TERRESTRIAL ECOLOGICAL ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF THE NORTHERN BULK DISTRIBUTION PIPELINE, FROM APPROXIMATELY 2.3 KM FROM THE R700 AND N1 JUNCTION TO FARM OLRIG (ERF NO. RE/1710), BLOEMFONTEIN FREE STATE PROVINCE.

Prepared by: Mr. JN Giddy
E- josh@envmgp.com

15 New Market Street, Groenvlei, Bloemfontein

Environmental Management Group

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Report details section

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Prepared by	JN Giddy	JN Giddy
Signature		
Final reviewed by	Ricus Nel	Ricus Nel
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Signature		
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Prepared by	Environmental Management Group (Pty) Ltd	
Lead Ecologist	JN Giddy SACNASP (*Cand. Bot. Sci. 167254)*	
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Specialist investigator: Mr JN Giddy

South African Council for Natural Scientific Professions (SACNASP) in Botanical Science (Cand. Sci. Nat. 167254)

BSc. Honours majoring in Botany – University of the Free State (2021)

BSc. Majoring in Botany and Genetics – University of the Free State (2020)

Declaration of independence:

I, the above-mentioned specialist investigator responsible for conducting this particular specialist ecological study, declare that

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development, except for financial compensation for work done in a professional capacity.
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part.
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience, and scientific data;
- I do not have any influence over decisions made by the governing authorities;
- I have the necessary qualifications and guidance from professional experts (registered Pr. Nat. Sci.) in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity
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Joshua Giddy

Specialist investigator Co-author: Mr R Nel
South African Council for Natural Scientific Professions (SACNASP) in Ecological Science (Pr. Sci. Nat. 144943)
SAAB (Mem. No 800)
BSc. Honours majoring in Botany (Vegetation Ecology) – University of the Free State (2020)
BSc. Majoring in Botany and Zoology – University of the Free State (2019)

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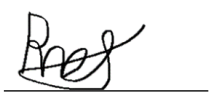

Ricus Nel

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1 Executive summary:

The pipeline will be roughly 12.7 km in length and have a width of 10m affected. The pipeline is proposed to start 2.3 km South of the N1 and R700 junction in the North of Bloemfontein ending in a ring around Farm Olrig (ERF No. Re/1710).

As a linear development, the proposed development passes through the Bloemfontein Dry Grassland (Gh 5), Winburg Grassy Shrubland (Gh 7) and Bloemfontein Karroid Shrubland (Gh 8) vegetation types and their remaining extent.

The topography of the study area is relatively uniform plains and a roadside. The vegetation is not prominent features of the study area with extensive infrastructure surrounding the entire site.

The site consists of three vegetation units with varying overall vegetation layer characteristics. Overall, the tree layer is well developed in some areas, while completely absent in others. The shrub layer is moderately developed throughout the site. While the study areas most prominent layer cover is that of the graminoid layer which is well to moderately developed in most areas. The overall vegetation is a good representation of the vegetation types in which they are located or an ecotone (mix) of adjacent vegetation types (Mucina and Rutherford, 2006; SANBI, 2006-2018; Skowno et al., 2018).

The DFFE screening tool has indicated the Plant Species Theme to be of low sensitivity, Terrestrial Biodiversity Theme to be of very high sensitivity, Aquatic Biodiversity Theme to be of very high sensitivity and a medium sensitivity for the Animal Species Theme. The very high Terrestrial Biodiversity Theme is attributed to the presence of ESA 1 & 2 areas surrounding the development, the presence of the Woodland Hills Golf and Wildlife Estate and the area being a FEPA sub catchment. The presence of the FEPA sub catchment also increases the sensitivity of the Aquatic Biodiversity Theme to a very high. The medium animal sensitivity can be attributed to the various protected species identified through the screening tool. Although none of these species were found within this ecological report's study area there is still a possibility of occurrence.

Anticipated environmental impact evaluation has overall indicated that the development would have a very low anticipated environmental impact. A very low environmental impact was influenced by the proposed developments overall ecological condition and associated disturbances. As per the EIA species guidelines, minimisation mitigation alternatives should be implemented.

This specialist is of the opinion that the development should be considered a favourable one with minimal environmental impact provided mitigation measures are followed.

2 Introduction:

Ecological infrastructure refers to the natural functioning ecosystems which provide essential services to people. An ecosystem functions as a collective of components, living and non-living, interacting with one another (Wohlitz, 2016). Humans benefit from healthy functioning ecosystems in the utilisation of the services they provide. Ecosystem services include provisioning services (food, raw materials, freshwater), regulating services (climate and air quality, carbon sequestration, water purification), supporting services (habitats and genetic diversity), and cultural services (recreation, tourism and spiritual) (Costanza et al., 1997; Fy et al., 2015; Wohlitz, 2016). Ecosystems can't provide these services when in a poorly functioning, unhealthy state. An ecosystem's health is largely threatened by anthropogenic influences such as habitat fragmentation, pollution and unsustainable harvesting. These anthropogenic activities destabilise ecosystems and will ultimately result in an ecological breakdown, which ultimately raises the costs of living. In terms of biological diversity, South Africa ranks third globally with a high level of endemism (found only in South Africa) (Hoveka et al., 2020). Because of this, South Africa's vegetation is highly localised and experiences a greater threat of extinction. Thus, it is our responsibility to protect South Africa's rich biodiversity.

Despite the seeming homogeneity and low diversity of vegetation, an area may contain endangered and rare species. Red data species presence may make the development unfeasible at that specific location. If this occurs, the project should be moved to an alternative location or cease immediately. Development is a necessity, especially for a developing country such as South Africa. New developments create job opportunities, increase capital growth, and overall create a better country. However, these developments should not come at the cost of pristine ecosystems as they produce invaluable services humans reap for free. For this reason, sustainable development practices should balance the need for development and the conservation of natural resources (Wohlitz, 2016).

2.1 Project Background

The proposed development is located in the north of Bloemfontein close to the Woodland Hills Gold and Wildlife Estate and the Dawn Valley Private Nature Reserve. Overall, the proposed development is expected to have a distance of just over 12 km and potentially affect 5 - 10 m on either side of the pipes' central line. Thus, the study area is 10 m wide by 12.7 km long. Along the route it's expected that the pipeline development will affect an area of around 30 ha. However, the actual affected area is expected to be smaller, as the machinery required for construction will not impact the full 10-meter corridor of the pipeline. Thus, the proposed development will likely have an expected indigenous vegetation clearance significantly less than the potential 30 ha.

This report forms part of the Environmental Authorisation Process for the proposed development and will discuss the various potential impacts that could arise given the approved authorisation of the development. The recommendations and mitigation measures generated in this report should be used to minimise the impact of the proposed development.

Table 1:The proposed pipeline development is envisioned to have the following specifications.

Proposed infrastructure	**Specifications (preliminary measurements)**
Pipeline Extent	~12.7 km
PVC-U pipeline:	~12.7 km
- *Diameter*	*250-710mm*
- *Material*	*PVC-U Class 9 and 12*
- *Flow rate*	*41.29 l/s and 529.02 l/s*
-PVC-U **630mm** Ø pipeline – Class 9	*3 230 m*
-PVC-U **500mm** Ø pipeline – Class 12	*2 107 m*
-PVC-U **400 mm** Ø pipeline – Class 12	*3 016 m*
-PVC-U **355mm** Ø pipeline – Class 12	*695 m*
-PVC-U **250mm** Ø pipeline – Class 12	*3 442 m*

3 Scope and limitations of the study:

- Evaluating the present ecological functioning of the area within which the proposed development will take place.
- Identifying and assessing possible environmental impacts that the proposed development could generate.

3.1 Scope:

Vegetation-related topics to be investigated include:

- Vegetation type within which the proposed development lies and the importance thereof.
- Assessing the overall ecosystem health in terms of its vegetation with emphasis on the level of disturbance (grazing- and anthropological impacts).
- Identification of the area's species composition with emphasis on dominant-, rare-, threatened[1]- and protected species[2]
- Environmental impacts on terrestrial plant species assessment in terms of site sensitivity verification and terrestrial plant species specialist assessment.

[1] Any species classified as Critically Endangered, Possibly Extinct (CR PE), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), indicated by the South African Red List categories.
[2] Protected species is any species listed as protected in terms of *Section 56 (1)(d)* of the Biodiversity Act.

3.2 Assumptions and limitations:

- Not all plants have the same growth and/or flowering period, and thus it is likely that the survey could have occurred outside of the growth and/or flowering period of a specific species. The study did however take place outside of the rainy season.
    - Thus, species diversity and growth form may be skewed towards perennial species.
    - Thus, true species diversity and richness are assumed to be underestimated.
- Some geophytic and succulent plants have specialised in mimicking their surrounding habitat. Thus, some of these plants might have been overlooked due to their cryptic nature.
- Species of conservation concern (SCC) are generally uncommon and/or localised.
    - Thus, locating such species can be challenging when attempts to locate such species occur outside the SCC's flowering season.
- With ecology being vast, dynamic, and highly complex, some aspects may have been overlooked. However, most floral communities have been accurately assessed and considered. Therefore, the information within this report is considered sufficient to allow informed decision-making to take place.
- Most plant species found in central South Africa experience summer rainfall, which allows for spring growth periods and summer-spring flowering season.
    - Thus, **autumn** is not within the optimal season in which to perform vegetation surveying for this study region.
    - However, due to the late abundant rains and absence of frost many species were still identifiable allowing for sufficient data to be collected.
- The overall species richness observed was **high**. As a result, the present species observed on site are a mixture of perennial and annuals. Thus, the number of species observed is a seemingly accurate estimate of the potential number of species that could occur on site with a few expected cryptic species not noted.

4 Methodology:

4.1 Literature review:

The desktop literature review aimed to gather and evaluate existing ecological information about key biodiversity and conservation elements within the Project's area of influence. This included identifying protected or significant conservation areas, understanding key ecological processes and functions, and assessing the probable composition and structure of local aquatic biodiversity.

- Field guides used for **species identification** (van Wyk and Malan, 1998; Botha, 2001; Bromilow, 2010; van Wyk and van Wyk, 2013; van Oudtshoorn, 2014; Manning, 2019).
- **Vegetation type descriptions** were obtained from Mucina and Rutherford (2006),
- The region's **conservation** status was defined according to provincial and national policies, informed by the Free State Biodiversity Sector Plan (2019), the National List of Threatened Ecosystems (NEMBA Threatened Ecosystems, 2011), the South African Protected Areas Database (SAPAD), the South African Conservation Areas Database (SACAD) and the national protected area expansion strategy (NPAES);
- Site **sensitivity verification** for the wetland and riparian habitats was informed by the South African National Wetland Map version 5 (NWM5) and the National Freshwater Ecosystem Priority Area database.

4.2 Survey:

Before visiting the site, a desktop study commenced where the following information was determined:

- Vegetation type.
- Climatic conditions.
- Probable rare- endemic- and protected species.
- Relatively homogenous vegetation units in which surveying will commence.
- Probable environmental impacts of the proposed development.
- The iNaturalist website was also consulted to obtain probable species presence as identified by the general public and other specialists.

The survey was performed by means of transects traversed on foot. The use of an unmanned aerial vehicle (UAV drone) was used to aid the delineation of relatively homogenous vegetation units. Plant species observed were recorded with particular emphasis on rare-, endemic-, protected- and dominant species. Attention was given to the current state of the environment regarding grazing impacts, anthropogenic disturbances, erosion and the presence of alien or invasive species. Observed animal species and evidence of their existence (dung, habitat requirements, excavations, animal tracks, burrows, and nests) were recorded.

Surveying was performed **over 3 days (Between the 28th and the 30th of April 2025)** totalling roughly 18 hrs. Surveying thus took place in the autumn season, which is not within the optimal season to perform vegetation surveying on areas dominated by the grassland biome (study area) as it is a summer rainfall region.

4.3 Assessment criteria:

4.3.1 Unit sensitivity assessment

As per the SANBI (2020) Species Environmental Assessment Guidelines, site ecological importance (SEI) was calculated. The fulfilling criteria of the conservation importance, functional integrity and resilience is not an exhaustive list, and the guidelines allow for adding additional, conditional aspects which were not included in the fulfilling criteria. Where the addition of additional, conditional aspects was required, the reasoning for the applicable addition was required to be stipulated.

Conservation importance (CI) concerns the sites' ability to support biodiversity features or species of conservation concern through largely natural processes. CI was calculated using internationally acceptable, recognized and established biodiversity value determination principles and criteria utilized in evaluating conservation importance (IUCN KBA, 2016; SANBI, 2020), as shown in the table below.

Table 2: Criteria that fulfil the requirements for the ratings of conservation importance (CI).

Conservation importance (CI) rating	Fulfilling criteria
Very high	Confirmed or high likelihood of occurrence of SCC with a global EOO of <10km^2. and/or Any environment featuring characteristics of a natural habitat of a CR vegetation type or a large area (>0.1% of total vegetation type extent) of natural habitat of an EN vegetation type. and/or Natural habitat featuring a unique combination of biophysical characteristics rarely seen in the surrounding environment. and/or A significant or unusually high population occurrence of protected/ endemic species.
High	Confirmed or highly likely occurrence of SCC species with a global EOO of >10km^2. SCC must be listed under any criterion other than A and if only listed under A, should be included for species with reported occurrences of <10 localities or < 10 000 individuals and/or Small area (>0.01% but <0.1% of total vegetation type extent) of natural habitat of an EN vegetation type or a large area of natural habitat of a VU vegetation type. and/or Natural habitat featuring a unique combination of biophysical characteristics and may also occur in the surrounding environment. and/or Any area hosting a unique combination of protected species not occurring in the surrounding environment.
Medium	Confirmed or high likely occurrence of SCC which have been observed in more than 10 locations or more than 10 000 reported mature individuals. and/or Any area of natural habitat of a VU vegetation type. and/or Confirmed species which exhibits a restricted range. and/or >50% of the unit contains natural habitat with potential to support SCC. and/or A fairly high species richness of naturally occurring species. Some protected species may also occur.
Low	No confirmed observations of, or low probability of SCC occurrence. and/or

	No confirmed observations or low probability of species with a restricted range. and/or <50% of unit contains natural habitat with a limited potential to support SCC. and/or Poor to moderate species richness. Some alien and invasive species may occur.
Very low	No confirmed observations or very low probability of SCC occurrence. and/or No confirmed observations or very low probability of species with a restricted range. and/or Very little to no natural habitat remaining.

Functional integrity refers to the site's ecological condition, where it's able to maintain its structure and functionality with regard to habitat connectivity and pristineness. The ecological condition of the vegetation units was determined by considering the remaining functional area, habitat connectivity and level of disturbance which influences the ecological processes of the site.

The ecological functioning of a large, uninterrupted, undisturbed natural area is considered intact and functional with high functional integrity. On the other hand, a small, fragmented, poorly connected, very disturbed site is inhibited and has a very low functional integrity.

Site functional integrity was determined using the fulfilling criteria as tabulated below in Table 2.

