PB CONSULT
ENVIRONMENTAL MANAGEMENT SERVICES

BOTANICAL & TERRESTRIAL BIODIVERSITY STATEMENT

REVISION 1

CALVINIA AQUIFER RECHARGE PROJECT

THE PROPOSED DEVELOPMENT OF EXPERIMENTAL AQUIFER RECHARGE INFRASTRUCTURE IN THE AKKERENDAM NATURE RESERVE, CALVINIA HANTAM MUNICIPALITY, NORTHERN CAPE PROVINCE.

PREPARED FOR:

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EXECUTIVE SUMMARY

Calvinia has always been privileged to have both surface water and ground-water sources for its water supply, but the Karee Dam dependents on good winter rainfalls to collect and store sufficient water. During times of drought the town becomes totally reliant on its groundwater sources to augment the dam. With sufficient winter rains the water supply can lasts to mid-summer, after which the groundwater sources are utilized. However, the town has outgrown its existing water supply. The recent 7-year drought period had put enormous strain on the existing infrastructure. During 2018, the Namakwa district was declared a disaster area and the Department of Water and Sanitation provided funds for drought relief.

The Department of Water and Sanitation wishes to implement several experimental structures to artificially recharge the underground water resources (existing extraction boreholes). During rainfall events, small seasonal streams and drainage lines will flow (and even flood), for short periods of time (days or weeks). The flow downhill can be fast, which means that water penetration is restricted. The aim is to slow the runoff by installing check dams with shallow infiltration ponds, from where some of the runoff can be diverted, *via* boreholes, directly back into the underlying aquifer. If successful it could be of great benefit to the town of Calvinia (and many other communities in similar circumstances). It is considered a much better practice to store water underground rather than above ground in warm arid regions (where evaporation rates are high). Various location options within the Calvinia area had been investigated, but because of land-owner resistance it was decided to start with 4 infiltration ponds **within the Akkerendam Nature Reserve**, which will link up with existing extraction boreholes. It is also in close proximity to the Karee Dam and the Calvinia Water Treatment Works.

VEGETATION TYPE & STATUS	The proposed development will have a slight impact on one vegetation type, **Hantam Karoo** (Figure 6), a vegetation type that has been classified as "Least threatened".
WATER COURSES AND WETLANDS	The proposed development will impact on two seasonal steams, namely the Kleinhoek River and a tributary to the Kleinhoek River. NB. A freshwater specialist was appointed to evaluate the significance of this watercourse and the potential impact (as a result the impact on watercourses it is not evaluated in this study).
SPECIAL HABITAT CONDITIONS	The proposed infiltration ponds are located in the lower or most southern part of the Akkerendam Nature Reserve (near the entrance gate). Altitude varied from 1010 to 1040 m asl. The soil can be described as red brown or light red brown in color, while the rock cover is generally low, consisting of pebbles and small stones. The vegetation can be described as a low Karoo shrubland with a cover that varied from 50% to 90%. Apart from the two seasonal streams not other special habitats, were observed.
LAND-USE	The proposed project will impact on the Akkerendam Nature Reserve, the second oldest proclaimed municipal nature reserve in the Northern Cape. But **one of the main reasons for establishing the Akkerendam Nature Reserve, was to protect the water resources of the town**.
VEGETATION ENCOUNTERED	The veld itself was in excellent condition and seems to have recovered well from the recent long-term drought. The vegetation was dominated by a combination of *Galenia africana*, *Chrysocoma ciliata*, *Pteronia incana* and *Eriocephalus ericoides*. The grass, *Ehrharta calycina,* was also common in most areas. In a vegetation study for the Akkerendam Nature Reserve, done by Van der Merwe (2014), three broad plant communities and 14 subcommunities were identified. According to this study, al 4 of the infiltration ponds will be located in the *Galenia africana – Eriocephalus ericoides* Hantam Karoo Community (Plant community 3 in Figure 9). The 4 ponds will be placed in two seasonal streams. The streams will have to be widened to accommodate the infiltration structure, which will result in a physical impact on riparian zone and the surrounding natural veld, at each location. The total impacted area for the construction of the ponds should be less than 2 ha. Considering that MAR5 will

be located on a rocky sheet (with almost no additional impact on vegetation) the total impact on vegetation is likely to be less than 1.2 ha. The **impact is considered temporary (considering that rivers and streams tend to change their routes from time-to-time)**, as it is expected that the natural veld and riparian vegetation will re-establish itself next to these ponds (which should be easy to achieve **with good environmental control** during construction). Two additional access (two-spoor) tracks will also have to established for access during construction and maintenance.

CONSERVATION PRIORITY AREAS

The proposed development will impact on the Akkerendam Nature Reserve (a Municipal Reserve) which had been identified as a critical biodiversity area (CBA1) within the NC CBA maps (2016) (Figure 7). The Akkerendam Nature Reserve is also located within the Hantam-Roggeveld Centre (HRC) of endemism (Figure 8), which is centred on the town of Calvinia and includes most of the Bokkeveld Plateau (Van Wyk & Smith, 2001).

The proposed project will thus have a relatively small (< 1.2 ha), temporary impact on indigenous vegetation within a municipal nature reserve, located within the HRC of endemism.

CONNECTIVITY

During construction, connectivity might be impacted slightly, but it is considered unlikely that the proposed project will result in any long-term or permanent additional impact on connectivity.

THREATENED AND PROTECTED PLANT SPECIES

According to the **DFFE Environmental Screening report** for this site (Appendix 2), the **plant species theme** sensitivity is considered **Very High Sensitive**, because of the potential of encountering sensitive plant species. Of these, one species was (potentially) observed, namely ***Cleretum* cf. *maughanii*** (Photo 16). Although only few of these plants were observed, they are expected to be scattered throughout the veld itself. However, they do not associate with watercourses or wetlands and the likelihood that the proposed project will have any significant detrimental impact on this species is considered low.

In her final report of the Vegetation of the Akkerendam Nature Reserve, Dr. Van der Merwe includes a preliminary species list of the Akkerendam Nature Reserve (Appendix D) (Van der Merwe, 2014), which, includes a much larger area and is a much more comprehensive species list than the one for this study. This species list only include one of the sensitive species named in the DFFE screening report, namely ***Cliffortia arborea*** (the star tree). This species normally grows in cliffs and on ledges within the mountains and is unlikely to be impacted by the proposed project.

There is thus a small change that the development may impact on a few *Cleretum maughanii* individuals, but it is unlikely that it will have any significant detrimental impact on the long-term survival of the species as such. As a result, the plant species sensitivity rating could be reduced to **Low Sensitive**.

FAUNA & AVI-FAUNA

According to the **DFFE Environmental Screening Report** the relative **Animal species theme** sensitivity is considered of **High Sensitivity** because of the potential impact on 4 bird species , one mammal species and one reptile species (Refer to Table 11).

Since the proposed development will result in temporary short term disturbance it is considered unlikely that it will result in any significant additional impact on any of the bird species. In fact, it may be beneficial to the long-term biodiversity in terms of amphibians and bird's species attracted by the temporary pooling.

Historically the critically endangered Riverine rabbit might have occurred in the Calvinia area. The upper seasonal streams within the Akkerendam Nature Reserve, lacks the dense riparian vegetation with which this species is normally associated (although the soils might be suitable for burrows). However, the Riverine rabbit has not been observed in the larger Calvinia area for the last 30 years and is thought to be locally extinct.

Sensitive species 32 refers to a tortoise endemic to South Africa and considered **Endangered** due to anthropogenic land transformation and other threats. The locations of the ponds are in the low open fields at the foothills of the Hantam Mountains (away from the rocky hills and ridges that is this tortoise's preferred habitat). The development might have a temporary impact on small areas of its habitat, but it is considered unlikely that the development will have any permanent long-term impact on this species.

The discussion in Table 11 suggests that it is considered highly unlikely that the proposed project will pose any significant additional impact on any of these species.

With regards to the is project the sensitivity rating is considered to be **Low sensitive**.

MAIN CONCLUSION

According to the **DFFE Environmental Screening Report** the relative Terrestrial Biodiversity theme sensitivity is considered of **Very High Sensitivity** because:

- The site is located within the Akkerendam Nature Reserve (a municipal managed reserve).

In addition:

- The site falls within the Hantam-Roggeveld Centre of endemism.
- It overlaps a CBA 1 area as identified in the NC CBA maps.
- The development may impact on at least one red-listed species and various NCNCA protected species.
- The site overlaps the distribution range of four red-listed bird species, one mammal and one reptile species.

The Terrestrial biodiversity assessment (Table 12) aims to take all the discussion in this report into account, including the fact that the fact that the vegetation is not vulnerable or endangered as well as all the other reasons discussed throughout this document. According, Table 12, the main impacts associated with the proposed development will be:

- The potential impact on a conservation priority area;
- The potential impact on red-listed fauna and flora species.

Because of the location and small size and the temporary nature of the proposed development even the cumulative impact given in Table 12 is considered to be **Low**. However, various mitigation actions is proposed to ensure that the impact remains low (especially because of its location within a Nature Reserve).

No fatal flaws or any other obstacles were found with respect to the flora, vegetation, fauna, and terrestrial biodiversity. **It is thus considered highly unlikely that the development will contribute significantly to any of the following:**

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

The findings of this assessment suggests that the relative terrestrial biodiversity theme sensitivity should be **Low Sensitive** (not Very High Sensitive as suggested in the DFFE screening report).

WITH THE AVAILABLE INFORMATION IT IS RECOMMENDED THAT THE PROJECT BE APPROVED WITH THE MITIGATION ACTIONS AS DESCRIBED UNDER HEADING 0.

INDEPENDENCE & CONDITIONS

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

RELEVANT QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

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

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

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

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

DECLARATION OF INDEPENDENCE

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

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

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

Note: The terms of reference must be attached.

Signature of the specialist:

PB Consult (Sole Proprietor)

Name of company:

15 November 2023

Date:

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ABBREVIATIONS

BAR	Basic Assessment Report
CBA	Critical biodiversity area
DENC	Department of Environment and Nature Conservation
EA	Environmental Authorization
EAP	Environmental assessment practitioner
ECO	Environmental Control Officer
EIA	Environmental impact assessment
EMP	Environmental Management Plan or Program
EMS	Environmental management system
EN	Endangered
ESA	Ecological support area
LT	Least Threatened
NEMA	National Environmental Management Act, 1998 (Act no. 107 of 1998)
VU	Vulnerable

1. INTRODUCTION

Calvinia is located in the Hantam Karoo, on the R27 between Nieuwoudtville and Brandvlei. The Hantam area is regularly subject to long periods of drought. Rainfall is predominantly in summer and usually in the form of short thunderstorms. Calvinia and Nieuwoudtville are exceptions to this, as they are located on the boundary between the winter and summer rainfall regions. Calvinia has always been privileged to have both surface water and ground-water sources for its water supply, but the Karee Dam dependents on good winter rainfalls to collect and store sufficient water. During times of drought the town becomes totally reliant on its groundwater sources to augment the dam.

With sufficient winter rains the water supply used to last to mid-summer, after which the groundwater sources are utilized. Over the last decade, the town has outgrown its existing water supply and the recent extended drought period placed enormous strain on the existing water resources (and infrastructure). During 2018, the Namakwa district was declared a disaster area and the Department of Water and Sanitation provided funds for drought relief. BVi Consulting Engineers conducted a feasibility study that determined that the extension of the groundwater sources will provide the most cost-effective medium- to long-term solution.

The Department of Water and Sanitation wishes to implement several experimental structures to artificially recharge the underground water resources (existing extraction boreholes). During rainfall events, episodic drainage lines will flow and even flood, for short periods of times. The flow downhill can be fast, which means that water penetration is restricted. The aim of this experiment is to slow the rundown of the water, by installing shallow infiltration ponds or check dams, from where some of the runoff can be diverted, *via* boreholes, directly back into the underlying aquifer. If successful it could be of great benefit to the town of Calvinia (and many other communities in similar circumstances). It is considered a much better practice to store water underground rather than above ground in warm arid regions (where evaporation rates are high).

Five managed aquifer recharge (MAR) boreholes sites were identified in the Akkerendam Nature Reserve based on a geophysical survey sone by GEOSS during 2023 and to be in close proximity to successful production boreholes (GEOSS, 2023). The chosen sites are also in close proximity to the Karee Dam and the Calvinia Water Treatment Works.

The DFFE screening report for the proposed site, compiled by PB Consult on the 9th of November 2023, identified various areas of potential environmental sensitivity, of which the following will be discussed in this report:

- The relative Animal species theme sensitivity is considered of **High Sensitivity**;
- The relative Plant species theme sensitivity is considered of **Very High Sensitivity**;
- The relative Terrestrial Biodiversity theme sensitivity is considered of **Very High Sensitivity**.

According to the Vegetation map of South Africa, the proposed footprint will impact on one vegetation type, namely Hantam Karoo, ("Least Threatened") (GN. No. 2747 of 18 November 2022). However, the proposed footprint falls within the Akkerendam Nature Reserve (the second oldest Municipal nature reserve in the Northern Cape) and overlaps a critical biodiversity area as identified in the 2016 Northern Cape critical biodiversity areas maps (Holness & Oosthuysen, 2016). The site also falls within the Hantam-Roggeveld Centre (HRC) of endemism. **On the other hand, one of the main purposes for establishing the Akkerendam NR was to protect the water catchment area of Calvinia.**

1.1. LEGISLATION GOVERNING THIS REPORT

EnviroAfrica was appointed to facilitate the NEMA EIA application for the project. PB Consult was appointed by EnviroAfrica to conduct a botanical and terrestrial biodiversity assessment of the proposed footprint area.

This is a 'specialist report', compiled in terms of:

- The National Environmental Management Act, Act. 107 of 1998 (NEMA);
- The "Protocol for the Specialist Assessment and Minimum report content requirements for environmental impacts on terrestrial biodiversity" in terms of Sections 24(5)(a) and (h) and 44 of the NEMA (Government Notice No. 320 of 20 March 2020).

1.2. TERMS OF REFERENCE

The Terms of Reference for this study were to undertake a visit to the study area and compile a specialist report that assesses the potential impacts on *Botanical and Terrestrial Biodiversity* features of the proposed development.

Study should address:

- Habitat sensitivity;
- Threatened ecosystems (including critical biodiversity areas and ecological support areas);
- Flora and fauna species of conservation concern;
- Any significant botanical or other terrestrial biodiversity features that might be impacted because of the proposed development as identified in the DFFE Screening Report for the site.
- Potential direct and cumulative impacts resulting from the proposed development on the receiving environment.

2. STUDY AREA

2.1. LOCATION & LAYOUT

Calvinia is 420 km north of Cape Town on the R27 Regional Road between Vanrhynsdorp and Brandvlei and lies at an altitude of 1 050 m above sea level. The town is 60 km northeast of Nieuwoudtville and 140 km south-southwest of Brandvlei. Calvinia is located south of the Hantam Mountains on the banks of the Oorlogskloof River and is the main town of the Hantam Municipality in the Northern Cape Province.

The proposed experimental infiltration ponds will be located in the most southern portion (just northwest of the entrance gate) of the Akkerendam Nature Reserve. The Nature Reserve, itself is located at the foothills of the Hantam Mountains, just north of Calvinia (Figure 1).

The ponds will be located within two small episodic watercourses which drains or forms part of the Kleinhoek River. The Kleinhoek River runs through Calvinia and drains into the Oorlogskloof River (Figure 3 & Table 1).

