



TERRESTRIAL ECOLOGY AND WETLAND ASSESSMENT REPORT FOR THE PROPOSED KAREERAND MINE WASTE SOLUTIONS PROJECT

Stilfontein, North West Province

December 2021

CLIENT



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Specialist Details

Report Name

TERRESTRIAL ECOLOGY AND WETLAND ASSESSMENT REPORT FOR THE PROPOSED
KAREERAND MINE WASTE SOLUTIONS PROJECT

Submitted to

Lusanda Matee

A handwritten signature in black ink, appearing to read 'Lusanda Matee'.

Report Writer

Lusanda Matee is a registered scientist (119257/2018) in the fields of Biological Science (Cand Nat.) and Ecological Science (Cand Nat.). He is a Terrestrial Biodiversity Specialist with 4 years of experience. He received a Bachelor of Science, Honours, and MSc in Biological Sciences from the University of KwaZulu-Natal.

Ivan Baker

A handwritten signature in black ink, appearing to read 'Ivan Baker'.

Report Writer

Ivan Baker is Cand. Sci Nat registered (119315) in environmental science and geological science. Ivan is a wetland and ecosystem service specialist, a hydrogeologist and pedologist that has completed numerous specialist studies ranging from basic assessments to EIAs. Ivan has carried out various international studies following FC standards. Ivan completed training in Tools for Wetland Assessments with a certificate of competence and completed his MSc in environmental science and hydrogeology at the North-West University of Potchefstroom.

Andrew Husted

A handwritten signature in black ink, appearing to read 'Andrew Husted'.

Report Writer/ Reviewer

Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.

Declaration

The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

1 Introduction

The Biodiversity Company was commissioned to conduct a biodiversity and wetland assessment in support of the environmental authorisations in the form of a Basic Assessment (BA) process for the proposed Mine Waste Solutions (MWS) additional pipeline infrastructure to meet the planned Life of Mine (LOM) production rates and increase the volume of the return water from Kareerand TSF to the reclamation pump stations. The infrastructure planned is an additional 6 km return water (RW) pipeline (750 mm) from Kareerand TSF to Midway, along the existing return water pipeline and a new 600 mm slurry pipeline from Midway Dam to MWS Processing Plant.

The approach has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated March 2020: “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation”.

Per the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project areas as identified by the National Web-Based Environmental Screening Tool. (Screening Tool). The following is deduced from the National Web-based Environmental Screening Tool:

- Terrestrial Biodiversity Theme is Very High, with an Ecological Support Area (ESA), Critical Biodiversity Area (CBA) 2 (The Midway-MWS Plant Slurry Pipeline traverse areas that are unclassified in the NWBSP, whereas the new Kareerand 750 mm Return Water Pipeline traverses areas classified as ESA1 and CBA2 areas) and Threatened and Vulnerable Ecosystems being indicated as being present;
- The aquatic theme indicates potential “High” sensitivity watercourses within 500 m of the proposed pipeline;
- Plant Species Theme is Medium and Low for both pipelines with floral species conservation concern indicated as possibly occurring in the vicinity of the site; and
- Animal Species Theme is Low/ Medium/High with possible species including a single bird, the African Marsh Harrier (*Circus ranivorus*).

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

1.1 Project Description

MWS, also known as Chemwes (Pty) Ltd (Chemwes), as a subsidiary of Harmony Gold Mining Company has been in business since 1964 and conducts its operations over a large area of land to the east of Klerksdorp, within the area of jurisdiction of the City of Matlosana and JB

Marks Local Municipalities (LM), which fall within the Dr Kenneth Kaunda District Municipality (DM) in the North-West Province (Figure 1-1).

MWS want to install additional pipeline infrastructure to meet the planned LOM production rates and increase the volume of RW from Kareerand TSF to the reclamation pump stations. The current slurry and return water infrastructure fail to meet the requirements of the planned LOM and impacts on the long-term sustainability of the MWS operations.

The infrastructure planned is an additional 6 km RW pipeline (750 mm) from Kareerand TSF to Midway Dam, along the existing return water pipeline and a new 600 mm slurry pipeline from Midway Dam to MWS Processing Plant as well as along the existing slurry and process water pipelines (Figure 1-2).

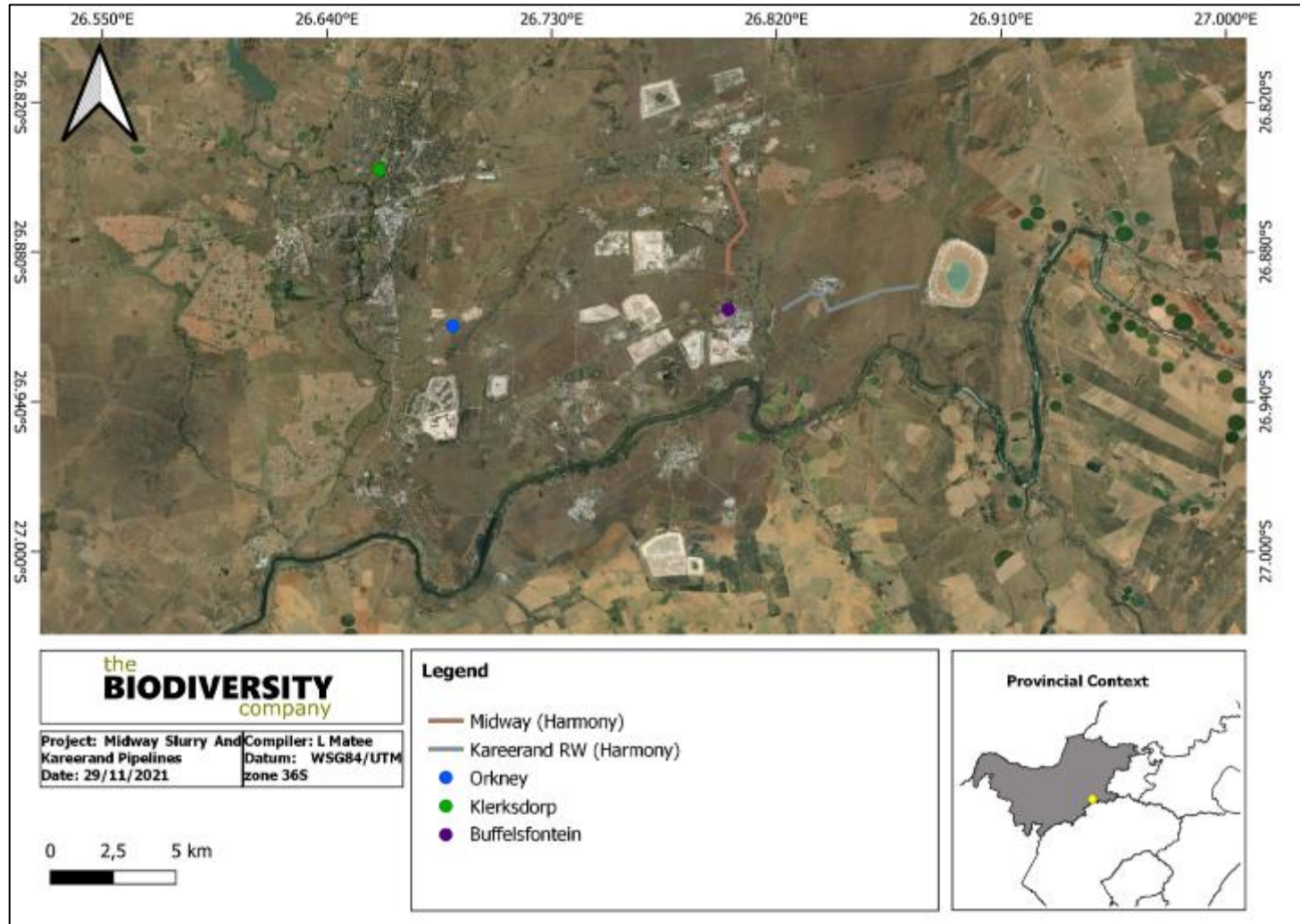


Figure 1-1 Locality map of the project areas in relation to the surrounding areas superimposed onto digital satellite imagery