Table 3: Criteria that fulfil the requirements for the ratings of functional integrity (FI)

Functional integrity (FI)	Fulfilling criteria
Very high	Very large (>100 ha) intact habitat and/or High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. and/or No or minimal current negative ecological impacts with no signs of major past disturbance
High	Large (>20 ha but <100 ha) intact area for any conservation status of vegetation type or > 10 ha for EN vegetation type. and/or Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches and/or Only minor current negative ecological impacts (e.g., few livestock utilising area) with no signs of major past disturbance (e.g. ploughing) and good rehabilitation potential.
Medium	Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of vegetation type or > 20 ha for VU vegetation type. and/or Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. and/or Mostly minor current negative ecological impacts with some major impacts (e.g., established population of alien and invasive flora) and a few signs of minor past disturbance. Moderate rehabilitation potential.
Low	Small (> 1 ha but < 5 ha) area and/or Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. and/or Several minor and major current negative ecological impacts.
Very low	Very small (< 1 ha) area. and/or No habitat connectivity except for flying species or flora with wind-dispersed seeds. and/or Several major current negative ecological impacts.

Biodiversity importance concerns the site's ability to support biodiversity features or species of conservation concern with its current ecological condition in terms of functional size, connectivity and level of disturbance. Using the determined conservation importance and functional integrity of the vegetation units, biodiversity importance was determined using the following simple matrix (SANBI, 2020), as seen in table 3 below.

Table 4: Matrix in calculating biodiversity importance (BI) using conservation importance and functional integrity.

Biodiversity importance		**Conservation importance (CI)**				
		Very high	High	Medium	Low	Very low
Functional integrity	Very high	Very high	Very high	High	Medium	Low
	High	Very high	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very low
	Low	Medium	Medium	Low	Low	Very low
	Very low	Medium	Low	Very low	Very low	Very low

Site resilience is the site's natural ability to overcome or recover from negative influences of disturbance without human intervention. A site's recovery to a specified level of restoration with respect to the site's original ecological functionality in an estimated time is the baseline evaluation criteria. Justification of the resilience rating with respect to estimated recovery time was required. Particular disturbances and impacts, as well as the time of year these impacts are expected to occur, are often associated with resilience and were considered (SANBI, 2020).

Site resilience was determined using the fulfilling criteria as indicated below (Table 4).

Table 5: Criteria that fulfil the requirements for the ratings for resilience (R)

Resilience category	Fulfilling criteria
Very high	Habitat that can recover rapidly (~ less than five years) to restore > 75% of the original species composition and functionality of the receptor functionality or species that have a very high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of returning to a site once the disturbance or impact has been removed.
High	Habitat that can recover relatively quickly (~ 5–10 years) to restore > 75% of the original species composition and functionality of the receptor functionality or species that have a high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of returning to a site once the disturbance or impact has been removed.
Medium	Will recover slowly (~ more than 1ten years) to restore > 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed.
Low	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed.
Very low	Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed.

Site ecological importance (SEI) concerns the site's biodiversity importance in its ability to support biodiversity features or SCC and its natural resilience ability to recover from negative influences.

SEI for each vegetation unit was determined through the simple matrix (SANBI, 2020) below (Table 5) by using the vegetation units' biodiversity importance (CI x FI) and resilience. SEI was determined for each relatively homogenous vegetation unit (VU) and should be used to inform sustainable development practices.

Table 6: Matrix for determining site ecological importance (SEI) using biodiversity importance and resilience

Site ecological importance		Biodiversity importance				
		Very high	High	Medium	Low	Very low
Receptor resilience	Very low	Very high	Very high	High	Medium	Low
	Low	Very high	Very high	High	Medium	Very low
	Medium	Very high	High	Medium	Low	Very low
	High	High	Medium	Low	Very low	Very low
	Very high	Medium	Low	Very low	Very low	Very low

Site ecological importance is specific to the proposed development activities and is not comparable to different proposed development activities (SANBI, 2020). Interpretation of the ratings of site ecological importance in relation to the activities associated with the proposed development is indicated in Table 6 below.

Table 7: Interpretation of the ratings of site ecological importance in relation to proposed development activities

Site ecological importance	Interpretation in relation to proposed development activities
Very high	Avoidance mitigation – no destructive development activities should be considered. Offset mitigation is not acceptable/not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/ unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high-impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact are acceptable, followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact are acceptable, followed by appropriate restoration activities.
Very low	Minimisation mitigation – development activities of medium to high impact are acceptable, and restoration activities may not be required.

4.3.2 Anticipated environmental impact assessment

Anticipated impacts (section 9) of the proposed development on the receiving environment at the proposed location were determined using the impact assessment and significance evaluation forms which are available in Appendix 1 and 2.

Anticipated environmental impacts of the proposed development on each SCC (section 9.1) were determined as above. Anticipated environmental impacts of the proposed development on the receiving environment were determined for the following components: habitat, indigenous floral and faunal, floral SCC and provincially protected flora.

5 Study area:

The proposed development area starts 2.3 km from the N1 and R700 junction in the North of Bloemfontein and ending in a ring of Farm Olrig (ERF No. Re/1710). As the development is roughly 12.7 km long and 10m wide (buffer), the proposed development is expected to influence approximately 30 ha of vegetation.

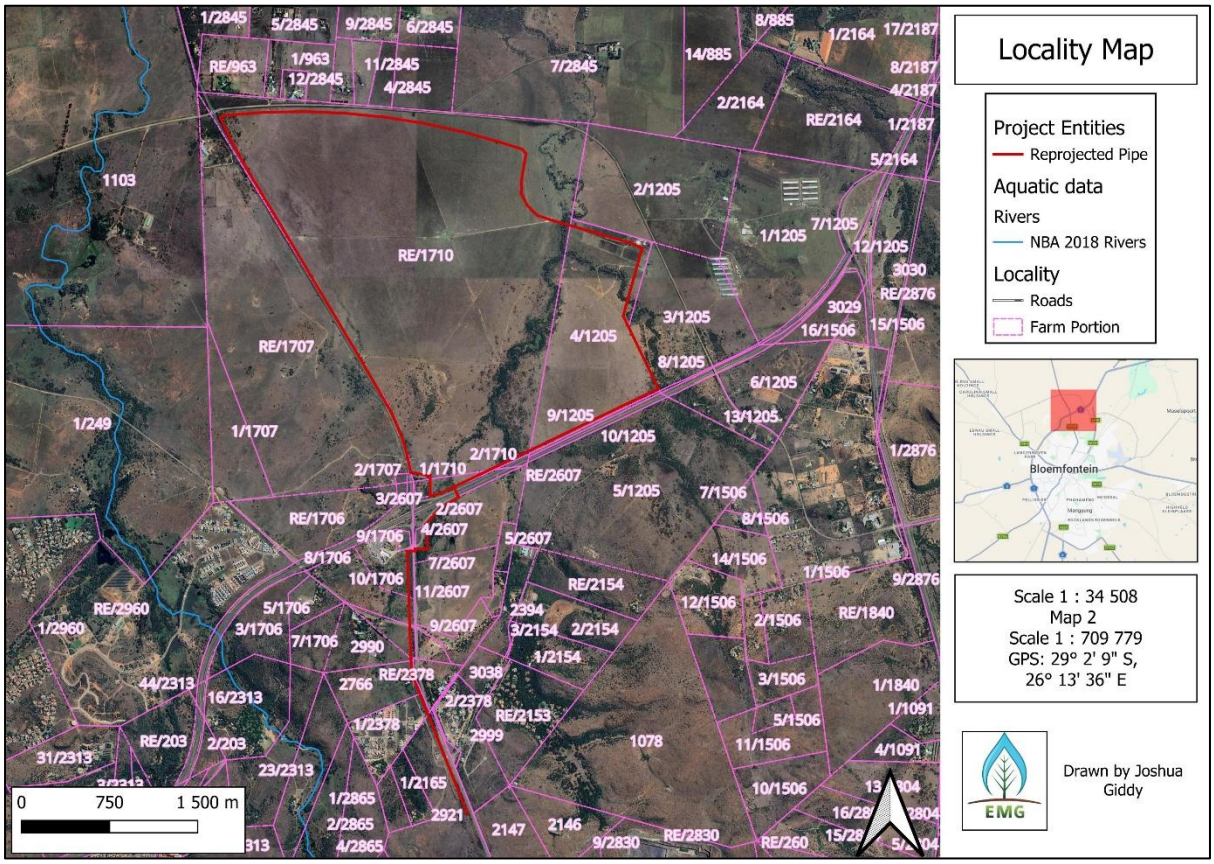

Figure 1: Map indicating the proposed pipeline development site locality.

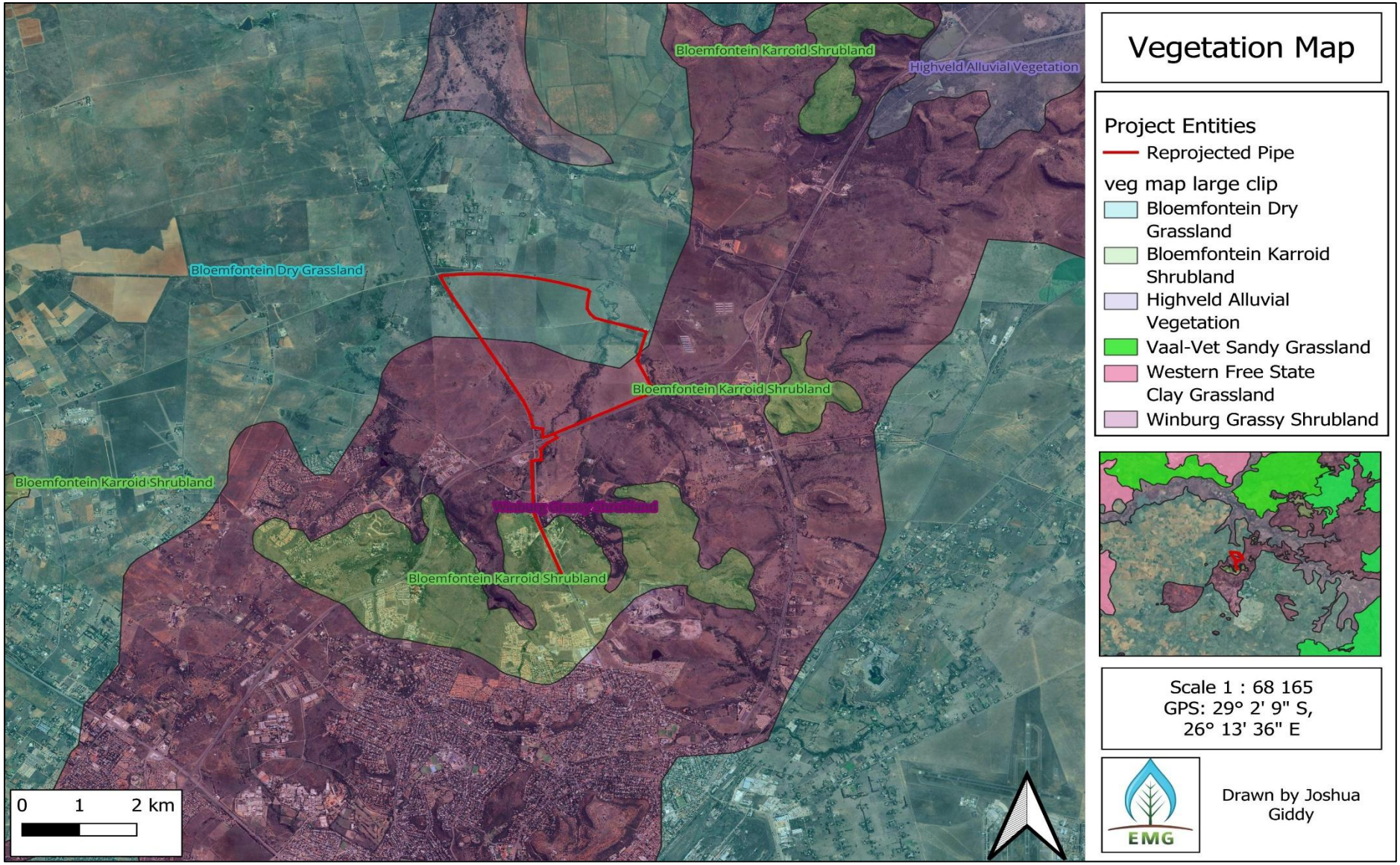

Figure 2: Regional vegetation indicating the site's locality within the Bloemfontein Dry Grassland (Gh 5) Winburg Grassy Shrubland (Gh 7) and Bloemfontein Karroid Shrubland (Gh 8) vegetation types (SANBI, 2006-2018).

5.1 The physical environment:

The topography of the study area is mainly undulating plains to bottomlands with occasional koppies, ridges and a valley which breaks up the landscape. Within the study area and surrounds, the vegetation is not the most prominent feature of the landscape due to the surrounding built up area.

Altitudes of the different vegetation types through which the proposed development passes ranges from 1 200 m a.m.s.l. to 1 840 m a.m.s.l. (Mucina and Rutherford, 2006). Overall, the topography of the study area ranges from 1 334 m a.m.s.l. to 1 454 m a.m.s.l. Thus, the altitude of the proposed development is within the overall altitude limits of the regional vegetation types through which the proposed development crosses. Thus, the physical characteristic of the proposed development somewhat agrees with that of the various vegetation types.

5.2 Regional vegetation:

The proposed development area is located within the Highveld Grassland bioregion of the Grassland biome. Regional vegetation which the proposed development is located within is the Bloemfontein Dry Grassland (Gh 5), Winburg Grassy Shrubland (Gh 7) and Bloemfontein Karroid Shrubland (Gh 8) vegetation types (Mucina and Rutherford, 2006).

Representative of 28% of South Africa's terrestrial vegetation, the grassland biome is the most widely distributed biome within South Africa (Carbutt *et al*., 2011; Blaire *et al*., 2014; Leys *et al*., 2018). The biome is comprised of relatively short herbaceous vegetation which is dominated by graminoids. Woody plants are rare in the relatively short and simple structure of the grassland. Four bioregions distinguish the vegetation of the Grassland. These are the (1) Drakensberg Grassland, (2) Dry Highveld Grassland, (3) Mesic Highveld Grassland and (4) Sub-escarpment Grassland (Mucina and Rutherford, 2006).

The grassland biome in terms of macroclimate is widely variable, likely due to its widespread nature, the biome does however experience two major climate traits. These traits are seasonal precipitation (strong summer rainfall and winter drought) and common frost occurrences. The seasonal precipitation of the biome is represented by the strong summer rainfall and the cold, dry winters. The grassland receives high lightning flash density resulting in a relatively high likelihood of lightning-induced fire (Mucina & Rutherford, 2006).

The proposed pipeline runs through **three** vegetation types, namely;

- Bloemfontein Dry Grassland (Gh 5) (least concern)
- Winburg Grassy Shrubland (Gh 7) (least concern)
- Bloemfontein Karroid Shrubland (Gh 8) (least concern)

Bloemfontein Dry Grassland (Gh 5)

The Gh 5 vegetation type occurs between 1 200-1 480m. The vegetation type experiences a mean annual precipitation (MAP) of 450 mm, majority of which occurs in the late summer months (January - February) (Mucina & Rutherford, 2006).

Gh 5 occurs on slightly undulating bottomland which is characterize by the tall, dense grassland with patches of karroid shrub occurring over calcrete deposits. The undulating topography is due to the alternating layers of mudstone and sandstone (Mucina & Rutherford, 2006).

