different habitat facies within the broader Karoo biome.	Oviparous. Mating occurs in late summer to autumn (February–April). Females lay small clutches of typically 1–3 eggs in shallow nests scraped in soft soil, concealed beneath shrubs. Incubation period approximately 150–200 days (dependent on temperature). Hatchlings emerge in late summer of the following year (December–February). Sexual maturity reached at approximately 5–8 years.	Strictly herbivorous. Diet consists almost entirely of succulent plant material including leaves and flowers of Karoo succulents (especially members of the families Aizoaceae, Crassulaceae, and Asteraceae). Also consumes dry plant material and occasionally fungi. Obtains water entirely from food. Forages during cooler parts of the day (morning and late afternoon) and becomes inactive during extreme heat.

Table 11. Habitat suitability and likelihood of occurrence of Species of Conservation Concern of the class Reptilia that occurred or might likely occur in the study area. **LC**, Least Concern.

Species	Regional Red list status	Observed	Suitable habitat	Likelihood of occurrence	Reason
Northern Tent Tortoise (<i>Psammobates tentorius verroxii</i>)	LC	No	Yes	High	The study area is situated on the Orange River in the central Northern Cape, within the Nama Karoo biome which is the core range of this species.

Table 12. Summary of the regional conservation status of reptile SCC in the study area (Prieska, Northern Cape Province, South Africa).
VU, Vulnerable; **LC**, Least Concern.

Common Name / Scientific Name	SANBI Status (2016)	IUCN Status	TOPS (NEMBA)	CITES
Northern Tent Tortoise (<i>Psammobates tentorius verroxii</i>)	LC	VU (species)	Protected under provincial nature conservation ordinances and biodiversity legislation in South Africa.	App II

3.3.4 Class Amphibia

No frog species was listed as a SCC by the DFFE screening tool. However, results from the desktop study revealed the possibility of 14 frog species that might occur in or on the study area (Appendix 4, Table A4). All identified frog species that might occur in the study area, are listed as Least Concern. No frogs were encountered in any of the two study sites.

4 SITE SENSITIVITY VERIFICATION

The DFFE screening tool identified the study area as having a **High sensitivity** (*vide* Fig. 4) for the animal species theme, due to the potential presence of three Species of Conservation Concern (SCC) as listed in Table 3. The site visit, and site sensitivity verification report confirmed that this property as a whole has a **High sensitivity**, due to:

- The likely presence of Verreaux's Eagle (VU) and Lanner Falcon (NT) in the study area as these species were confirmed to be present on a neighbouring farm close to the study area.
- The confirmed presence of other SCC which was not listed by the DFFE screening tool namely the Kori Bustard (*Ardeotis kori*) and Aardvark (*Orycteropus afer*).
- The likely presence of Tawny Eagle (*Aquila rapax*), Ludwig's Bustard (*Neotis ludwigii*), Caspian Tern (*Hydroprogne caspia*), Black-footed Cat (*Felis nigripes*), Brown Hyena (*Parahyaena brunnea*), African Striped Weasel (*Poecilogale albinucha*), Damara Horseshoe Bat (*Rhinolophus damarensis*), Southern African Hedgehog (*Atelerix frontalis*) and the Tent Tortoise (*Psammobates tentorius verroxii*).

5 IMPACT BY THE DEVELOPMENT

Although any development where natural vegetation is removed will have an impact on the environment, some animal species might take advantage of the establishment of agricultural crop production. For example, according to Shaw et al. (2016) Ludwig's Bustards are likely to be seen in transformed habitats with the preference of these birds to feed on pastures but they also utilise crops, stubbles or ploughed/fallow fields. The impact of the development of orchards on animal species include habitat loss by the removal of natural vegetation and fencing or fragmentation of habitats. This will lead to the diminishing of food sources or the prey basis for carnivorous or insectivorous feeders. Once the orchard is operational, the use of pesticides, rodenticides or herbicides will continue to have an effect on such food sources.

5.1 Class Aves

The impact of orchards relating to habitat loss or transformation of land, foraging or food sources and the use of pesticides or insecticides on bird Species of Conservation Concern is listed in Table 13. Bird species that are highly impacted in the study area are Tawny Eagles, Ludwig's Bustards and Kori Bustards. The impact on Verreaux's Eagle is considered to be moderately high based on their preference to feed on Rock Hyraxes which occurs in rocky terrains. The impact of orchards on both Lanner Falcons and Caspian Terns is considered to be moderate.

Table 13. Impact of orchard development on bird Species of Conservation Concern. (Impact Rating Key: **HIGH** — Significant, mitigation and permit conditions required; **MODERATE-HIGH** — Notable, targeted mitigation essential; **MODERATE** — Manageable with good-practice mitigation). **EN**, Endangered; **VU**, Vulnerable; **NT**, Near Threatened.