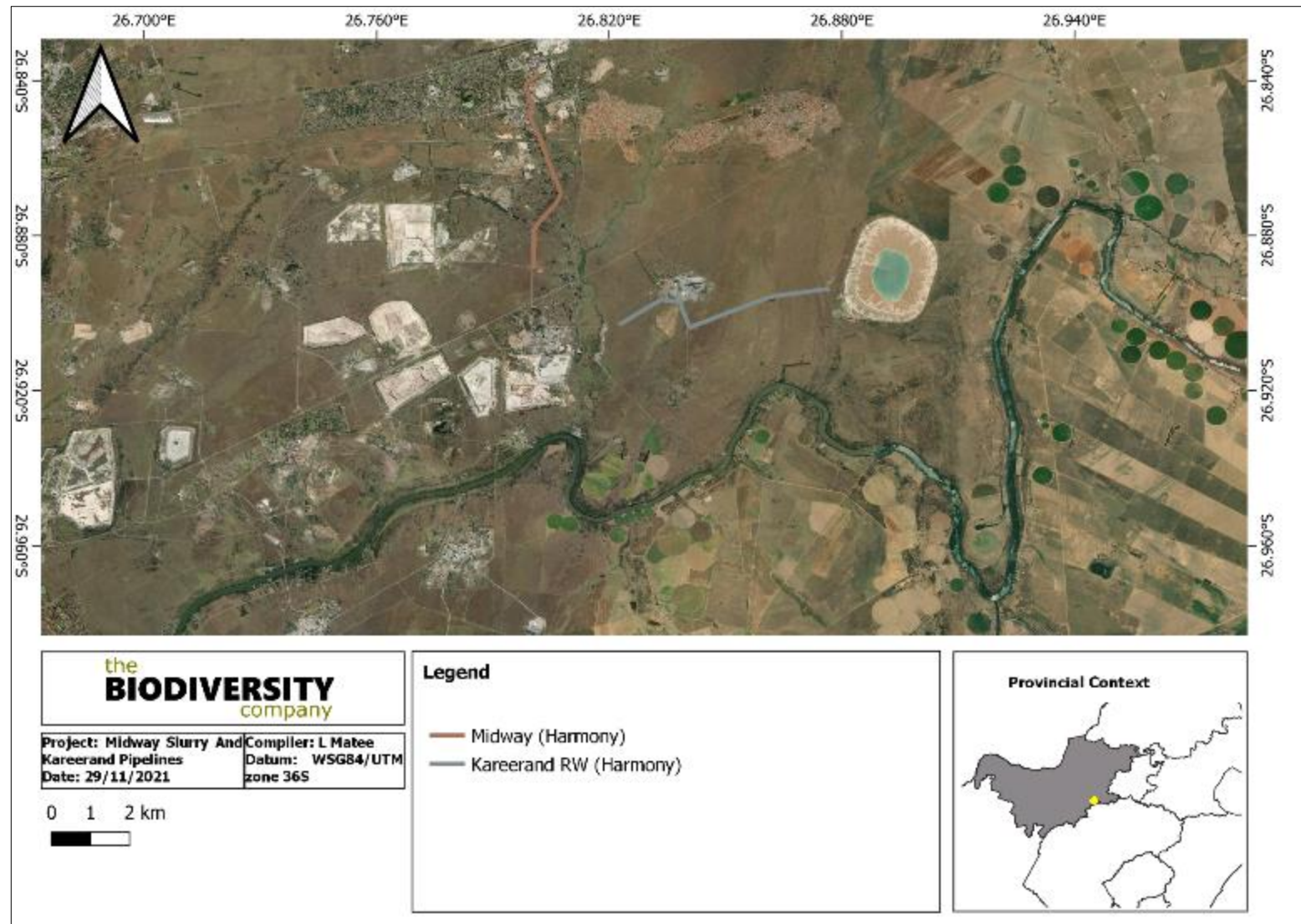


Figure 1-2 Project layout

info@thebiodiversitycompany.com

1.2 Terms of Reference

The Terms of Reference (ToR) included the following:

- Description of the baseline receiving environment specific to the field of expertise (general surrounding area as well as the site-specific environment);
- Identification and description of any sensitive receptors in terms of relevant specialist disciplines (biodiversity and wetland) that occur in the project areas, and how these sensitive receptors may be affected by the activity;
- Identify 'significant' ecological, botanical and faunal features within the proposed project areas;
- Identification of conservation significant habitats around the project areas which might be impacted;
- Screening to identify any critical issues (potential fatal flaws) that may result in project delays or rejection of the application;
- Provide a map to identify sensitive receptors in the project areas, based on available maps and database information;
- The delineation, classification and assessment of wetlands within 500 m of the project areas; and
- Conduct risk assessments relevant to the proposed activity.

2 Key Legislative Requirements

The legislation, policies and guidelines listed below apply to the current project in terms of biodiversity and ecological support systems. The list below, although extensive, is not exhaustive and other legislation, policies and guidelines may apply in addition to those listed below (Table 2-1).

Table 2-1 ***A list of key legislative requirements relevant to biodiversity and conservation in the North West Province***

| | |
|----------------------|--|
| INTERNATIONAL | Convention on Biological Diversity (CBD, 1993) |
| | The United Nations Framework Convention on Climate Change (UNFCC, 1994) |
| | The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973) |
| | The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979) |
| NATIONAL | Constitution of the Republic of South Africa (Act No. 108 of 2006) |
| | The National Environmental Management Act (NEMA) (Act No. 107 of 1998) |
| | The National Environmental Management Protected Areas Act (Act No. 57 of 2003) |
| | The National Environmental Management Biodiversity Act (Act No. 10 of 2004) |
| | The National Environmental Management: Waste Act, 2008 (Act 59 of 2008); |
| | The Environment Conservation Act (Act No. 73 of 1989) |
| | National Environmental Management Air Quality Act (No. 39 of 2004) |
| | National Protected Areas Expansion Strategy (NPAES) |

| | |
|-------------------|--|
| | Natural Scientific Professions Act (Act No. 27 of 2003) |
| | National Biodiversity Framework (NBF, 2009) |
| | National Forest Act (Act No. 84 of 1998) |
| | National Water Act, 1998 (Act 36 of 1998) |
| | National Freshwater Ecosystem Priority Areas (NFEPA's) |
| | National Spatial Biodiversity Assessment (NSBA) |
| | World Heritage Convention Act (Act No. 49 of 1999) |
| | National Heritage Resources Act, 1999 (Act 25 of 1999) |
| | Municipal Systems Act (Act No. 32 of 2000) |
| | Alien and Invasive Species Regulations, 2014 |
| | South Africa's National Biodiversity Strategy and Action Plan (NBSAP) |
| | Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) |
| | Sustainable Utilisation of Agricultural Resources (Draft Legislation). |
| | White Paper on Biodiversity |
| PROVINCIAL | The North West Biodiversity Sector Plan. (NW BSP) (READ, 2015) |

3 Methods

3.1 Terrestrial Assessment

3.1.1 Geographic Information Systems (GIS) Mapping

Existing data layers were incorporated into GIS software to establish how the proposed project might interact with any ecologically important entities. Emphasis was placed around the following spatial datasets:

- National Biodiversity Assessment (NBA) (Skowno *et al.*, 2019);
- Vegetation Map of South Africa, Lesotho and Swaziland (SANBI, 2018); and
- The North West Biodiversity Sector Plan (READ, 2015).

Brief descriptions of the standardised methodologies applied in each of the specialist disciplines are provided below. More detailed descriptions of survey methodologies are available upon request.

3.1.2 Botanical Assessment

The botanical assessment encompassed an assessment of all the vegetation units and habitat types within the project areas. The focus was on an ecological assessment of habitat types as well as identification of any Red Data species within the known distribution of the project areas. The South African National Biodiversity Institute (SANBI) provides an electronic database system, namely the Botanical Database of Southern Africa (BODATSA), to access distribution records on southern African plants. This is a new database that replaces the old Plants of Southern Africa (POSA) database. The POSA database provided distribution data of flora at the quarter degree square (QDS) resolution. The Red List of South African Plants website (SANBI, 2017) was utilized to provide the most current account of the national status of flora.