The Gh 5 vegetation type occurs on predominantly undulating grassland which is characterized by primarily grasses, namely; *Themeda triandra, Tragus koelerioides* and multiple, various *Eragrostis* species. The grass layer is dominated by *Anthephora pubescens, Aristida congesta, A. diffusa, Cynodon dactylon, Digitaria argyrograpta, Elionurus muticus, Eragrostis chloromelas, E. lehmanniana, E. obtusa, E. plana, E. superba, E. trichophora, Heteropogon contortus, Panicum stapfianum, Setaria sphacelata, Themeda triandra, Tragus koelerioides*. The dominant herbs include *Selago densiflora* and the geophytic herb *Oxalis depressa.* The low shrub layer is dominated by *Chrysocoma ciliata, Felicia filifolia* subsp. *filifolia, Pentzia globosa* and *P. incana* (Mucina & Rutherford, 2006).

Winburg Grassy Shrubland (Gh 7)

The Gh 7 vegetation type occurs between 1 300-1 660 m. The MAP (Summer rainfall) is around 500 mm (Mucina & Rutherford, 2006).

The vegetation type occurs on solitary hills, slopes and escarpments of mesas, ranging from shrubland to open grassland. The vegetation type occurs on extensive dolerite sills and is characterised by a medium height evergreen shrubland with occasional trees in drainage lines (Mucina & Rutherford, 2006).

The vegetation consists of a sparse, small tree stratum and closed shrub layer with a well-developed grass layer. The tall shrub layer is dominated by *Buddleja saligna, Euclea crispa subsp. ovata, Gymnosporia polyacantha, Olea europaea subsp. africana* (shrub form), *Searsia burchellii* and *S. erosa,* The low shrub layer is dominated by *Helichrysum dregeanum* and *Pentzia globosa.* The graminoid layer is dominated by *Aristida adscensionis, A. congesta, A. diffusa, Cymbopogon pospischilii, Cynodon dactylon, C. incompletus, Eragrostis chloromelas, E. lehmanniana, E. micrantha, E. obtusa, E. trichophora, Eustachys paspaloides, Heteropogon contortus, Panicum stapfianum, Setaria lindenbergiana, S. sphacelata, Sporobolus fimbriatus, Themeda triandra, Tragus koelerioides* (Mucina & Rutherford, 2006).

Bloemfontein Karroid Shrubland (Gh 8)

The Gh 8 vegetation type occurs with the altitude of 1 320- 1 840 m and a MAP of ~550 mm. The vegetation type receives most of its rain in Summer and also receives frequent frost during the winter months (Mucina & Rutherford, 2006).

The characteristic landforms of Gh 8 are plateaus or sloping flanks of dolerite outcrops with minimal grass cover (limited to depressions). The vegetation occurs on Jurassic dolerite (Mucina & Rutherford, 2006).

The vegetation type is characterized by the shrub layer. The dominant low shrubs include *Eriocephalus ericoides* and *Euryops empetrifolius* with the succulent shrub layer being dominated by *Chasmatophyllum musculinum, Euphorbia mauritanica, Ruschia spinosa* and *Stomatium mustellinum.* The grassland layer is dominated by *Aristida diffusa, Eragrostis nindensis, Heteropogon contortus* and *Oropetium capense.* The succulent herb understory is dominated by *Senecio radicans* (Mucina & Rutherford, 2006).

5.3 Conservation:

Vegetation conservation status

All the vegetation types through which the proposed development passes; Bloemfontein Dry Grassland (Gh 5), Winburg Grassy Shrubland (Gh 7) and Bloemfontein Karroid Shrubland (Gh 8), have conservation statuses of Least Concern (LC). Previously Gh 5 was determined to be endangered according to Mucina and Rutherford (2006) and vulnerable according to NBA (2011). However, according to the National Biodiversity Assessment of 2018 Volume 1 and Government Gazette No. 2747: the revised national list of ecosystems that are threatened and in need of protection, Gh 5 has since been categorized as Least Concern. It should be noted however that the latest BGIS information does however indicate Gh 5 as a threatened ecosystem with a Vulnerable status.

5.4 Study area sensitivity context

Terrestrial context

As per the DFFE screening tool, the proposed development area will affect an area with a low sensitivity for the Plant Species theme and a very high sensitivity for the Terrestrial Biodiversity theme. No sensitive species were identified under the Plant Species theme.

According to the Vegetation Map of South Africa, Lesotho and Swaziland (SANBI, 2006-2018), the proposed development is majorly located in the Bloemfontein Dry Grassland and Winburg Grassy Shrubland vegetation types. The development is located within an area classified as Environmental Support Areas (ESA 1 & 2) according to the Terrestrial Biodiversity theme, which is the reason for the very high sensitivity alongside the proximity to the Woodland Hills Golf and Wildlife estate.

Aquatic context

As per the DFFE screening tool, the proposed development area will affect an area with a very high sensitivity for the Aquatic Biodiversity Theme.

According to the screening tool the sensitivity is very high due to the development occurring within the FEPA sub catchment.

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

Figure 3: DFFE screening tool results summarised in a table format, the fous groups are the terrestrial biodiversity theme and the plant species theme.

Regional biodiversity context

Within the broader pipeline vicinity, there are several ecologically significant zones, such as **Critical Biodiversity Areas (CBA 1 and 2), Ecological Support Areas (ESA 1 and 2)**, along with **degraded land classified as "No Natural Remaining" (NNR)** and **Other Natural Areas (ONA).**

- **CBA 1 areas** are **irreplaceable** for biodiversity conservation, as they meet biodiversity targets for the region with few or no alternative options to protect the species or ecosystems present.
- **CBA 2 areas** are **optimal** for achieving biodiversity targets, as they avoid land-use conflicts while efficiently contributing to conservation goals (Collins, 2024).

Ecological Support Areas (ESA) are regions in at least **fair ecological condition** that serve to:

- Support the ecological functioning of CBAs or protected areas,
- Generate or deliver ecosystem services,
- Meet remaining biodiversity targets when these cannot be achieved in natural or near-natural areas.

Degraded (Non-Natural Habitat Remaining - NNR) areas are in **poor ecological condition**, having been severely or irreversibly altered. These areas are **not required** to meet biodiversity targets for species, ecosystems, or ecological processes.

Other Natural Areas (ONA) consist of land in **good or fair ecological condition** (natural, near natural, or semi-natural) but lack specific management objectives and are not essential for meeting biodiversity targets (SANBI, 2017).

The study area is located largely in areas classified as **ESA 1** with minor occurrences in areas classified as **ESA 2** according to the Free State spatial biodiversity plan (see Figure 4).

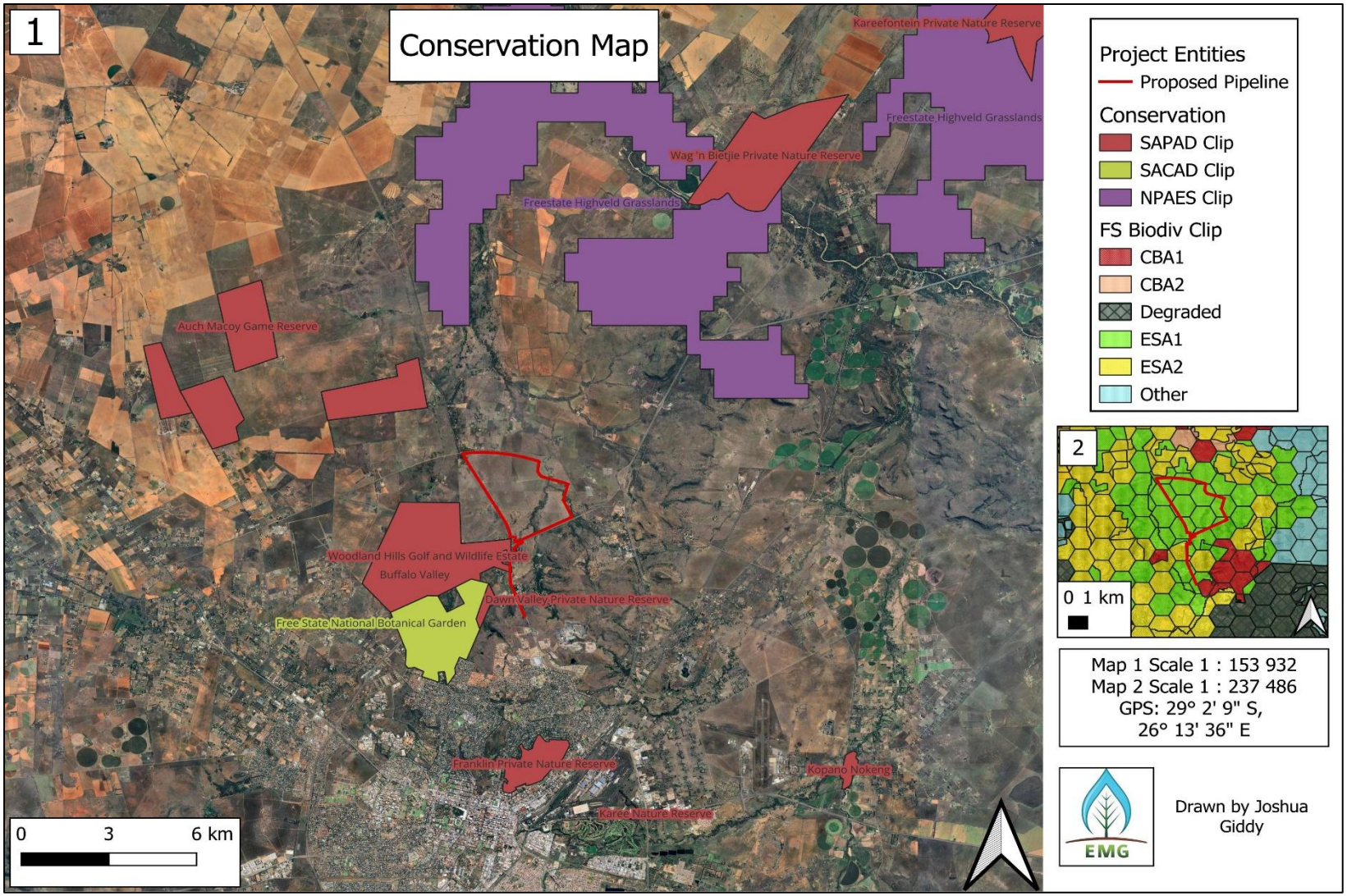

Figure 4: The study area does not occur within priority focus areas but occurs close to a nature reserve (Woodland Hills Golf and Wildlife estate) protected under SAPAD. Within 1 km there is another SAPAD protected nature reserve (Dawn Valley Private Nature Reserve) and a SACAD protected area (Free State National Botanical Garden) (NPAES, 2018). *The study area is majorly found in ESA 1 with minor occurrences in ESA 2 areas according to the Free State spatial biodiversity plan (DESTEA, 2017).*

6 Results:

A comprehensive floral species list is available in Table 18.

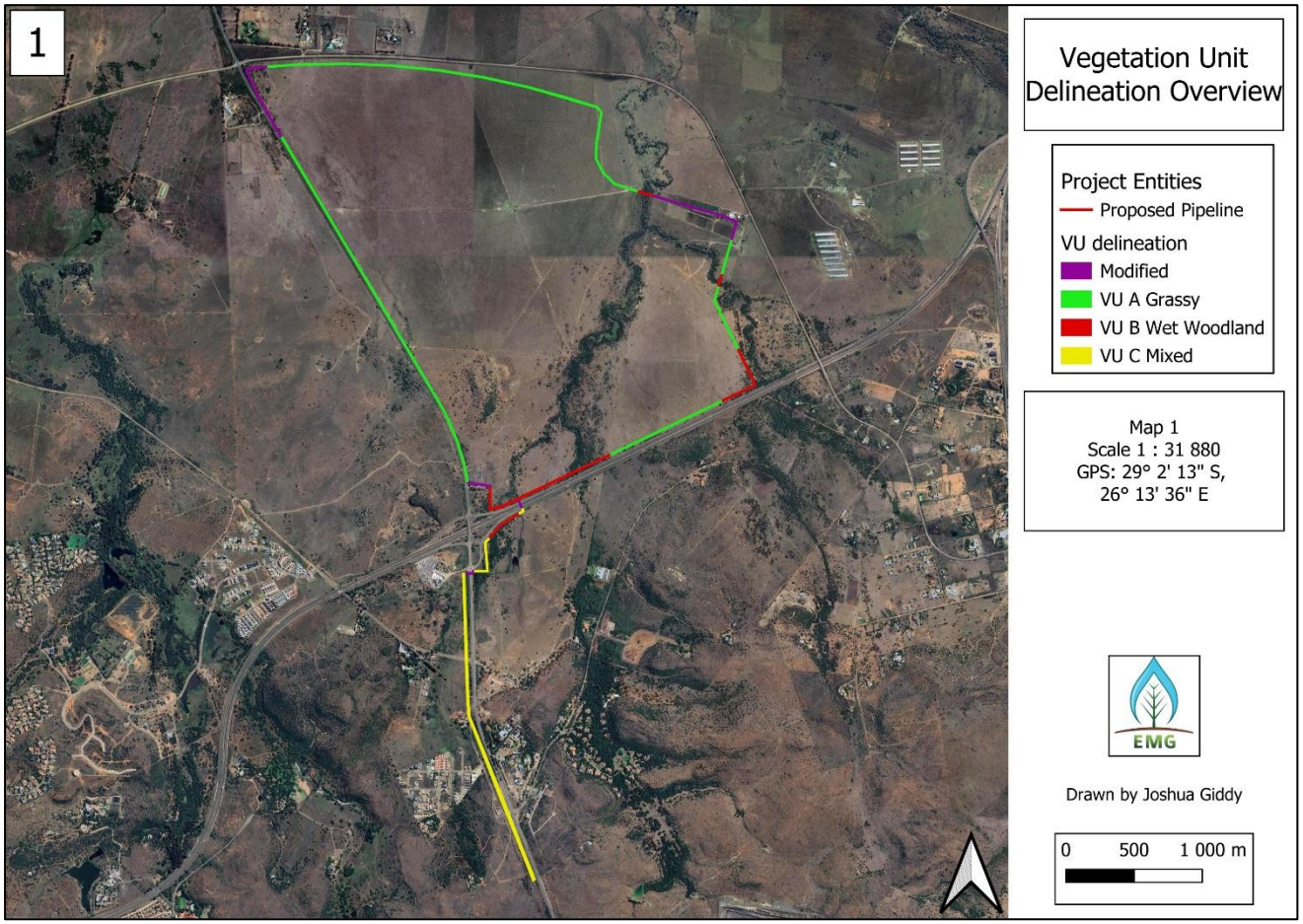

Figure 5: Map indicating the spatial distribution of the homogenous vegetation units (VU's) within the study area. A total of two distinguishable vegetation units can be found within the study area.

6.1 Floral survey:

Overall, three homogeneous vegetation units were identified within the study area. The vegetation unit delimitation was based on floral homogeneity, vegetation composition distinctiveness and influences of anthropogenic disturbances.

For the majority of the study area, vegetation coverage is relatively full with minimal bare patches. Areas devoid of vegetation occur due to a large transformation such as quarry areas or areas mechanically cleared for anthropogenic use. Overall, the tree layer is majorly missing in some parts while being the prominent vegetation feature in others. The same can be said for the graminoid layer. The shrub layer is moderately to well-developed throughout the site depending on the vegetation unit and occurs mainly as karroid patches interspersed in the grassland areas. Overall, the vegetation resembles a dry grassland or shrubland and the different vegetation units align with the vegetation types or ecotones of the vegetation types in which they are found. Some areas are more structurally similar to a vegetation type than compositionally and vice versa.