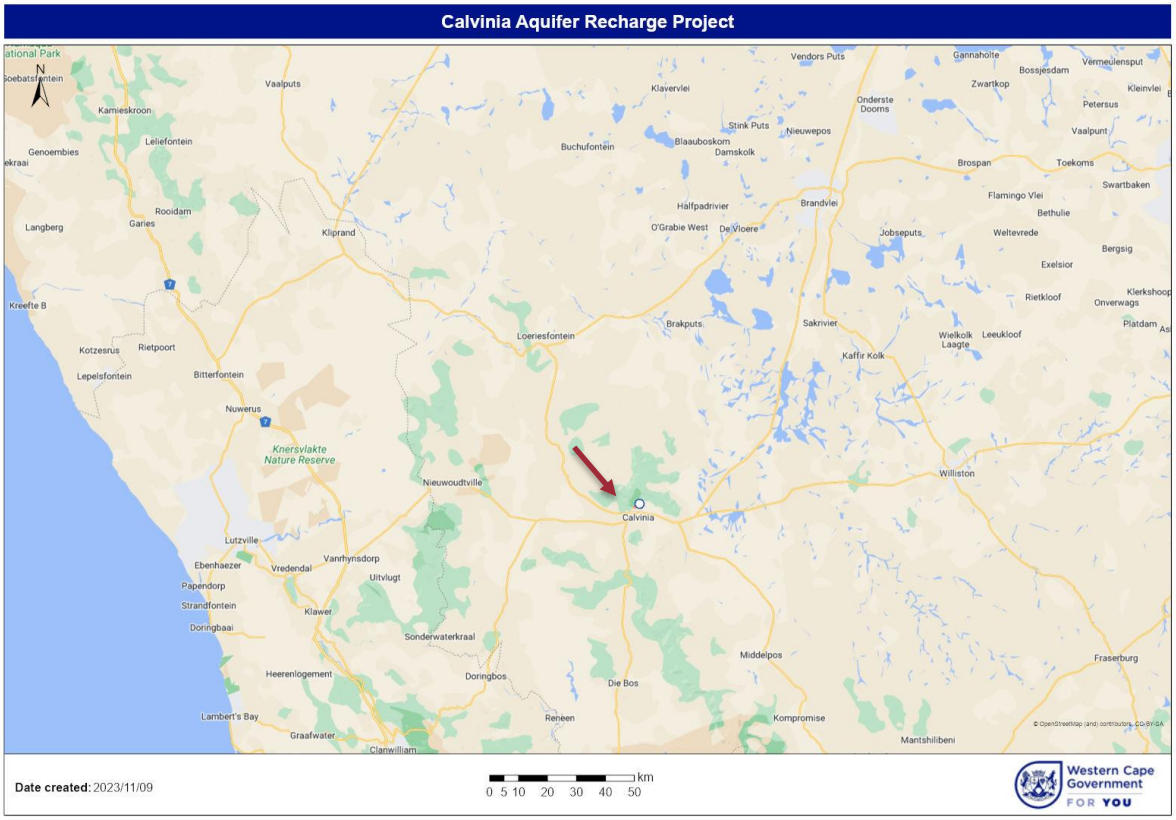

Figure 1: A map showing the location of Calvinia between Nieuwoudtville and Brandvlei

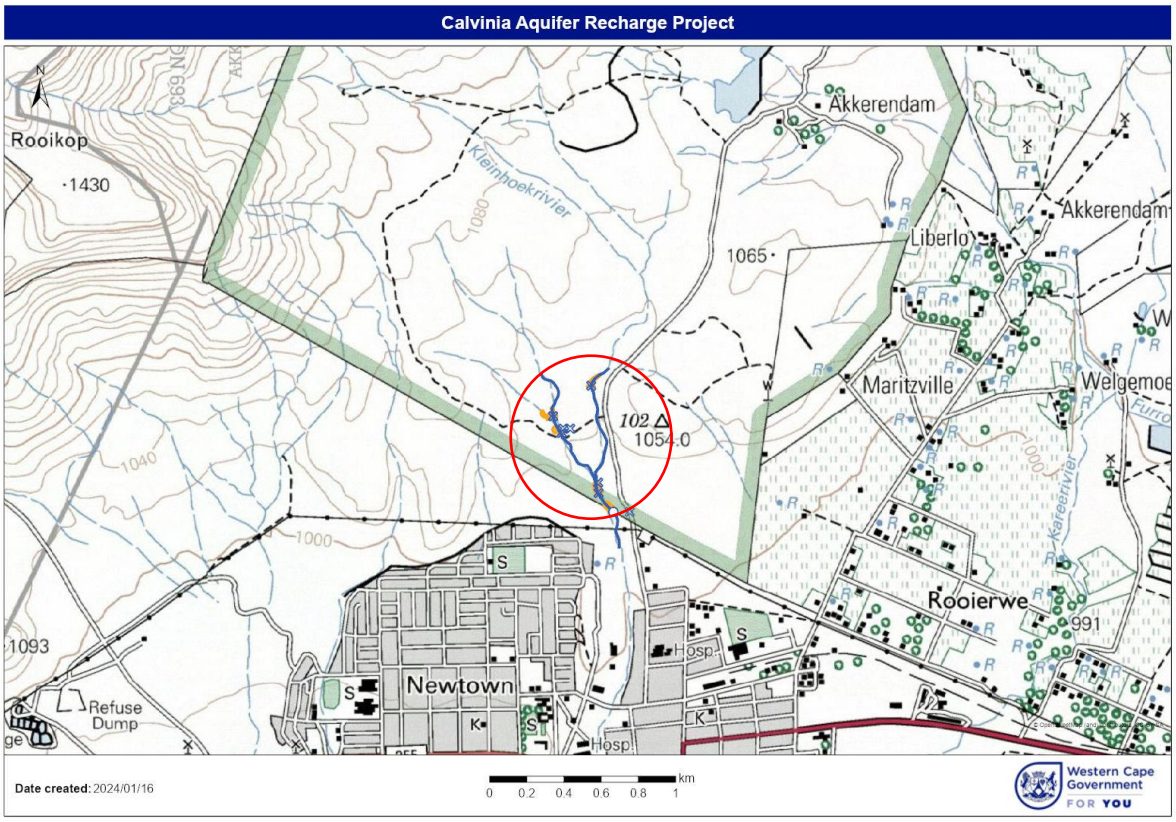

Figure 2: A map showing the location of the proposed infiltration ponds in the southern part of the Akkerendam NR

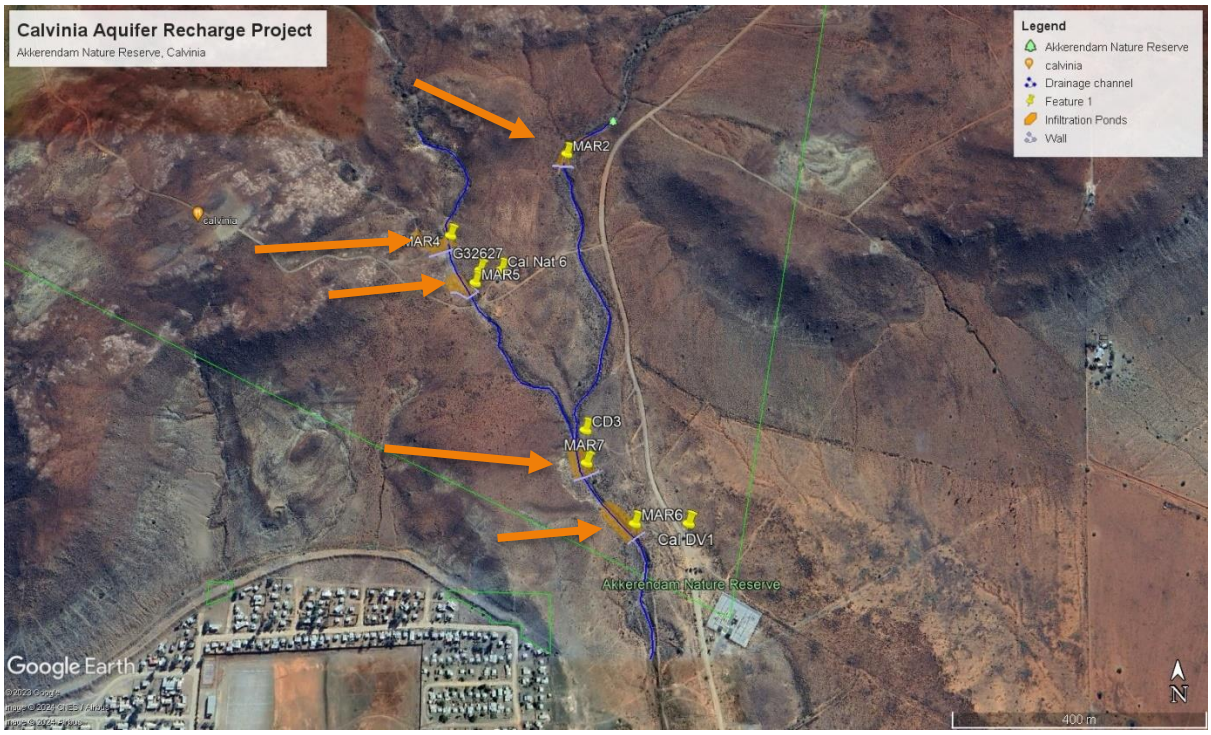

Figure 3: A Google Image showing the location of the proposed infiltration ponds within the Akkerendam Nature Reserve.

Table 1: Co-ordinates for the location of the infiltration ponds (WGS 84 format)

DESCRIPTION	CO-ORDINATE
MAR2	31°26'57.13"S 19°46'18.05"E
MAR4	31°27'2.42"S 19°46'10.26"E
MAR5	31°27'5.33"S 19°46'12.05"E
MAR6	31°27'19.02"S 19°46'22.56"
MAR7	31°27'15.75"S 19°46'19.54"E

2.2. ACTIVITY DESCRIPTION

The Department of Water and Sanitation wishes to implement several experimental structures to artificially recharge the underground water resources (existing extraction boreholes) (Hohne & Fourie, 2022). During rainfall events, episodic drainage lines will flow and even flood, for short periods of time (weeks). The flow downhill can be fast, which means that water penetration is restricted. The aim is to slow down the runoff by installing shallow infiltration ponds or check dams, from where some of the runoff can be diverted, *via* boreholes, directly back into the underlying aquifer.

The proposal is to install gabion walls (to slow down or check the flow of water) within the watercourse and to install small intake structures, within a small pond, behind the gabion walls. Gabion walls are typically tight packed rocks within a wire basket. These walls are not watertight but will slow down and back-up the water behind the gabion wall. The infiltration pond will be excavated and fitted with

an intake structure (Figure 4).

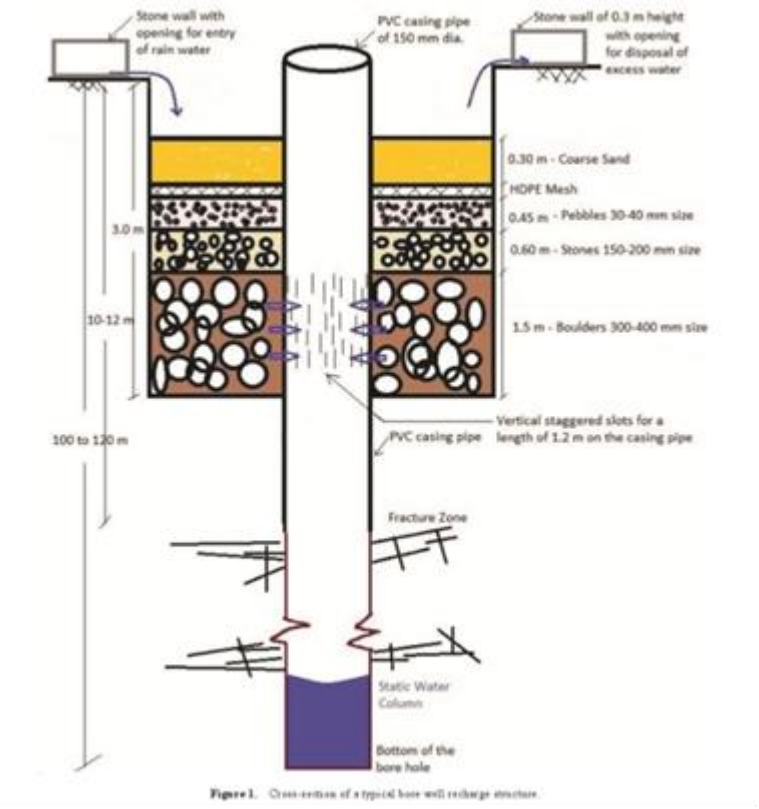

Figure 4: A sketch of an example of the proposed intake structure (Hohne & Fourie, 2022)

The intake structure will consist of an excavated sand filter, filled with porous stone and coarse sand with a borehole in its middle. In this proposal the borehole is just a pipe with infiltration holes along its sides, located within a sand filter (the intake structure). Water will accumulate behind the gabion wall which will then drain through the sand and rock filter into the borehole pipe and down to the underground aquifer, which in theory should enhance the recharge of the aquifers, which should result in a more sustainable groundwater supply.

MAR5 will be located on a rocky shale layer on which a gabion wall will not find any purchase. Here a concrete retention wall will be constructed, anchored in the rock with steel dowels.

2.2.1. FOOTPRINT SIZES

The sizes of the 5 ponds will be determined by the terrain but will be between 0,1 – 0.25ha in size (MAR2 = ± 0.14 ha; MAR4 = ± 0.21 ha; MAR5 = ±0.15 ha; MAR6 = ±0.24 and MAR7 = ±0.24ha).

The size of the gabions will also vary depending on the terrain but will for the most part be between 40 - <80 m (the concrete retention wall of MAR5 is expected to be about 75 m in length to encircle the flat rocky surface).

The excavated sand filter will be 10 m long by 5 m wide and 1 m deep located behind the gabion wall at the bottom of the pond.

2.3. TOPOGRAPHY, GEOLOGY AND SOILS

The study area is loosely described as the areas impacted by the proposed infiltration ponds and the surrounding vegetation. It was located on the flats and undulating lower slopes of the Hantam Mountain within the Akkerendam Nature Reserve (the southern part of the Reserve, to the west of the entrance gate and -road). The altitude varied from about 1010 to 1040 m asl. The soil can be described as red brown or light red brown in color, while the rock cover varied from almost absent to 80%. According to Mucina & Rutherford (2006), this vegetation type is associated with soils with a pedocutanic horizon and a marked clay accumulation, strongly structured and a reddish colour.

2.4. CLIMATE

Calvinia is located at the foot of the Hantam Mountains (about 987 m above sea level). The Hantam Karoo has a semi-desert climate receiving its rainfall mainly in winter (although the eastern portions of the Hantam Karoo lies in the transition to summer rainfall). The mean annual precipitation is unreliable and can vary from year to year (Van Wyk & Smith, 2001). Average annual precipitation is about 232 mm which falls mainly during the winter months, with June normally the wettest month of the year, while January normally is the driest month of the year. Summers (October to March) are mild too hot with January normally being the warmest month with an average temperature of 23.1°C and maximum temperatures reaching 30°C. Winters are cold to very cold with regular snow on the higher mountains (e.g., the Hantam Mountains). July is normally the coldest month with average temperatures of 9.7°C. (Refer to Table 2). (www.climate-data.org).

Table 2: Weather averages for Calvinia (www.climate-data.org)

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C	23.1 °C	23 °C	21 °C	17.1 °C	13.2 °C	9.4 °C	9.3 °C	10.1 °C	13.3 °C	17 °C	19.2 °C	21.4 °C
(°F)	(73.5) °F	(73.4) °F	(69.8) °F	(62.8) °F	(55.7) °F	(48.9) °F	(48.7) °F	(50.2) °F	(55.9) °F	(62.7) °F	(66.5) °F	(70.6) °F
Min. Temperature °C	15.6 °C	15.8 °C	14 °C	10.7 °C	7.4 °C	4.1 °C	3.6 °C	4.1 °C	6.4 °C	9.5 °C	11.4 °C	13.9 °C
(°F)	(60.1) °F	(60.4) °F	(57.2) °F	(51.3) °F	(45.3) °F	(39.4) °F	(38.5) °F	(39.4) °F	(43.4) °F	(49) °F	(52.4) °F	(57) °F
Max. Temperature °C	30.3 °C	30.2 °C	27.9 °C	23.4 °C	19.2 °C	15.2 °C	15.4 °C	16.6 °C	20.2 °C	24.3 °C	26.5 °C	28.8 °C
(°F)	(86.6) °F	(86.4) °F	(82.2) °F	(74.2) °F	(66.5) °F	(59.4) °F	(59.6) °F	(61.8) °F	(68.4) °F	(75.7) °F	(79.7) °F	(83.9) °F
Precipitation / Rainfall	13	17	26	23	22	28	24	22	12	15	15	15
mm (in)	(0.5)	(0.7)	(1)	(0.9)	(0.9)	(1.1)	(0.9)	(0.9)	(0.5)	(0.6)	(0.6)	(0.6)
Humidity(%)	34%	36%	39%	45%	51%	59%	54%	52%	41%	34%	33%	34%
Rainy days (d)	2	2	3	3	3	4	3	3	2	2	2	2

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

3. APPROACH & METHODOLOGY

The protocol for specialist assessment and minimum report content and requirements for environmental impacts on terrestrial biodiversity was published in GN. No. 320 of 20 March 2020. It includes the requirements for a desktop analysis and site verification.

3.1. DESKTOP ANALYSIS

The first step of the study was to conduct a desktop analysis of the study area and its immediate surroundings. Using the DFFE screening tool report as basis, spatial information from online databases such as SANBI BGIS, available literature and Google Earth were used to evaluate the site in terms of vegetation, obvious differences in landscape (e.g., variations in soil type, rocky outcrops etc.) or vegetation densities , which might indicate differences in plant community or species composition, critical biodiversity areas and other terrestrial biodiversity features as identified in the screening tool.

This information was used to prepare a study area map, which is used as a reference during the physical site visit. Plant species lists were prepared, and species of special significance were flagged.