Relevant field guides and texts consulted for identification purposes in the field during the surveys included the following:

- Field Guide to the Wild Flowers of the Highveld (Van Wyk & Malan, 1997);
- A field guide to Wild flowers (Pooley, 1998);
- Guide to Grasses of Southern Africa (Van Oudtshoorn, 1999);
- Orchids of South Africa (Johnson & Bytebier, 2015);
- Guide to the Aloes of South Africa (Van Wyk & Smith, 2014);
- Mesembs of the World (Smith *et al.*, 1998);
- Medicinal Plants of South Africa (Van Wyk *et al.*, 2013);
- Freshwater Life: A field guide to the plants and animals of southern Africa (Griffiths & Day, 2016); and
- Identification guide to southern African grasses. An identification manual with keys, descriptions and distributions (Fish *et al.*, 2015).

Additional information regarding ecosystems, vegetation types, and species of conservation concern (SCC) included the following sources:

- The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2012); and
- Red List of South African Plants (Raimondo *et al.*, 2009; SANBI, 2016).

The field work methodology included the following survey techniques:

- Timed meanders;
- Sensitivity analysis based on structural and species diversity; and
- Identification of floral red-data species.

3.1.3 Floristic Analysis

A single season targeted vegetation assessment was undertaken in the whole project area in November 2021. The focus of the fieldwork was therefore to maximise coverage and navigate to each target site in the field to perform rapid vegetation and ecological assessment at each sample site. Emphasis was placed on sensitive habitats, especially those overlapping with the proposed project areas.

Homogenous vegetation units were subjectively identified using satellite imagery and existing land cover maps. The floristic diversity and search for flora SCC were conducted through timed meanders within representative habitat units delineated during the scoping fieldwork. Emphasis was placed mostly on sensitive habitats overlapping with the proposed project areas.

The timed random meander method is a highly efficient method for conducting floristic analysis, specifically in detecting flora SCC and maximising floristic coverage. In addition, the method is time and cost-effective and highly suited for compiling flora species lists and therefore gives a rapid indication of flora diversity. The timed meander search was performed

based on the original technique described by Goff *et al.* (1982). Suitable habitats for SCC were identified according to Raimondo *et al.* (2009) and targeted as part of the timed meanders.

Notes were made regarding current impacts (e.g., solid waste pollution, erosion etc.), subjective recording of dominant vegetation species and any sensitive features (e.g., wetlands, outcrops etc.). In addition, opportunistic observations were made while navigating through the project areas.

3.1.4 Faunal Assessment (Mammals & Avifauna)

The faunal desktop assessment included the following:

- Compilation of expected species lists;
- Identification of any Red Data or species of conservation concern (SCC) potentially occurring in the area; and
- Emphasis was placed on the probability of occurrence of species of provincial, national and international conservation importance.

Mammal distribution data were obtained from the following information sources:

- The Mammals of the Southern African Subregion (Skinner & Chimimba, 2005);
- Bats of Southern and Central Africa (Monadjem *et al.*, 2010);
- The 2016 Red List of Mammals of South Africa, Lesotho and Swaziland (www.ewt.org.za) (EWT, 2016); and
- Animal Demography Unit (ADU) - MammalMap Category (MammalMap, 2021) (mammalmap.adu.org.za).

The field survey component of the assessment utilised a variety of sampling techniques including, but not limited to, the following:

- Visual observations;
- Identification of tracks and signs; and
- Utilization of local knowledge.

Site selection for trapping focussed on the representative habitats within the project areas. Sites were selected based on GIS mapping and Google Earth imagery and then the final selection was confirmed through ground-truthing during the surveys. Habitat types sampled included pristine, disturbed and semi-disturbed zones, drainage lines and wetlands.

3.1.5 Herpetology (Reptiles & Amphibians)

A herpetofauna desktop assessment of the possible species in the area was done and attention was paid to the SCCs, sources used included the IUCN (2017) and ADU (2021).

Herpetofauna distributional data were obtained from the following information sources:

- South African Reptile Conservation Assessment (SARCA) (sarca.adu.org);

- A Guide to the Reptiles of Southern Africa (Alexander & Marais, 2007);
- A field guide to Snakes and other Reptiles of Southern Africa (Branch, 1998);
- Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland (Bates *et al.*, 2014);
- A Complete Guide to the Frogs of Southern Africa (du Preez & Carruthers, 2009);
- Animal Demography Unit (ADU) - FrogMAP (frogmap.adu.org.za);
- Atlas and Red Data Book of Frogs of South Africa, Lesotho and Swaziland (Mintner *et al.*, 2004); and
- Ensuring a future for South Africa's frogs (Measey, 2011).

A herpetofauna field assessment was conducted in each habitat or vegetation type within the project areas, as identified from the desktop study, with a focus on those areas which will be most impacted by the proposed development (i.e., the stormwater discharge to a wetland area and stormwater Infrastructure area).

The herpetological field survey comprised the following techniques:

- Hand searching is used for reptile species that shelter in or under particular habitats. Visual searches, typically undertaken for species whose activities occur on surfaces or for species that are difficult to detect by hand-searches or trap sampling.

3.1.6 Site Ecological Importance (SEI)

The different habitat types within the assessment area were delineated and identified based on observations during the field assessment as well as available satellite imagery. These habitat types were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of species of conservation concern and their ecosystem processes.

Site Ecological Importance (SEI) is a function of the Biodiversity Importance (BI) of the receptor (e.g., SCC, the vegetation/fauna community or habitat type present on the site) and Receptor Resilience (RR) (its resilience to impacts) as follows.

BI is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor as follows. The criteria for the CI and FI ratings are provided in Table 3-1 and Table 3-2, respectively.

Table 3-1 Summary of Conservation Importance (CI) criteria

| Conservation Importance | Fulfilling Criteria |
|-------------------------|---|
| Very High | Confirmed or highly likely occurrence of CR, EN, VU or Extremely Rare or Critically Rare species that have a global EOO of < 10 km ² . Any area of the natural habitat of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent) of natural habitat of an EN ecosystem type. Globally significant populations of congregatory species (> 10% of global population). |
| High | Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km ² . IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. |

| | |
|----------|--|
| | Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type. Presence of Rare species. Globally significant populations of congregatory species (> 1% but < 10% of global population). |
| Medium | Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals. Any area of natural habitat of threatened ecosystem type with status of VU. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC. |
| Low | No confirmed or highly likely populations of SCC. No confirmed or highly likely populations of range-restricted species. < 50% of receptor contains natural habitat with limited potential to support SCC. |
| Very Low | No confirmed and highly unlikely populations of SCC. No confirmed and highly unlikely populations of range-restricted species. No natural habitat remaining. |

Table 3-2 Summary of Functional Integrity (FI) criteria

| Functional Integrity | Fulfilling Criteria |
|----------------------|---|
| Very High | Very large (> 100 ha) intact area for any conservation status of ecosystem type or > 5 ha for CR ecosystem types. High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. 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 ecosystem type or > 10 ha for EN ecosystem types. Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts with no signs of major past disturbance and good rehabilitation potential. |
| Medium | Medium (> 5 ha but < 20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts with some major impacts and a few signs of minor past disturbance. Moderate rehabilitation potential. |
| Low | Small (> 1 ha but < 5 ha) area. 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. Several minor and major current negative ecological impacts. |
| Very Low | Very small (< 1 ha) area. No habitat connectivity except for flying species or flora with wind-dispersed seeds. Several major current negative ecological impacts. |

BI can be derived from a simple matrix of CI and FI as provided in Table 3-3

Table 3-3 Matrix used to derive Biodiversity Importance (BI) from Functional Integrity (FI) and Conservation Importance (CI)

| Biodiversity Importance (BI) | | Conservation Importance (CI) | | | | |
|------------------------------|-----------|------------------------------|-----------|----------|----------|----------|
| | | Very high | High | Medium | Low | Very low |
| Functional Integrity (FI) | 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 |

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor as summarised in Table 3-4.

Table 3-4 Summary of Resource Resilience (RR) criteria

| Resilience | Fulfilling Criteria |
|------------|---|
| Very High | Habitat that can recover rapidly (~ less than 5 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 10 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. |

Subsequent to the determination of the BI and RR, the SEI can be ascertained using the matrix as provided in Table 3-5.

Table 3-5 Matrix used to derive Site Ecological Importance (SEI) from Receptor Resilience (RR) and Biodiversity Importance (BI)

| Site Ecological Importance (SEI) | | Biodiversity Importance (BI) | | | | |
|----------------------------------|-----------|------------------------------|-----------|----------|----------|----------|
| | | Very high | High | Medium | Low | Very low |
| Receptor Resilience (RR) | 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 |

Interpretation of the SEI in the context of the proposed development activities is provided in Table 3-6.