It is the recommendation of this specialist that a thorough walkthrough be done for all provincially and nationally protected species as individuals of the *Aloe* and *Euphorbia* (provincially protected) genera were noted as well as specimens of *Olea europaea* subsp. *africana* (provincially protected). The appropriate authority must be contacted with regard to the feasibility of obtaining removal permits for any protected species which would require such a permit should the development be approved. Removal permits for all protected species which will be affected by the development must be obtained before development commences.

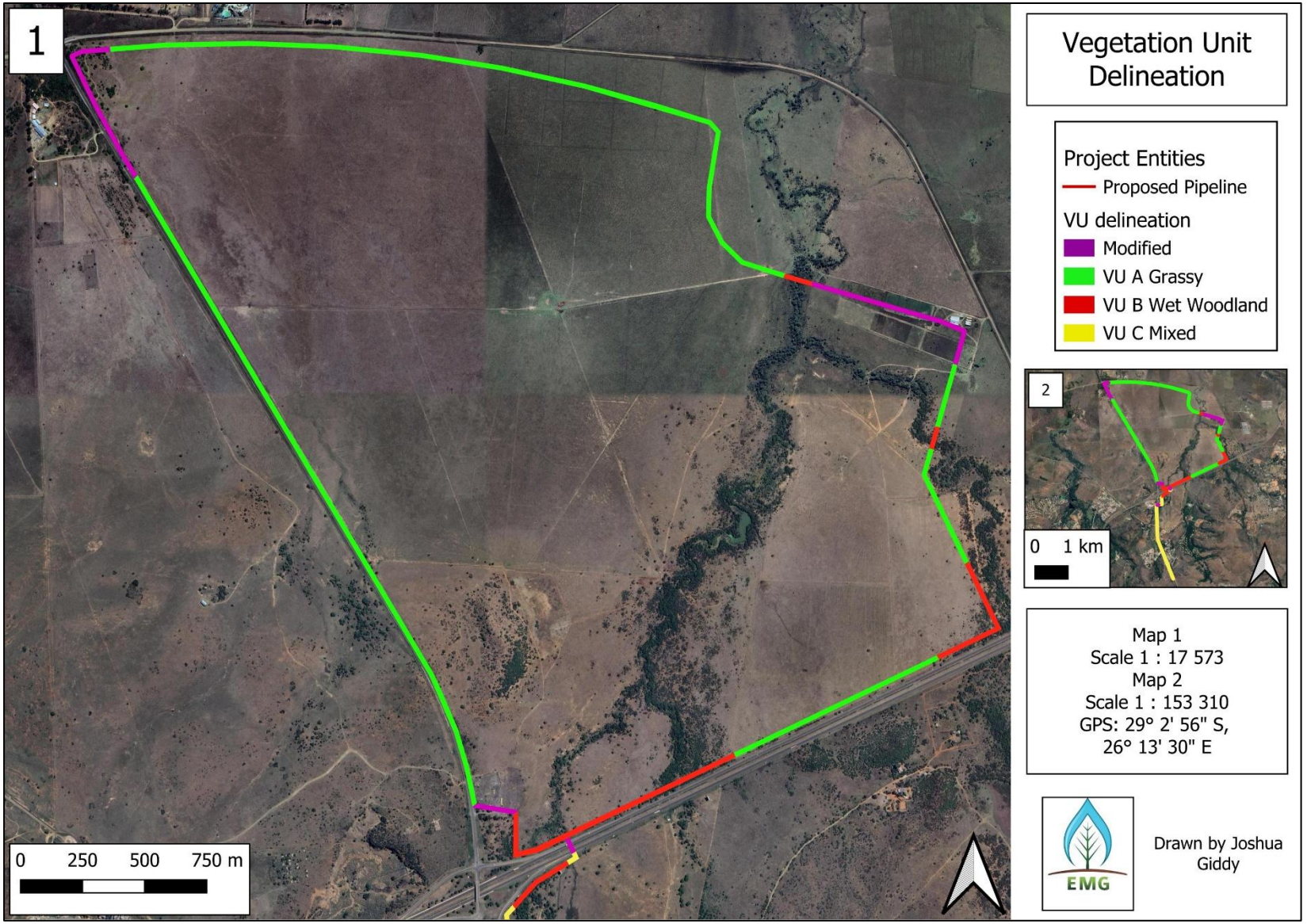

Figure 6: Map indicating the spatial distribution of the homogenous vegetation units (VU's) within the study area. The map depicts a view of VU A. Areas mapped in pink are completely modified areas which no longer contain vegetation.

6.1.1 VU – A - Grassy

Vegetation Unit A is found throughout the northern section (Farm Olrig ERF No. Re/1710) of the study area. This vegetation unit resembles the Bloemfontein Dry Grassland vegetation type (Mucina and Rutherford, 2006) (see Figure 7). In some more wooded areas interspersed in the grassland with a more developed tree/shrub layer the area better resembles the Winburg Grassy Shrubland (Gh 7) split to form VU B.

The tree layer is poorly developed with *Searsia lancea, Vachellia karoo* and *Olea europaea* ssp. *africana* (tree form) dominating the few occurrences. The tall shrub layer is poorly developed and sparse. The tall shrub layer is dominated by *Asparagus suaveolens, Searsia lancea* and *Ziziphus mucronata*. The sub-shrub layer is fairly developed with *Felicia muricata* and *Schkuhria pinnata* dominating the layer. The forb layer is fairly developed, with *Geigeria burkei* and *Pentzia incana* dominating. The grass layer is well developed and makes up majority of the vegetation cover. Dominating graminoids include *Themeda triandra, Tragus koelerioides* and *Cynodon dactylon* with notable occurrences of *Eragrostis superba, E. lehmanniana, Heteropogon contortus* and *Aristida diffusa.*

Other species observed include varying occurrences of; *Datura ferox* (Category 1b), *D. stramonium* (Category 1b)*, Bidens bipinnata* (naturalised alien species)*, Tagetes minuta* (alien invasive species)*, Verbena bonariensis* (naturalised alien species), *Cestrum laevigatum* (naturalised alien species).

Figure 7: Ground view of VU A which has a prominent graminoid layer. The graminoid layer is well developed while the herbaceous layer is fairly developed with moderate coverage throughout. GPS: 29° 1' 32" S, 26° 14' 28" E.

Besides the existing two track, very few disturbances were noted in this vegetation unit. Grazing game were encountered (see Figure 8) and evidence of past livestock grazing were noted. However; the ecological functioning of this vegetation unit is likely not negatively influenced. Due to this the current ecological functioning of this vegetation unit is considered **near natural. The majority of this vegetation unit is in a good ecological condition.**

Figure 8: Game presence within the area. GPS: 29° 1' 11" S, 26° 13' 41" E.

VU A – Discussion

The poorly developed tree layer for this VU is expected due to the dominant grassland vegetation type along with the dominant vegetation being grass. The interspersed patches of shrubs are also expected, aligning with the vegetation type (Gh 5) description per Mucina and Rutherford (2006). It should be noted that the *Asparagus* spp. has been noted as an indicator for bush encroachment in South Africa (Turpie *et al.,* 2019). As such the presence of *Asparagus suaveolens* may be due to bush encroachment and not a natural indigenous occurrence despite its presence in the vegetation type description.

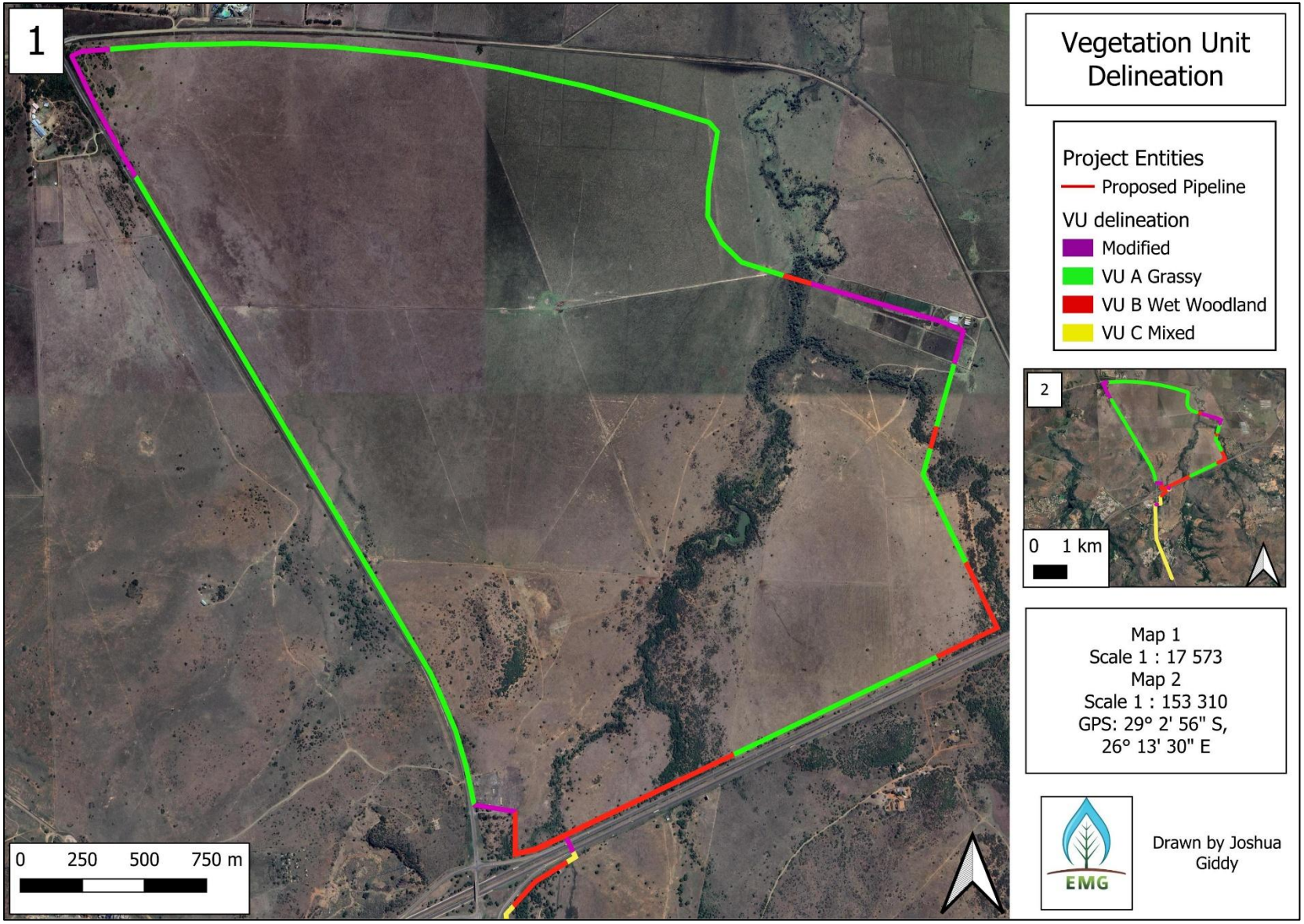

Figure 9: Map indicating the spatial distribution of the homogenous vegetation units (VU's) within the study area. The map depicts a view of VU B interspersed in VU A. Areas mapped in pink are completely modified areas which no longer contain vegetation.

6.1.2 VU B Wet woodland

This vegetation unit occurs within the previously described grassy VU A and is found along inundated areas, classified as a non-perennial watercourse by the Aquatic specialist (Lamprecht, 2026). VU B partially reflects the woody components of the Winburg Grassy Shrubland (Gh 7). In terms of species composition, VU B resembles Gh 7, although it differs from it in structure it shares the landscape features described for this vegetation types; however, due to the limited extent of the study area, this vegetation unit does not fully and accurately represent the vegetation type.

The tree layer is well developed and dominates, with individuals of *Searsia lancea, Vachellia karoo, Ziziphus mucronata, Celtis africana, Olea europaea* ssp. *africana* (tree form) and *Buddleja saligna* occurring. The shrub layer is well developed under the tree canopy o within canopy gaps, with *Asparagus suaveolens, Diospyros lycioides, Ziziphus mucronata* and *Olea europaea* ssp. *africana* (shrub form) occurring. The grass layer is moderately developed in larger canopy gaps, with grasses such as *Melinas repens*, *Hyparhenia hirta, Andropogon appendiculatus, Tragus koelerioides, Themeda triandra, Eragrostis curvula*, *E. lehmanniana* occurring. The herbaceous layer is sparsely developed with occurrences being dominated by *Pentzia incana* and *Tagetus minuta* (naturalised alien species).

VU B contained few noted alien species observed which includes occurrences of; *Bidens bipinnata* (naturalised alien species), *Tagetes minuta* (naturalised alien species), *Verbena bonariensis* (Category 1b), *Cestrum laevigatum* (Category 1b), and *Pyracantha angustifolia* (Category 1b). Most notably the occurrences of *Eucalyptus camaldulensis* (Category 1b) and *Pinus pinaster* (Category 1b) dominate (minimal) sections of this VU in the southwestern part of the farm (see Figure 10).

Within this VU patches of wooded areas can be seen to be following wet areas identified as a non-perennial watercourse. The canopy cover becomes denser and more spread as the watercourse meets the N1 (southern section of Farm Olrig ERF No. Re/1710) (see Figure 11) with the tree layer becoming dominant and canopy gaps being covered by either grass or shrubs. Besides the existing two track very few disturbances were noted in this vegetation unit. Grazing game were encountered and evidence of past livestock grazing were noted. However; the ecological functioning of this vegetation unit is likely not negatively influenced. Due to this the current ecological functioning of this vegetation unit is considered **near natural. The majority of this vegetation unit is in a good ecological condition.**

VU B – Discussion

The well-developed tree and shrub layer for this VU is attributed to the non-perennial watercourse which the pipeline intersects multiple times. The presence of trees and shrubs are almost exclusive to the drainage lines, aligning with the vegetation type (Gh 7) description per Mucina and Rutherford (2006). It should be noted that the present *Asparagus* spp. has been noted as an indicator for bush encroachment in South Africa (Turpie *et al.,* 2019). As such the presence of *Asparagus suaveolens* may be due to bush encroachment and not a natural indigenous occurrence despite its presence in the vegetation type description.

Figure 10: Aerial photo evidence of the presence of alien invasive species (Eucalyptus camaldulensis) occupying the southwest of Farm Olrig ERF No. Re/1710. GPS: 29° 2' 9" S, 26° 13' 32" E.

Figure 11: Aerial View of VU B which has a dominant tree layer and the large gaps in tree canopy cover which give way to VU A (VU A depicted in light green, VU B depicted in dark green). GPS: 29° 2' 3" S, 26° 13' 57" E.