Species	Regional Status	Habitat Loss / Transformation	Food Source / Foraging	Pesticide / Insecticide	Overall Significance
Tawny Eagle (<i>Aquila rapax</i>)	EN	HIGH — open savanna and Karoo shrubland converted; requires large undisturbed tracts	HIGH — carrion, small mammals and prey diversity all reduced in intensively managed orchards; scavenging opportunities near farm infrastructure reduced	HIGH — secondary poisoning from rodenticide-killed carcasses and pesticide-affected prey; primary driver of raptor declines across Africa	HIGH
Ludwig's Bustard (<i>Neotis ludwigii</i>)	EN	HIGH — flat open Karoo gravel plains and sparse shrubland converted; near-endemic with no capacity to use cultivated land	MODERATE — omnivorous; some invertebrate foraging possible near unsprayed orchard margins on open ground	MODERATE — insecticides reduce large invertebrate prey (beetles, locusts, termites) in surrounding landscape	HIGH
Kori Bustard (<i>Ardeotis kori</i>)	NT	HIGH — requires large open dry savannas and Karoo shrubland;	MODERATE — omnivorous; may exploit invertebrates	MODERATE — insecticides reduce large invertebrate prey	HIGH

Species	Regional Status	Habitat Loss / Transformation	Food Source / Foraging	Pesticide / Insecticide	Overall Significance
		cannot use orchard habitat; ground-nesting species sensitive to human disturbance	near unsprayed orchard margins; will forage in open areas adjacent to development	availability in the surrounding landscape	
Verreaux's Eagle (<i>Aquila verreauxii</i>)	VU	MODERATE — rocky terrain specialist; surrounding landscape conversion reduces hyrax prey base although cliff habitat not directly threatened	HIGH — extreme prey specialisation on Rock Hyrax; any hyrax population reduction through habitat change directly reduces eagle food availability	MODERATE — lower exposure than ground-foraging raptors; secondary poisoning risk present but reduced relative to diet	MODERATE-HIGH
Lanner Falcon (<i>Falco biarmicus</i>)	NT	LOW to MODERATE — highly adaptable; has colonised agricultural landscapes; corvid nests on irrigation pylons provide nesting opportunities	LOW to MODERATE — adaptable diet; small birds and insects associated with agricultural margins can be exploited	MODERATE — pesticide accumulation through prey documented; bioaccumulation in food chain a long-term risk	MODERATE
Caspian Tern <i>Hydroprogne caspia</i>	VU	LOW — associated with large water bodies; orchard	LOW to MODERATE — piscivorous; fish populations in the	MODERATE — pesticide and herbicide runoff into	MODERATE

Species	Regional Status	Habitat Loss / Transformation	Food Source / Foraging	Pesticide / Insecticide	Overall Significance
		footprint does not directly affect aquatic habitat along the Orange River	Orange River may be indirectly affected by agricultural chemical runoff and irrigation abstraction	water bodies accumulates in fish and passes to piscivorous birds through biomagnification	

5.2 Class Mammalia

The impact of orchards relating to habitat loss or transformation of land, food sources or prey and the use of pesticides or rodenticides on mammal Species of Conservation Concern is listed in Table 14. Mammal species that are highly impacted in the study area are the Black-footed Cat, African Striped Weasel and Aardvark as all three listed categories in Table 14 have a high significant impact on these species. The Southern African Hedge Hog will experience only a moderate-high impact. Based on the three listed categories, the Damara Horseshoe Bat will be affected moderately while the effect on the Brown Hyaena will be low-moderate.

Table 14. Impact of orchard development on mammal Species of Conservation Concern. (Impact Rating Key: **HIGH** — Significant, mitigation and permit conditions required; **MODERATE-HIGH** — Notable, targeted mitigation essential; **MODERATE** — Manageable with good-practice mitigation). **VU**, Vulnerable; **NT**, Near Threatened.

Species	Regional Status	Habitat Loss / Transformation	Food Source / Prey	Pesticide / Rodenticide	Overall Significance
Black-footed Cat (<i>Felis nigripes</i>)	VU	HIGH — open Karoo short-grass habitat converted; strict short-grass specialist with no capacity to use orchard habitat; loss of open structure eliminates hunting ability	HIGH — rodenticides deployed in orchards eliminate the small mammal prey base entirely; no prey-switching capacity in this dietary specialist	HIGH — direct secondary poisoning from rodenticide-killed prey; bioaccumulation of organochlorines documented in small felids globally	HIGH
African Striped Weasel (<i>Poecilogale albinucha</i>)	NT	HIGH — grassland and rank grass habitat replaced; requires structurally complex ground cover that orchards completely remove; only 7 138 km ² of natural habitat remains regionally	HIGH — rodenticides eliminate the rodent and snake prey base; obligate specialist predator with no alternative prey; high metabolic rate means prey depletion is rapidly fatal	HIGH — highest secondary poisoning risk of all species assessed; colonial burrowing rodents (primary prey) are direct targets of orchard rodenticide programmes	HIGH

Species	Regional Status	Habitat Loss / Transformation	Food Source / Prey	Pesticide / Rodenticide	Overall Significance
Aardvark (<i>Orycteropus afer</i>)	NT	HIGH — natural Karoo shrubland converted; soil preparation destroys burrow systems; compaction by heavy machinery renders soil unburrowable	HIGH — insecticides applied to orchard soils eliminate ant and termite colonies that are the sole food source; cannot survive without sufficient colony availability	HIGH — insecticide application directly destroys the entire food base; no alternative diet exists; Karoo densities of ~8 animals per 10 km ² make local losses significant	HIGH
Southern African Hedgehog (<i>Atelerix frontalis</i>)	NT	MODERATE — some tolerance of garden-like environments; orchard margins with leaf litter and mulch may provide partial substitute habitat adjacent to natural veld	MODERATE — insecticides reduce invertebrate prey (beetles, worms, crickets); reduction in prey abundance rather than total elimination given broader diet	HIGH — direct poisoning from insect-control schemes well-documented; orchard and vegetable farmers in the Free State specifically report severe hedgehog declines linked to insecticide use	MODERATE–HIGH