Table 3-6 Guidelines for interpreting Site Ecological Importance (SEI) in the context of the proposed development activities

| Site Ecological Importance (SEI) | Interpretation in relation to proposed development activities |
|----------------------------------|--|
| Very High | Avoidance mitigation – no destructive development activities should be considered. Offset mitigation 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 acceptable followed by appropriate restoration activities. |
| Low | Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities. |
| Very Low | Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required. |

The SEI evaluated for each taxon can be combined into a single multi-taxon evaluation of SEI for the assessment area. Either a combination of the maximum SEI for each receptor should be applied, or the SEI may be evaluated only once per receptor but for all necessary taxa simultaneously. For the latter, justification of the SEI for each receptor is based on the criteria that conforms to the highest CI and FI, and the lowest RR across all taxa.

3.2 Wetland Assessment

The following information sources were considered for the desktop assessment;

- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- South African Inventory of Inland Aquatic Ecosystems (Van Deventer *et al.*, 2019);
- Topographical Data (Topo Data) (2012)
- The National Freshwater Ecosystem Priority Areas (Nel *et al.*, 2011); and
- Contour data (5m).

3.2.1 Wetland Identification and Mapping

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) was considered for this assessment. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels. In addition, the method also includes the assessment of structural features at the lower levels of classification (Ollis *et al.*, 2013).

The wetland areas are delineated per the DWAF (2005) guidelines, a cross-section is presented in Figure 3-1. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practice, the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

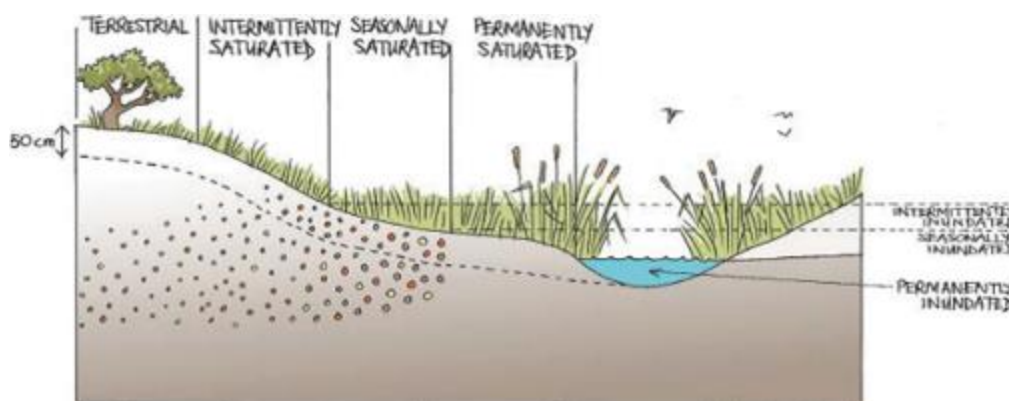


Figure 3-1 Cross-section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013).

3.2.2 Present Ecological Status

The overall approach is to quantify the impacts of human activity or visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of the impact of individual activities/occurrences and then separately assessing the intensity of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present State categories are provided in Table 3-7.

Table 3-7 The Present Ecological Status categories (Macfarlane et al., 2009)

| Impact Category | Description | Impact Score Range | PES |
|-----------------|---|--------------------|-----|
| None | Unmodified, natural | 0 to 0.9 | A |
| Small | Largely Natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place. | 1.0 to 1.9 | B |
| Moderate | Moderately Modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact. | 2.0 to 3.9 | C |
| Large | Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred. | 4.0 to 5.9 | D |
| Serious | Seriously Modified. The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable. | 6.0 to 7.9 | E |
| Critical | Critical Modification. The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota. | 8.0 to 10 | F |

3.2.3 Importance and Sensitivity

The importance and sensitivity of water resources are determined to establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants is used to assign the Importance and Sensitivity (IS) category, as listed in Table 3-8 (Rountree and Kotze, 2013).

Table 3-8 Description of Ecological Importance and Sensitivity categories

| EIS Category | Range of Mean | Recommended Ecological Management Class |
|--------------|---------------|---|
| Very High | 3.1 to 4.0 | A |
| High | 2.1 to 3.0 | B |

| | | |
|--------------|------------|---|
| Moderate | 1.1 to 2.0 | C |
| Low Marginal | < 1.0 | D |

3.2.4 Ecological Classification and Description

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this assessment. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and also then includes structural features at the lower levels of classification (Ollis *et al.*, 2013).

3.2.5 Determining Buffer Requirements

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane *et al.*, 2014) was used to determine the appropriate buffer zone for the proposed activity.

3.3 Limitations

The following limitations should be noted for the assessment:

- Time constraints limited a wet season survey, but this was deemed enough for this level of assessment;
- The exact design and specifications were not made available, as such assumptions were made by referring to standard features;
- The wetlands within the project areas were the focus of the assessment, these systems were ground-truthed and further assessed. Wetland areas beyond the project areas but within the 500 m regulated area not considered to be at any appreciable level of risk were only considered at a desktop level; and
- The GPS used for delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.

4 Receiving Environment

4.1 Desktop Spatial Assessment

The following features describe the general area and habitat, this assessment is based on spatial data that are provided by various sources such as the provincial environmental authority and SANBI. The desktop analysis and its relevance to this project are listed in Table 4-1.

Table 4-1 Desktop spatial features examined.

| Desktop Information Considered | Relevant/Not relevant | Section |
|--------------------------------|---|---------|
| Conservation Plan | The Midway-MWS Plant Slurry Pipeline traverses areas that are unclassified in the NWBSP, whereas the new Kareerand 750 mm Return Water Pipeline traverses areas classified as ESA1 and CBA2 areas | 4.3 |
| Ecosystem Threat Status | The Midway-MWS Plant Slurry Pipeline traverses LC and EN ecosystems, whereas the new Kareerand 750 mm Return Water Pipeline traverses areas Vulnerable (VU) and Least Concern (LC) ecosystems | 4.4.1 |

| | | |
|--------------------------------------|---|-------|
| Ecosystem Protection Level | Midway-MWS Plant Slurry Pipeline traverses an NP ecosystem, whereas the new Kareerand 750 mm Return Water Pipeline traverses areas Not Protected (NP) and Poorly Protected (PP) ecosystems | 4.4.2 |
| National Threatened Ecosystem | The Kareerand RW pipeline traverses the Rand Highveld Grassland (VU) (original extent) which is currently listed as Vulnerable (VU) whilst the Midway ST pipeline traverses Vaal-Vet Sandy Grassland (Gh 10) which is listed as Endangered (EN) | 4.4.4 |
| NBA Wetlands | Two wetland types have been identified using this data set, namely channelled valley bottom wetlands and seeps. These wetland systems are "Critically Endangered" since less than 20% of these systems are in a natural or largely natural condition. | 4.4.5 |
| NFEPA Rivers and Wetlands | According to Nel et al. (2011), three wetland types have been identified within the 500 m regulated area, namely a unchannelled valley bottom wetlands, wetland flats and seeps. | 4.7 |

4.2 Regional and Local Climate

Stilfontein has a BSk: Cold semi-arid (steppe) climate according to the Köppen-Geiger Climate classification. This classifies a semi-arid climate, with warm to hot summers and cool, dry winters. Months with the largest precipitation are January, December, February with 284 mm precipitation. Most precipitation occurs in January with an average precipitation of 104 mm. The annual amount of precipitation in Stilfontein is 601 mm. The average annual temperature is 27 °C in Stilfontein. The warmest month of the year is January, with an average temperature: 31°C. Usually, June is the coldest month in Stilfontein, with an average temperature of 21 °C. The difference between the hottest month: January and the coldest month: June is: 10 °C. The difference between the highest precipitation (January) and the lowest precipitation (July) is 96 mm.