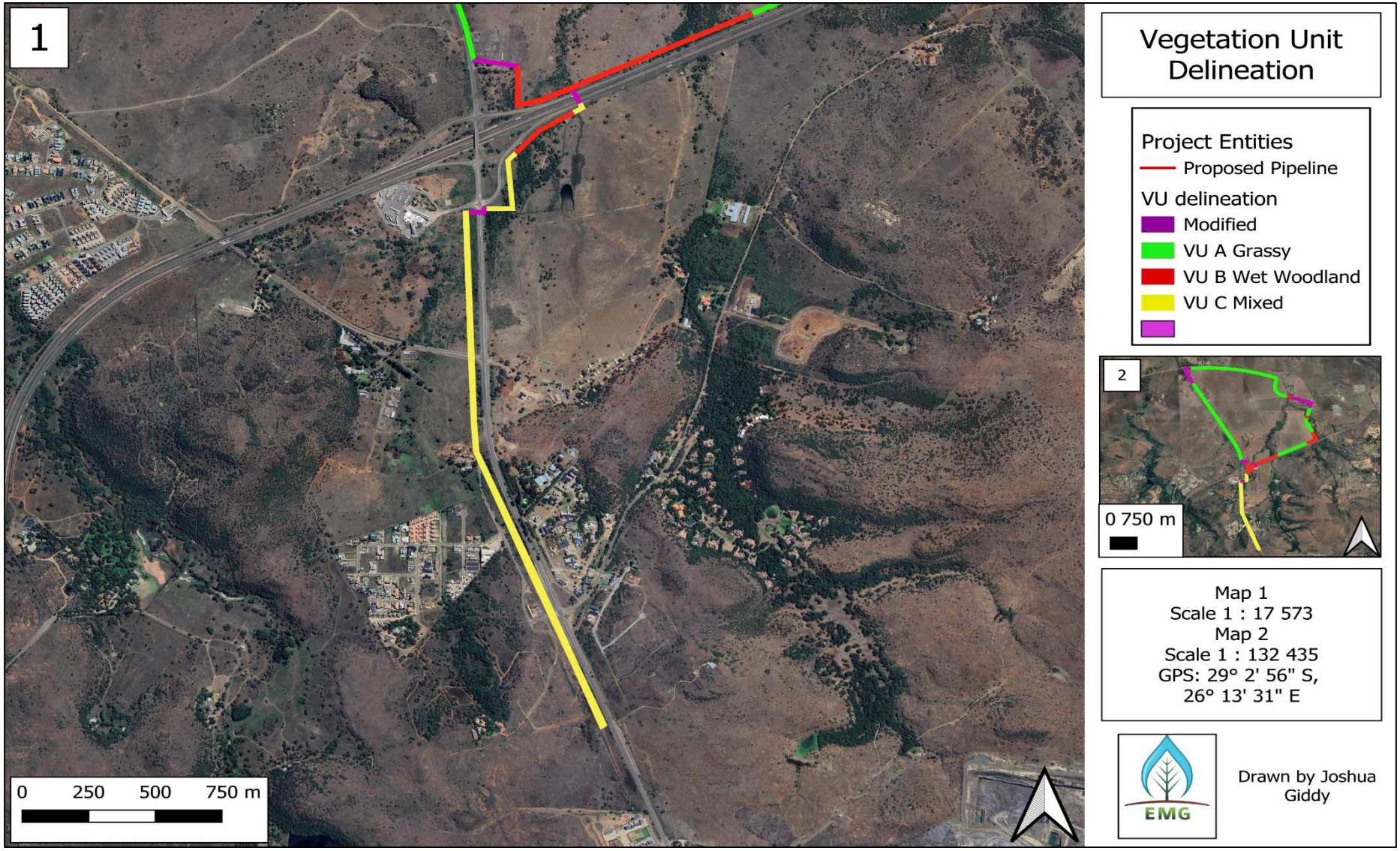

Figure 12: Map indicating the spatial distribution of the homogenous vegetation units (VU's) within the study area. The map depicts a view of VU B interspersed in VU A. Areas mapped in pink are completely modified areas which no longer contain vegetation.

6.1.3 VU C Mixed

This vegetation unit is located along a roadside including outcrops. VU C somewhat represents the Bloemfontein Karroid Shrubland (Gh 8) and Winburg Grassy Shrubland (Gh 7). VU B partially resembles the Gh 7 and Gh 8 vegetation types in structure and compositional characteristics, sharing the landscape features in the vegetation types of description however due to the limited extent of the study area the vegetation is not a fully accurate representation.

The tree layer is well developed, with few individuals of *Searsia lancea, Vachellia karoo, Ziziphus mucronata, Celtis africana, Olea europaea* ssp. *africana* (tree form) and *Buddleja saligna* occurring. The shrub layer is well developed, with *Diospyros lycioides, Ziziphus mucronata* and *Olea europaea* ssp. *africana* (shrub form) occurring in the wooded area with *Vachellia karoo*. A lower shrub layer occurs in non wooded, more grassy, areas contain shorter shrubs such as *Ruschia spinosa, Euphorbia mauritanica* and *Euryops empetrifolius.* The grass layer is moderately developed in patches, with grasses such as *Melinas repens*, *Hyparhenia hirta, Andropogon appendiculatus, Tragus koelerioides, Themeda triandra, Eragrostis curvula*, *E. lehmanniana* dominating the graminoid layer. The herbaceous layer is sparsely developed with occurrences being dominated by *Pentzia incana* and *Tagetus minuta* (naturalised alien species). Sparse occurrences of *Hereroa glenensis, Aloe grandidentata, Curio radicans* and *Crassula nudicaulis* are noted to occur in patches within the VU.

VU C contained a prominent amount of alien species observed which includes varying occurrences of; *Datura ferox* (Category 1b), *D. stramonium* (Category 1b), *Bidens bipinnata* (naturalised alien species), *Tagetes minuta* (naturalised alien species), *Verbena bonariensis* (Category 1b), *Cestrum laevigatum* (Category 1b), *Eucalyptus camaldulensis* (Category 1b), *Sphaeralcea bonariensis* (naturalised alien species), *Pinus pinaster* (Category 1b) and *Pyracantha angustifolia* (Category 1b). The VU's proximity to the road shoulder is most likely the primary driver of increased alien invasive species proliferation.

Within this VU patches of large rocks and boulders create outcrops in which more Gh 8 characteristic species can be seen occurring. In the wooded areas canopy cover becomes denser with the tree layer becoming dominant and canopy gaps being covered by either grass or shrubs (see Figure 12). Due to the existing road (regional road - R700) there are many disturbances surrounding the proposed pipeline (i.e. anthropogenic movement, litter and proximity to developments). Due to these ecological disturbances, this vegetation unit has **fair ecological functioning, with a moderately modified ecological condition**.

VU C – Discussion

Minimal consideration has been given to this VU due to the high level of disturbance which is present. The VU is a mix of sparse indigenous vegetation elements holding out in sporadic patches interspersed in aliens and encroacher species. The VU can therefore no longer be considered natural and should not be taken into account when considering the ecological impact of this development.

Figure 13: Ground View of VU C which has a prominent grassy / shrub layer on the flatter area (Picture 1.) and a more woody / shrub cover in the depressed areas (2.). GPS 1: 29° 3' 22" S, 26° 13' 42" E, GPS 2: 29° 3' 0" S, 26° 13' 32" E.

6.2 Fauna

Fauna species present or with potential occurrences within the study area and its general surrounds are summarised in the sections to follow. The occurrence of these species is subject to confirmation.

6.2.1 Mammals

Two protected species was identified by the DFFE Screening tool with potential to occur in the study area. The identified species are the Spotted Neck Otter (*Hydrictis maculicollis*) which is Vulnerable as per Ponsonby *et al.* (2016) and the White-tailed rat (*Mystromys albicaudatus*) which is Vulnerable as per SANBI's Redlist (2026).

Mystromys albicaudatus – the White-tailed rat (Vulnerable)

According to Avenant *et al.* (2016) research on the white-tailed rat (further referred to as WTR) is limited due to its rare encounters and infrequent capture rates. The WTR is a highveld grassland specialist endemic to South Africa and Lesotho where they primarily inhabit highveld grassland but also occur in fynbos and succulent karoo habitats (Dean, 1978; Avery & Avery, 2011; Avenant *et al.,* 2016). The WTR has adapted a complex digestive system allowing a wide range of foods to become a part of their diet which results in no available data being available on the preferred plant species used for food (Avenant *et al.,* 2016). During the winter months there is no research to suggest the WTR enters torpor however it does reduce its activity and foraging times during the colder months (Avenant *et al.,* 2016).

Based on the above information there no evidence suggesting its absence within the general area of the development but was not sighted due to the fact that the survey took place in late summer / early winter meaning the WTR would have decreased its activity. The description of the preferred habitat of the WTR suits the area which was surveyed being a highveld grassland area with proximity to wet areas.

Figure 14: White-tailed rat (Mystromys albicaudatus) photos obtained from INaturalist (2026).

Spotted Neck Otter (*Hydrictis maculicollis*)

The spotted neck otter (further referred to as SNO) is restricted to areas of permanent freshwater with an abundant prey base which limits its actual distribution despite its extensive range. The SNO is typically found in lakes and larger rivers in Africa and due to habitat degradation and polluted waterways less suitable habitats are available leading to a decline in population size. Larger freshwater habitats are a requirement due to the use of the surrounding vegetation (often long grass/ reeds and dense bush) acting as cover for denning and rest areas (Reed-Smith *et al.,* 2015).

Based on the above information it is unlikely that the SNO is present within the general area of the development as the present waterway is neither large enough nor can it sustain the population of fish necessary to the diet of the SNO. The description of the preferred habitat of the SNO does not suit the area which was surveyed being a highveld grassland area with proximity to a small-scale farm dam without fish stock. SNO presence is further unlikely due to the lack of connectivity of the farm dam to the surrounding rivers.

Figure 15: Spotted Neck Otter (Hydrictis maculicollis) photos obtained from INaturalist (2026).

7 Aquatic Biodiversity Baseline

Drawing on existing studies and published literature, this section offers a desktop-level summary of the baseline conditions of the Project area's aquatic environment. This section also intends to provide a base level assessment of various watercourses / waterbodies identified during both the desktop and field verification work. Note that although this report touches on the aquatic ecological component a separate dedicated aquatic ecological report is drafted (Lamprecht, 2026).

7.1 Environmental Screening Tool

Using the DFFE Web-based Environmental Screening Tool, a desktop assessment of the proposed infrastructure footprint was conducted. As per the DFFE Screening tool, the Aquatic Biodiversity Theme for the study area has a 'Very High Sensitivity' due to:

- FEPA Sub catchments.

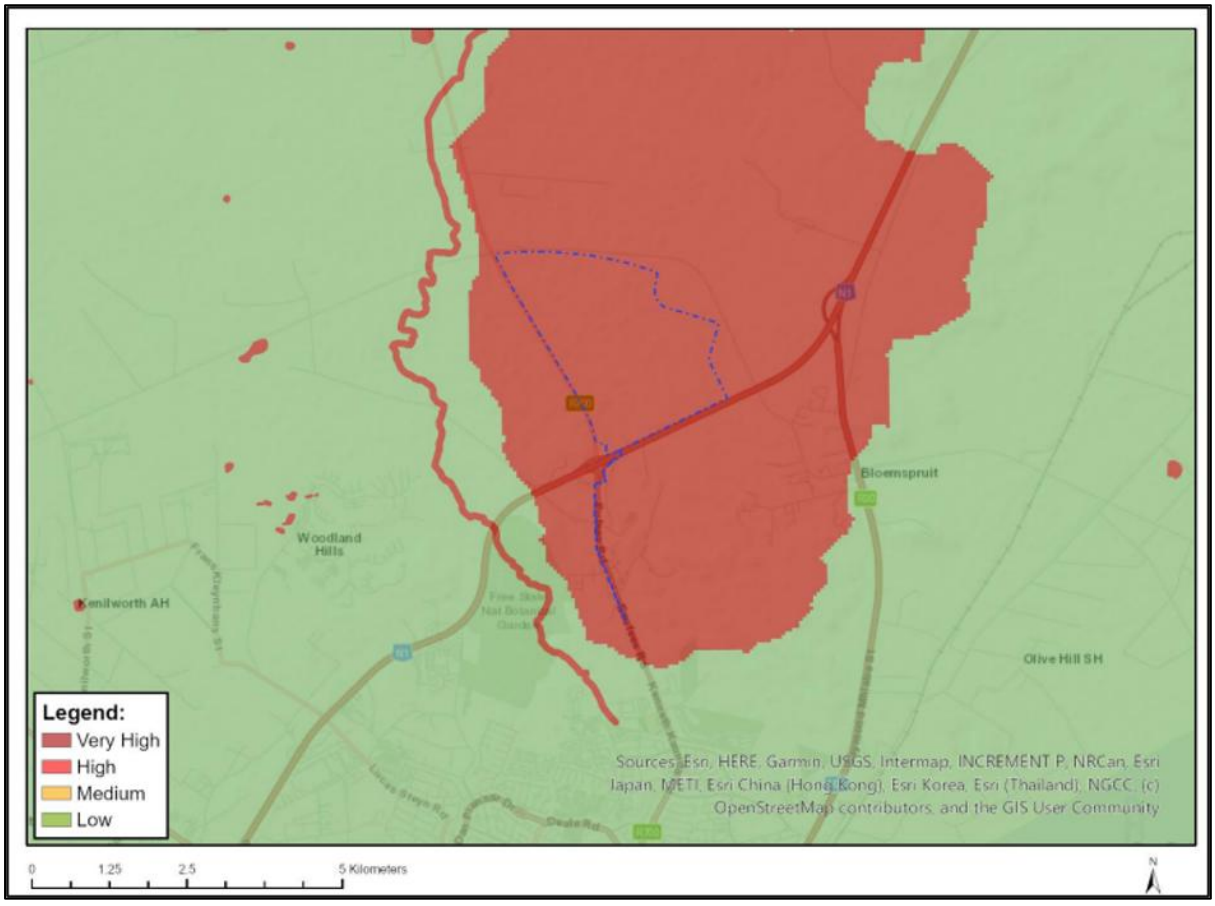

Figure 16: The sensitivity map provided by the DFFE Screening tool.

7.2 Regional Aquatic Biodiversity

Desktop screening identified three freshwater ecosystems, the majority of which constitute wetlands under the National Water Act (36 of 1998). The precise extent and classification of these wetland systems were validated during the site assessment.

The Project area falls within the Upper Orange Water Management Area (WMA) within the DC17 quaternary catchment. This region receives a mean annual precipitation of approximately 545 mm (www.climate-data.org).

The DWS (2016) Sub-Quaternary Reach (SQR) summary (obtained from BGIS SANBI LUDS tool), including the Present Ecological Status (PES), is provided for each of the associated watercourses (Table 8). The following watercourses have been identified as occurring in proximity to the development.

The Stinkhoutspruit (lower reaches) does not cross the study area. The SQR is;

- approximately 33 km in length
- flowing North to South in relation to the project area and
- the PES of this system is ‘‘**Moderately** modified’’ (bgis.sanbi.org).

These systems are considered ecologically stressed due anthropogenic activities including agricultural practices and anthropogenic development.

Table 8: Present Ecological State, Ecological Importance and Ecological Sensitivity of the rivers occurring in the study area (bgis.sanbi.org).

River Name	Number	SQR Code	PES	Category Description	EPL	ETS
Stinkhoudspruit (lower reaches)	75092	C52G-060000	C	Moderately Modified	Poorly protected	Critically endangered

7.3 Local Aquatic Biodiversity

Using on site findings and the report by Lamprecht (2026) a non-perennial watercourse was identified which crosses the pipeline at multiple points. According to the aquatic report Lamprecht states that these systems are second and third order non-perennial watercourses which have a source approximately 3 km south of the study area. When conducting the desktop survey for these systems it can be seen that the watercourses converge and flow into the Stinkhoudspruit. These systems have a significant impact on the present vegetation, going so far as to influence an entire vegetation unit.