Species	Regional Status	Habitat Loss / Transformation	Food Source / Prey	Pesticide / Rodenticide	Overall Significance
Damara Horseshoe Bat (<i>Rhinolophus damarensis</i>)	NT	LOW — roosts in rocky caves and mine shafts well away from orchard footprint; direct land transformation does not affect roost sites	MODERATE — insecticides reduce aerial insect biomass over irrigated areas, reducing foraging productivity in the surrounding landscape	MODERATE — organochlorine and systemic insecticides reduce flying insect prey; bioaccumulation documented globally; horseshoe bats are among the most insecticide-sensitive bat families	MODERATE
Brown Hyæna (<i>Parahyaena brunnea</i>)	NT	LOW — wide habitat tolerance; very large home range (up to 1 000 km ²) means orchard footprint represents a small fraction of total territory	LOW — primary scavenger with extremely broad diet; carrion, wild fruits, insects and small vertebrates remain available well beyond the orchard footprint	LOW to MODERATE — not a primary target of rodenticide programmes; risk of secondary poisoning through scavenging poisoned carcasses exists but is low relative to body mass	LOW–MODERATE

5.3 Class Reptilia

The impact of orchards relating to habitat loss or transformation of land, food sources or foraging and the use of pesticides or herbicides on reptile Species of Conservation Concern is listed in Table 15. The transformation of land and ultimately loss of habitat will ultimately have an effect on food source and foraging. Although the Northern Tent Tortoise (*Psammobates tentorius verroxii*) is listed as Least Concern, the impact of orchards on the collective group of the Tent Tortoise (*Psammobates tentorius*) sub-species is **High**.

Table 15. Impact of orchard development on reptile Species of Conservation Concern. (Impact Rating Key: **HIGH** — Significant, mitigation and permit conditions required). **NT**, Near Threatened.

Species	Regional Status	Habitat Loss / Transformation	Food Source / Foraging	Pesticide / Herbicide	Overall Significance
Tent Tortoise (<i>Psammobates tentorius</i>)	NT	HIGH — strictly confined to arid Nama Karoo succulent shrubland on specific soil types; soil preparation, ripping and irrigation destroy both substrate and food plants simultaneously; no capacity to use cultivated land	HIGH — entirely dependent on Karoo succulent plants (Aizoaceae, Crassulaceae, Asteraceae) for food and moisture; conversion of shrubland eliminates the food source completely; all water obtained from succulent food items	MODERATE — not a direct target of rodenticide programmes; herbicide use to control orchard understory eliminates the succulent plant food base; systemic pesticide uptake through plant consumption possible	HIGH

6 RECOMMENDATIONS AND CONCLUSION

The proposed development of pecan nut orchards under irrigation across approximately 141 hectares on the farms Tweefontein (Erf No. 373) and Kalkfontein (Erf No. 374) will take place within a landscape that supports a high diversity of Species of Conservation Concern (SCC). The assessment confirmed the presence of the Kori Bustard, Lanner Falcon and Aardvark in or adjacent to the study area, and identified a further eleven SCC as likely or possibly occurring on site. The overall site sensitivity is High.

6.1 Overall Assessment

The existing pivot areas (approximately 95 ha) that were established before 2006 represent already-transformed habitat and their conversion to orchard does not require additional mitigation beyond the general operational measures. The proposed 46 ha infill expansion is the primary ecological concern and must be subject to all pre-clearance surveys before any earthworks commence.

Should any of the pre-clearance surveys described in this section confirm the presence of Black-footed Cat, African Striped Weasel, or an active Tawny Eagle or Verreaux's Eagle nest within the development footprint, the affected portion of the infill expansion must be suspended and the developer must consult with the proper authorities before proceeding. In such a scenario, a TOPS Section 57 permit will be required before any development that would negatively affect these species' individuals or habitat may lawfully proceed.

The developers are encouraged to approach this development not only as a compliance exercise but as an opportunity to establish the farm as a model of biodiversity-compatible agriculture in the Karoo, a region where farming practices and wildlife conservation are increasingly being shown to be mutually reinforcing when managed with ecological intelligence.

Of all the species in this ecological report, the African Striped Weasel is arguably the most sensitive to orchard development because of its absolute dependence on prey-rich, structurally complex grassland habitat and its extreme vulnerability to rodenticide secondary poisoning. Any orchard development on the farm should include an explicit rodenticide management protocol that prohibits or strictly controls anticoagulant and acute rodenticide use in the vicinity of known or potential weasel habitat.

The Black-footed Cat's possible presence in the study area is highly significant. The Northern Cape Karoo is the global stronghold of this species. The IUCN Red List categorises the Black-footed Cat as Vulnerable to extinction with fewer than 10,000 individuals remaining. Any development that converts open Karoo shrubland to intensively managed orchard habitat should explicitly assess the potential impact on this species, and a rodenticide management protocol and habitat buffer strategy should be mandatory components of any environmental authorisation conditions.