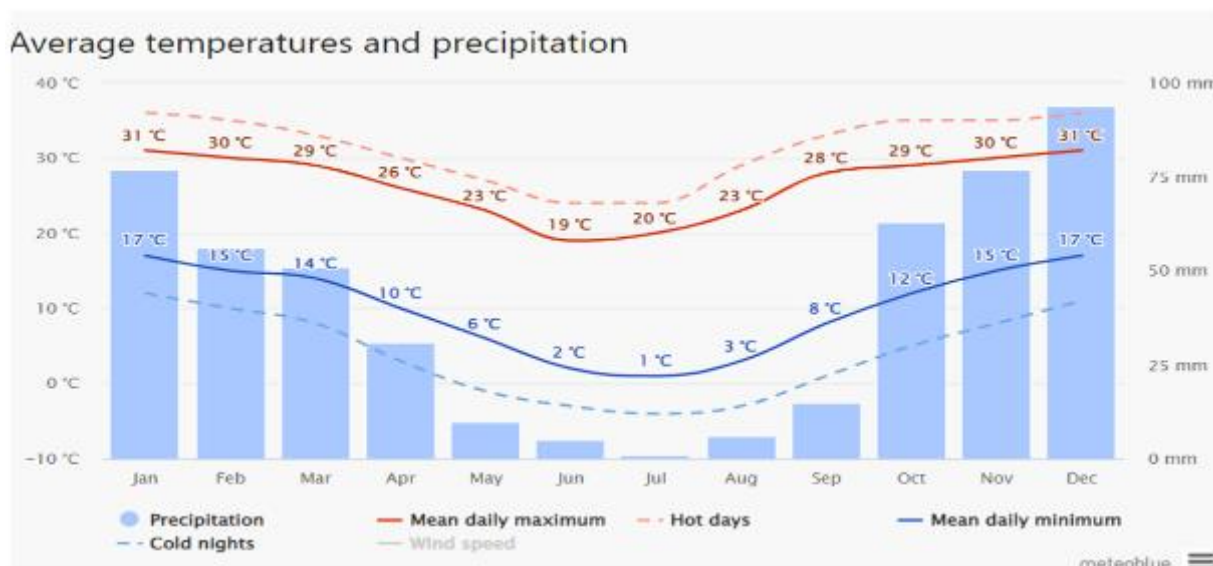


Figure 4-1 Stilfontein Monthly Temperatures and Precipitation (Meteoblue, 2021)

4.3 Critical Biodiversity Areas (CBA)

The North West - Department of Agriculture, Conservation, Environment and Rural Development (NWREAD) developed the North West Biodiversity Sector Plan (NWBSP) in 2015. In essence, the NWBSP is a map guiding area of conservation concern for the North West Province. Two maps have been developed, namely one for terrestrial biodiversity, and the other for freshwater/aquatic biodiversity. The spatial component of the Biodiversity Sector

Plan is based on systematic biodiversity planning undertaken by NWREAD. The purpose of a Biodiversity Sector Plan is to inform land-use planning, environmental assessments, land, and water use authorisations, as well as natural resource management, undertaken by a range of sectors whose policies and decisions impact biodiversity. This is done by providing a map of biodiversity priority areas, referred to as Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), with accompanying land-use planning and decision-making guidelines (NWREAD, 2015).

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. Thus, if these areas are not maintained in a natural or near-natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (NWREAD, 2015).

Ecological Support Areas (ESAs) are terrestrial and aquatic areas that are not essential for meeting biodiversity representation targets (thresholds), but which play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree or extent of the restriction on land use and resource use in these areas may be lower than that recommended for CBAs (NWREAD, 2015).

The Midway-MWS Plant Slurry Pipeline traverses areas that are unclassified in the NWBSP, whereas the new Kareerand 750 mm Return Water Pipeline traverses areas classified as ESA1 and CBA2 areas (Figure 4-2).

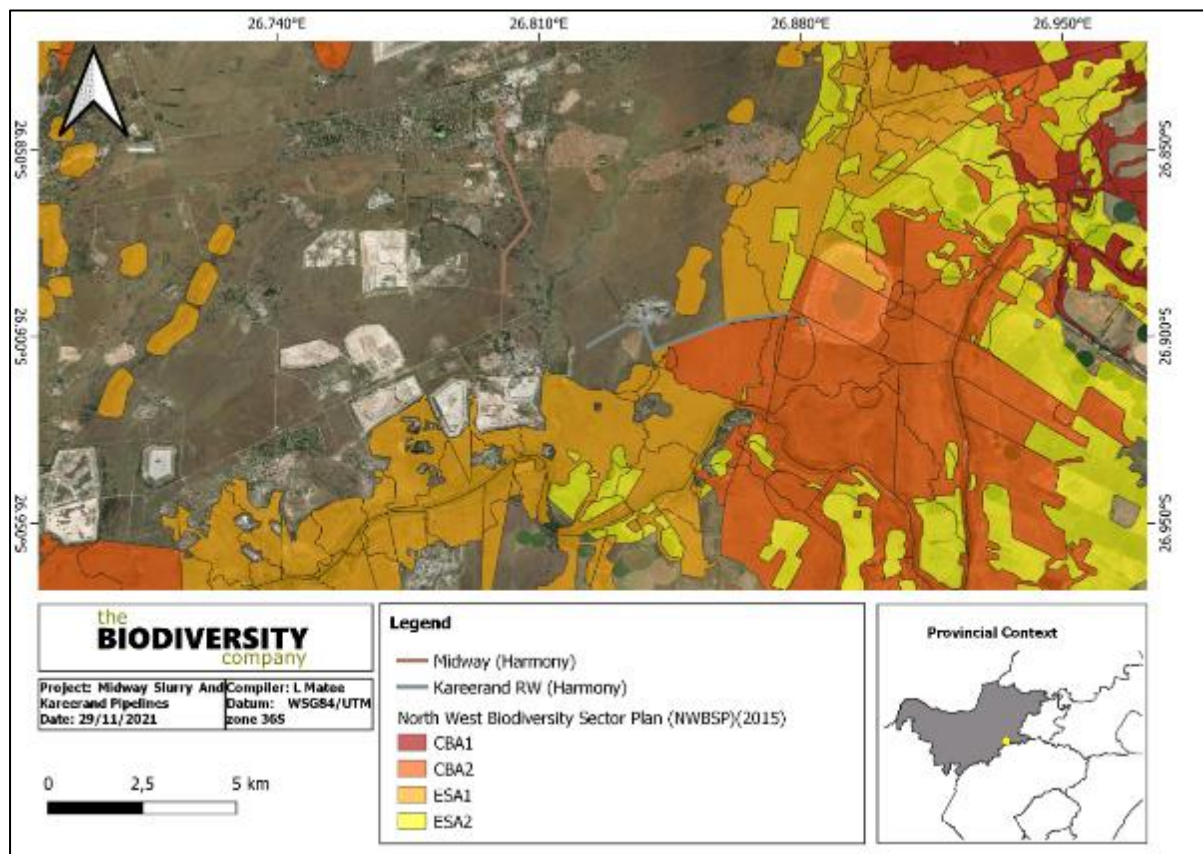


Figure 4-2 **The project areas superimposed on the NWBSP(READ,2015)**

4.4 The National Biodiversity Assessment

The National Biodiversity Assessment (NBA) was completed as a collaboration between the SANBI, the DEA and other stakeholders, including scientists and biodiversity management experts throughout the country over three years (Skowno *et al.*, 2019).

The purpose of the NBA is to assess the state of South Africa's biodiversity with a view to understanding trends over time and informing policy and decision-making across a range of sectors (Skowno *et al.*, 2019).

The two headline indicators assessed in the NBA are *ecosystem threat status* and *ecosystem protection level* (Skowno *et al.*, 2019).

4.4.1 Ecosystem Threat Status

Ecosystem threat status outlines the degree to which ecosystems are still intact or losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends (Skowno *et al.*, 2019).

Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT), based on the proportion of each ecosystem type that remains in good ecological condition (Skowno *et al.*, 2019).

The project areas were superimposed on the terrestrial ecosystem threat status (Figure 4-3). The Midway-MWS Plant Slurry Pipeline traverses LC and EN ecosystems, whereas the new Kareerand 750 mm Return Water Pipeline traverses areas VU and LC ecosystems (Figure 4-3).

4.4.2 Ecosystem Protection Level

The ecosystem protection level tells us whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as not protected, poorly protected, moderately protected or well protected, based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Skowno *et al.*, 2019).

The project areas were superimposed on the ecosystem protection level map to assess the protection status of terrestrial ecosystems associated with the development. Based on Figure 4-4 the Midway-MWS Plant Slurry Pipeline traverses an NP ecosystem, whereas the new Kareerand 750 mm Return Water Pipeline traverses areas NP and PP ecosystems.