3.2. SITE SENSITIVITY VERIFICATION

The fieldwork for project was carried out on the 27th of September 2023. The site survey was conducted over a 4--hour period, by walking the site and sampling the vegetation, using a modified approach, based on the Braun-Blanquet vegetation survey method (Werger, 1974).

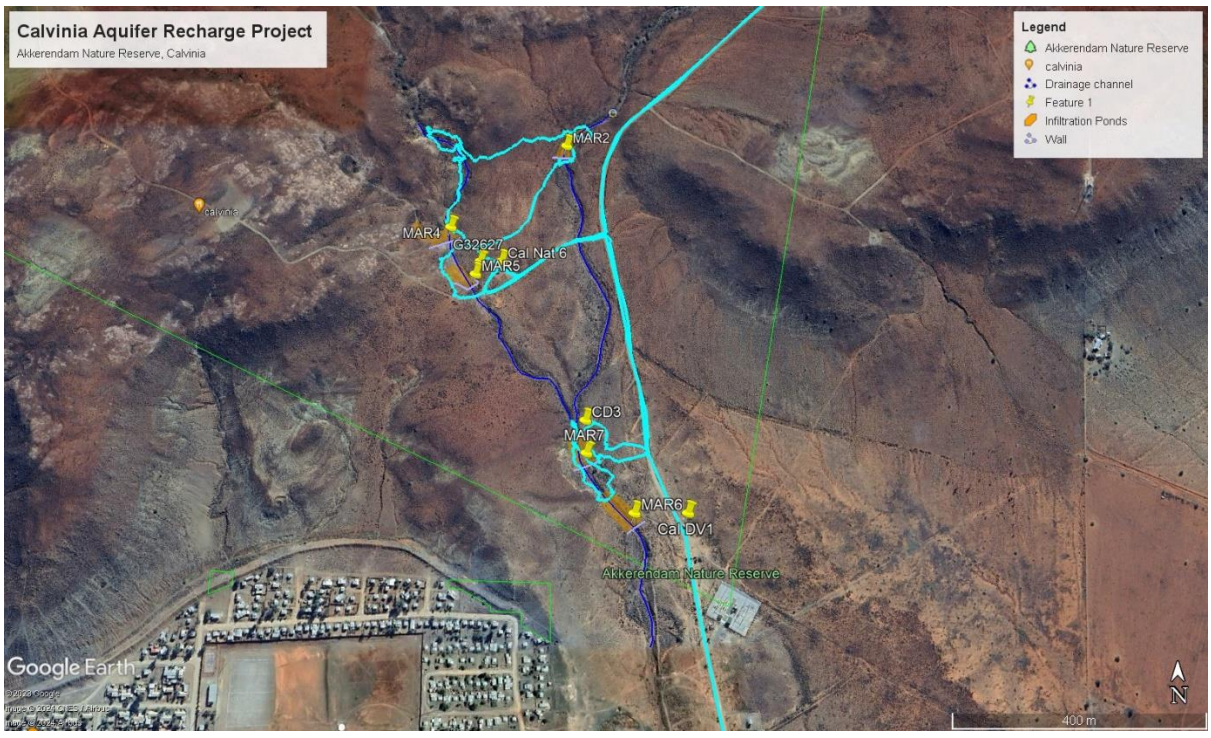

Figure 5: Google image, showing the southern portion of the Akkerendam NR and the routes walked during the site visit.

Protected or other special plants and any terrestrial feature of significance was, marked by waypoints

and/or on the study map, and photographed (Figure 5). A hand-held Garmin GPSMAP 62s was used to track the sampling route and for recording waypoints. During the survey notes, and photographic records were collected. All efforts were made to ensure that any variation in vegetation or soil condition, which might indicate special botanical features (e.g., rocky outcrops, watercourses or heuweltjies), were visited. Efforts was also made to ensure that the plant species list was as complete as possible.

3.3. LIMITATIONS, ASSUMPTIONS AND UNCERTAINTIES

The findings are based on a one-day site visit (not long-term repetitive sampling), which means that it is likely that plant species might have been missed (out of season). However, the timing of the site visit was excellent in that almost all of the plants were in flower or seed. Recent rains (and follow-up rains) meant that the veld was in a very healthy condition. Essentially all perennial plants were identifiable and a good understanding of the status of the vegetation and plant species in the study areas were obtained and confidence in the findings are high. There should be no limiting factors which could significantly alter the outcome of this study. It is unlikely that a full botanical assessment will result in any additional findings that would have a significant impact on the outcome.

3.4. IMPACT ASSESSMENT METHOD

The concept of environmental impact assessment in terms of the National Environmental Management Act, Act 107 of 1998 (NEMA) and the Environmental Impact Assessment (EIA) was developed to identify and evaluate the nature of potential impact to determine whether an activity is likely to cause significant environmental impact on the environment. The concept of significance is at the core of impact identification, evaluation and decision making, but despite this the concept of significance and the method used for determining significance remains largely undefined and open to interpretation (DEAT, 2002).

The objective of this study was to evaluate the status of the veld within the study area to identify special or significant environmental features which might be impacted by the proposed development.

The Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al*., 2005), were used to evaluate the botanical significance of the property with emphasis on:

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

3.4.1. DETERMINING SIGNIFICANCE

Determining impact significance from predictions of the nature of the impact has been a source of debate and will remain a source of debate. The author used a combination of scaling and weighting

methods to determine significance based on a simple formula. The formula used is based on the method proposed by Edwards (2011). However, the criteria used were adjusted to suite its use for botanical assessment. In this document significance rating was evaluated using the following criteria.

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

3.4.2. CRITERIA USED

***Conservation value*:** Conservation value refers to the intrinsic value of an attribute (e.g., an ecosystem, a vegetation type, a natural feature or a species) or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species (Refer to Table 3 for categories used).

Likelihood refers to the probability of the specific impact occurring because of the proposed activity (Refer to Table 4, for categories used).

Duration refers to the length in time during which the activity is expected to impact on the environment (Refer to Table 5).

Extent refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur (Refer to Table 6).

Severity refers to the direct physical or biophysical impact of the activity on the surrounding environment should it occur (Refer to Table 7).

Table 3: Categories used for evaluating conservation status.

CONSERVATION VALUE	
Low (1)	The attribute is transformed, degraded not sensitive (e.g., Least threatened), with unlikely possibility of species loss.
Medium/low (2)	The attribute is in good condition but not sensitive (e.g., Least threatened), with unlikely possibility of species loss.
Medium (3)	The attribute is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.
Medium/high (4)	The attribute is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.
High (5)	The attribute is considered critically endangered or is part of a proclaimed provincial or national protected area.

Table 4: Categories used for evaluating likelihood.

LIKELHOOD	
Highly Unlikely (1)	Under normal circumstances it is almost certain that the impact will not occur.
Unlikely (2)	The possibility of the impact occurring is very low, but there is a small likelihood under normal circumstances.
Possible (3)	The likelihood of the impact occurring, under normal circumstances is 50/50, it may, or it may not occur.
Probable (4)	It is very likely that the impact will occur under normal circumstances.
Certain (5)	The proposed activity is of such a nature that it is certain that the impact will occur under normal circumstances.

Table 5: Categories used for evaluating duration.

DURATION	
Short (1)	Impact is temporary and easily reversible through natural process or with mitigation. Rehabilitation time is expected to be short (1-2 years).
Medium/short (2)	Impact is temporary and reversible through natural process or with mitigation. Rehabilitation time is expected to be relative short (2-5 years).
Medium (3)	Impact is medium-term and reversible with mitigation but will last for some time after construction and may require ongoing mitigation. Rehabilitation time is expected to be longer (5-15 years).
Long (4)	Impact is long-term and reversible but only with long term mitigation. It will last for a long time after construction and is likely to require ongoing mitigation. Rehabilitation time is expected to be longer (15-50 years).
Permanent (5)	The impact is expected to be permanent.

Table 6: Categories used for evaluating extent.

EXTENT	
Site (1)	Under normal circumstances the impact will be contained within the construction footprint.
Property (2)	Under normal circumstances the impact might extent outside of the construction site (e.g., within a 2 km radius), but will not affect surrounding properties.
Surrounding properties (3)	Under normal circumstances the impact might extent outside of the property boundaries and will affect surrounding landowners or –users, but still within the local area (e.g., within a 50 km radius).
Regional (4)	Under normal circumstances the impact might extent to the surrounding region (e.g., within a 200 km radius), and will impact on landowners in the larger region (not only surrounding the site).
Provincial (5)	Under normal circumstances the effects of the impact might extent to a large geographical area (>200 km radius).

Table 7: Categories used for evaluating severity.

SEVERITY	
Low (1)	It is expected that the impact will have little or no affect (barely perceptible) on the integrity of the surrounding environment. Rehabilitation not needed or easily achieved.
Medium/low (2)	It is expected that the impact will have a perceptible impact on the surrounding environment, but it will maintain its function, even if slightly modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium (3)	It is expected that the impact will have an impact on the surrounding environment, but it will maintain its function, even if moderately modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium/high (4)	It is expected that the impact will have a severe impact on the surrounding environment. Functioning may be severely impaired and may temporarily cease. Rehabilitation will be needed to restore system integrity.
High (5)	It is expected that the impact will have a very severe to permanent impact on the surrounding environment. Functioning irreversibly impaired. Rehabilitation often impossible or unfeasible due to cost.

3.4.3. SIGNIFICANCE CATEGORIES

The formal NEMA EIA application process was developed to assess the significance of impacts on the surrounding environment (including socio-economic factors), associated with any specific development proposal to allow the competent authority to make informed decisions. Specialist studies must advise the environmental assessment practitioner (EAP) on the significance of impacts in his field of specialty. To do this, the specialist must identify all potentially significant environmental impacts, predict the nature of the impact, and evaluate the significance of that impact should it occur.

Potential significant impacts are evaluated, using the method described above, to determine its potential significance. The potential significance is then described in terms of the categories given in Table 8. Mitigation options are evaluated, and comparison is then made (using the same method) of potential significance before mitigation and potential significance after mitigation (to advise the EAP).

Table 8: Categories used to describe significance rating (adjusted from DEAT, 2002)

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

4. DESKTOP ASSESSMENT

The results of the desktop analysis is given underneath.

4.1. BROAD-SCALE VEGETATION EXPECTED

Hantam Karoo corresponds largely with Acock's (1953) Western Mountain Karoo veld and to Low & Rebello's (1996) Upland Succulent Karoo vegetation type. In accordance with the 2018 Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006), the proposed footprint(s) will only impact on one broad vegetation type, namely **Hantam Karoo** (Figure 6), a vegetation type classified as "Least Threatened" in terms of the "*Revised National list of ecosystems that are threatened and in need of protection*" (GN. No. 2747 of 18 November 2022).

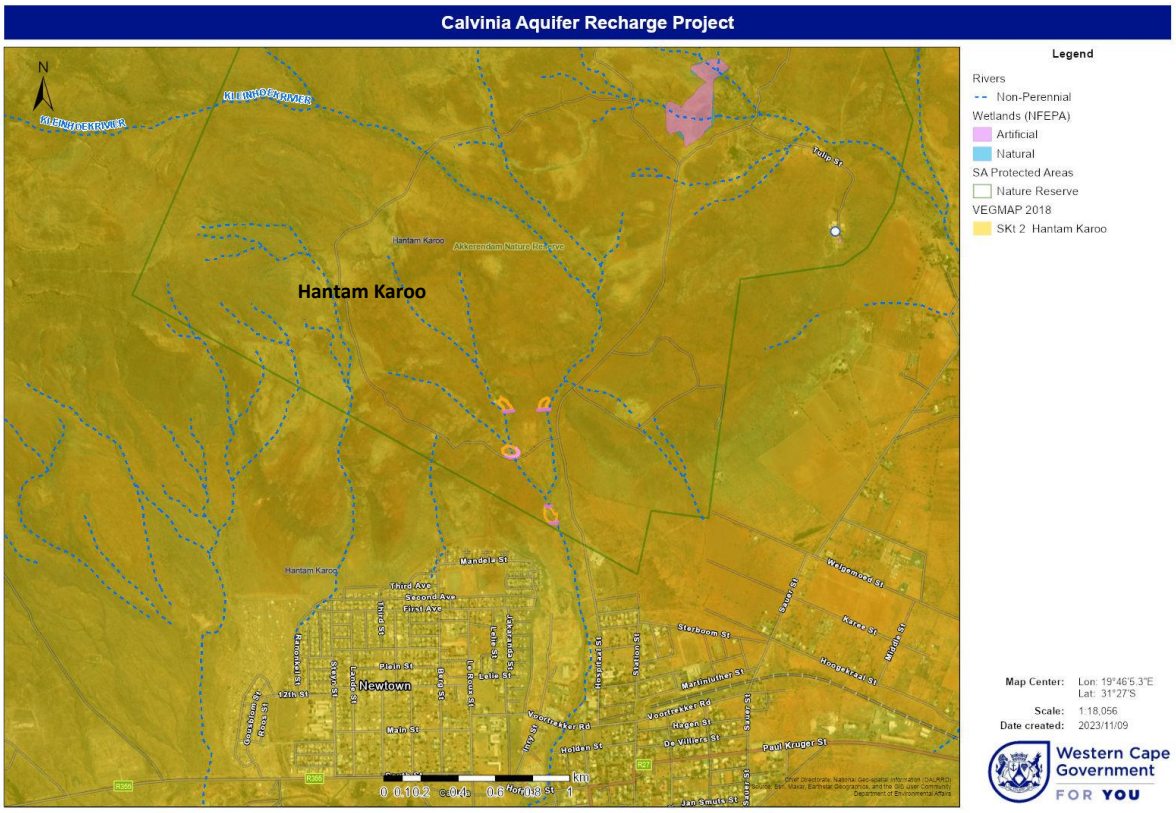

Figure 6: Vegetation map of South Africa (2012), showing the expected vegetation type (CapeFarmMapper)

Mucina & Rutherford (2006) describe Hantam Karoo as a dwarf Karoo shrubland with nearly equal proportions of succulent elements (*Aloe, Antimima, Euphorbia, Ruschia*) and low microphyllous karroid shrubs, particularly of the family Asteraceae (*Eriocephalus, Pentzia, Pteronia*), which can have a rich display of spring annuals and geophytes.

4.2. ECOLOGICAL DRIVERS & FUNCTIONING

Hantam Karoo is a subtype of the Succulent Karoo Biome (the fourth largest Biome in South Africa)

which falls within a semi-desert region with a strong maritime influence characterized by even, mild climate. It interfaces with the Fynbos Biome (with which it also shares its greatest floristic affinity) to the south and east, the Nama-Karoo to the north and west and the Desert Biome to the north. Globally there are few other places than can claim to be as biologically distinct as the Succulent Karoo Biome. It is unrivalled in its status as the world's only entirely arid region diversity hotspot and has a high diversity of dwarf leaf-succulent shrubs. "Vygies" or members of the Aizoaceae are particularly prominent, with "spurges" or Euphorbiaceae and "stone crops" or Crassulaceae and succulent members of the Asteraceae, Iridaceae and Hyacinthaceae also prominent. The Succulent Karoo Biome has an equal status to the other biomes in South Africa – it is not a subtype of "a Karoo Biome." However, it is important to note that unlike in other parts of the Succulent Karoo, succulence (measured by the proportions of species in the Mesembryanthemaceae family) is poorly developed in the Hantam Karoo.

The Succulent Karoo Biome is primarily determined by the presence of low winter rainfall and extreme summer aridity. Rainfall varies between 20 and 290 mm per year. Because the rains in this area are cyclonic (and not thunderstorms) the erosive power is far less than of the summer rainfall biomes. During summer, temperatures in excess of 40°C are common. The vegetation is dominated by dwarf, succulent shrubs. Mass flowering displays of annuals (mainly Daisies, Asteraceae) occur in spring, often on degraded or fallow lands. Grasses are rare, except in some sandy areas, and are of the C3 type. The number of plant species (mostly succulents) is very high and unparalleled elsewhere in the world for an arid area of this size. Of importance in the area are heuweltjies, raised mounds of calcium-rich soil, thought to have been created by termites. (Mucina *et al*, 2006).

The Karoo used to support millions of antelope, mainly springbuck, but also numerous other larger antelope (and other grazing animal). These animals roamed the vast plains of the Karoo, utilizing different selections of plants and allowing for long "rest" periods as they move around, and as a result preventing overgrazing (Shearing, 1994). The Succulent Karoo has little agricultural potential due to the lack of water. The scarcity of grasses limits grazing, and the low carrying capacity requires extensive supplementary feeds. However, much soil has been lost from the biome, through sheet erosion, as a consequence of nearly 200 years of grazing. Tourism, on the other hand, is a major industry with the coastal scenery and the spring mass flower displays the main attractions, while mining, although to a lesser degree is also important, especially in the north (Mucina *et al*, 2006).