It is recommended that an Aardvark burrow survey must be done prior to soil preparation. A study in the Karoo estimated the density of Aardvark to be approximately eight animals per 10 km² — meaning the farm likely supports several individuals within its boundaries. Any orchard expansion should include an explicit no-insecticide buffer zone around known burrow sites, and farm infrastructure design should account for Aardvark movement to minimise the conflict that typically drives persecution.

6.2 Environmental Awareness Training

Environmental awareness training is a regulatory requirement under the Protocols (GG 43110, 20 March 2020) and is the single most cost-effective conservation measure available to the developer. The following minimum standard is required:

- Training must be conducted before construction begins, repeated annually, and documented with a signed attendance register.
- Training content must cover: identification of all SCC listed in this report; legal protection status and penalties under NEMBA; the prohibition of rodenticides and gin traps;

Aardvark burrow avoidance; tortoise pre-clearance obligations; and the dead-animal reporting protocol.

- Laminated SCC identification cards with photographs must be produced and posted at the farm office, workshop, and worker accommodation.

6.3 Conclusion

The proposed pecan nut orchard development on Tweefontein and Kalkfontein is considered **permissible from a faunal conservation perspective**, subject to the full and documented implementation of the recommendations set out below.

7 REFERENCES

- BirdLife South Africa. 2025. *The 2025 Red Data Book of Birds of South Africa, Lesotho and Eswatini*. Johannesburg: BirdLife South Africa. Available at: <https://www.birdlife.org.za/red-list/>
- Endangered Wildlife Trust (EWT). 2025. *2025 Regional Red List of Mammals of South Africa, Eswatini and Lesotho*. [Online]. Available at: <https://ewt.org/2025-red-mammal-list/>. Accessed: April 2026.
- Hofmeyr, M.D., Leuteritz, T. & Baard, E.H.W. 2023. *Psammobates tentorius* (Bell, 1828). In: Tolley, K.A., Conradie, W., Pietersen, D.W., Weeber, J., Burger, M. & Alexander, G.J. (eds), *Conservation Status of the Reptiles of South Africa, Eswatini and Lesotho*. Suricata 10. Pretoria: South African National Biodiversity Institute.
- Mucina, L. & Rutherford, M.C. (eds), *The Vegetation of South Africa, Lesotho and Swaziland*. Pretoria: South African National Biodiversity Institute (SANBI). Strelitzia 19. pp. 439–539.
- Shaw, J.M., Jenkins, A.R., Allan, D.G. & Ryan, P.G. 2016. Population size and trends of Ludwig's Bustard *Neotis ludwigii* and other large terrestrial birds in the Karoo, South Africa. *Bird Conservation International* 26(1): 69–86.
- Smith, C. & da Silva, J.M. 2025. A conservation assessment of *Atelerix frontalis*. In: Patel, T., Smith, C., Roxburgh, L., da Silva, J.M. & Raimondo, D. (eds), *The Red List of Mammals of South Africa, Eswatini and Lesotho*. Pretoria: South African National Biodiversity Institute and Endangered Wildlife Trust.
- South African Frog Re-Assessment Group (SA-FRoG). No Date. *Conservation status of South African frogs*. [Online]. Available at: <https://speciesstatus.sanbi.org/person/south-african-frog-re-assessment-group-sa-frog/>
- Taylor, W.A. & Skinner, J.D. 2003. Activity patterns, home ranges and burrow use of aardvarks (*Orycteropus afer*) in the Karoo. *Journal of Zoology*, 261: 291–297.
- Tolley, K.A., Conradie, W., Pietersen, D.W., Weeber, J., Burger, M. & Alexander, G.J. (eds). 2023. *Conservation Status of the Reptiles of South Africa, Eswatini and Lesotho*. Suricata 10. Pretoria: South African National Biodiversity Institute.

APPENDIX 1

Table A1. Bird species (Class Aves) as listed by SABAP2 for pentad 2920_2300 and 2925_2300 combined at Tweefontein (Erf No. 373) and Kalkfontein (Erf No. 374), the Global and Regional Red Data Book Assessment of each species, as well as species observed during the field survey. (Source; GBIF, iNaturalist, SABAP2, SANBI). **EN**, Endangered; **VU**, Vulnerable; **NT**, Near Threatened; **LC**, Least Concern.