7.4 Mapped National Freshwater Ecosystem Priority Area (NFEPA) sub-catchments

Various watercourses run along the study area. NFEPA maps natural and artificial wetlands, and the NBA 2018 Rivers are included, these wetlands and rivers are mapped in relation to the study area (Figure 10).

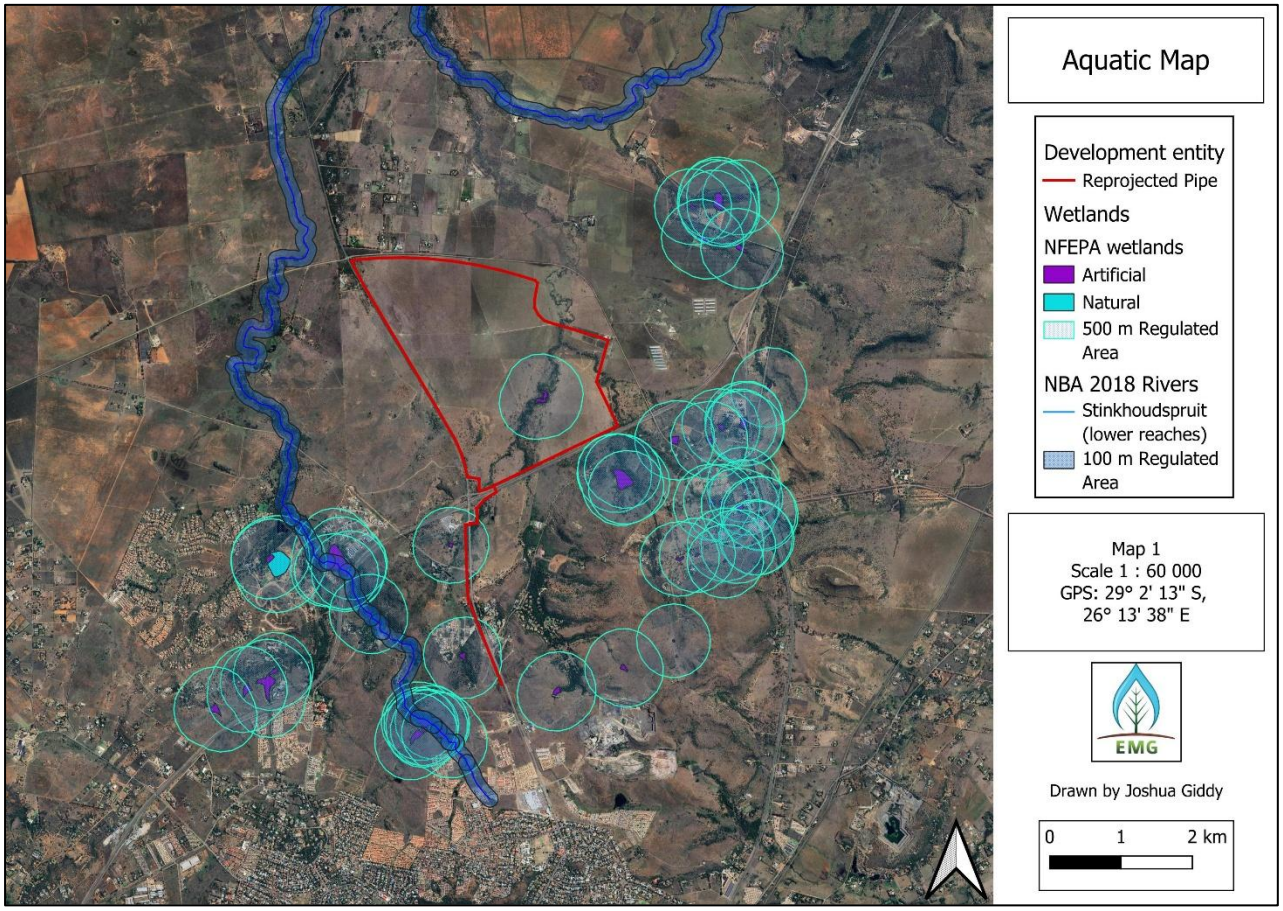

Figure 17: NFEPA wetlands and NBA 2018 Rivers in relation to the study area. Due to the land use (majority agricultural and infrastructure) of the surrounding area, the majority of the wetlands surrounding the study area consists of artificial wetlands in the form of dams (NFEPA, 2011).

7.5 Mapped local watercourses

The local and regional watercourses significant to the development has been mapped by the aquatic specialist. The map (Figure 18) shows the watercourses which occur in the general area of the development as well as the mapped non-perennial watercourses that occur in the area.

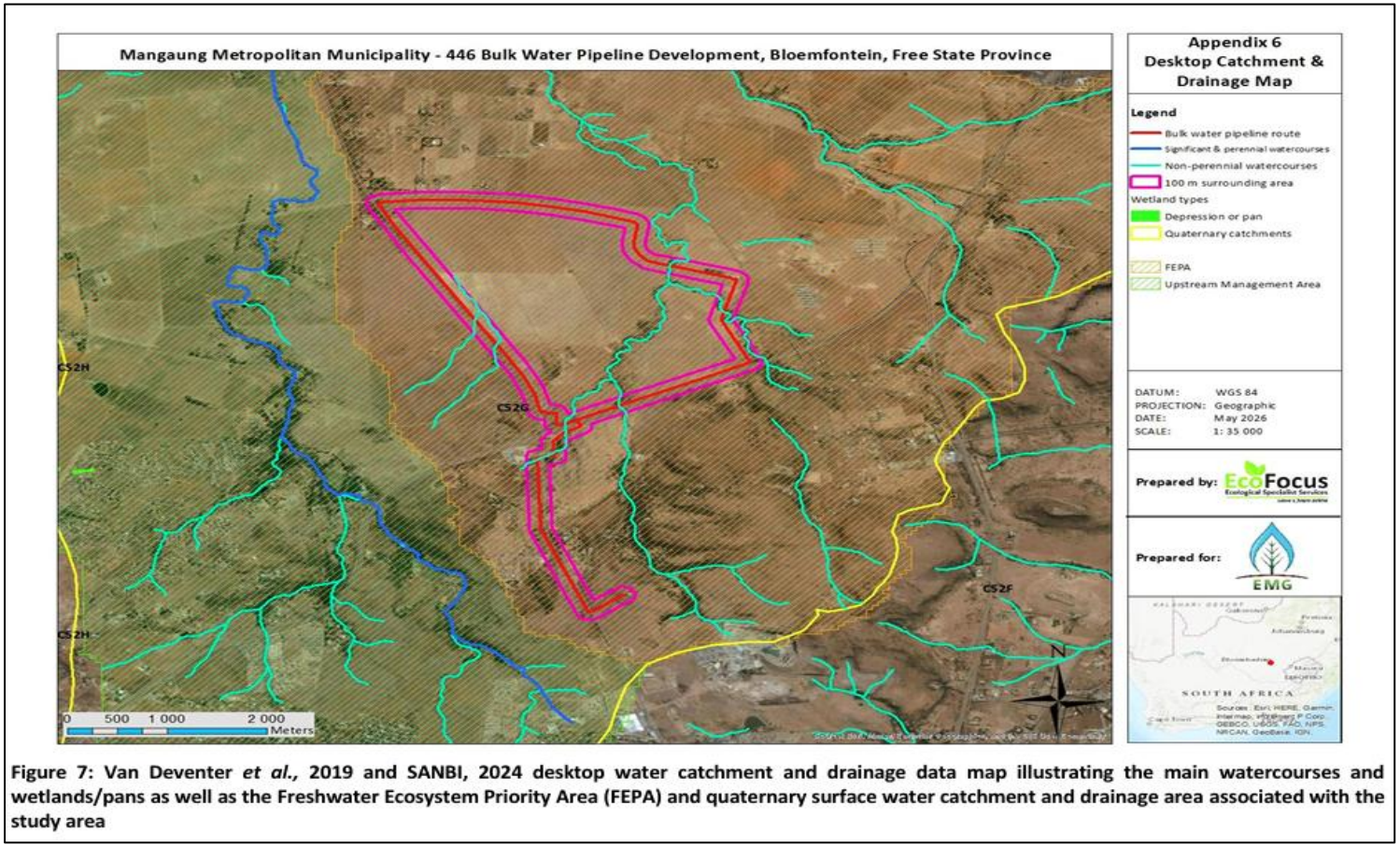

Figure 7: Van Deventer *et al.*, 2019 and SANBI, 2024 desktop water catchment and drainage data map illustrating the main watercourses and wetlands/pans as well as the Freshwater Ecosystem Priority Area (FEPA) and quaternary surface water catchment and drainage area associated with the study area

Figure 18: Aquatic Site Sensitivity Verification Map from Lamprecht (2026) aquatic report. The map indicates the second and third order non-perennial watercourses which can be seen crossing the development at multiple points.

8 Sensitivity assessment

Unit sensitivity is calculated according to SANBI's (2020) Species Environmental Assessment Guidelines for site ecological importance (SEI). Unit sensitivity is calculated using resilience (R) and. biodiversity importance (BI), which is calculated as the sum of conservation importance (CI) and functional integrity (FI).

Table 9: Ratings determining the Unit sensitivities for the vegetation units found within the study areas.

Vegetation unit	Conservation importance	Functional integrity	Biodiversity importance	Resilience category	**Site Ecological Importance**
VU A	Medium	High	Medium	High	**Low**
VU B	Low	High	Medium	Medium	**Medium**
VU C	Very Low	Low	Very Low	Medium	**Very Low**

8.1 Vegetation unit sensitivity

8.1.1 VU A

Was given a **medium** conservation importance rating due to approximately more than half of the vegetation unit being in a natural ecological condition and the consideration that the area is a primary grassland. Furthermore, there is a high species richness of naturally occurring species. The functional integrity rating of **high** was given, as there were no signs of past disturbances and the occurrence of a few minor current disturbances such as grazing with the area showing a good rehabilitation potential. Thus, the biodiversity importance rating is **medium**. There is a high likelihood that species will return to a site post-disturbance due to the large, intact broadscale habitat that allows for migration and the hardy nature of the present species. Thus, the resilience rating of this vegetation unit was given a resilience rating of **high**. Together, the biodiversity importance rating of **medium** and receptor resilience rating of **high** results in a **site ecological importance rating of low**. The proposed development is expected to negatively influence a relatively small area of this vegetation unit.

8.1.2 VU B

Was given a **low** conservation importance rating due to the moderate species richness alongside the occurrence of alien invasive species. A functional integrity rating of **high** was given, as there were as there were no signs of past disturbances and the occurrence of a few minor current disturbances such as grazing. Thus, the biodiversity importance rating is **medium**. There is a moderate likeliness that species will return to a site post-disturbance due to the large, intact broadscale habitat that allows for migration however due to the present species' woody nature the return rate may take longer. Thus, this vegetation unit was given a resilience rating of **medium**. Together,

the biodiversity importance rating of **medium** and receptor resilience rating of **medium** results in **a site ecological importance rating of medium**. The proposed development is expected to negatively influence a small area of this vegetation unit.

8.1.3 VU C

Was given a **very low** conservation importance rating due to the vegetation unit having very little habitat remaining due to the surrounding developments. Due to limited habitat connectivity and significant disturbances such as existing infrastructure and multiple negative ecological impacts (anthropogenic activities), the area's functional integrity was rated **low**. Consequently, its biodiversity importance is rated as **very low**. There is a moderate likeliness that species will remain at the site even with the disturbance occurrences. Thus, the resilience rating of this vegetation unit was given a resilience rating of **medium**. Together, the biodiversity importance rating of **very low** and receptor resilience rating of **medium** results in a **site ecological importance rating of very low**. The proposed development is expected to negatively influence a relatively small area of this vegetation unit.

The vegetation unit sensitivity map (Figure 13) indicates the ecological importance of each of the mapped vegetation units.

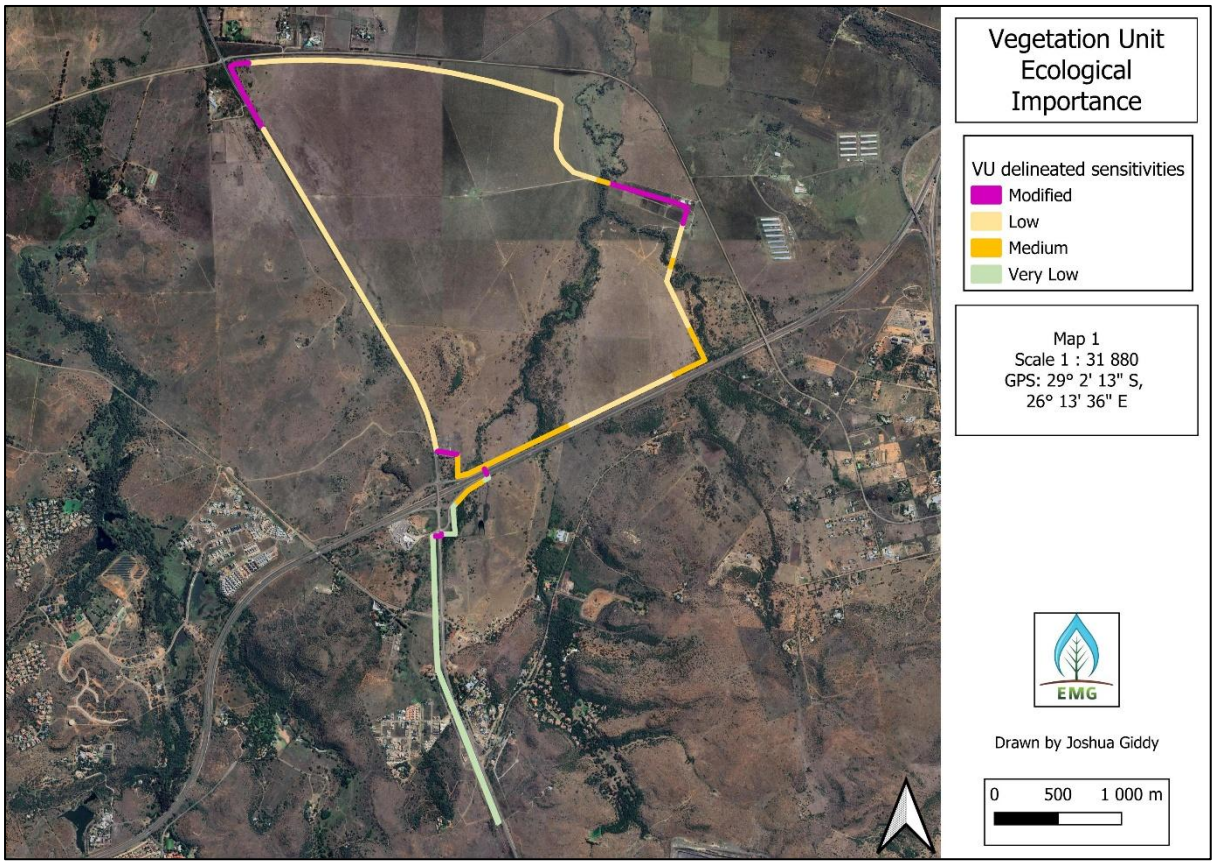

Figure 19: A map of the proposed developments ecological importance. Areas mapped in pink are completely modified areas which no longer contain vegetation.