Lastly it is important to note that less than 0.5% of the Succulent Karoo Biome is formally conserved. The high species richness, high number of rare and Red Data Book species and unique global status of the biome require urgent conservation attention (Mucina *et al*, 2006).

4.3. CRITICAL BIODIVERSITY AREAS & ECOLOGICAL CORRIDORS

The Northern Cape CBA Map (2016) identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape (Holness & Oosthuysen, 2016). The 2016 Northern Cape Critical Biodiversity Area (CBA) Map updates, revises and replaces all older systematic biodiversity plans and associated products for the province (including the Namakwa District Biodiversity Sector Plan, 2008). Priorities from existing plans such as the Namakwa District Biodiversity

Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes.

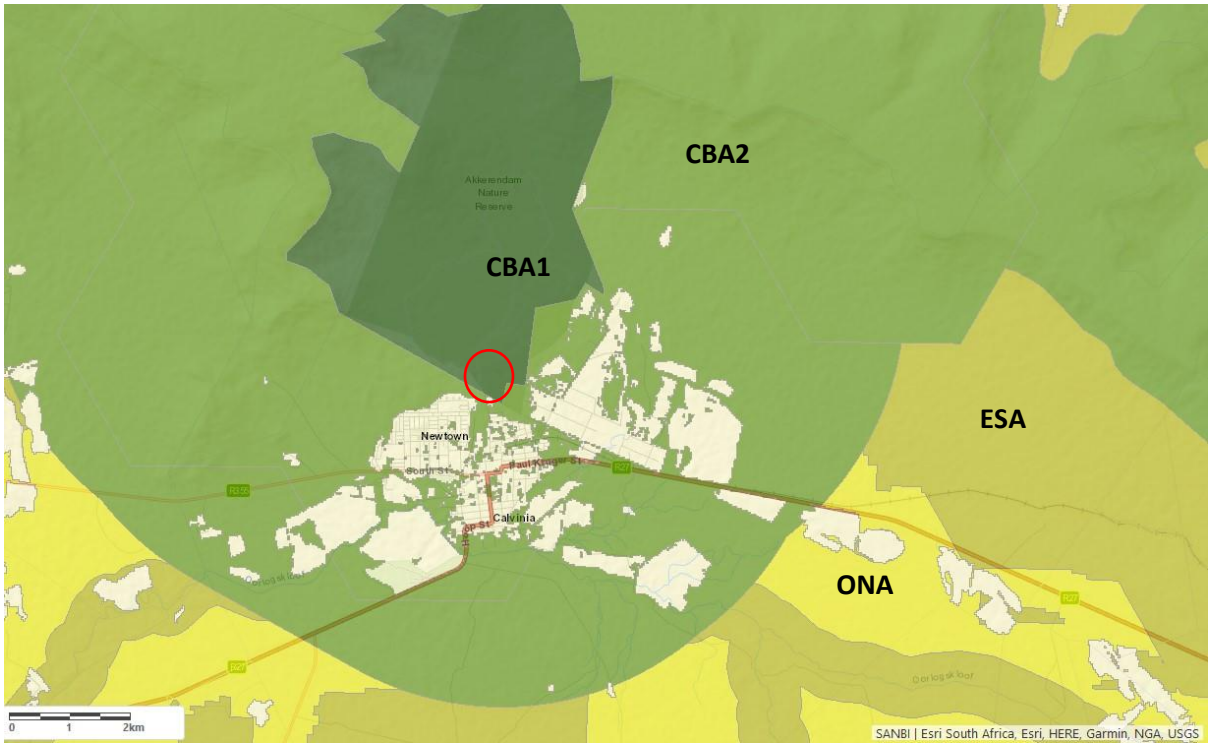

Figure 7: Northern Cape CBA map (2016) showing the study area and associated critical biodiversity areas.

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

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

The proposed development will impact on the Akkerendam Nature Reserve (a Municipal Reserve) which had been identified as a critical biodiversity area (CBA1) within the Northern Cape critical biodiversity areas maps (2016) (Figure 7) (Holness & Oosthuysen, 2016).

4.4. WATERCOURSES AND WETLANDS

According to the **DFFE Screening Tool** report for the footprint area (Appendix 2), the relative Aquatic biodiversity theme sensitivity is considered of **Low sensitivity**.

A Freshwater Specialist has been appointed to evaluate the aquatic biodiversity theme since the proposed project will impact on watercourses, for which a DWS License application will have to be submitted. It is important to note that one of the main reasons for establishing the Akkerendam Nature Reserve, was to protect the water resources of the town. The proposed experimental project is likely to enhance water resources security for the town of Calvinia but will have at least a temporary impact on two small seasonal water courses (the Kleinhoek River and a tributary to this stream) and small areas of indigenous vegetation within the reserve.

4.5. POTENTIAL IMPACT ON CENTERS OF ENDEMISM

According to Van Wyk & Smith (2001), the proposed project may impact on the Hantam-Roggeveld Centre (HRC) of endemism (Figure 8), which is named after the Hantam and Roggeveld regions in the Western Karoo of the Northern Cape Province. The Hantam is centred on the town of Calvinia and includes most of the Bokkeveld Plateau.

The HRC occupies the high-lying far south-western corner of the inland plateau of South Africa. It is bounded by the Bokkeveld Mountains in the west, the Renoster River in the east, the Bushmanland in the north and the Roggeveld Mountains in the south. Hantam is most probably derived from the KhoeKhoe word "*heyntame*", the name for *Pelargonium bifolium* (a plant with a reddish edible tuber). Diels (1908) mentioned the high levels of endemism in the Hantam-Roggeveld and concurred that the region is floristically more closely related to the Succulent Karoo and the Great Karoo than the Cape Floristic Region, although Cape floristic elements are clearly present, especially on the Hantam Mountains.

The HRC is one of the subdivisions of the Karoo and forms part of the Succulent Karoo Region, which is recognised as an important centre of plant diversity. The vegetation is typically dominated by low-growing small leaved perennial bushes up to 0.5 m in height. Common species include *Pentzia incana, Galenia africana, Zygophyllum gilfillanii, Euphorbia mauritanica, Ruschia caroli* and several species of *Eriocephalus*, *Salsola* and *Pteronia*. Grasses are few, apart from *Ehrharta calycina* and *Merxmuellera stricta*. Succulents, although present, are not very prominent, except in the drier areas north and west of Calvinia (which had been mapped as Upland Succulent Karoo by Low & Rebelo, 1996), a rather diverse vegetation type. At higher altitudes and in moister areas (200 – 300 mm), located mainly on the slopes and plateaux of mountains associated with the Great Escarpment it merges into a rare type of Mountain Renosterveld (with strong Karoo affinities) endemic to the HRC (Van Wyk & Smith, 2001).

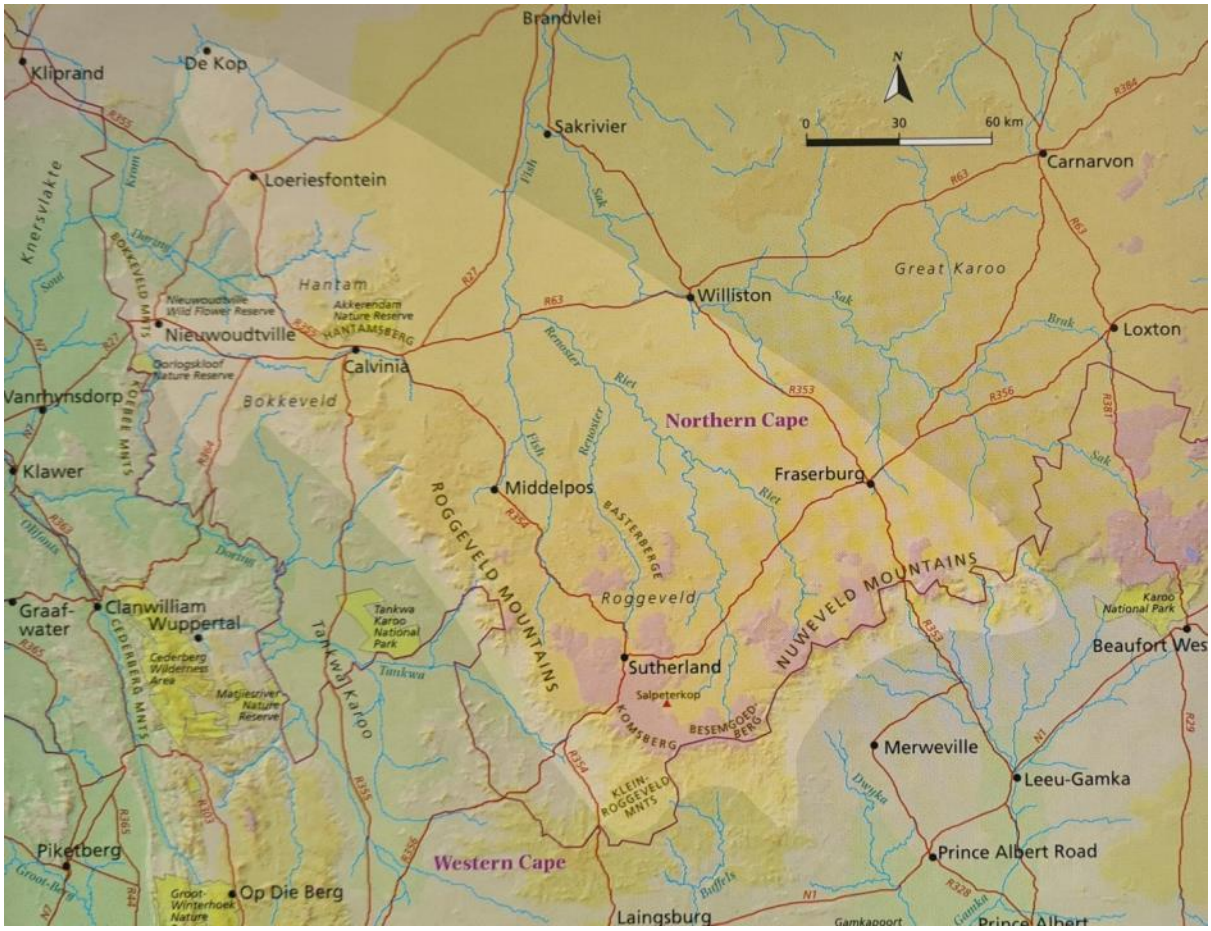

Figure 8: Hantam-Roggeveld Centre of endemism (highlighted), taken from Van Wyk & Smith (2001)

In contrast to other areas of the Succulent Karoo, succulence as measured by the proportion of species in the Mesembryanthemaceae is poorly developed in the HRC and no succulent genera are endemic to this centre of endemism (probably due to a less reliable or consistent rainfall pattern). However, the HRC is exceptionally high in geophytes and petaloid monocots, many of which are endemic to the region (Snijman & Perry, 1987).

The more recent Northern Cape Critical Biodiversity Areas map (2016) aims at the conservation of important corridors and local priority areas. It is clear that the proposed project will have a small (potentially temporary) impact on the Hantam-Roggeveld Centre (HRC) of endemism as well as critical biodiversity area, associated with the Akkerendam Nature Reserve (Refer to Heading 4.3).

4.6. LANDUSE AND COVER

The proposed project will impact on the Akkerendam Nature Reserve, the second oldest proclaimed municipal nature reserve in the Northern Cape. The vegetation of the reserve is still in good condition, but there seems to be very little active management of the reserve itself (gates are open and fences are in poor condition). During the vegetation study, it was observed that the local community still uses the veld to gather herbs and medicinal plants (possibly even firewood).

5. THE VEGETATION

During the site visit the general vegetation in the surrounding veld as well as the riparian vegetation (where present) along the watercourses were evaluated. For most part the two small seasonal or episodic streams seems to run basically through the natural veld, with a poorly defined riparian sone. Only in areas where these streams are slightly wider and shallower (e.g., at MAR2 &2) additional species were identified that actually represents a riparian zone.

In a vegetation study for the Akkerendam Nature Reserve, done by Van der Merwe (2014), three broad plant communities and 14 subcommunities were identified. According to this study, al 4 of the infiltration ponds will be located in the *Galenia africana – Eriocephalus ericoides* Hantam Karoo Community (Plant community 3 in Figure 9).

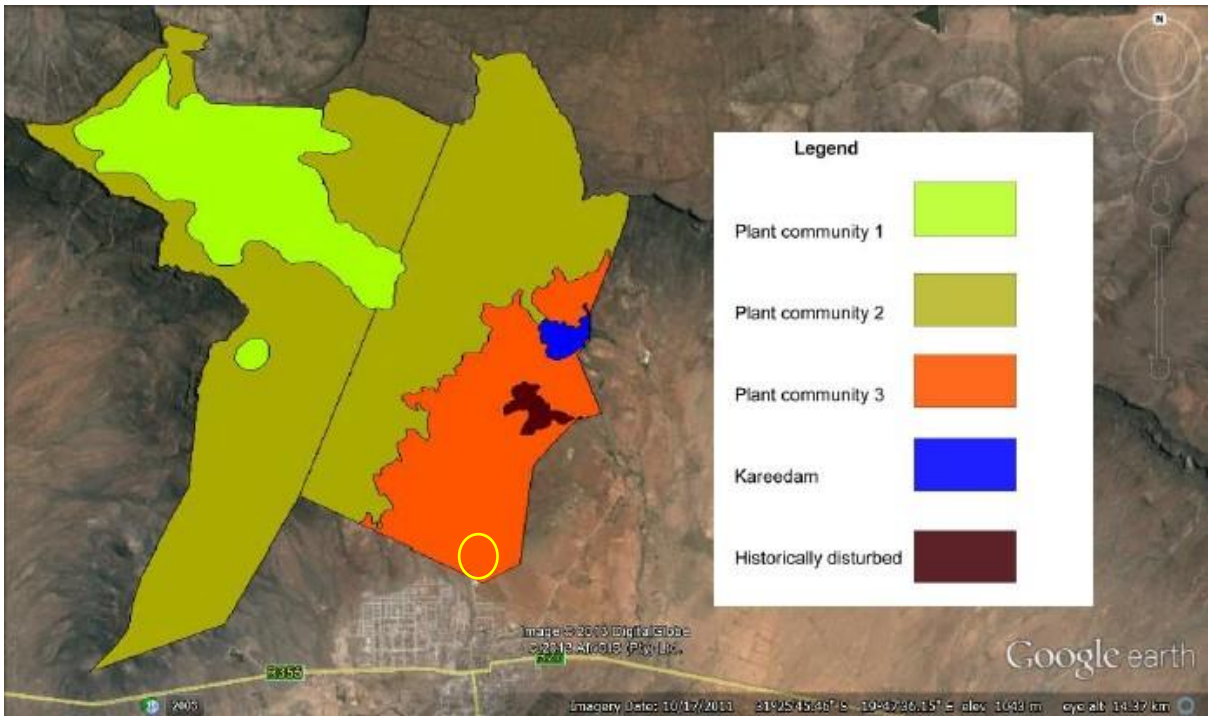

Figure 9: The vegetation map of Akkerendam Nature Reserve as identified by Van der Merwe (2014), showing the general location of the proposed infrastructure (infiltration ponds) within the yellow oval.

5.1. THE GENERAL VEGETATION

The proposed infiltration ponds are located in the lower (almost the most southern part of the Akkerendam Nature Reserve). Altitude varied from 1010 to 1040 m asl. The soil can be described as red brown or light red brown in color, while the rock cover is generally low, consisting of pebbles and small stones. The vegetation can be described as a low Karoo shrubland with a cover that varied from 50% to 90%. The veld itself was in excellent condition and seems to have recovered well from the recent long term drought period. The vegetation was dominated by a combination of *Galenia africana*, *Chrysocoma ciliata*, *Pteronia incana* and *Eriocephalus ericoides*. The grass, *Ehrharta calycina,* was also common in most areas.

Other larger shrubs and herbs observed included: *Cotula microglossa* (dominating open areas after the recent rains), *Cotyledon orbiculata, Crassula subaphylla*, *Drosanthemum lique*, *Euphorbia*

mauritanica, *Galenia sarcophylla*, *Gonialoe variegata*, *Hermannia* cf. *glabrata*, *Hirpicium alienatum* (haarbos), *Lycium cinereum*, *Mesembryanthemum junceum (=Psilocaulon), M. nodiflorum*, *M.* cf. *rapaceum*, *M. noctiflorum* (vleisbos), *Nenax* cf. *namaquensis, Osteospermum oppositifolium, O. sinuatum, Pelargonium rapaceum, Pentzia incana, P. spinescens, Pteronia glauca, Roepera pubescens, Ruschia* cf. *grisea (grey tent fig), R. divaricata, R.* cf. *uncinata, Salvia chamelaeagnea, Selago glabrata* (aarbossie), *Tetragonia fruticosa* and the parasitic *Septulina glauca.*

Photo 1: Looking north (the Hantam Mountains in the background) from the middle of the site towards MAR2 & 2.