Order / Family	Genus & Species	Common Name	Red Data Book Assessment		Observed	
			Global	Regional	Tweefontein	Kalkfontein
Accipitriformes						
Accipitridae	<i>Aquila rapax</i>	Tawny Eagle	VU	EN		
	<i>Aquila verreauxii</i>	Verreaux's Eagle	LC	VU		
	<i>Haliaeetus vocifer</i>	African Fish Eagle	LC	LC		
Anseriformes						
Anatidae	<i>Alopochen aegyptiaca</i>	Egyptian Goose	LC	LC		
	<i>Tadorna cana</i>	South African Shelduck	LC	LC		
Bucerotiformes						
Upupidae	<i>Upupa africana</i>	African Hoopoe	LC	LC	1	
Caprimulgiformes						
Apodidae	<i>Apus affinis</i>	Little Swift	LC	LC		
	<i>Cypsiurus parvus</i>	African Palm Swift	LC	LC		
Charadriiformes						
Charadriidae	<i>Vanellus armatus</i>	Blacksmith Lapwing	LC	LC	1	
	<i>Vanellus coronatus</i>	Crowned Lapwing	LC	LC		
Laridae	<i>Hydroprogne caspia</i>	Caspian Tern	LC	VU		

Pteroclididae	<i>Pterocles namaqua</i>	Namaqua Sandgrouse	LC	LC		
Ciconiiformes						
Threskiornithidae	<i>Bostrychia hagedash</i>	Hadada Ibis	LC	LC		1
Coliiformes						
Coliidae	<i>Colius colius</i>	White-backed Mousebird	LC	LC	1	1
	<i>Urocolius indicus</i>	Red-faced Mousebird	LC	LC		
Columbiformes						
Columbidae	<i>Columba guinea</i>	Speckled Pigeon	LC	LC		1
	<i>Columba livia</i>	Rock Dove	LC	LC		
	<i>Oena capensis</i>	Namaqua Dove	LC	LC		1
	<i>Spilopelia senegalensis</i>	Laughing Dove	LC	LC		
	<i>Streptopelia capicola</i>	Ring-necked Dove	LC	LC		1
	<i>Streptopelia semitorquata</i>	Red-eyed Dove	LC	LC		
Coraciiformes						
Dacelonidae	<i>Halcyon albiventris</i>	Brown-hooded Kingfisher	LC	LC		
	<i>Megaceryle maxima</i>	Giant Kingfisher	LC	LC		1
Meropidae	<i>Merops apiaster</i>	European Bee-eater	LC	LC		
	<i>Merops bullockoides</i>	White-fronted Bee-eater	LC	LC		
Galliformes						
Numididae	<i>Numida meleagris</i>	Helmeted Guinea fowl	LC	LC		1
Otidiformes						
Otididae	<i>Afrotis afraoides</i>	Northern Black Korhaan	LC	LC		1
	<i>Ardeotis kori</i>	Kori Bustard	NT	NT	Camera trap	Camera trap
	<i>Lophotis ruficrista</i>	Red-crested Korhaan	LC	LC		
	<i>Neotis ludwigii</i>	Ludwig's Bustard	EN	EN		
Passeriformes						
Acrocephalidae	<i>Acrocephalus baeticatus</i>	African Reed-warbler	LC	LC		
Alaudidae	<i>Calendulauda africanoides</i>	Fawn-colored Lark	LC	LC		

	<i>Calendulauda sabota</i>	Sabota Lark	LC	LC	
	<i>Certhilauda subcoronata</i>	Karoo Long-billed Lark	LC	LC	
	<i>Chersomanes albofasciata</i>	Spike-heeled Lark	LC	LC	
Cisticolidae	<i>Cisticola aridulus</i>	Desert Cisticola	LC	LC	
	<i>Cisticola juncidis</i>	Zitting Cisticola	LC	LC	
	<i>Cisticola tinniens</i>	Levaillant's Cisticola	LC	LC	
	<i>Malcorus pectoralis</i>	Rufous-eared Warbler	LC	LC	
	<i>Phragmacia substriata</i>	Namaqua Warbler	LC	LC	
	<i>Prinia flavicans</i>	Black-chested Prinia	LC	LC	
Corvidae	<i>Corvus albus</i>	Pied Crow	LC	LC	
Fringillidae	<i>Crithagra atrogularis</i>	Black-throated Canary	LC	LC	
	<i>Crithagra flaviventris</i>	Yellow Canary	LC	LC	1
Hirundinidae	<i>Hirundo dimidiata</i>	Pearl-breasted Swallow	LC	LC	
	<i>Ptyonoprogne fuligula</i>	Large rock martin	LC	LC	1
	<i>Riparia paludicola</i>	Brown-throated Martin	LC	LC	
Macrosphenidae	<i>Sylvietta rufescens</i>	Long-billed Crombec	LC	LC	
Malaconotidae	<i>Batis pririt</i>	Pirit Batis	LC	LC	
	<i>Nilaus afer</i>	Brubru	LC	LC	
	<i>Tchagra australis</i>	Brown-crowned Tchagra	LC	LC	
	<i>Telophorus zeylonus</i>	Bokmakierie	LC	LC	
Motacillidae	<i>Anthus cinnamomeus</i>	African Pipit	LC	LC	
	<i>Motacilla capensis</i>	Cape Wagtail	LC	LC	
Muscicapidae	<i>Cercotrichas coryphoeus</i>	Karoo Scrub Robin	LC	LC	1
	<i>Cercotrichas paena</i>	Kalahari Scrub Robin	LC	LC	
	<i>Cossypha caffra</i>	Cape Robin-Chat	LC	LC	1
	<i>Melaenornis silens</i>	Fiscal Flycatcher	LC	LC	
	<i>Monticola brevipes</i>	Short-toed Pied Thrush	LC	LC	
	<i>Myrmecocichla formicivora</i>	Ant-eating Chat	LC	LC	1