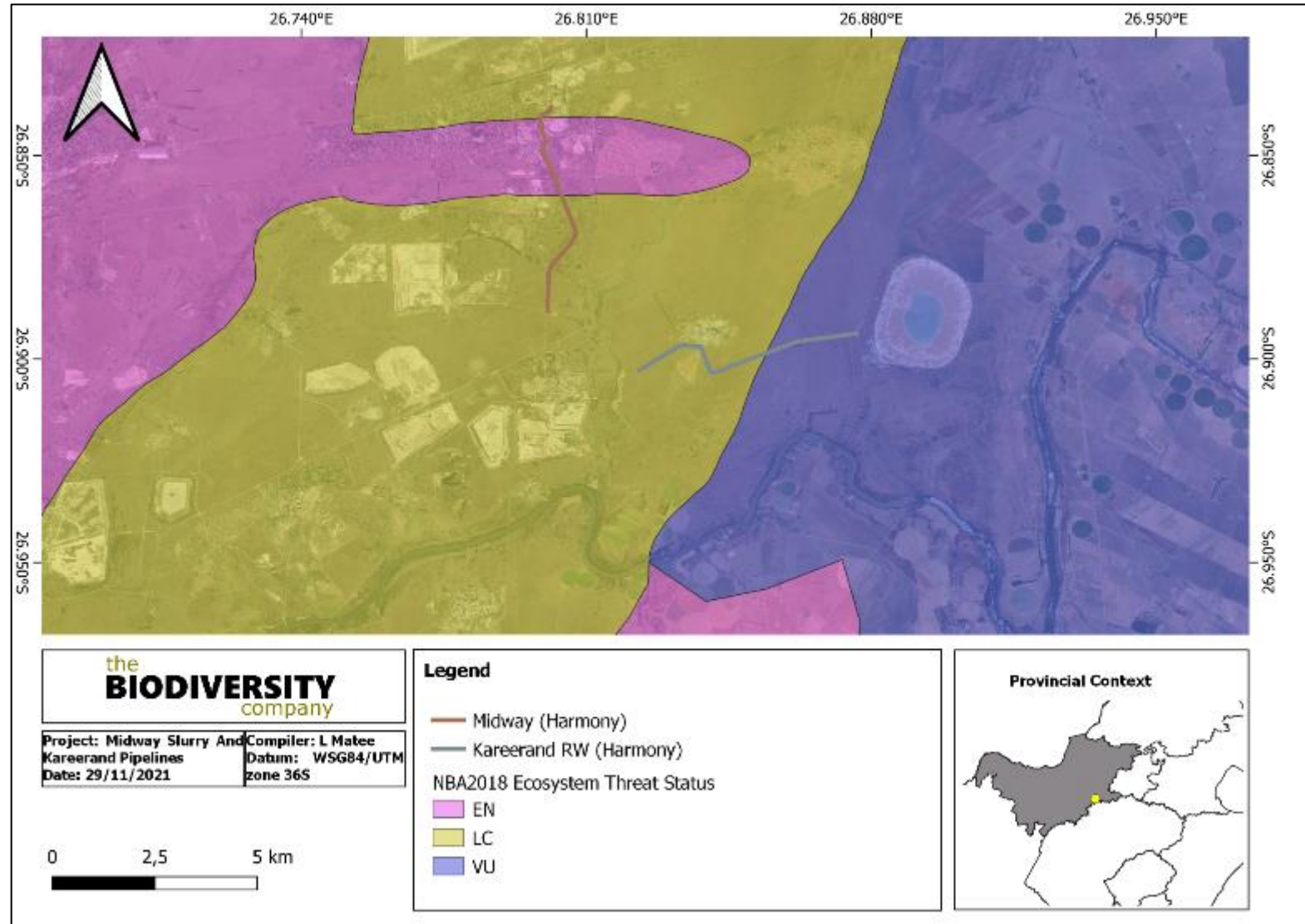


Figure 4-3 The project areas showing the regional ecosystem threat status of the associated terrestrial ecosystems (NBA, 2018)

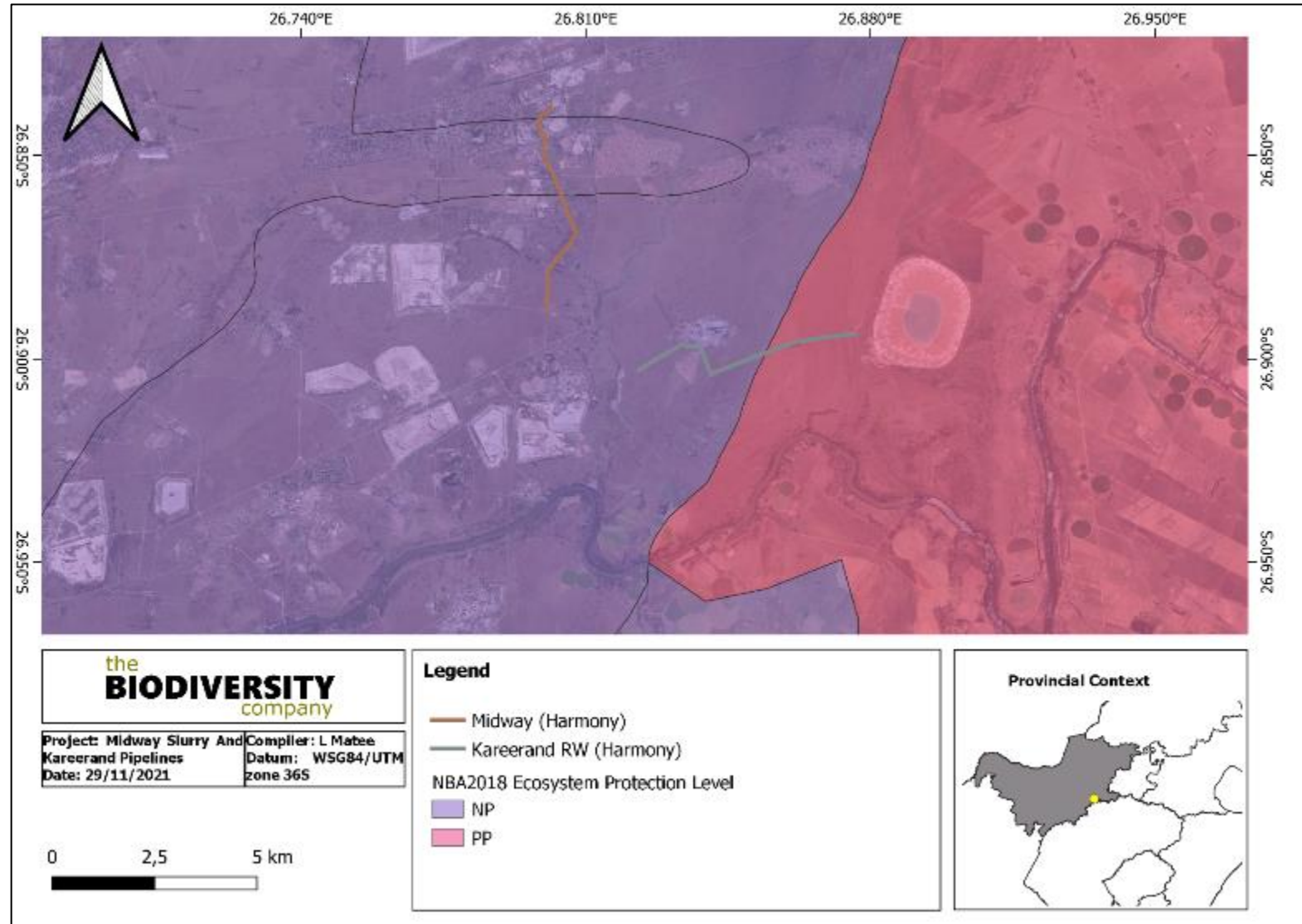


Figure 4-4 The project areas showing the regional level of protection of terrestrial ecosystems (NBA, 2018)

4.4.3 Important Bird & Biodiversity Areas

None of the proposed pipelines is located within an IBA nor is there one within the immediate landscape.