Photo 2: Looking south from the middle of the site towards MAR7. Note the existing borehole to the left of picture.

Photo 3: One of the open areas towards MAR2 & 2. Not the dense stands of the herb *Cotula microglossa* with the geophyte *Moraea miniata* scattered in between.

Smaller- and prostrate shrubs observed included: *Aptosimum indivisum*, *Crassula muscosa, Dimorphotheca pinnata, Felicia macrorrhiza, Gazania lichtensteinii, Mesembryanthemum guerichianum (soutslaai), Senecio arenarius, Leobordea* cf. *hirsuta* and one of the *Manulea* cf. *silenoides.*

A number of bulb and smaller herb species were also observed, including species such as: *Albuca concordiana*, *A. setosa*, *A. suaveolens*, *A viscosa, Brunsvigia* cf. *bosmaniae* (only leaves), *Cleretum* cf. *maughanii*, *Colchicum capense*, *C. crispum*, *C.* species, *Cyanella hyacinthoides*, *Eriospermum* cf. *capense*, *Ferraria macrochlamys* subsp. *kamiesbergensis*, *Hyobanche glabrata, Lachenalia* species (flowers were past), *Massonia depressa*, *Moraea* cf. *inconspicua, M. miniata, Trachyandra falcata, Wahlenbergia* cf. *roelliflora* and *Wurmbea* cf. *variabilis.*

5.2. VEGETATION MAR2

MAR2 is located to the northwest of the site (still in the lower half of the Akkerendam Nature Reserve) (Figure 10). It will be located in a small seasonal watercourse (a tributary to the Kleinhoek River). The pond will be located in a small depression behind a low hill at the foothills of the Hantam Mountains.

The pond is expected to be about 0.14 ha in size with a gabion wall of about 39m. Both of these features will be out of sight once established. The construction of the pond will result in physical change in the stream itself, which will have to be widened at that point to allow for the fitment of the infiltration structure and pond. The gabion wall will result in trench (probably 1 m deep by 1 m wide). In addition, there is no existing access road to the site. A small road (at least a twee-spoor track) will have to be established for construction and maintenance purposes (the nearest connecting road is about 230 – 250 meters away).

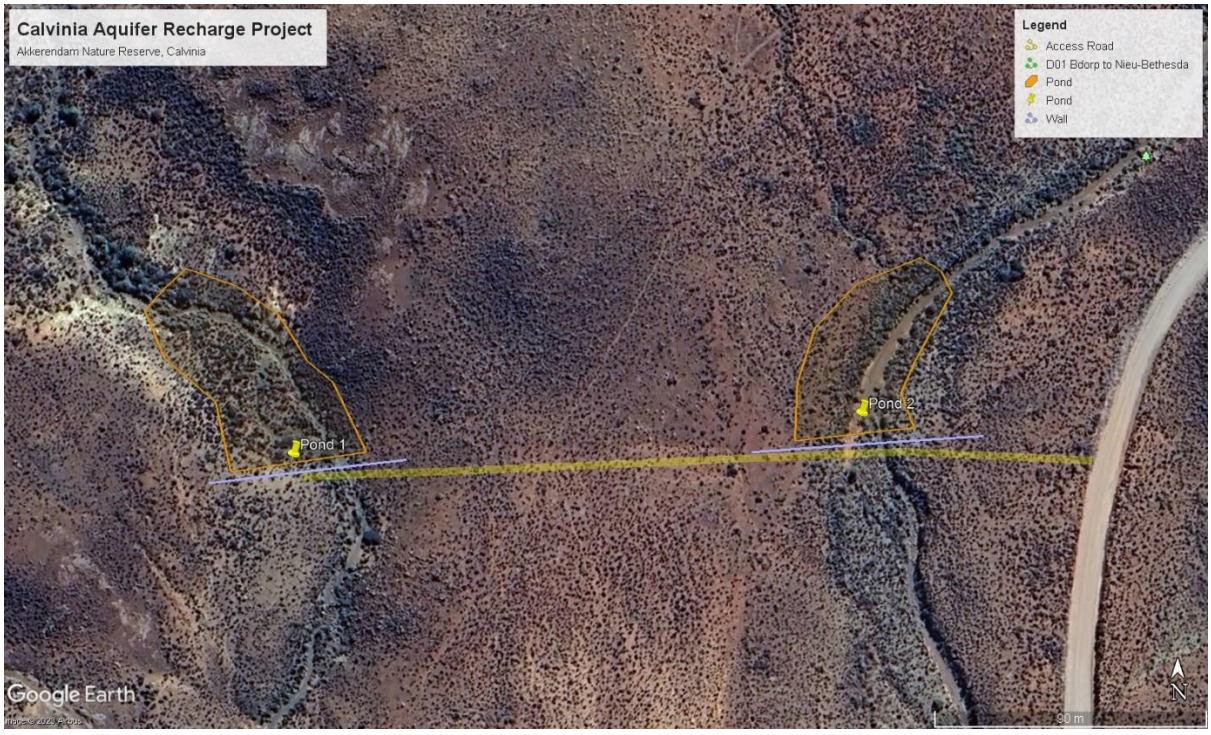

Figure 10: A google image showing the approximate locations and sizes of MAR2 & 2, and a potential access road (yellow).

Photo 4: A photo showing the proposed location for MAR2 (looking upstream or from south to north onto the pond location). Note the *Ehrharta* grass species next to the stream and the *Diospyros* shrub to the left.

Both MAR2 & MAR4 shows a slightly denser (and often higher) riparian vegetation along its banks (varying from 1.5 to 2.5 m in height) within the lower "floodplain" areas associated with these two streams (Photo 4 to Photo 6). Right next to the stream (almost within the stream) the vegetation usually consisted out of patches (sometimes mixed) of erect, evergreen shrub such as *Polygala virgata*, *Psoralea glaucescens*, *Struthiola* cf. *leptantha* and *Wiborgia* cf. *monoptera* (Photo 6). In between these shrubs (still almost within the normal flood line) *Ehrharta* grasses may dominate with other species such as the sedge, *Cyperus marginatus* and the bulb *Gladiolus splendens* occasionally observed. On slightly elevated sand banks (slightly above the normal water line) but still in close vicinity to the watercourse, larger shrubs such as *Diospyros austro-africana*, *Euryops lateriflorus*, *Lycium cinereum*, *Nenax* cf. *namaquensis*, *Melianthus comosus* (kruidtjie-roer-my-nie), and *Salvia chamelaeagnea* were usually prominent with species such as *Tetragonia fruticosa*, *Lessertia frutescens* subsp. *frutescens*, *Atriplex lindleyi* and *Osteospermum grandiflorum* growing underneath them or within their shade (Photo 5). Slightly further away, but still influenced by the water from these watercourses' small trees such as *Searsia lancea* and *Searsia longispina* were occasionally encountered (the stem parasite *Viscum capense* was occasionally observed on larger trees). The moment one moves out of the areas directly influenced by the water course (or its associated sediment areas) the vegetation reverts back to the general vegetation as described under Heading 5.1 above.

Photo 5: Some of the denser shrubs observed near MAR2, showing *Polygala virgata* (to the left), *Melianthus comosus* in the foreground, *Searsia lancea* to the left in the back, and *Diospyros austro-africana* to right in the back.

Photo 6: The upper part of the small stream at MAR2. Note the . *Polygala virgata* in the foreground, with *Euryops lateriflorus* in the background to the left.

5.3. VEGETATION MAR4

MAR4 is located, to the southeast of MAR2 (still in the lower half of the Akkerendam Nature Reserve) (Figure 10). It will be placed within a small seasonal watercourse (the Kleinhoek River). The pond will also be located in a depression behind a low hill.

The pond is expected to be about 0.21 ha in size with a gabion wall of about 58 m. Both of these features should be out of sight once established. Again, the construction of the pond will result in physical change in the stream itself, which will have to be widened at that point to allow for the fitment of the infiltration structure and pond. The gabion wall will result in trench (probably 1 m deep by 1 m wide). In addition, there is no existing access road to the site. A small road (at least a twee-spoor track) will have to be established for construction and maintenance purposes (the nearest connecting road is about 230 – 250 meters away).

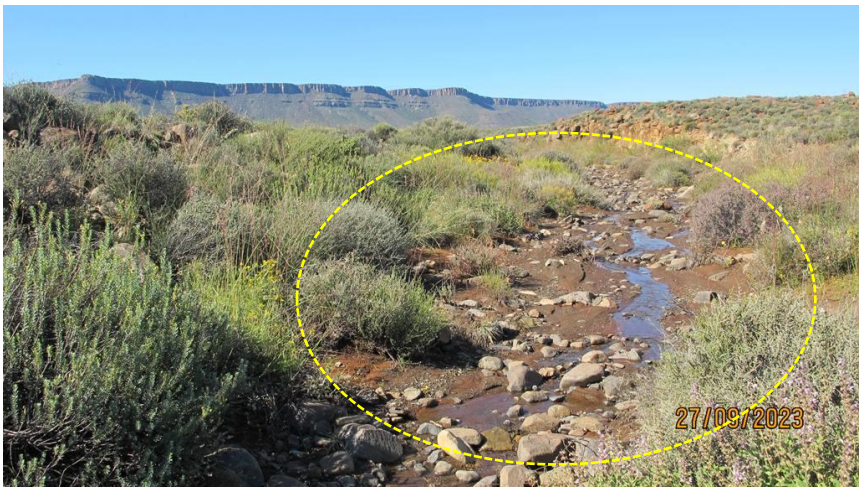

Photo 7: Looking from south to north onto the proposed site for MAR4.

The vegetation encountered in this areas was very similar to that described for MAR2, with erect perennials (besembosse) shrubs such as *Polygala virgata*, *Psoralea glaucescens*, *Struthiola* cf. *leptantha* and *Wiborgia* cf. *monoptera* as well as the sedge, *Cyperus marginatus* and the bulb *Gladiolus splendens* growing right next to the stream (almost with its feet in the water). On the banks of the stream, larger shrubs starts to appear such as *Diospyros austro-africana*, *Euryops lateriflorus*, *Lycium*

cinereum, *Nenax* cf. *namaquensis*, *Melianthus comosus*, and *Salvia chamelaeagnea.* Slightly further away, but still influenced by the water from these watercourses' small trees such as *Searsia lancea* and *Searsia longispina* were occasionally observed.

Photo 8: A photo taken slightly further up-stream. *Gladiolus splendens* flowers can be seen to the left in picture (red).

Photo 9: Still looking from south to north (upstream) along the Kleinhoek River, with *Psoralea glaucescens* to the left in picture.

5.4. VEGETATION MAR5

MAR5 will be just south of MAR4 on a plate of surface rock within the small stream (a tributary to the Kleinhoek River) (Photo 10 to Photo 12). Because of the shale a gabion won't find any purchase and a concrete retention wall is proposed on this rocky plate.

The pond is expected to be about 0.15 ha in size with a concrete wall of about 77 m (surrounding the plate). Both of these features will be out of sight once established. The construction of the pond will result in little further physical change in the stream itself, which is already widened as a result of the shale plate. The concrete wall will be about 1 m high. No additional access road will be required, as there is an existing road to the site and to Borehole Cal Nat 6 (which is located just east of the proposed site).

The rocky plate itself is mostly devoid of vegetation and very little of the riparian vegetation encountered at MAR2 & MAR4 was visible. In this case the natural vegetation of the surrounding veld grows up to the rocky plate. None of the larger "besembosse" or larger shrubs and small trees were observed in its vicinity, apart from a few individuals of *Cyperus marginatus*. The following species

were observed on the edges of the shale plate, next to the proposed pond area: *Crassula muscosa*, *Drosanthemum lique*, *Galenia africana*, *Gazania lichtensteinii*, *Lycium cinereum*, *Mesembryanthemum junceum*, *Nenax* cf. *namaquensis*, *Pelargonium rapaceum*, *Pteronia incana*, *Ruschia divaricata*, *Salvia chamelaeagnea*, *Selago glabrata* and *Trachyandra falcata*.

Photo 10: Looking from south to north over the shale plate on which MAR5 will be located. Note the lack of defining riparian vegetation. *Galenia africana* can be seen in the foreground .

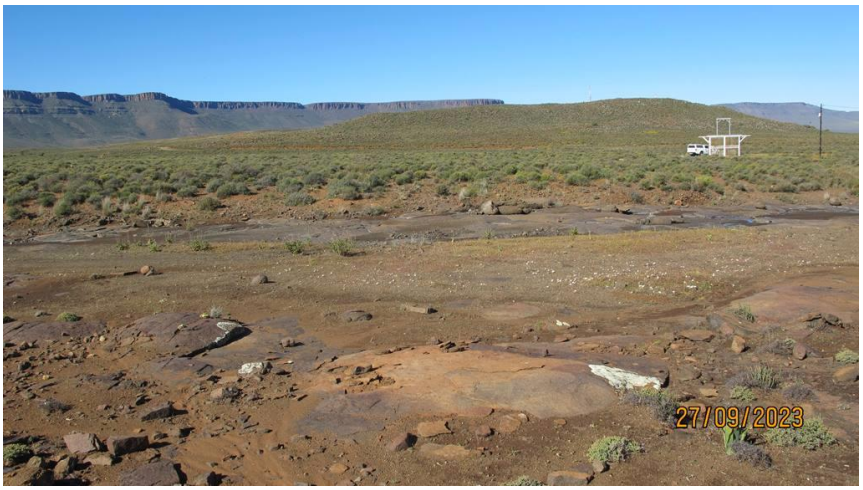

Photo 11: Looking from east to west over the rocky plate. Again, the lack of natural vegetation on the plate can be observed.

Photo 12: Looking from northwest to southeast over the site.

5.5. VEGETATION MAR6 & MAR7

MAR6 and MAR7 will also be located in the Kleinhoek River, about 300m to the south of MAR5 (almost

at the entrance to the Akkerendam Nature Reserve) (Figure 10). The two steams (in which MAR2, MAR4 and MAR5 are located) converged just above the location of MAR7. At this point the Kleinhoek River has become about double its size, but still only representing a relatively small stream in the landscape (Photo 13 & Photo 14). To install the infiltration ponds, the stream will have to be widened at both locations.

MAR6 is expected to be about 0.24 ha in size with a gabion wall of about 36 m, while MAR7 is expected to be about 0.21 ha in size with a gabion wall of about 45 m. Again, the construction of the ponds will result in physical change in the stream itself, which will have to be widened to allow for the fitment of the infiltration structure and pond. The gabion wall will result in trench (probably 1 m deep by 1 m wide). In addition, there is only a partial access road (twee-spoor tracks) to the site. A small road (at least a twee-spoor track) will have to be established for construction and maintenance purposes (the nearest connecting road is about 110 meters away).

Within the stream some to the riparian species encountered at MAR2 & MAR4 was observed (e.g., *Cyperus marginatus*, *Salvia chamelaeagnea* and *Wiborgia* cf. *monoptera*), but for the most part, a defined riparian zone was not visible, and the general vegetation grows up to the edges of the furrow in which the seasonal stream is located (Photo 15). A number of *Albuca* species as well as the *Ferraria* species was observed in close proximity of the western bank of the stream.

Photo 13: Looking from south to north upstream from above the location of MAR7. .

Photo 14: Looking from north to south (downstream) at the watercourse from the proposed location of MAR7. .

Photo 15: Looking from southeast to northeast over the watercourse at the proposed location of MAR6. Note the lack of a defined riparian zone.

5.6. FLORA ENCOUNTERED

Table 9 gives a list of the plant species encountered during this study. It is important to note that the species list is only based on a one-day site visit. It is likely that some species (especially annuals and geophytes) might have been missed. However, the author is confident that a good understanding of the vegetation was achieved and confidence in the findings is high.

Two (2) red-listed plants was observed, and twenty six (26) species protected in terms of the NCNCA was observed.

Table 9: List of plant species observed within the proposed development footprint.

NO.	SPECIES NAME	FAMILY	STATUS	LOCATION
1.	*Albuca concordiana*	HYACINTHACEAE	LC	Deciduous bulb. One of various species commonly observed
2.	*Albuca setosa*	HYACINTHACEAE	LC	Deciduous bulb. One of various species commonly observed
3.	*Albuca suaveolens*	HYACINTHACEAE	LC	Deciduous bulb. One of various species commonly observed
4.	*Albuca viscosa*	HYACINTHACEAE	LC	Deciduous bulb. One of various species commonly observed
5.	*Aptosimum indivisum*	SCROPHULARIACEAE	LC	Viooltjie: small rounded compact shrub. Occasional in open veld.
6.	*Atriplex lindleyi*	AMARANTHACEAE	**Naturalised Weed**	Medium shrub. Occasionally observed.
7.	*Brunsvigia* cf. *bosmaniae* (only leaves visible)	AMARYLLIDACEAE	LC NCNCA, Schedule 2 protected	A bulb with large flat growing leaves. Occasionally observed.
8.	*Chrysocoma ciliata*	ASTERACEAE	LC	Small shrub. Comon throughout.
9.	*Cleretum* cf. *maughanii*	AIZOACEAE	**RARE** NCNCA, Schedule 2 protected	Karoo snow: Small succulent, occasionally in general veld.
10.	*Colchicum capense*	COLCHICACEAE	LC	Uilblaar. A small flat geophyte. Occasionally observed.
11.	*Colchicum crispum*	COLCHICACEAE	LC	A small flat geophyte. Occasionally observed.