	<i>Oenanthe familiaris</i>	Familiar Chat	LC	LC		
	<i>Saxicola torquatus</i>	African Stonechat	LC	LC		
	<i>Turdus smithi</i>	Karoo Thrush	LC	LC	1	1
Nectariniidae	<i>Cinnyris fuscus</i>	Dusky Sunbird	LC	LC		
Paridae	<i>Melaniparus cinerascens</i>	Ashy Tit	LC	LC		
		Southern Grey-headed				
Passeridae	<i>Passer diffusus</i>	Sparrow	LC	LC		
	<i>Passer domesticus</i>	House Sparrow	LC	LC		
	<i>Passer melanurus</i>	Cape Sparrow	LC	LC	1	1
Ploceidae	<i>Euplectes orix</i>	Southern Red Bishop	LC	LC		
	<i>Philetairus socius</i>	Sociable Weaver	LC	LC	1	1
	<i>Plocepasser mahali</i>	White-browed Sparrow-Weaver	LC	LC		
	<i>Ploceus velatus</i>	Southern Masked Weaver	LC	LC	1	1
	<i>Quelea quelea</i>	Red-billed Quelea	LC	LC		1
	<i>Sporopipes squamifrons</i>	Scaly-feathered Weaver	LC	LC		
Pycnonotidae	<i>Pycnonotus nigricans</i>	African Red-eyed Bulbul	LC	LC	1	1
Sturnidae	<i>Creatophora cinerea</i>	Wattled Starling	LC	LC		
	<i>Lamprotornis nitens</i>	Cape Glossy Starling	LC	LC	1	1
Sylviidae	<i>Acrocephalus gracilirostris</i>	African Reed Warbler	LC	LC		
	<i>Curruca subcoerulea</i>	Chestnut-vented Warbler	LC	LC		
	<i>Eremomela icteropygialis</i>	Yellow-bellied Eremomela	LC	LC		
Zosteropidae	<i>Zosterops pallidus</i>	Orange River White-eye	LC	LC	1	1
Pelecaniformes						
Ardeidae	<i>Ardea cinerea</i>	Grey Heron	LC	LC	1	
	<i>Ardea melanocephala</i>	Black-headed Heron	LC	LC		
Piciformes						
Lybiidae	<i>Trachyphonus vaillantii</i>	Crested Barbet	LC	LC		
	<i>Tricholaema leucomelas</i>	Acacia Pied Barbet	LC	LC		

Strigiformes					
Strigidae	<i>Glaucidium perlatum</i>	Pearl-spotted Owlet	LC	LC	
Tytonidae	<i>Tyto alba</i>	Western (Common) Barn Owl	LC	LC	
Suliformes					
Anhingidae	<i>Anhinga rufa</i>	African Darter	LC	LC	1
Phalacrocoracidae	<i>Phalacrocorax lucidus</i>	White-breasted Cormorant	LC	LC	
Upupiformes					
Rhinopomastidae	<i>Rhinopomastus cyanomelas</i>	Common Scimitarbill	LC	LC	

APPENDIX 2

Table A 2. Mammal species (Class Mammalia) as listed by iNaturalist, GBIF, the Global and Regional Red Data Book Assessment of each species, as well as species observed during the field survey at Tweefontein (Erf No. 373) and Kalkfontein (Erf No. 374). **EN**, Endangered; **VU**, Vulnerable; **NT**, Near Threatened; **LC**, Least Concern.

Order/Family	Genus & Species	Common Name	Red Data Book Assessment		Observed	
			Global	Regional	Tweefontein	Kalkfontein
Carnivora						
Canidae	<i>Lupulella mesomelas</i>	Black-backed Jackal	LC	LC	Camera trap	Camera trap
	<i>Otocyon megalotis</i>	Bat-eared Fox	LC	LC	Road kill	Road kill
	<i>Vulpes chama</i>	Cape Fox	LC	LC		
Felidae	<i>Caracal caracal</i>	Caracal	LC	LC		
	<i>Felis lybica cafra</i>	Southern African Wildcat	LC	LC		
	<i>Felis nigripes</i>	Black-footed Cat	VU	VU		
Herpestidae	<i>Atilax paludinosus</i>	Water/Marsh Mongoose	LC	LC	1	
	<i>Cynictis penicillata</i>	Yellow mongoose	LC	LC		
	<i>Herpestes pulverulentus</i>	Cape Grey Mongoose	LC	LC		
	<i>Herpestes sanguineus</i>	Slender Mongoose	LC	LC		1
	<i>Suricata suricatta</i>	Suricate/Meerkat	LC	LC		1
Hyaenidae	<i>Parahyaena brunnea</i>	Brown Hyaena	NT	NT		
	<i>Proteles cristatus</i>	Aardwolf	LC	LC		
Mustelidae	<i>Ictonyx striatus</i>	Striped polecat/Zorilla	LC	LC	Road kill	Road kill
	<i>Mellivora capensis</i>	Honey Badger	LC	LC		
	<i>Poecilogale albinucha</i>	African Striped Weasel	LC	NT		
Viverridae	<i>Genetta genetta</i>	Southern Small-spotted Genet	LC	LC	Road kill	Road kill