9 Anticipated impacts:

Overall, the proposed development will directly impact a linear area over **three** terrestrial distinguishable vegetation units. Overall, the proposed development is expected to influence less than the potential 30 ha of vegetation indicated by the size of the pipeline. The following section provides a breakdown of the impacts imposed on the receiving environment due to the development and operation of the proposed development.

Table 10 Summary of anticipated impacts associated with the proposed development. It's important to note that this table is not all-inclusive but merely provides perspective concerning the types of activities that contribute to the deterioration of concerned ecological aspects.

Concerned aspect	**Activities directly contributing to the concerned aspect**	**Secondary activities which may contribute to the concerned aspect**
Habitat loss	• Physical clearance of vegetation • Habitat fragmentation leading to edge effects • Trampling • Accidental events such as fire • Loss of protected species	• Introduction of alien and invasive species • Soil compaction reducing re-establishment success • Soil erosion • Reduced biodiversity • Disrupted general animal behaviour
Loss of ESA's	• Physical clearance of vegetation • Loss of protected species • Habitat fragmentation • Accidental events such as fire • Increased anthropogenic movement • Loss of biomass and biodiversity	• Introduction of alien and invasive species • Soil compaction reducing re-establishment success • Soil erosion • Thinning of local genetic diversity • Increased ecological disturbance • Loss in ecological functionality
Loss of indigenous floral and faunal diversity	• Physical clearance of vegetation • Loss of protected species • Trampling • Habitat fragmentation • Accidental events such as fire, oil spills etc • Unlawful harvesting of plants • Unlawful hunting/ poaching of animals	• Introduction of unnatural competitors, i.e. alien and invasive species • Reduced fecundity through reduced reproductive ability and success • Reduced survivability

	• Road mortalities • Accidental entrapment • Accidental injury	• Disrupted general animal behaviour • Disrupted circadian rhythms • Noise pollution (construction phase)
Loss of floral and faunal species of conservation concern	• Clearance of vegetation • Loss of protected species • Habitat fragmentation • Poaching, unlawful hunting and gathering of plants and animals • Careless and reckless behaviour • Trampling • Accidental road mortalities • Accidental events such as fire	• Thinning of local genetic diversity • Reduced fecundity through reduced reproductive ability and success • Disrupted circadian rhythms • Interruption of lifecycle patterns due to noise pollution.

9.1 Concerned terrestrial ecological aspects:

9.1.1 Habitat loss

Habitat loss and fragmentation is the leading cause of the global biodiversity crisis. The removal of crucial environmental units will lead to the destabilisation of the entire ecosystem and, eventually, ecological breakdown.

This project will result in an overall loss of biodiversity through habitat destruction and reduction of species diversity. Site location across multiple vegetation types, Bloemfontein Dry Grassland (Gh 5), Winburg Grassy Shrubland (Gh 7) and Bloemfontein Karroid Shrubland (Gh 8) vegetation types, all of which are of Least Conservation Concern (Mucina and Rutherford, 2006; SANBI 2006-2018; Government Gazette no. 34809, 2011; Department of Environmental Affairs, 2016, NBA, 2018). The study area consists of three vegetation units with varying, sparse-moderate overall vegetation layer characteristics.

Relatively large areas of the overall area have experienced direct disturbances in the past with some area experiencing ongoing disturbances. Direct disturbances as a result of the past development of infrastructure, daily anthropogenic movements, agricultural activities, illegal dumping of various waste types, alien invasion and anthropogenic based infrastructure developments can be reported. Despite this, a little over half of the proposed development area has experienced little to no disturbance besides grazing.

Overall, the expected disturbance is expected to influence a relatively small area considering the existing road allowing access to much of the development and the pipeline requiring relatively few localised areas for equipment and material storage. The expected level of disturbance caused by the proposed development is relatively low, resulting in slight vegetation and habitat transformation within the terrestrial area of the study area. This development will cause loss of habitat with the overall impact thereof on the receiving environment being low. However, the expected low levels of disturbance will only be for if all appropriate mitigation measures are met. The receiving environment's overall landscape is not considered unique regarding vegetation type and broadscale vegetation structure however is considered near pristine within the affected farm. Due to the pristine nature of the affected farm, it is the recommendation of this specialist that stringent adherence to the following mitigation measures is required.

The impacts associated with habitat loss are evaluated to be of low significance since the new pipeline is a linear development, which is somewhat occurring on / near existing roads. Medium to High-intensity mitigation measures are recommended and should form a critical part of the Environmental Management Plan. The efficient implementation of the proposed mitigation measures will lower the impact significance on habitat loss. However, **minimisation mitigation** must be implemented (SANBI, 2020).

Table 11 The anticipated impact on habitat loss for fauna and flora during the construction phase. Post-mitigation significance is also indicated.

Construction phase			
Concerned aspect:	**Impact characteristic**	**Pre mitigation**	**Post mitigation**
Habitat loss	Geographical extend	1	1
	Probability	2	1
	Duration	2	1
	Reversibility	2	1
	Cumulative impacts	2	1
	Intensity	1	1
	TOTAL	**9**	**5**
Significance rating		Very Low	Very Low
General mitigation: • Removal of indigenous flora should be kept at a minimum. • No collection of plants other than for holding for use in rehabilitation is allowed. • Disturbance-related activities may only occur in the authorised area. • Vehicle movement should strictly be kept on designated dirt/gravel roads and/or bypasses. • Soil erosion mitigation measures need to be implemented. • Post-development open/barren areas should be revegetated and kept free of exotic plant species. • Vehicles may only move within the demarcated space of the development area. • Any other relevant recommendations listed in this report should be implemented.			
Operation phase			
Not applicable due to loss of definitive characteristics of habitats in the construction phase. Additionally, no greater impact during operation can occur than those impacts occurring during construction.			

9.1.2 Loss of CBA, ESA and (potentially) protected areas

According to the Technical Guidelines for CBA Maps, CBAs are areas which must remain largely in a natural ecological condition whilst ESAs require at least semi-natural ecological condition (SANBI, 2017). Protected (i.e. Woodland Hills Golf and Wildlife Estate) and potentially protected areas (i.e. NPAES areas) are areas which have been formally protected or are part of the National Protection Areas Expansion Strategy (NPAES, 2018). The crossing of the study area and areas mapped ESA or formally protected areas (NPAES / SACAS / SAPAD) is largely limited and localised.

The loss of ESA areas for the proposed development is closely associated with the presence of watercourses, which should be discussed fully in the Aquatic Specialists report. Considering the proposed development's proximity to an existing development, roads and bordering spaces, part of the area to be influenced has previously been negatively affected. The overall area covered by the development within ESA areas is minimal compared to the extent of the ESA areas. As such, the proposed development is likely to have a significantly lessened negative effect of loss of ESA areas. The affected SAPAD areas are in part due to the site's proximity to the Woodland Hills Golf and Wildlife Estate and the Dawn Valley Private Nature Reserve however due to the temporary nature of the pipeline construction the effect on protected areas will be minimal.

Due to this, the anticipated impact on this aspect without mitigation is considered **very low**. Mitigation is necessary and would be easily achieved. After mitigation measures are implemented, the anticipated impact on the loss of ESA areas is very low and due to the temporary nature of the construction the anticipated impacts on SAPAD areas are likely low.

Table 12: The anticipated impact on Critical Biodiversity Areas, Ecological Support and Protected Areas during the construction phase. Post-mitigation significance is also indicated.

Construction phase			
Concerned aspect:	Impact characteristic	Pre mitigation score	Post mitigation score
Loss of CBA, ESA and protected areas	Geographical extend	2	1
	Probability	1	1
	Duration	1	1
	Reversibility	2	1
	Cumulative impacts	2	1
	Intensity	1	1
	TOTAL	**8**	**5**
Significance rating:		**Very Low**	**Very Low**
Recommended mitigation measures:			
General Mitigation: • Limit the removal of vegetation in these ESA/Protected areas. • Vegetation and topsoil must be kept for use in rehabilitation. • Holding areas for plants and soil must be demarcated and utilised. • Topsoil storage must be prevented from contamination and invasion by alien and invasive species. ○ The excavated ground should be separated into piles of topsoil, subsoil and other material. • General works should, where possible, take place from the edge of any existing road to the side opposite a watercourse. In cases where the watercourses intersect the pipe, care must be taken to limit the distance across affected by construction activities.			

• No heavy machinery or material storage should occur on the side closest to a water course or within 100m of a watercourse. • A comprehensive **fire management plan** and **alien invasive management plan** needs to be drafted prior to construction. • Removal of indigenous flora should be kept at a minimum. • Disturbance related activities may only occur in the authorised area. • No unnecessary clearance of vegetation or topsoil may take place outside of the development area. • No other activity than that authorised may be taken within the authorised area. • Post-development open areas should be revegetated and kept free of exotic plant species. • Vehicles may only move within the demarcated space of the development area. • Any other relevant recommendations listed in this report should be implemented.
Operation phase
Not applicable due to loss of definitive characteristics of ESA areas in the construction phase. Additionally, no greater impact during operation can occur than those impacts occurring during construction.

9.1.3 Loss of indigenous floral and faunal diversity

Indigenous fauna and flora have a far greater conservation value compared to exotic species. Indigenous species have adapted to the surrounding environment and have established many stable networks of energy transfer. The removal or disruption of indigenous species disrupts this balance that has formed over many years.

Some alien and invasive plant species were recorded within the study area; however, their occurrences were restricted or sparse. The receiving environment's structure and species composition are primarily natural despite the road, with most areas showing signs of few to significant habitat disturbance. Therefore, the construction phase of the proposed development will result in the localized removal of mostly indigenous vegetation and the loss of local floral diversity. During the construction phase of the proposed development, faunal elements will likely migrate to lesser disturbed spaces (broadly available in the area). Due to this, the anticipated impact on this aspect without mitigation is considered very low. Mitigation is necessary and would be easily achieved. After mitigation measures are implemented, the anticipated impact on the loss of floral and faunal diversity is very low.

During the construction and operational phases, the anticipated impact on the loss of indigenous floral and faunal diversity will be of very low significance whether or not mitigation measures are implemented. However, the implementation of mitigation measures is required for minimisation mitigation.

Table 13 The anticipated impact on the loss of indigenous floral and faunal diversity. The impacts were calculated for both the construction and operational phases. Post-mitigation significance is also indicated.

<table>
<tr><th colspan="4">Construction phase</th></tr>
<tr><th>Concerned aspect:</th><th>Impact characteristic</th><th>Pre mitigation</th><th>Post mitigation</th></tr>
<tr><td rowspan="7">Loss of Indigenous floral and faunal diversity</td><td>Geographical extend</td><td>1</td><td>1</td></tr>
<tr><td>Probability</td><td>2</td><td>1</td></tr>
<tr><td>Duration</td><td>2</td><td>1</td></tr>
<tr><td>Reversibility</td><td>2</td><td>1</td></tr>
<tr><td>Cumulative impacts</td><td>2</td><td>1</td></tr>
<tr><td>Intensity</td><td>1</td><td>1</td></tr>
<tr><td>TOTAL</td><td>9</td><td>5</td></tr>
<tr><td colspan="2">Significance rating</td><td>Very Low</td><td>Very Low</td></tr>
<tr><td colspan="4">General mitigation:
Development may only occur within the clearly demarked area.
Monitoring for the emergence of exotic species should be conducted.
An alien invasive species management plan must be drafted.
Vehicle movement should remain within the authorised boundary.
A comprehensive rehabilitation plan must be adhered to.
No unnecessary destruction or removal of vegetation is allowed.
Wildlife elements such as nests and burrows should be carefully inspected, and animals responsibly removed by a relevant specialist.
Post-development open areas should be revegetated and kept free of exotic plant species by way of an alien and invasive management plan (AIMP). The AMP should be developed to avoid the possibility of invasions and supply eradication techniques should they arise in the development area.
Quarterly alien and invasive species monitoring should take place according to the AIMP.
Any other relevant recommendations listed in this report should be implemented.</td></tr>
<tr><th colspan="4">Operational phase</th></tr>
<tr><td colspan="4">Not applicable due to the negligible impact of operation as no diversity will be lost as a result of operation.
Additionally, no greater impact during operation can occur than those impacts occurring during construction.</td></tr>
</table>

9.1.4 Loss of floral and faunal species of conservation concern

The loss of rare, threatened and or protected species should always evoke a conservative approach regarding land use management. These species have been

declared as species of conservation concern due to various population declining factors such as urban expansion, the loss of species-specific symbiotic relationships, innate small population sizes, habitat loss, etc. The further loss of these species should be prevented at all costs.

The proposed development is not expected to affect provincially or nationally protected flora, however, two faunal SCC have been identified by the DFFE Screening Tool.

These faunal SCC were Mammalia-*Hydrictis maculicollis* and Mammalia-*Mystromys albicaudatus*. It is important to note that no sitings were recorded during the site assessment.

Anticipated environmental impacts on the loss of faunal SCC during the construction phase and operational phase is expected to be very low. After the efficient implementation of mitigation measures during the construction phase the anticipated impact on the loss of faunal and floral SCC is expected to be very Low. Strict mitigation measures are required to lower the overall impact.

Table 14 The anticipated impact on the loss of floral SCC. The impacts were calculated for both the construction and operational phases. Post-mitigation significance is also indicated.

Construction phase			
Concerned aspect:	**Impact characteristic**	**Pre mitigation**	**Post mitigation**
Loss of floral and faunal species of conservation concern	Geographical extend	1	1
	Probability	2	1
	Duration	4	4
	Reversibility	4	4
	Cumulative impacts	1	1
	Intensity	1	1
	TOTAL	**12**	**11**
Significance rating		Very Low	Very Low
General mitigation: Prior to construction: • On-site environmental and health and safety officers must report any observations of SCC/protected species to a qualified botanist and apply the recommended buffer area for that SCC/protected species. • Protected plant species should be located and demarcated. • Removal or relocation of the SCC are prohibited without the appropriate permits.			

- DARDEA should be consulted with regard to the feasibility of transplanting or removing provincially protected species.
- Removal or transplant permits from DARDEA must be obtained for all provincially protected fauna / flora.
- If DARDEA indicates transplant or relocation of some of the provincially protected flora, a formal relocation management plan should be drafted and implemented.
- Pictures of typical WTM dens should be visible at the site office.
- Any small mammal observations should be reported to the ECO immediately and construction in that area should halt until the ECO can confirm the species identification.
- Pictures of WTM should be displayed at the site office.
- If the presence of WTM is suspected small mammal traps should be placed by an experienced zoologist.
- The findings of these traps should be communicated through to the ECO.
- A nest survey should be conducted to identify possible occurrences in the survey area.

Construction phase:

- All construction staff should be informed on SCC and protected species or species of special conservation concern.
- A relevant specialist should be notified when any of the mentioned SCC and protected flora are observed during construction.
- All disturbance-related activities must be restricted to the authorised development boundary.
- No illegal harvesting of plant material is allowed.
- Any other relevant recommendations listed in this report should be implemented.

Operational phase

Not applicable due to the negligible impact of operation as no diversity will be lost as a result of operation.

Additionally, no greater impact during operation can occur than those impacts occurring during construction.