4.4.4 National Threatened Ecosystems

The National List of Threatened Terrestrial Ecosystems for South Africa (NEM:BA: National list of ecosystems that are threatened and in need of protection, (GN 34809, GN 1002), 9 December 2011) was published in terms of NEM: BA and the list categorizes ecosystems into Critically Endangered (CR) which have undergone severe degradation; Endangered (EN) which have undergone lesser degradation; Vulnerable (VU), which are at a high risk of undergoing degradation and protected which are of high conservation importance. The criteria used for identifying threatened terrestrial ecosystems was done through extensive stakeholder engagement and based on the best available science. The criteria for thresholds for ecosystems are summarized in Table 4-2.

Table 4-2 Criteria used to identify threatened terrestrial ecosystems

| Criterion | Critically Endangered | Endangered | Vulnerable |
|---|---|---|--|
| A1: Irreversible loss of natural habitat | Remaining natural habitat < biodiversity target | Remaining natural habitat < biodiversity target + 15% | Remaining natural habitat < 60% of the original area |
| A2: Ecosystem A2: Ecosystem degradation and loss of integrity | > 60% of ecosystem significantly degraded | > 40% of ecosystem significantly degraded | > 20% of ecosystem significantly degraded |
| C: Limited extent and C: Limited extent and imminent threat | - | Ecosystem extent < 3000ha and imminent threat | Ecosystem extent < 6000 ha and imminent threat |
| D1: Threatened plant D: Threatened plant species associations | > 80 threatened Red List plant species | > 60 threatened Red List plant species | > 40 threatened Red List plant species |
| F: Priority areas for meeting explicit biodiversity targets as defined in a systematic biodiversity plan | Very high irreplaceability and high threat | Very high irreplaceability and medium threat | Very high biodiversity and low threat |

There are four main types of implications of listed ecosystems on development:

- Planning related implications, linked to the requirement in the National Environmental Management Biodiversity Act (NEM: BA) for listed ecosystems to be considered in municipal Integrated Development Plans (IDPs) and Spatial Development Frameworks (SDFs);
- Environmental authorisation implications, especially in terms of NEMA and EIA regulations;
- Proactive management implications, in terms of the Biodiversity Act; and
- Monitoring and reporting implications, in terms of the Biodiversity Act.

The Kareerand RW pipeline traverses the Rand Highveld Grassland (VU) (original extent) which is currently listed as Vulnerable (VU) whilst the Midway ST pipeline traverses Vaal-Vet

Sandy Grassland (Gh 10) which is listed as Endangered (EN) (Figure 4-5). According to the description in GN 1002, both these ecosystems fall under Criterion A1, which identifies ecosystems that have undergone loss of natural habitat, impacting on their structure, function, and composition. Loss of natural habitat includes outright loss, for example, the removal of natural habitat for cultivation, building of infrastructure, mining etc., as well as severe degradation. An ecosystem is categorised as vulnerable if the extent of the remaining natural habitat in the ecosystem is less than or equal to 60% of the original extent of the ecosystem. For this purpose, habitat is considered severely degraded if it would be unable to recover to a natural or near-natural state following the removal of the cause of the degradation (e.g., invasive aliens, over-grazing), even after very long periods. For EIAs, the 2011 National list of Threatened Ecosystems remains the trigger for a Basic Assessment in terms of Listing Notice 3 of the EIA Regulations published under the NEMA.

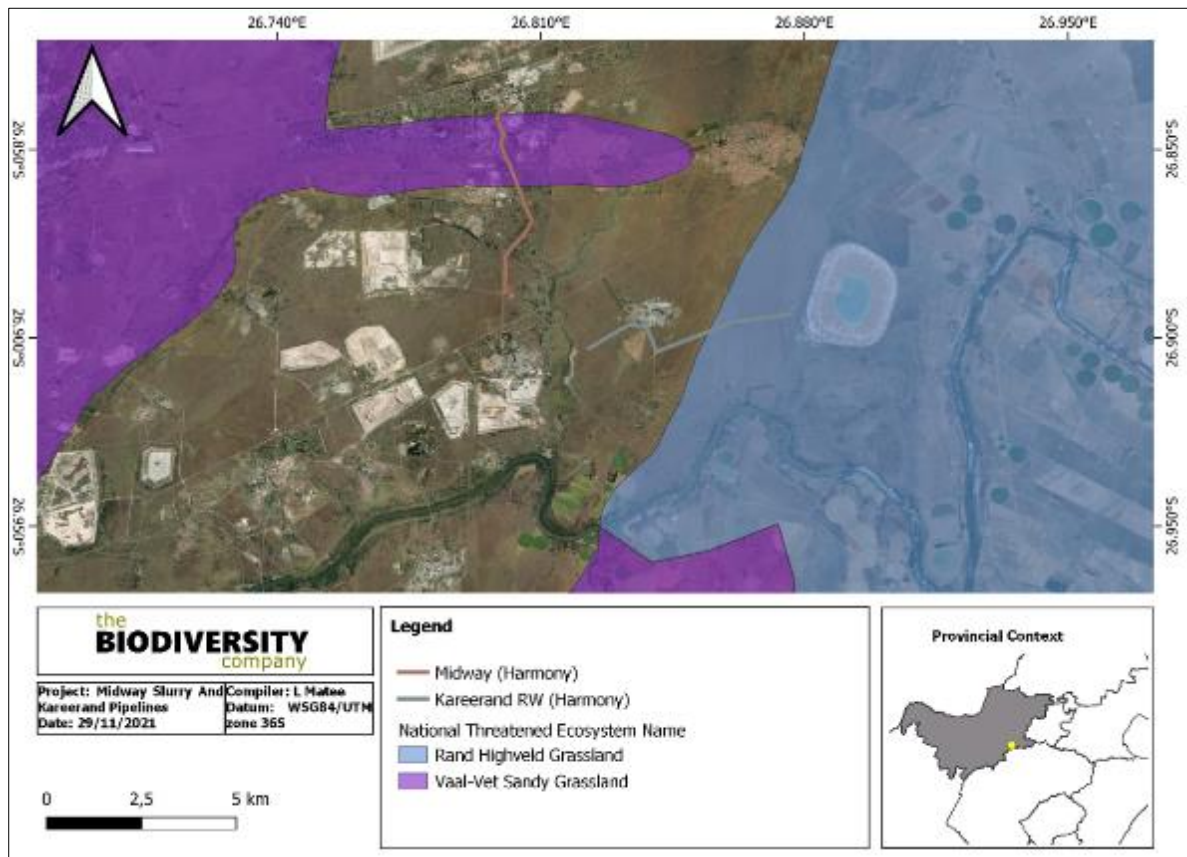


Figure 4-5 The Pipelines in relation to National Threatened or Protected Ecosystems

4.4.5 Protected Areas

According to the protected area spatial dataset from SAPAD (2021), SACAD (2021) and SAMPAD (2021), none of the options of the proposed development occurs within any protected area. The closest protected area, the Bushybend Private Nature Reserve is located more than 2 km south of the project area (Figure 4-6).