Cetartiodactyla							
Bovidae	<i>Alcelaphus buselaphus caama</i>	Red Hartebeest	LC	LC			
	<i>Antidorcas marsupialis</i>	Springbok	LC	LC			
	<i>Connochaetes taurinus</i>	Blue Wildebeest	LC	LC			
	<i>Connochaetes gnou</i>	Black Wildebeest	LC	LC			
	<i>Kobus ellipsiprymnus</i>	Common Waterbuck	LC	LC			
	<i>Oreotragus oreotragus</i>	Klipspringer	LC	LC			
	<i>Oryx gazella</i>	Gemsbok	LC	LC			
	<i>Raphicerus campestris</i>	Steenbok	LC	LC	Camera trap	Camera trap	
	<i>Sylvicapra grimmia</i>	Common duiker	LC	LC	Camera trap	Camera trap	
	<i>Tragelaphus oryx</i>	Eland	LC	LC			
	<i>Tragelaphus strepsiceros</i>	Greater Kudu	LC	LC			
Giraffidae	<i>Giraffa camelopardalis</i>	Southern Giraffe	VU	LC			
Chiroptera							
Molossidae	<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat	LC	LC			
Nycteridae	<i>Nycteris thebaica</i>	Egyptian Slit-faced Bat	LC	LC			
Rhinolophidae	<i>Rhinolophus clivosus</i>	Geoffroy's Horseshoe Bat	LC	LC			
	<i>Rhinolophus damarensis</i>	Damara Horseshoe Bat	LC	VU			
Vespertilionidae	<i>Cnephaeus hottentotus</i>	Long-tailed Serotine Bat	LC	LC			
	<i>Laephotis capensis</i>	Cape Roof Bat	LC	LC			
Eulipotyphla							
Erinaceidae	<i>Atelerix frontalis</i>	Southern African Hedgehog	LC	NT			
Soricidae	<i>Suncus varilla</i>	Lesser Dwarf Shrew	LC	LC			
Hyracoidea							
Procaviidae	<i>Procavia capensis</i>	Rock Hyrax	LC	LC			
Lagomorpha							
Leporidae	<i>Lepus capensis</i>	Cape Hare	LC	LC			

	<i>Pronolagus rupestris</i>	Smith's Red Rock Rabbit	LC	LC		
Macroscelidea						
Macroscelididae	<i>Macroscelides proboscideus</i>	Karoo Round-eared Sengi	LC	LC		
	<i>Macroscelides rupestris</i>	Western Rock Sengi	LC	LC		
Primates						
Cercopithecidae	<i>Chlorocebus pygerythrus</i>	Vervet Monkey	LC	LC	Road obs.	Road obs.
	<i>Papio ursinus</i>	Chacma Baboon	LC	LC		
Rodentia						
Sciuridae	<i>Xerus inauris</i>	Cape ground squirrel	LC	LC		1
Bathyergidae	<i>Cryptomys hottentostus</i>	Common Mole-rat	LC	LC		
Hystriidae	<i>Hystrix africaeaustralis</i>	Cape Porcupine	LC	LC	1	1
Muridae	<i>Aethomys chrysophilus</i>	Red Veld Rat	LC	LC		
	<i>Desmodillus auricularis</i>	Cape Short-eared Gerbil	LC	LC		
	<i>Gerbilliscus brantsii</i>	Brants's Gerbil	LC	LC		
	<i>Gerbilliscus leucogaster</i>	Bushveld Gerbil	LC	LC		
		Southern Multimammate				
	<i>Mastomys coucha</i>	Mouse	LC	LC		
	<i>Micaelamys namaquensis</i>	Namaqua Rock Rat	LC	LC		
	<i>Mus minutoides</i>	Pygmy Mouse	LC	LC		
	<i>Otomys unisulcatus</i>	Karoo Bush Rat	LC	LC		
	<i>Parotomys brantsii</i>	Brants' Whistling Rat	LC	LC		
		West-Central Four-striped				
	<i>Rhabdomys bechuanae</i>	Grass Rat	LC	LC		
Nesomyidae	<i>Malacothrix typica</i>	Large-eared Mouse	LC	LC		
Pedetidae	<i>Pedetes capensis</i>	Springhare	LC	LC		
Tubulidentata						
Orycteropodidae	<i>Orycteropus afer</i>	Aardvark	LC	NT	Camera trap	Camera trap

APPENDIX 3

Table A 3. Reptile species (Class Reptilia) as listed by iNaturalist, GBIF, the Global and Regional Red Data Book Assessment of each species, as well as species observed during the field survey at Tweefontein (Erf No. 373) and Kalkfontein (Erf No. 374). **EN**, Endangered; **VU**, Vulnerable; **NT**, Near Threatened; **LC**, Least Concern.