NO.	SPECIES NAME	FAMILY	STATUS	LOCATION
12.	*Colchicum* species	COLCHICACEAE		A small flat growing geophyte. Occasionally observed.
13.	*Cotyledon orbiculata*	CRASSULACEAE	LC NCNCA, Schedule 2 protected	Plakkie. Large plant with succulent leaves. Rare in general veld.
14.	*Crassula muscosa*	CRASSULACEAE	LC NCNCA, Schedule 2 protected	Lizard's tail: small shrub. Occasionally observed.
15.	*Crassula subaphylla*	CRASSULACEAE	LC NCNCA, Schedule 2 protected	Straggling succulent, occasionally observed east of MAR7
16.	*Cyanella hyacinthoides*	TECOPHILAEACEAE	LC	Small perennial herb with a corm. Occasionally observed.
17.	*Cyperus marginatus*	CYPERACEAE	LC	A medium large, tufted sedge. Only near watercourses.
18.	*Dimorphotheca pinnata (=Osteospermum pinnatum)*	ASTERACEAEA	LC	Prostrate annual herb. Occasionally observed.
19.	*Diospyros austro-africana*	EBENACEAE	LC	Medium small tree. Only near watercourses.
20.	*Drosanthemum lique*	AIZOACEAE	LC NCNCA, Schedule 2 protected	Small succulent. Occasional in general veld.
21.	*Ehrharta calycina*	POACEAE	LC	Slender graminoid
22.	*Eriocephalus ericoides*	ATERACEAE	LC	Small Shrub
23.	*Eriospermum cf. capense*	RUSCACEAE	LC	Small herb with a tuber. Occasional in general veld.
24.	*Euphorbia mauritanica*	EUPHORBIACEAE	LC NCNCA, Schedule 2 protected	Succulent shrub with milk sap. Occasionally near MAR2 & 2.
25.	*Euryops lateriflorus*	ASTERACEAE	LC	Large straggly shrub. Only near watercourses.
26.	*Felicia macrorrhiza*	ASTERACEAE	LC	Medium size herb. Occasionally in general veld.
27.	*Ferraria macrochlamys* subsp. *kamiesbergensis*	IRIDACEAE	LC NCNCA, Schedule 2 protected	Spinnekopblom. Geophyte. Occasionally in general veld.
28.	*Galenia africana**	AIZOACEAE	LC NCNCA, Schedule 2 protected	Medium shrub. Common throughout (**D**)
29.	*Galenia sarcophylla*	AIZOACEAE	LC NCNCA, Schedule 2 protected	Leaf succulent shrub. Occasionally observed.
30.	*Gazania lichtensteinii*	ASTERACEAE	LC	Geelgousblom – annual herb. Occasionally observed.
31.	*Gladiolus splendens*	IRIDACEAE	LC NCNCA, Schedule 2 protected	Long lax plant with bright red flowers. Only near watercourses.
32.	*Gonialoe variegata*	ASPHODELACEAE	LC NCNCA, Schedule 2	Small, Aloe: Occasionally observed in the shade of larger shrubs.

NO.	SPECIES NAME	FAMILY	STATUS	LOCATION
			protected	
33.	*Hermannia* cf. *glabrata*	MALVACEAE	LC	Haarbos, medium shrub: Occasionally observed
34.	*Hirpicium alienatum*	ASTERACEAE	LC	Small shrub: Occasionally observed.
35.	*Hyobanche glabrata*	OROBANCHACEAE	LC	A small root parasite (orange in colour). Rarely observed.
36.	*Lachenalia* species (past its flowering time)	HYACINTHACEAE		Viooltjie. A deciduous perennial herb. Rarely observed.
37.	*Leobordea* cf. *hirsuta*	FABACEAE	LC	A small prostrate herb. Occasionally in open areas.
38.	*Lessertia frutescens* (=*Sutherlandia*)	FABACEAE	LC NCNCA, Schedule 2 protected	Small low growing shrub. Occasional in the shade of larger plants.
39.	*Lycium cinereum*	SOLANACEAE	LC	Medium large shrub. Relatively common in general veld.
40.	*Manulea silenoides*	SCHROPHULARIACEAE	LC NCNCA, Schedule 2 protected	Spreading annual herb. Occasionally in general veld.
41.	*Massonia depressa*	HYACINTHACEAE	LC	Small plant with flat growing leaves. Occasional in general veld.
42.	*Melianthus comosus*	MELIANTHACEAE	LC	Kruidtjie-roer-my-nie. Large shrub. Occasional near watercourses.
43.	*Mesembryanthemum* cf. *nodiflorum**	AIZOACEAE	LC NCNCA, Schedule 2 Protected	Only a few individuals were observed, just starting to grow after the drought period.
44.	*Mesembryanthemum guerichianum**	AIZOACEAE	LC NCNCA, Schedule 2 Protected	Succulent plant -occasionally observed.
45.	*Mesembryanthemum junceum (=Psilocaulon)*	AIZOACEAE	LC NCNCA, Schedule 2 Protected	Lidjiesbos. Erect succulent plant. Occasionally observed.
46.	*Mesembryanthemum noctiflorum*	AIZOACEAE	LC NCNCA, Schedule 2 Protected	Vleisbos – common throughout.
47.	*Mesembryanthemum rapaceum* (=*Caulipsolon*)	AIZOACEAE	LC NCNCA, Schedule 2 Protected	Succulent plant, often associated with disturbed veld.
48.	*Moraea* cf. *inconspicua*	IRIDACEAE	LC NCNCA, Schedule 2 protected	Taaiuintjie. small geophyte occasional in general veld.
49.	*Moraea miniata*	IRIDACEAE	LC NCNCA, Schedule 2 protected	Tulp. Medium large geophyte common in general veld.
50.	*Nenax* cf. *namaquensis*	RUBIACEAE	LC	Medium shrub. Relatively common throughout.
51.	*Osteospermum grandiflorum*	ASTERACEAE	LC	Low growing herb. Occasionally near wetter areas.
52.	*Osteospermum oppositifolium*	ASTERACEAE	LC	Skaapbos. A medium large shrub: relatively common throughout.

NO.	SPECIES NAME	FAMILY	STATUS	LOCATION
53.	*Osteospermum sinuatum*	ASTERACEAE	LC	Klein Skaapbos. Medium small shrub: Occasionally observed.
54.	*Pelargonium rapaceum*	GERANIACEAE	LC	Perennial herb with a tuber: occasionally observed
55.	*Pentzia incana*	ASTERACEAE	LC	Karoobossie – occasionally observed in general veld.
56.	*Pentzia spinescens*	ASTERACEAE	LC	Karoobossie. Occasionally observed in general veld.
57.	*Polygala virgata*	POLYGALACEAE	LC	Purple Broom: Erect evergreen shrub. Only near watercourses.
58.	*Psoralea glaucescens*	FABACEAE	LC	A lax, weeping evergreen shrub. Only near watercourses.
59.	*Pteronia glauca*	ASTERACEAE	LC	Medium small silver bush.
60.	*Pteronia incana*	ASTERACEAE	LC	Small shrub – only just starting to show.
61.	*Roepera pubescens (=Zygophyllum)*	ZYGOPHYLLACEAE	LC	Small succulent shrub: relatively common
62.	*Ruschia* cf. *uncinate*	AIZOACEAE	LC NCNCA, Schedule 2 protected	Small succulent: Common throughout (**D**)
63.	*Ruschia divaricata*	AIZOACEAE	LC NCNCA, Schedule 2 protected	Small thorny succulent: Common throughout
64.	*Ruschia grisea*	AIZOACEAE	LC NCNCA, Schedule 2 protected	Grey tent fig: very common throughout (**D**)
65.	*Salvia chamelaeagnea*	LAMICACEAE	LC	Large shrub: Common along watercourses.
66.	*Searsia lancea*	ANACARDACEAE	LC	Medium small tree: occasional near watercourses.
67.	*Searsia longispina*	ANACARDACEAE	LC	Medium small tree: occasional near watercourses.
68.	*Selago glabrata*	SCROPHULARIACEAE	LC	Aarbossie. Medium small shrub: relatively common.
69.	*Senecio arenarius*	ASTERACEAE	LC	Pershongerblom. Annual herb. Occasionally observed.
70.	*Septulina glauca*	LORANTHACEAE	LC	Kooitjie-nam-nam: parasitic plant in larger shrubs.
71.	*Struthiola* cf. *leptantha*	THYMELAEACEAE	LC	Jakkalsgare. A slender shrub up to 1.2m. Only near watercourses.
72.	*Tetragonia fruticosa*	AIZOACEAE	LC NCNCA, Schedule 2 protected	Succulent herb: relatively common
73.	*Trachyandra falcata*	ASPHODELACEAE	LC NCNCA, Schedule 2 protected	A rhizomes herb, with large erect flat leaves. Common.
74.	*Viscum capense*	SANTALACEAE	LC	Stem parasite. On *Searsia longispina*.
75.	*Wahlenbergia* cf. *roelliflora*	CAMPANULACEAE	DDT	A small herb occasionally observed in general veld.

NO.	SPECIES NAME	FAMILY	STATUS	LOCATION
76.	*Wiborgia* cf. *monoptera*	FABACEAE	LC	Wolfdoring. A slender shrub up to 1m. Only near watercourses.
77.	*Wurmbea cf. variabilis*	COLCHICACEAE	LC	A small plant, occasionally observed.

* These species are often seen as disturbance indicators (although they can play a vital role in soil protection through its rapid germination and spread) (Vlok & Schutte-Vlok, 2015).

5.7. THREATENED AND PROTECTED PLANT SPECIES

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

Red list of South African plant species: The Red List of South African Plants online provides up to date information on the national conservation status of South Africa's indigenous plants (SANBI, 2020).

- Two red-listed plant species were observed during the study (Refer to Table 10 for impact minimisation recommendations).

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

- No NEM: BA protected species was observed.

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

- No species protected in terms of the NFA was observed.

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

- Twenty six (26) species protected in terms of the NCNCA was observed (Refer to Table 10).

Table 10: Plant species protected in terms of the NCNCA encountered within the study area.

FAMILY NAME	SPECIES NAME	RECOMMENDATIONS
AIZOACEAE All species within this family are protected by default in terms of Schedule 2 of the NCNCA. One of the species is a red-listed species.	*Mesembryanthemum guerichianum* *Mesembryanthemum junceum* ***Cleretum* cf. *maughanii* (Rare)** *Drosanthemum lique* *Galenia africana* *Mesembryanthemum cf. nodiflorum* *Mesembryanthemum rapaceum* *Ruschia cf. uncinate* *Ruschia divaricata* *Ruschia grisea* *Tetragonia fruticosa*	Most of these species are common, widespread species (some are considered disturbance indicator species). In this case most of these species are found in the surrounding veld and not specifically associated with the steams or its immediate surroundings. The potential impact on these species should be low. However, **topsoil should be removed** from all the excavated areas and re-used for the rehabilitation process. This will ensure that the seedbed is protected (and thus protecting the Aizoaceae by default).
AMARYLLIDACEAE All species within this family are protected by default in terms of Schedule 1 or 2 of the NCNCA.	*Brunsvigia* cf. *bosmaniae*	None of the plants was observed within any of the proposed footprint areas and the potential impact on these species should be low. **Search & Rescue**: Any bulb of the Amaryllidaceae observed within the footprint area, must be transplanted into the adjacent natural veld.
ASPOPHODELACEAE All species within this family are protected by default in terms of Schedule 1 or 2 of the NCNCA.	*Gonialoe variegata* *Trachyandra falcata*	A number of *Trachyandra* individual is likely to be impacted by the construction of the ponds, but they are common and widespread species. The *Gonialoe variegata* (=*Aloe variegata*) is less likely to be impacted (not normally associated with watercourses or wetlands) and although widespread, search & rescue is proposed. **Search & Rescue**: All *Aloe* and *Gonialoe* species observed within the footprint area must be transplanted into the adjacent natural veld.
CRASSULACEAE All species within this family are protected by default in terms of Schedule 1 or 2 of the NCNCA.	*Cotyledon orbiculata* *Crassula muscosa* *Crassula subaphylla*	All of these species are relatively common and widespread species. However, search & rescue of the two species is recommended (both should transplant relatively easy). **Search & Rescue**: All *Cotyledon* and all *Crassula muscosa* species observed within the footprint area must be transplanted into the adjacent natural veld.
EUPHORBIACEAE All *Euphorbia* species are protected by default in terms of Schedule 2 of the NCNCA.	*Euphorbia mauritanica*	This is a common widespread species and difficult to transplant. Protection through topsoil conservation and management.
FABACEAE All *Lessertia* and *Sutherlandia* species are protected by default in terms of Schedule 1 of the NCNCA.	*Lessertia frutescens (=Sutherlandia)*	Again, this is a relatively common and widespread species. Protection will be achieved through topsoil conservation and management.
IRIDACEAE All species are protected by default in terms of Schedule 1 or 2 of the NCNCA.	*Ferraria macrochlamys subsp. kamiesbergensis* *Gladiolus splendens* *Moraea cf. inconspicua* *Moraea miniata*	The *Gladiolus* and potentially some of the *Ferraria* individuals is likely to be impacted. The *Moraea* species are common in the surrounding veld but might also be impacted. Because of the short flowering times and small bulb sizes, it will be difficult to search & rescue

FAMILY NAME	SPECIES NAME	RECOMMENDATIONS
		these species. Some protection will, however, be achieved through topsoil conservation.
SCROPHULARIACEAE All *Manulea* species are protected by default in terms of Schedule 1 or 2 of the NCNCA.	*Manulea silenoides*	The *Manulea* individuals observed were all associated with the general veld and not the watercourses as such. Although some of the individuals might be impacted the potential impact on the species should be low. Protection will be achieved through topsoil conservation and management.

Photo 16: *Cleretum* cf. *maughanii*. one of a few individuals observed.

5.8. PLANT SPECIES SENSITIVITY THEME

According to the **DFFE Environmental Screening Tool** report for this site (Appendix 2), the **plant species theme sensitivity is considered Very High Sensitive**, because of the potential of encountering the 12 sensitive species (listed on page 14 of the DFFE screening report). Of these 12 sensitive species, 11 are of medium sensitivity and 1 of very high sensitivity (*Hesperantha hantamensis*). Of these species, only one medium sensitive species was (potentially) observed, namely ***Cleretum* cf. *maughanii*** (Photo 16). Although only a few of these plants were observed, they are expected to be scattered throughout the veld itself. However, they do not associate with watercourses or wetlands and the likelihood that the proposed project will have any significant detrimental impact on this species is considered low.

In her final report of the Vegetation of the Akkerendam Nature Reserve, Dr. Van der Merwe includes a preliminary species list of the Akkerendam Nature Reserve (Appendix D) (Van der Merwe, 2014), which, includes a much larger area and is a much more comprehensive species list than the one for this study. This species list only include one of the sensitive species named in the DFFE screening report, namely ***Cliffortia arborea*** (the star tree). However, this species normally grows in cliffs and on ledges within the mountains and is unlikely to be impacted by the proposed project.

There is a small change that the development may impact on a few *Cleretum maughanii* individuals, but it is unlikely that it will have any significant detrimental impact on the species. As a result, the plant species sensitivity rating could be reduced to **Low Sensitive**.

6. FAUNA AND AVI-FAUNA

The Northern Cape is also home to an exceptionally high level of insect and reptile endemism, with new species still being discovered. However, it is important to note that this remarkable diversity is not distributed evenly throughout the region but is concentrated in many local centres of endemism.

Because of its aridity and unpredictable rainfall patterns, the Karoo region would historically have favoured free moving herbivores such as ostrich and springbok, nomadic birds and invertebrates with variable dormancy cued by rain. Plant defence against herbivores and seed adaption for dispersal by mammals are relatively uncommon, except along rivers and seasonal pans, where they would have lingered longer, suggesting the transient nature of herbivores. However, since the 19th century the vast herds of migratory ungulates indigenous to this biome have been replaced by domestic stock with selective grazing habits confined within farm boundaries (Skead, 1982). Once farmers started fencing their properties into camps (following the Fencing Act of 1912), stock numbers were dramatically increased with dire consequences to plant and animal diversity. This change in the grazing regime is thought to be responsible for alterations in both plant species composition and cover, which ultimately influence ecosystem functioning (Roux & Theron, 1986). Grazing during and immediately after droughts periods is regarded as a major cause of detrimental change in vegetation composition and were ultimately responsible for the decline of large numbers of palatable plants (Mucina *et. al*., 2006). Heavily disturbed Karoo veld seldom recovers within one lifetime (Esler *et. al*., 2010).