9.1.5 Overall anticipated environmental impacts

The anticipated environmental impact evaluation indicated that the proposed development's construction phase would have an overall very low impact on the receiving environment. The anticipated environmental impact generated through the facility's operational phase will have a very low impact. Any deviation from the proposed development plan will significantly influence this score. The developer and the appointed contractor should remain mindful of low-impact developmental practices. The recommended mitigation measures should be strongly enforced.

Table 15 Overall anticipated environmental impact pre- and post-mitigation.

Concerned aspect	**Score pre-mitigation**	**Rating pre-mitigation**		**Score post-mitigation**	**Rating post-mitigation**
Construction phase					
Habitat loss	9	Very low		5	Very Low
Loss of CBA and ESA areas	8	Very low		5	Very Low
Loss of indigenous floral and faunal diversity	9	Very low		5	Very low
Loss of floral species of special conservation concern	12	Very low		11	Very Low
Overall impact:	**9.5**			**6.5**	
Significance rating:	Very Low			Very low	

10 Recommendations to be included in the EMPr:

- Limit the removal of indigenous vegetation.
- Low impact transplanting techniques must be utilised.
- Vegetation and topsoil must be kept for use in rehabilitation.
- Holding areas for plants must be demarcated and utilised.
- Topsoil storage must be prevented from contamination and invasion by alien and invasive species.
- During general works, in cases where watercourses intersect the development, care must be taken to limit the distance across affected by construction activities.
- No heavy machinery or material storage should occur within 100m of a watercourse.
- A thorough walk-through of the study area by a qualified zoologist/ avifaunal specialist should occur to locate any potential SCC/protected species.
- Protected plant species should be located and demarcated prior to development by way of walkthrough by a qualified botanist.
- Removal or relocation of the SCC/protected species are prohibited without the appropriate permits.

- No protected flora may be removed or harmed without the necessary permits.
  - Prior to development, DARDEA should be consulted with regard to the feasibility of transplanting or removing provincially protected species.
  - Removal or transplant permits from DARDEA must be obtained for all provincially protected flora prior to development.
  - If DARDEA indicates transplant or relocation of some of the provincially protected flora, a formal relocation management plan should be drafted and implemented prior to development.
- On-site environmental and health and safety officers must report any observations of SCC/protected species to a qualified botanist/ zoologist/ avifaunal specialist and apply the recommended buffer area for that SCC/protected species.
- During development, care should be taken to not unnecessarily clear or destroy indigenous vegetation.
- An alien invasive management plan is a strongly recommended requirement for monitoring the invasion of alien and invasive species found in areas affected by disturbance. Early detection of alien invasion is recommended to lower the development's environmental impact as well as overall project costs.
  - The presence of alien and invasive species needs to be monitored quarterly.
- Vehicle movement should be restricted to the authorised site boundary.
- Excavated topsoil should be stockpiled for rehabilitation efforts and kept clean of exotic vegetation.
- It is recommended that contractors install a temporary wire fence around excavations to prevent faunal access of the area.
  - Should any fauna become trapped in excavations, a qualified individual must be responsible for their safe relocation and release.
- A designated construction waste/debris area should be placed on site and located as far as possible from sensitive habitats.
- Waste should be removed from the site on a regular basis and not allowed to pile up to start polluting the environment.
- All construction-related waste/material should be appropriately disposed of after the construction has ceased.
- A comprehensive fire management plan should be implemented to prevent any fire outbreaks.

11 Discussion and conclusion:

The site consists of three vegetation units with varying overall vegetation layer characteristics. Overall, the tree layer is well developed in some areas and completely absent in others. The shrub layer is moderately developed throughout the site, with few areas of well-developed, dense shrub canopy. Moderately to well-developed graminoid and herbaceous layers are consistent throughout the study area. The overall vegetation is a good representation of the vegetation types in which they are located or an ecotone (mix) of adjacent vegetation types (Mucina and Rutherford, 2006; SANBI, 2006-2018; Skowno et al., 2018).

The DFFE screening tool has indicated the Plant Species Theme to be of low sensitivity, Aquatic Biodiversity Theme to be of very high sensitivity and a medium sensitivity for the Animal Species Theme. The medium animal sensitivity can be attributed to the various protected species identified through the screening tool. Although none of these species were found within this ecological report's study area there is still a possibility of occurrence.

Anticipated environmental impact evaluation has overall indicated that the development would have a very low anticipated environmental impact. A very low environmental impact was influenced by the proposed developments overall ecological condition and associated disturbances. As per the EIA species guidelines, minimisation mitigations should be implemented.

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13 Appendices:

13.1 Appendix 1: Impact assessment evaluation form

Table 16 description of the rating system used to evaluate the possible impacts concerned with the proposed development.

Geographical extent: This describes the spatial reach an impact might have.		
Score		
1	Site specific	The impacts will only affect the specific site.
2	Local	The impacts will affect the local area or district.
3	Provincial	The impacts will be recognised across most of the province.
4	International/ national	Will affect the entire country or other countries.
Probability: This describes the probability that a specific environmental impact will occur.		
1	Unlikely	Less than 25% chance of occurrence.
2	Possible	Between 25-50% chance of occurrence.
3	Most likely	50-75% chance of occurrence.
4	Definite	Greater than 75% chance of occurrence.
Duration: This describes the amount of time an environment will be affected by the impact.		
1	Short term	The impact will disappear very quickly, either through mitigation or through natural processes. The impact should have disappeared within 1 year.
2	Medium term	The impact will endure for a short while after the construction processes and will be mitigated by either human intervention or natural processes. The impact should have disappeared between 2-10 years. .
3	Long term	The impact will persist through the construction phase and disappear by either human intervention or natural processes in 10-30 years.
4	Permanent	Mitigation either by man or natural processes is highly unlikely. The impact will have permanently affected the environment.
Reversibility: Describes the potential of an impact to be entirely reversed after development.		
1	Entirely reversable	The impact is entirely reversible and can be achieved with minor mitigation measures.
2	Possibly reversable	The impact might be reversible. Suitable mitigation measures will increase the chances of reversibility and should be considered.
3	Barely reversible	It is unlikely that the impact will be reversed. Extreme mitigation measures might increase the chances of successful reversibility.
4	Irreversible	The impact is irreversible. No mitigation measures can reverse the effects on the environment.
Cumulative impacts: Describes the cumulative impacts of the proposed development, i.t.o. the development process and all activities emanating from the operation of the facility.		
1	Very low cumulative impact	The impact will result in no or minimal cumulative effects.

2	Low cumulative impact	The impact will result in an overall low cumulative effect.
3	Moderate cumulative impact	The cumulative impacts will have moderate levels of impact.
4	High cumulative impact	The cumulative impact will result in high to very high environmental effects.
Intensity: Describes the severity of the impact on the environment		
1	Low	The impact's effect on the system will be hardly noticeable, if at all. Rehabilitation measures have to be in place if required.
2	Medium	The impact will have a recognisable effect on the environment. However, system functionality will still be present with negligible effects on ecosystem integrity. Rehabilitation measures have to be in place.
3	High	The impact will severely affect ecosystem integrity and function. Rehabilitation will be costly, and extreme mitigation measures have to be in place.
4	Very high	The impact will result in the entire ecological breakdown of the system or components thereof. Rehabilitation will be costly with minimal chances of success. Extreme mitigation measures must be in place.

13.2 Appendix 2: Impact significance on the environment

13.2.1 Appendix 2A: Impact significance evaluation:

Impact significance describes the overall environmental impact resulting from the cumulation of impact characteristics. Significance gives a judgement of the effect a development will have on the environment. Significance is calculated as the total score for each criterion (**geographical extend + probability + duration + reversibility + cumulative impacts**) multiplied by the intensity. A greater significance score results in an overall greater environmental impact and should be avoided or allowed with extreme mitigation measures in place. A lower significance score results in an overall lesser environmental impact and may be allowed with very little or no mitigation measures needed.

Table 17 impact significance evaluation form

Score	Impact significance rating	Description
5-19	Very low	Impact significance is of a very low order. Development is acceptable
20-34	Low	Impact significance is of a low order, and development is acceptable.
35-49	Moderate	The impact will be recognisable and may pose a problem to the development.
50-64	High	The impact is substantial and will significantly affect the environment. Development is unacceptable.
65-80	Very high	The impact is of the highest possible order and will cause irrefutable damage to the environment. Development unacceptable.

13.3 Appendix 3: Species list

Table 18 Floral species recorded during the field survey. Alien invasive genus and species are noted using (*).

Family	Species Name	Indigenous Status	Ecological Status	Conservation Status
Agavaceae	*Agave americana*	notindig; nat; inv	"a. 3 in Western Cape. b. Not listed elsewhere."	Least Concern
Aizoaceae	*Chasmatophyllum musculinum*	indig; end		Least Concern
	Hereroa glenensis	indig; end		Least Concern
	Ruschia intricata	indig; end		Least Concern
Amaranthaceae	*Alternanthera pungens*	notindig; nat		Not Evaluated
	Dysphania carinata	notindig; nat; inv		#N/A
Amaryllidaceae	*Ammocharis coranica*	indig		Least Concern
Anacardiaceae	*Searsia lancea*	indig		Least Concern
Apocynaceae	*Gomphocarpus fruticosus*	indig		Least Concern
Asparagaceae	*Asparagus suaveolens*	indig		Least Concern
Asphodelaceae	*Aloe grandidentata*	indig; end		Least Concern
Asteraceae	*Berkheya onopordifolia*	indig; end		Least Concern

	Berkheya pinnatifida	indig; end		Least Concern
	Bidens pilosa	notindig; nat		Not Evaluated
	Chrysocoma ciliata	indig		Least Concern
	Cineraria lyratiformis	indig; end		Least Concern
	Cirsium vulgare	notindig; nat; inv	1b	Not Evaluated
	Curio radicans	indig; end		Least Concern
	Erigeron bonariensis	notindig; nat		#N/A
	Euryops empetrifolius	indig; end		Least Concern
	Felicia muricata	indig; end		Least Concern
	Geigeria burkei	indig		Not Evaluated
	Hypochaeris radicata	notindig; nat		Not Evaluated
	Nidorella hottentotica	indig; end		Least Concern
	Nidorella resedifolia	indig		Least Concern
	Pentzia incana	indig; end		Least Concern

	Schkuhria pinnata	notindig; nat		Not Evaluated
	Senecio inaequidens	indig; end		Least Concern
Cactaceae	*Cylindropuntia imbricata*	notindig; nat; inv	1b	#N/A
	Opuntia ficus-indica	notindig; cult; nat; inv		Not Evaluated
Cannabaceae	*Celtis africana*	indig		Least Concern
Combretaceae	*Combretum erythrophyllum*	indig		Least Concern
Convolvulaceae	*Cuscuta campestris*	notindig; nat; inv	1b	Not Evaluated
Crassulaceae	*Crassula nudicaulis*	indig; end		Least Concern
Ebenaceae	*Diospyros lycioides*	indig; end		Least Concern
Euphorbiaceae	*Euphorbia mauritanica*	indig		Least Concern
Fabaceae	*Vachellia karroo*	indig		#N/A
Hyacinthaceae	*Ledebouria luteola*	indig; end		Least Concern
Kalanchoideae	*Cotyledon orbiculata*	indig		Not Evaluated
Malvaceae	*Sphaeralcea bonariensis*	notindig; nat		Not Evaluated

Myrtaceae	*Eucalyptus camaldulensis*	notindig; cult; nat; inv	(iii) within a Listed Ecosystem or an ecosystem identified for conservation in terms of a Bioregional Plan or Biodiversity Management Plans published under the Act. b. Not listed within Nama-Karoo, Succulent Karoo and Desert biomes, excluding within any area mentioned in (a) above. c. Category 1b in Fynbos, Grassland, Savanna, Albany Thicket,"	Not Evaluated
Oleaceae	*Olea europaea*	indig		Least Concern
Pinaceae	*Pinus pinaster*	notindig; nat; inv	"a. 2 for plantations and windrows. b. 1b elsewhere. c. National Heritage Trees or National Monument Trees in terms of the National Heritage Resources Act, 1999, (Act No. 25 of 1999), are not listed. d. Except for “a” above, specimens with a circumference greater"	Not Evaluated
Plantaginaceae	*Plantago lanceolata*	indig		Least Concern

Poaceae	*Andropogon appendiculatus*	indig		Least Concern
	Aristida congesta	indig		Least Concern
	Aristida diffusa	indig		Least Concern
	Chloris virgata	indig		Least Concern
	Cymbopogon pospischilii	indig		Not Evaluated
	Cynodon dactylon	indig		Least Concern
	Digitaria eriantha	indig		Least Concern
	Eragrostis curvula	indig; end		Least Concern
	Eragrostis lehmanniana	indig; end		Least Concern
	Eragrostis nindensis	indig		Least Concern
	Eragrostis obtusa	indig; end		Least Concern
	Eragrostis superba	indig		Least Concern
	Eustachys paspaloides	indig		Least Concern
	Fingerhuthia africana	indig; end		Least Concern

	Heteropogon contortus	indig		Least Concern
	Hyparrhenia hirta	indig		Least Concern
	Melinis repens	indig		Least Concern
	Microchloa afra	indig		Least Concern
	Oropetium capense	indig		Least Concern
	Panicum coloratum	indig		Least Concern
	Pogonarthria squarrosa	indig		Least Concern
	Sporobolus fimbriatus	indig		Least Concern
	Themeda triandra	indig		Least Concern
	Tragus koelerioides	indig		Least Concern
	Tristachya leucothrix	indig		Least Concern
Pteridaceae	*Hemionitis eckloniana*	indig		Least Concern
	Hemionitis calomelanos	indig		Least Concern
Rhamnaceae	*Ziziphus mucronata*	indig		Least Concern

Rosaceae	*Pyracantha angustifolia*	notindig; cult; nat; inv	1b	Not Evaluated
Rubiaceae	*Richardia brasiliensis*	notindig; nat		Not Evaluated
Scrophulariaceae	*Buddleja saligna*	indig		Least Concern
	Selago densiflora	indig; end		Least Concern
Solanaceae	*Cestrum laevigatum*	notindig; nat; inv	1b	Not Evaluated
	Datura ferox	notindig; nat; inv	1b	Not Evaluated
	Datura stramonium	notindig; nat; inv	1b	Not Evaluated
Verbenaceae	*Glandularia aristigera*	notindig; nat; inv		#N/A
	Verbena bonariensis	notindig; nat; inv	1b	Not Evaluated

13.4 Appendix 3: Species list

General Appearance

The white-tailed rat is a thickset, mouse-like rodent found mainly in the Highveld grasslands, with only marginal populations in the Succulent Karoo and Fynbos biomes.

Reproduction

Regarding reproduction, this species does not have a fixed breeding season, and there is some evidence that fires may stimulate breeding (Specker, 2006). After a gestation period of 37 days, females give birth to litters of four or five pups. These litters are referred to as "colonies," but each colony is thought to consist solely of a single breeding pair and their offspring, suggesting that breeding pairs are solitary and form the complete reproductive unit (Armstrong & Hensbergen, 1996). These units have low sightings due to their use of burrow systems; it's for that same reason that there are no photos of their nests. Although Avenant *et al.* (2016) describes the nests as high sided and cup shaped which resemble "Elizabethan neck ruffs", it is assumed that the white-tailed rat nest is somewhat similar to the nest of the Hazel dormouse (figure 20).

Figure 20: Picture of the next of a hazel dormouse which shares a similar structure to that of the white-tailed rat.