Order/Family Genus & Species Common Name			Red Data Book Assessment		Observed	
			Global	Regional	Tweefontein	Kalkfontein
Order Squamata						
Agamidae	<i>Agama aculeata</i>	Ground Agama	LC	LC	Road kill	Road kill
	<i>Agama atra</i>	Southern Rock Agama	LC	LC		
Amphisbaenidae	<i>Monopeltis infuscata</i>	Dusky Worm Lizard	LC	LC		
	<i>Zygaspis quadrifrons</i>	Kalahari Dwarf Worm Lizard	LC	LC		
Colubridae	<i>Dasypeltis scabra</i>	Common Egg Eater	LC	LC		
	<i>Telescopus beetzii</i>	Karoo Tiger Snake	LC	LC		
Cordylidae	<i>Karusasaurus polyzonus</i>	Karoo Girdled Lizard	LC	LC		
Elapidae	<i>Naja nivea</i>	Cape cobra	LC	LC		
	<i>Elapsoidea sundevallii</i>	Sundevall's Garter Snake	LC	LC		
	<i>Naja nigricincta</i>	Western Barred Spitting Cobra	LC	LC		
Gekkonidae	<i>Chondrodactylus bibronii</i>	Bibron's Thick-toed Gecko	LC	LC		
	<i>Lygodactylus capensis</i>	Common Dwarf Gecko	LC	LC		
	<i>Ptenopus garrulus</i>	Common Barking Gecko	LC	LC		
Lacertidae	<i>Meroles suborbitalis</i>	Spotted Desert Lizard	LC	LC		
	<i>Heliobolus lugubris</i>	Bushveld Lizard	LC	LC		
	<i>Nucras intertexta</i>	Spotted Sandveld Lizard	LC	LC	1	1
	<i>Nucras tessellata</i>	Western Sandveld Lizard	LC	LC		

	<i>Pedioplanis lineoocellata</i>	Spotted Sand Lizard	LC	LC		
	<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard	LC	LC		
Lamprophiidae	<i>Boaedon capensis</i>	Cape House Snake	LC	LC		
	<i>Pseudaspis cana</i>	Mole Snake	LC	LC		
Leptotyphlopidae	<i>Leptotyphlops scutifrons</i>	Peter's Thread Snake	LC	LC		
Prosymnidae	<i>Prosymna sundevallii</i>	Sundevall's Shovel-snout	LC	LC		
Psammophiidae	<i>Psammophis leightoni</i>	Cape Whip Snake	LC	LC		
	<i>Psammophis notostictus</i>	Karoo Sand Snake	LC	LC		
	<i>Psammophis trinasalis</i>	Fork-marked Sand Snake	LC	LC		
Scincidae	<i>Acontias lineatus</i>	Striped Legless Skink	LC	LC		
	<i>Acontias occidentalis</i>	Western Legless Skink	LC	LC		
	<i>Trachylepis capensis</i>	Cape skink	LC	LC		
	<i>Trachylepis spilogaster</i>	Kalahari Tree Skink	LC	LC	1	1
	<i>Trachylepis sulcata</i>	Western Rock Skink	LC	LC		
	<i>Trachylepis variegata</i>	Variegated Skink	LC	LC		
Typhlopidae	<i>Rhinotyphlops lalandei</i>	Delalande's Beaked Blind Snake	LC	LC		
Varanidae	<i>Varanus albigularis</i>	Rock Monitor	LC	LC		
	<i>Varanus niloticus</i>	Water Monitor	LC	LC		
Viperidae	<i>Bitis arietans</i>	Puff adder	LC	LC	Road kill	Road kill
	<i>Bitis caudalis</i>	Horned Adder	LC	LC		
Order Testudines						
Testudinidae	<i>Stigmochelys pardalis</i>	Leopard Tortoise	LC	LC		
	<i>Psammobates tentorius</i>	Tent Tortoise	NT	NT		
Pelomedusidae	<i>Pelomedusa galeata</i>	South African Helmeted Terrapin	LC	LC		

APPENDIX 4

Table A 4. Frog species (Class Amphibia, Order Anura) as listed by iNaturalist, GBIF, the Global and Regional Red Data Book Assessment of each species, as well as species observed during the field survey at Tweefontein (Erf No. 373) and Kalkfontein (Erf No. 374). **EN**, Endangered; **VU**, Vulnerable; **NT**, Near Threatened; **LC**, Least Concern.

Family	Genus & Species	Common Name	Red Data Book Assessment		Observed	
			Global	Regional	Tweefontein	Kalkfontein
Brevicipitidae	<i>Breviceps a. adspersus</i>	Common Rain Frog	LC	LC		
Bufonidae	<i>Poyntonophrynus vertebralis</i>	Southern Pygmy Toad	LC	LC		
	<i>Sclerophrys capensis</i>	Raucous/Ranger's Toad	LC	LC		
	<i>Sclerophrys gutturalis</i>	Guttural Toad	LC	LC		
	<i>Sclerophrys poweri</i>	Western Olive Toad	LC	LC		
	<i>Vandijkophrynus gariensis</i>	Karoo Toad	LC	LC		
Hyperoliidae	<i>Kassina senegalensis</i>	Bubbling Kassina	LC	LC		
Pipidae	<i>Xenopus leavis</i>	Common Platanna	LC	LC		
Pyxicephalidae	<i>Amietia delalandii</i>	Common River Frog	LC	LC		
	<i>Amietia poyntoni</i>	Poynton's River Frog	LC	LC		
	<i>Cacosternum boettgeri</i>	Boettger's Caco	LC	LC		
	<i>Pyxicephalus adspersus</i>	Giant Bullfrog	LC	LC		
	<i>Tomopterna adastola</i>	Tremolo Sand Frog	LC	LC		
	<i>Tomopterna tandyi</i>	Tandy's Sand frog	LC	LC		