No fauna or avi-fauna screening was done as part of this study, but observations were made during the site visit. The proposed footprint area falls within the municipal managed Akkerendam Nature Reserve. The vegetation within the reserve was in excellent conditions and the last years rains have helped the veld to recover significantly after a prolonged (<7-years) drought period.

6.1. MAMMALS

The Akkerendam Nature Reserve borders on the Calvinia urban edge and is not securely fenced. Because of the proximity to anthropogenic impacts, it is not expected to house any larger mammal species, especially in the lower half of the Reserve.

Smaller mammals like Aardvark (*Orycteropus afer*), Bat-eared fox (*Otocyon megalotis*), Black-backed jackal (*Canis mesomelas*), Cape hare (*Lepus capensis*), Scrub hare (*Lepus saxatilis*), Four-striped grass mouse (*Rhabdomys pumilio*), Gerbil mouse (*Malacothrix typica*), House mouse (*Mus domesticus*), Karoo bush rat (*Otomys unisulcatis*), Grey duiker (*Sylvicapra grimmia*), Meerkat (*Suricata suricatta*), Cape porcupine (*Hystrix africaeaustralis*), Small-spotted genet (*Genetta genetta*), Steenbok (*Raphicerus campestris*) and the yellow mongoose (*Cynictis penicillata*) are still expected in the larger area and the Hantam Mountains, but very few of these species is expected to venture onto the lower parts of the reserve (because of the proximity to the urban edge).

The construction of the infiltration ponds is expected to have a relative short construction period and should only result in a temporary impact. Any mammals in the construction footprint areas are expected to move to the adjacent natural veld during the construction period.

As a result, the proposed project is not expected to have any significant or long lasting impact on the numbers of the remaining mammal species in the reserve.

6.2. REPTILE & INVERTEBRATE SPECIES

The Succulent Karoo in general is considered a centre of diversity and endemism for reptiles and many invertebrates (e.g., of the 50 scorpion species, 22 are endemic). Monkey beetles, largely endemic to southern Africa, are concentrated in the Succulent Karoo and are important pollinators of the flora. So, too, are the *Hymenoptera* and masarine wasps, and colletid, fideliid, and melittid bees (Vernon, 1999). Approximately 15 amphibians are found in this ecoregion, including three endemics. Among the region's 115 reptile species, 48 are endemic. The genus *Cordylus* (spinytail lizards) includes six strict endemics. Other strict endemics are Broadley's lance skink (*Acontias litoralis*), Richtersveld dwarf leaf-toed gecko (*Goggia gemmula*), Smith's sand lizard (*Meroles ctenodactylus*), Calvinia thick-toed gecko (*Pachydactylus labialis*), Namaqua thick-toed gecko (*P. namaqua*), and Meyer's legless skink (*Typhlosaurus meyeri*). The Sperregebiet region is a hotspot for endemic reptiles, including an unusual endemic tortoise, the Namba padloper (*Homopus bergeri*, VU) (Hilton-Taylor 2000).

Again, the construction of the infiltration ponds is expected to have a relative short construction period and should only result in a temporary impact. Reptiles and invertebrate species that can, are expected to move to the adjacent natural veld during the construction period. The ponds itself might even result in additional habitat for amphibian and bird species.

As a result, the proposed project is not expected to have any significant or long lasting impact on the numbers of the reptile and invertebrate species in the reserve.

6.3. AVI-FAUNA

In common with other desert areas, the avifauna (birdlife) of Namaqualand is dominated by ground-living species like larks, chats, sandgrouse, korhaans and bustards. Although naturally sparse, many of these birds are very interesting in particular in their adaption to the extreme ecological conditions associated with the Succulent Karoo (Manning, 2008). According to the Namaqualand District Biodiversity Sector Plan (2008), the Goegap Reserve host up to 94 bird species. Typical species that can be expected in the Namaqualand includes the common Ostrich, White Pelican, Greater Flamingo, Blackheaded Heron, Southern Black Korhaan, Cape Spurfowl, African Sacred Ibis, South African Shelduck, Pied Crow, Blacksmith Lapwing, Namaqua Sandgrouse, Jackal Buzzard, Southern Pal Chanting Goshawk, Rock Kestrel, Bokmakierie, Pale-winged Starling, White-backed Mousebird, Namaqua Dove, Ant –eating Chat, Cape Weaver, Cape Sparrow, Yellow Canary, Malachite Sunbird and the Southern Double-collared Sunbird.

The Akkerendam Nature Reserve is popular with bird watchers and a proclaimed bird sanctuary, containing more than 65 different species of birds including, the Cinnamon-breasted Warbler or Kopje Warbler, Karoo Lark, Dwarf eagle, Black Harrier, Black-headed canary, Malachite Sunbird, Layards Warbler and Fairy Flycatcher. The avi-fauna report done by Van Driel (2020) for the proposed upgrades to the Calvinia bulk water list about 127 bird species that might be expected in the larger area (using data from SABAP 2). It also addresses the likelihood of these species to occur in the study area.

Poles and powerlines normally constitute the biggest risk to bird species, especially larger species and

birds of prey. The proposed project will not require additional overhead powerlines or poles, which will reduce the risk to larger avi-fauna significantly.

Since the project will have a relative short construction period, the impact on bird species will be temporary and may even be beneficial to some species in the long run.

6.4. ANIMAL SPECIES THEME SENSITIVITY

According to the **DFFE National Web Based Environmental Screening Tool** the relative Animal species theme sensitivity is considered of **High Sensitivity** because of the potential presence of the potential for impacting on the species discussed in the table underneath.

Table 11: Animal species theme according to the DFFE Sensitivity Scan results.

FEATURES	MOTIVATION
Aves – High *Neotis ludwigii* (Ludwig's Bustard)	Ludwig's Bustard is a near endemic and classified as **endangered** because of a projected rapid population decline. It has a large range centred on the dry biomes of the Karoo and Namib in southern Africa, being found in the extreme south-west of **Angola**, western **Namibia** and in much of **South Africa** (Del Hoyo *et al.* 1996, Anderson 2000). Today if occurs predominantly in the dry Karoo region of South Africa (Herold, 1988), but historically its distribution is believed to have extended to the eastern and north-eastern portions of the Grassland Biome (Brooke, 1984). This species inhabits open lowland and upland plains with grass and light thornbush, sandy open shrub veld and semi-desert in the arid and semi-arid Namib and Karoo biomes. The breeding season spans from August-December, with the species nesting on bare ground with a clutch of 2-3 eggs (Del Hoyo *et al.* 1996, Jenkins & Smallie 2009) Although near to the urban edge, it is likely that the bird may occur in the Akkerendam Nature Reserve. However, the proposed development will only result in a temporary disturbance period with an impact on small areas of natural veld. It is expected that the bird will move away during the construction period but that it will resume its normal activities once the construction period is completed. It is considered unlikely that the development of the ponds will have any significant or long-term impact on this species of bird. As a result, with regards to this project the sensitivity rating should be **Low Sensitive**.
Aves – High *Polemaetus bellicosus* (Martial eagle)	The Martial Eagle is southern Africa's largest eagle and is considered **endangered**, because of deliberate or accidental poisoning, habitat loss, and loss of available prey, collisions with power lines etc. The remaining population is believed to be 800 pairs in South Africa (Taylor, 2015). The Martial Eagle has an extensive range across much of sub-Saharan Africa but is generally scarce to uncommon or rare. It inhabits open woodland, wooded savanna, bushy grassland, thornbush and, in southern Africa, more open country and even subdesert, from sea level to 3,000 m but mainly below 1,500 m (Ferguson-Lees & Christie 2001). Evidence suggests that breeding pairs select strongly against human-disturbed habitats. They need large trees for nests and prefer protected areas as breeding spots. The Martial Eagle might occur in the surrounding area and even hunt in the nearby mountains but is unlikely to breed or feed in the lower parts of the Akkerendam Nature Reserve, because of its proximity to the urban edge. In addition, the proposed project will only result in a short-term temporary impact, which should not have any additional long-term impact on the feeding or breeding patterns of this species of bird.

FEATURES	MOTIVATION
	With regards to this project the sensitivity rating should be **Low sensitive**.
Aves – Medium *Circus maurus* (Black Harrier)	The Black harrier is an **endangered** bird and one of southern Africa's rarest endemic raptors. It favors Renosterveld, short Fynbos and Karoo habitat, where it breeds in shallow nests on the ground. These birds are mostly associated with larger, well-connected, and more pristine patches of veld and is often considered an indicator of well-preserved natural veld (Curtis-Scott *et. al.*, 2020). The proposed development will result in a temporary impact on small patches of natural veld. The long-term impact on indigenous vegetation will be low. The black harrier might hunt over this area (although even this is unlikely, because of proximity of the urban edge - human activity), but it is unlikely to roost or breed in this area. As a result, it is considered highly unlikely that the proposed development will have any significant additional impact on the breeding or feeding patterns of these birds. With regards to the is project the sensitivity rating should be **Low Sensitive**.
Aves – Medium *Sagittarius serpentarius* (Secretary bird)	The secretary bird is considered **vulnerable** because of population size reduction of greater than 30% over the past 10 years. The cause for this reduction is not fully understood and may not be reversible (Retief, 2015). This species is widespread throughout sub-Saharan Africa (Ferguson-Lees & Christie, 2001), except the extreme deserts of the Namib coast and the forested region around the equator in western Africa. Secretary birds are not migratory but are highly mobile. Young birds in particular can undertake extensive and often rapid movements, primarily in arid areas (Boshoff & Allan, 1997; Herholdt & Anderson 2006). Habitat loss, driven by agriculture and urban development, is the primary threat to this species (Barnes 2000, Hofmeyr et al. 2014). Excessive burning and overgrazing of grasslands for livestock may reduce carrying capacity and availability of prey species (Parker 1994). Secretary birds suffer mortalities through collisions with power-lines (Hartley 1991) and there is a risk in South Africa that wind farms might have a negative impact on this species (EF Retief pers. obs). These birds hunt exclusively on the ground, either alone or in pairs and prefers open savannahs or grasslands and are common near agricultural areas. The secretary bird might occur and hunt in the Akkerendam Nature Reserve (although even this is considered unlikely because of its proximity to the urban edge), but the temporary impact posed by the construction of the ponds is unlikely to have any additional long-term impact on the breeding or feeding patterns for this bird. With regards to the is project the sensitivity rating should be **Low sensitive**.
Mammalia – Medium *Bunolagus monticularis* (Riverine rabbit)	The Riverine rabbit is considered critically endangered and recent population estimates of 157-207 mature individuals indicate an alarmingly small species population size, with no subpopulation having > 50 mature individuals (Collins *et.al.*, 2016). This species is endemic to the central Karoo region of South Africa and is associated with the dense, discontinuous vegetation fringing the seasonal rivers. It is the only indigenous burrowing rabbit in Africa and is dependent on soft and deep alluvial soils along the river courses for constructing stable breeding stops. Approximately 40-60% of habitat was lost or fragmented during the 1930s to 1970s due to agricultural expansion on the seasonal river flood plains across its distribution range (Robinson 1981b, Duthie *et al*. 1989, Duthie and Robinson 1990). Historically, this species was known to occur in five localities towards the northwestern portion of its range, along the Vis and Renoster Rivers, as well as their tributaries near Calvinia (Duthie 1989). However, the lack of sightings data during the last 30 years, suggests that *Bunolagus monticularis* is now locally extinct in these regions (Collins & Toit 2016). This is likely to be a direct consequence of the extensive agricultural expansion along riverine floodplains (Duthie *et al*. 1989). These upper seasonal streams within the Akkerendam Nature Reserve, lacks the

FEATURES	MOTIVATION
	dense riparian vegetation with which this species is normally associated. However, the soils is likely to be suitable to be used for burrows. Unfortunately, the Riverine rabbit has not been observed in the larger Calvinia area for the last 30 years and is thought to be locally extinct. With regards to the is project the sensitivity rating is thus **Low sensitive**. However, during the construction phase, the ECO should investigate any open burrows near the ponds with care.
Medium *Sensitive species 32* (Tortoise species)	Sensitive species 32 refers to a tortoise endemic to South Africa and considered **Endangered** due to anthropogenic land transformation and other threats. It occurs predominantly in the winter rainfall region of the northwestern Succulent Karoo and Fynbos biomes along the West Coast and adjacent inland of South Africa. It is found from a few metres above sea level on the West Coast to elevations of around 1,000 m in the interior at Springbok, Loeriesfontein-Calvinia, and the Cederberg Range (Boycott, 1989) and shows a particular preference for rocky terrain (Loehr, 2002), which includes typical Namaqualand and Hardeveld granite koppies and typical Sandveld and Cederberg sandstone koppies and rocky ridges in the south. The proposed development will be temporary of nature with a small potential impact on indigenous vegetation. The locations of the ponds are in the low open fields at the foothills of the Hantam Mountains (away from the rocky hills and ridges that is this tortoise's preferred habitat). The development might have a temporary impact on small areas of its habitat, but it is considered unlikely that the development will have any permanent long-term impact on this species. However, the ECO should ensure that any tortoise that might be impacted is moved to a save area during the construction period. As a result, with regards to this project the sensitivity rating should be **Low Sensitive**.

7. TERRESTRIAL BIODIVERSITY DISCUSSIONS

The proposed development footprint will result in a temporary impact on a relatively small area (less than 2 ha, including the ponds and the gabion walls). Considering that MAR5 will be located on a rocky sheet (with almost no additional impact on vegetation) the total impact on vegetation is likely to be less than 1.2 ha. Most of the impact will be within two seasonal streams, which will be widened in 4 places to accommodate 4 infiltration ponds, using gabion walls (to slow down or check the flow of water) while the ponds will be fitted with small intake structures to allow groundwater recharge directly from these ponds. The construction of these ponds may impact on several NCNCA protected species and potentially on one red-listed plant species. It may also affect two fauna species, namely the Riverine Rabbit and a sensitive tortoise species. However, with good environmental control it is unlikely that the construction of the ponds will lead to any significant additional long-term impacts on any of these species.

7.1. HABITAT CONDITIONS AND DIVERSITY

The proposed infiltration ponds are located in the lower (almost the most southern part of the Akkerendam Nature Reserve). Altitude varied from 1010 to 1040 m asl. The soil can be described as red brown or light red brown in color, while the rock cover is generally low, consisting of pebbles and small stones. The vegetation can be described as a low Karoo shrubland with a cover that varied from 50% to 90%. Apart from the two seasonal streams not other special habitats, were observed.

7.2. LAND-USE

The proposed project will impact on the Akkerendam Nature Reserve, the second oldest proclaimed municipal nature reserve in the Northern Cape. It is important to note that **one of the main reasons for establishing the Akkerendam Nature Reserve, was to protect the water resources of the town**.

7.3. VEGETATION ENCOUNTERED

In accordance with the 2018 Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006), the proposed footprint(s) will only impact on one broad vegetation type, namely **Hantam Karoo** (Figure 6), a vegetation type classified as "Least Threatened" in terms of the "*Revised National list of ecosystems that are threatened and in need of protection*" (GN. No. 2747 of 18 November 2022). Hantam Karoo corresponds largely with Acock's (1953) Western Mountain Karoo veld and to Low & Rebello's (1996) Upland Succulent Karoo vegetation type.

The veld itself was in excellent condition and seems to have recovered well from the recent long-term drought. The vegetation was dominated by a combination of *Galenia africana*, *Chrysocoma ciliata*, *Pteronia incana* and *Eriocephalus ericoides*. The grass, *Ehrharta calycina,* was also common in most areas. In a vegetation study for the Akkerendam Nature Reserve, done by Van der Merwe (2014), three broad plant communities and 14 subcommunities were identified. According to this study, al 4 of the infiltration ponds will be located in the *Galenia africana – Eriocephalus ericoides* Hantam Karoo Community (Plant community 3 in Figure 9).

The 4 ponds will be placed in two seasonal streams. The streams will have to be widened to accommodate the infiltration structure, which will result in a physical impact on riparian zone and the surrounding natural veld, at each location. The total impacted area for the construction of the ponds should be less than 2 ha. Considering that MAR5 will be located on a rocky sheet (with almost no additional impact on vegetation) the total impact on vegetation is likely to be less than 1.2 ha.

7.4. THREATENED AND PROTECTED PLANT SPECIES

According to the **DFFE Environmental Screening** report for this site (Appendix 2), the **plant species theme sensitivity is considered Very High Sensitive**, because of the potential of encountering the 12 sensitive species (listed on page 14 of the DFFE screening report) of which, 11 are of medium sensitivity and 1 of very high sensitivity (*Hesperantha hantamensis*). Of these species, only one medium sensitive species was (potentially) observed, namely ***Cleretum* cf. *maughanii*** (Photo 16). Although only few of these plants were observed, they are expected to be scattered throughout the veld itself. However, they do not associate with watercourses or wetlands and the likelihood that the proposed project will have any significant detrimental impact on this species is considered low.

In her final report of the Vegetation of the Akkerendam Nature Reserve, Dr. Van der Merwe includes a preliminary species list of the Akkerendam Nature Reserve (Appendix D) (Van der Merwe, 2014), which, includes a much larger area and is a much more comprehensive species list than the one for this study. This species list only include one of the sensitive species named in the DFFE screening report, namely ***Cliffortia arborea*** (the star tree). This species normally grows in cliffs and on ledges within the mountains and is unlikely to be impacted by the proposed project.

There is a small change that the development may impact on a few *Cleretum maughanii* individuals, but it is unlikely that it will have any significant detrimental impact on the species as such. As a result, the plant species sensitivity rating could be reduced to **Low Sensitive**.

7.5. FAUNA AND AVI-FAUNA

According to the **DFFE Environmental Screening Report** the relative Animal species theme sensitivity is considered of **High Sensitivity** because of the potential presence of the potential for impacting on 4 bird species , one mammal species and one reptile species (Refer to Table 11).

Since the proposed development will result in temporary short term disturbance it is considered unlikely that it will result in any significant additional impact on any of the bird species. In fact, it may be beneficial to the long-term biodiversity in terms of amphibians and bird's species attracted by the temporary pooling.

Historically the critically endangered Riverine rabbit might have occurred in the Calvinia area. Although the upper seasonal streams within the Akkerendam Nature Reserve, lacks the dense riparian vegetation with which this species is normally associated the soils would have been suitable for burrows. Unfortunately, the Riverine rabbit has not been observed in the larger Calvinia area for the last 30 years and is thought to be locally extinct.

Sensitive species 32 refers to a tortoise endemic to South Africa and considered **Endangered** due to anthropogenic land transformation and other threats. The locations of the ponds are in the low open

fields at the foothills of the Hantam Mountains (away from the rocky hills and ridges that is this tortoise's preferred habitat). The development might have a temporary impact on small areas of its habitat, but it is considered unlikely that the development will have any permanent long-term impact on this species.

The discussion in Table 11 suggests that it is considered highly unlikely that the proposed project will pose any significant additional impact on any of these species.

With regards to the is project the sensitivity rating is considered to be **Low sensitive**.

7.6. CONSERVATION PRIORITY AREAS

The proposed development will impact on the Akkerendam Nature Reserve (a Municipal Reserve) which had been identified as a critical biodiversity area (CBA1) within the NC CBA maps (2016) (Figure 7). The Akkerendam Nature Reserve is also located within the Hantam-Roggeveld Centre (HRC) of endemism (Figure 8), which is centred on the town of Calvinia and includes most of the Bokkeveld Plateau (Van Wyk & Smith, 2001).

The proposed project will thus have a relatively small (< 1.2 ha), temporary impact on indigenous vegetation within a municipal nature reserve, located within the HRC of endemism.

7.7. CONNECTIVITY

During construction, connectivity might be impacted slightly, but it is considered unlikely that the proposed project will result in any long-term or permanent additional impact on connectivity.

7.8. INDIRECT IMPACTS

Indirect impacts occur away from the 'action source' i.e., away from the development site. The impact assessed here is specifically how the proposed development would have an indirect impact on vegetation, flora, mammals, birds, reptiles, and invertebrates away from the development site.

The indirect impact in this case will be a temporary disturbance. Because of the small size of the development footprint, the indirect impact is considered to be Low Significant.

7.9. CUMULATIVE IMPACTS

Refer to Table 12. In this impact assessment method, cumulative impacts are calculated by using the worst scenarios for each aspect as input into the cumulative impact calculation.

7.10. THE "NO-GO" ALTERNATIVE

The **"No Go" alternative** means there would be no change to the *status quo*. The site will continue to be used for grazing. The No-Go alternative will mean no loss of vegetation or connectivity. The impact

on the protected plant species will not occur. The land would remain in its natural state and any changes that would occur would only be attributable to the management of the reserve and external factors such as climate change.

However, the potential positive impact in terms of long-term water security will not be realized. The 'No Go' alternative is included in the impact table below (Table 12).

7.11. TERRESTRIAL BIODIVERSITY IMPACT ASSESSMENT

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

Table 12: Terrestrial biodiversity impact associated with the proposed development.

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
Special habitats: Potential impact on special habitats (e.g. true quartz or "heuweltjies")	Without mitigation	3	3	2	1	1	21	The project will impact on two seasonal streams and its associated riparian vegetation.
	With mitigation	3	2	2	1	1	18	Ensure that topsoil is removed, protected and re-used during the rehabilitation of the site.
Watercourses & Wetlands: Potential impact on natural water resources and it's ecological support areas.	Without mitigation						0	Refer to Heading 4.4 (A freshwater specialist was appointed)
	With mitigation						0	
Landuse and cover: Potential impact on socio-economic activities.	Without mitigation	3	3	2	1	1	21	Temporary impact on <1.2 ha of natural veld (Least Threatened), but located within the HRC of endemism, within a Municipal Nature Reserve, identified as a CBA 1.
	With mitigation	3	2	2	1	1	18	Ensure that the footprint is minimised, and that good environmental control is implemented.
Vegetation status: Loss of vulnerable or endangered vegetation and associated habitat.	Without mitigation	3	3	2	1	1	21	Temporary impact on <1.2 ha of natural veld (Least Threatened).
	With mitigation	3	2	2	1	1	18	Ensure that the footprint is minimised, and that good environmental control is implemented.
Conservation priority: Potential impact on protected areas, CBA's, ESA's or Centre's of Endemism.	Without mitigation	4	4	2	1	1	32	Temporary impact on <1.2 ha of natural veld (Least Threatened), within a nature reserve.
	With mitigation	4	2	2	1	1	24	Ensure that the footprint is minimised, and that good environmental control is implemented.
Connectivity: Potential loss of ecological	Without mitigation	4	2	2	1	1	24	Temporary impact on <1.2 ha of natural veld (Least Threatened), within a nature reserve.

Impact assessment								
Aspect	**Mitigation**	**CV**	**Lik**	**Dur**	**Ext**	**Sev**	**Significance**	Short discussion
migration corridors.	With mitigation	4	2	2	1	1	24	Ensure that the footprint is minimised, and that good environmental control is implemented.
Protected & endangered plant species: Potential impact on threatened or protected plant species.	Without mitigation	4	3	2	1	1	28	The potential impact on one red-listed species and various NCNCA protected species (Refer to Table 10)
	With mitigation	4	2	1	1	1	20	Ensure that the recommendations given in Table 10 are implemented.
Fauna & Avi-fauna Potential impact on mammals, reptiles, amphibians & birds.	Without mitigation	4	2	2	1	2	28	The potential impact on four red-listed bird, one mammal and one reptile species (Refer to Table 11).
	With mitigation	4	1	2	1	1	20	Refer to Table 11 (and its recommendations).
Cumulative impacts: Cumulative impact associated with proposed activity.	Without mitigation	4	4	2	1	1	32	Temporary impact on <1.2 ha of natural veld (Least Threatened), within Nature Reserve and the potential impact on red listed and protected fauna & flora.
	With mitigation	4	2	2	1	1	24	Ensure that the footprint is minimised and that the mitigation recommendations are implemented.
The "No-Go" option: Potential impact associated with the No-Go alternative.	Without mitigation	4	2	2	1	1	24	There would be no change to the status quo (no impact on vegetation, connectivity, protected fauna & flora) and the site will continue to be used as a nature reserve, but the potential positive impact on water security will not be realized.
	With mitigation							

According to the **DFFE Environmental Screening Report** the relative Terrestrial Biodiversity theme sensitivity is considered of **Very High Sensitivity** because:

- The site is located within the Akkerendam Nature Reserve (a municipal managed reserve).

In addition:

- The site falls within the Hantam-Roggeveld Centre of endemism.
- It overlaps a CBA 1 area as identified in the NC CBA maps.
  - The development may impact on at least one red-listed species and various NCNCA protected species.
  - The site overlaps the distribution range of four red-listed bird species, one mammal and one reptile species.

The Terrestrial biodiversity assessment (Table 12) aims to take all the discussion in this report into account, including the fact that the fact that the vegetation is not vulnerable or endangered as well as all the other reasons discussed throughout this document.

According, Table 12, the main impacts associated with the proposed development will be:

  - The potential impact on a conservation priority area;
- The potential impact on red-listed fauna and flora species.

Because of the location and small size and the temporary nature of the proposed development even the cumulative impact given in Table 12 is considered to be **Low**. However, various mitigation actions is proposed to ensure that the impact remains low (especially because of its location within a Nature Reserve).

No fatal flaws or any other obstacles were found with respect to the flora, vegetation, fauna, and terrestrial biodiversity.

It is thus considered highly unlikely that the development will contribute significantly to any of the following:

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

The findings of this assessment suggests that the relative terrestrial biodiversity theme sensitivity should be **Low Sensitive** (not Very High Sensitive as suggested in the DFFE screening report).

7.12. TERRESTRIAL BIODIVERSITY SENSITIVITY MAP

The whole site must be regarded as a sensitive area deserving of its status as a Nature Reserve. Within the study area no additional areas of special significance have been identified (other than those associated with watercourses and wetlands). As a result, not sensitivity map has been produced. All areas must be seen as sensitive.

Construction MUST FOCUS on footprint minimization, topsoil conservation and good environmental control throughout the construction phase.

8. MITIGATION RECOMMENDATIONS

Impact minimisation should focus on footprint minimisation and topsoil management which will result in the protection of the majority of protected plant species. During construction and operation, the overriding goal should be to clearly define the final layout, to minimise the disturbance footprint.

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must be developed by a suitably experienced Environmental Assessment Practitioner.
- A **suitably qualified Environmental Control Officer must be appointed to monitor the**

construction phase in terms of the EMP and any other conditions pertaining to specialist studies.

- Before any work is done the footprint and access roads must be clearly demarcated. The demarcation must aim at minimum footprint and minimisation of disturbance.
- Once the footprint area has been finalized (before construction commences) the "Search & Rescue" recommendations given in Table 10 must be implemented.
- Access roads should remain twee-spoor tracks (not accessible to the public) and should not be scraped (where-ever possible).
- A Northern Cape Nature Conservation Act permit must be obtained for the "Search & Rescue" and other impacts on the protected species listed in Table 10 species.
- All alien invasive species within the footprint and its immediate surroundings must be removed responsibly.
    - Care must be taken with the eradication method to ensure that the removal does not impact or lead to additional impacts (e.g., spreading of the AIP due to incorrect eradication methods);
    - Care must be taken to dispose of alien plant material responsibly.
- Indiscriminate clearing of any area outside of these footprints may not be allowed.
- An integrated waste management approach must be implemented during construction.
    - Construction related general and hazardous waste may only be disposed of at approved waste disposal sites.

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APPENDIX 1: REQUIREMENTS FOR SPECIALIST REPORTS

Minimum Content Requirements for Botanical and Terrestrial Biodiversity Specialist Reports as per Protocol for the Specialist Assessment of Environmental Impacts on Terrestrial Biodiversity (GN 320 of 20 March 2020).

Protocol Ref	**Botanical and Terrestrial Biodiversity Specialist Assessment Report Content**	**Section / Page**
3.1.1.	Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	Page I & v - vi
3.1.2.	a signed statement of independence by the specialist;	Page vi
3.1.3.	a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Heading 3.2
3.1.4.	a description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;	Heading 3.1, 3.2 & 3.3.
3.1.5.	a description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Heading 3.3
3.1.6.	a location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	Heading 7.12
3.1.7.	additional environmental impacts expected from the proposed development;	Heading 7
3.1.8.	any direct, indirect and cumulative impacts of the proposed development;	Heading 7
3.1.9.	the degree to which impacts and risks can be mitigated;	Table 12 & Heading 8
3.1.10.	the degree to which the impacts and risks can be reversed;	Heading 7
3.1.11.	the degree to which the impacts and risks can cause loss of irreplaceable resources;	Heading 7.11
3.1.12.	proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	Heading 8
3.1.13.	a motivation must be provided if there were development footprints identified as per paragraph 2.3.6 above that were identified as having a "low" terrestrial biodiversity sensitivity and that were not considered appropriate;	NA
3.1.14.	a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not; and	Page iii
3.1.15.	any conditions to which this statement is subjected.	N/A

APPENDIX 2: DFFE SCREENING REPORT

APPENDIX 3: CURRICULUM VITAE – P.J.J. BOTES

Curriculum Vitae: Peet JJ Botes

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

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

BRIEF RESUME OF RELEVANT EXPERIENCE

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

2005-2010: Joined Enviroscientific, as an independent environmental consultant specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity and environmental legal compliance audits.

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

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

LIST OF MOST RELEVANT BOTANICAL & BIODIVERSITY STUDIES

Botes. P. 2007:	Botanical assessment. Schaapkraal, Erf 644, Mitchell's Plain. A preliminary assessment of the vegetation in terms of the Fynbos Forum: Ecosystem guidelines. 13 November 2007.
Botes. P. 2008:	Botanical assessment. Schaapkraal Erf 1129, Cape Town. A preliminary assessment of the vegetation using the Fynbos Forum Terms of Reference: Ecosystem guidelines for environmental Assessment in the Northern Cape. 20 July 2008.
Botes, P. 2010(a):	Botanical assessment. Proposed subdivision of Erf 902, 34 Eskom Street, Napier. A Botanical scan and an assessment of the natural vegetation of the site to assess to what degree the site contributes towards conservation targets for the ecosystem. 15 September 2010.
Botes, P. 2010(b):	Botanical assessment. Proposed Loeriesfontein low cost housing project. A preliminary Botanical Assessment of the natural veld with regards to the proposed low cost housing project in/adjacent to Loeriesfontein, taking into consideration the National Spatial Biodiversity Assessment of South Africa. 10 August 2010.
Botes, P. 2010(c):	Botanical assessment: Proposed Sparrenberg dam, on Sparrenberg Farm, Ceres. . A Botanical scan and an assessment of the natural vegetation of the site. 15 September 2010.
Botes, P. 2011:	Botanical scan. Proposed Cathbert development on the Farm Wolfe Kloof, Paarl (Revised). A botanical scan of Portion 2 of the Farm Wolfe Kloof No. 966 (Cathbert) with regards to the proposed Cathbert Development, taking into consideration the National Spatial Biodiversity Assessment of South Africa. 28 September 2011.
Botes, P. 2012(a):	Proposed Danielskuil Keren Energy Holdings Solar Facility on Erf 753, Danielskuil. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 17 March 2012.
Botes, P. 2012(b):	Proposed Disselfontein Keren Energy Holdings Solar Facility on Farm Disselfontein no. 77, Hopetown. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 28 March 2012.
Botes, P. 2012(c):	Proposed Kakamas Keren Energy Holdings Solar Facility on Remainder of the Farm 666, Kakamas. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 13 March 2012.
Botes, P. 2012(d):	Proposed Keimoes Keren Energy Holdings Solar Facility at Keimoes. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 9 March 2012.
Botes, P. 2012(e):	Proposed Leeu-Gamka Keren Energy Holdings Solar Facility on Portion 40 of the Farm Kruidfontein no. 33, Prince Albert. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 27 March 2012.
Botes, P. 2012(f):	Proposed Mount Roper Keren Energy Holdings Solar Facility on Farm 321, Kuruman. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 28 March 2012.
Botes, P. 2012(g):	Proposed Whitebank Keren Energy Holdings Solar Facility on Farm no. 379, Kuruman. A Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa. 27 March 2012.

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

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

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

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

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

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

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

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

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

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

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

Botes, P. 2014(a): Brandvlei Bulk Water Supply: Proposed construction of a 51 km new bulk water supply pipeline (replacing the existing pipeline) from Romanskolk Reservoir to the Brandvlei Reservoir, Brandvlei (Northern Cape Province). A preliminary Biodiversity & Botanical scan in order to identify significant environmental features (and to identify the need for additional studies if required). 24 February 2014.

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

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

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

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

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

Botes, P. 2015(b): Steenkampspan proving ground. Proposed establishment of a high speed proving (& associated infrastructure) on the farm Steenkampspan (No. 419/6), Upington, ZF Mgcawu (Siyanda) District

Municipality, Northern Cape Province. Biodiversity and Botanical Scan of the proposed footprint. 20 February 2015.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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