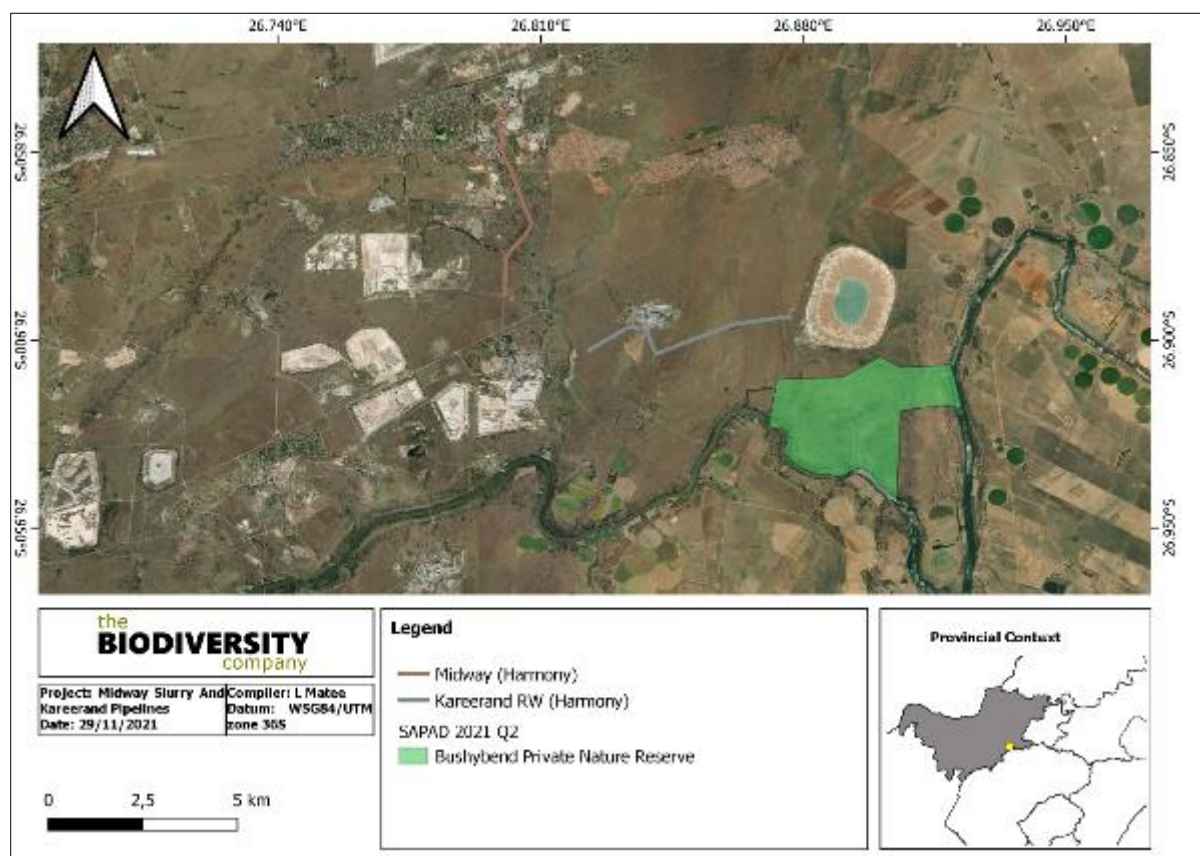


Figure 4-6 Map illustrating the location of protected areas proximal to the pipeline areas.

4.5 Wetland National Biodiversity Assessment

This spatial dataset is part of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the National Biodiversity Assessment (NBA) 2018. National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) 2018.

Two wetland types have been identified using this data set, namely channelled valley bottom wetlands and seeps (see Figure 4-7). These wetland systems are “Critically Endangered” since less than 20% of these systems are in a natural or largely natural condition.

4.6 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPAs) database forms part of a comprehensive approach for the sustainable and equitable development of South Africa’s scarce water resources. This database guides how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA. This directly applies to the NWA, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al.* 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act’s biodiversity

goals (Act No.10 of 2004) (NEM:BA), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al.*, 2011).

According to Nel *et al.* (2011), three wetland types have been identified within the 500 m regulated area, namely unchannelled valley bottom wetlands, wetland flats and seeps (see Figure 4-7).

4.7 Topographical River Lines

According to the topographical river line data from the “2626” quarter degree square, various non-perennial river lines are located throughout the 500 m regulated area and is likely to represent wetland indicators (see Figure 4-7).

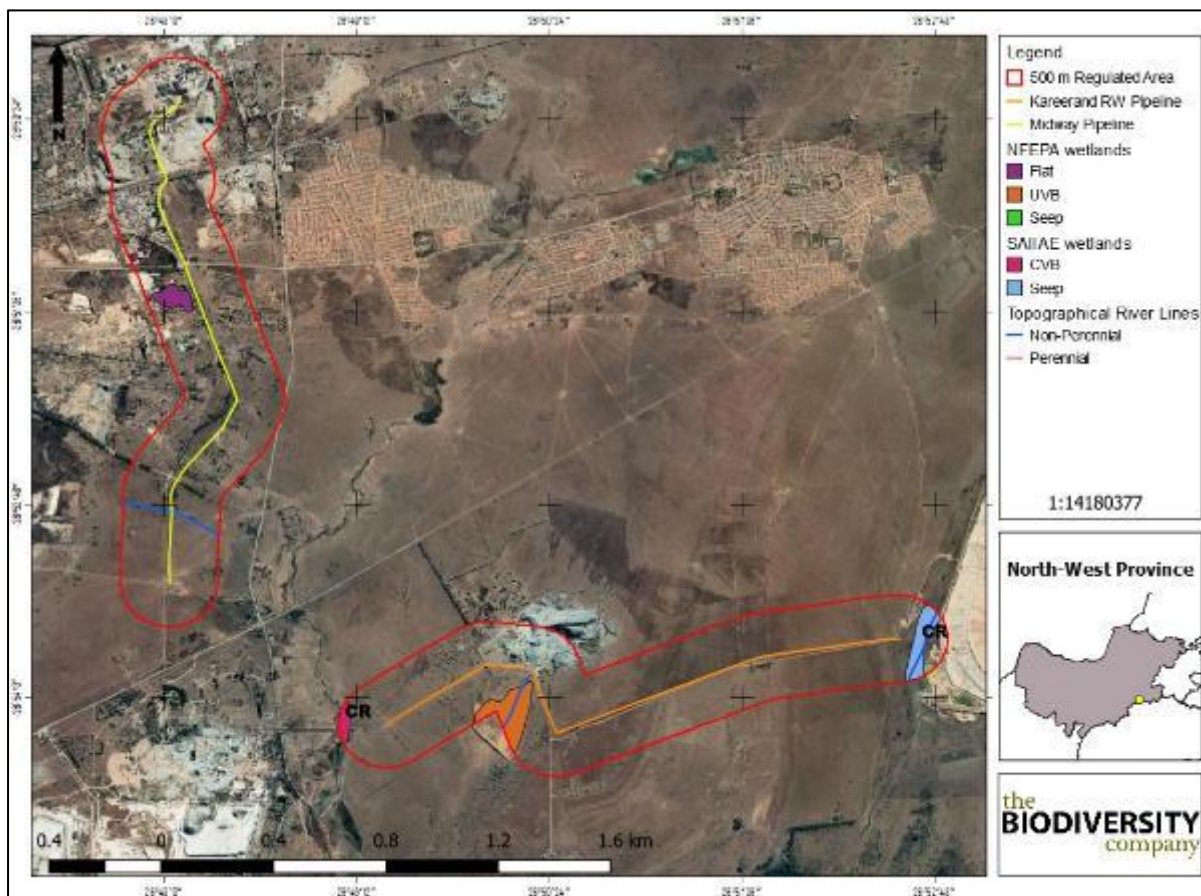


Figure 4-7 Topographical River lines, SAIIE (NBA) and NFEPA wetlands located within the 500 m regulated area

4.8 Soil and Geology

The geology of this area is characterised by aeolian and colluvial sand which overlies mudstone, sandstone and shale of the Karoo Supergroup. Older Ventersdorp Supergroup basement gneiss and andesite is located to the north. Soil forms associated with the project area includes the Bd, Bc, Ae and Ba land types, which correlates with the findings from the land type database (Mucina and Rutherford, 2006).

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Bc 24, the Fa 13 and the Bc 25 land type. The Bc land type is

characterised by plinthic catena. Upland duplex and marginalitic soils are rare within this land type. Eutrophic red soils are widespread across this area. The Fa land type is characterised by Glenrosa and/or Mispah soil forms which are common in this area, however, other soils may occur. Lime is rare or absent throughout the entire landscape.

4.9 Desktop Assessment

4.9.1 Vegetation Assessment

The project areas are situated within the grassland biome. This biome is centrally located in southern Africa and adjoins all except the desert, fynbos and the succulent Karoo biomes (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the grassland biome include:

- a) Seasonal precipitation; and
- b) The minimum temperatures in winter (Mucina & Rutherford, 2006).

The grassland biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. The topography is mainly flat and rolling but includes the escarpment itself. The altitude varies from near sea level to 2 850 m above sea level.

Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. The grassland biome experiences summer rainfall and dry winters with frost (and fire), which are unfavourable for tree growth. Thus, trees are typically absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire and grazing maintain the grass dominance and prevent the establishment of trees.

4.9.1.1 Vegetation Types

The project areas are situated within three vegetation types (Rand Highveld Grassland, Vaal Vet Sandy Grassland and Vaal Reefs Dolomite Sinkhole Woodland according to Mucina & Rutherford (2006) (SANBI, 2018) (Figure 4-8).

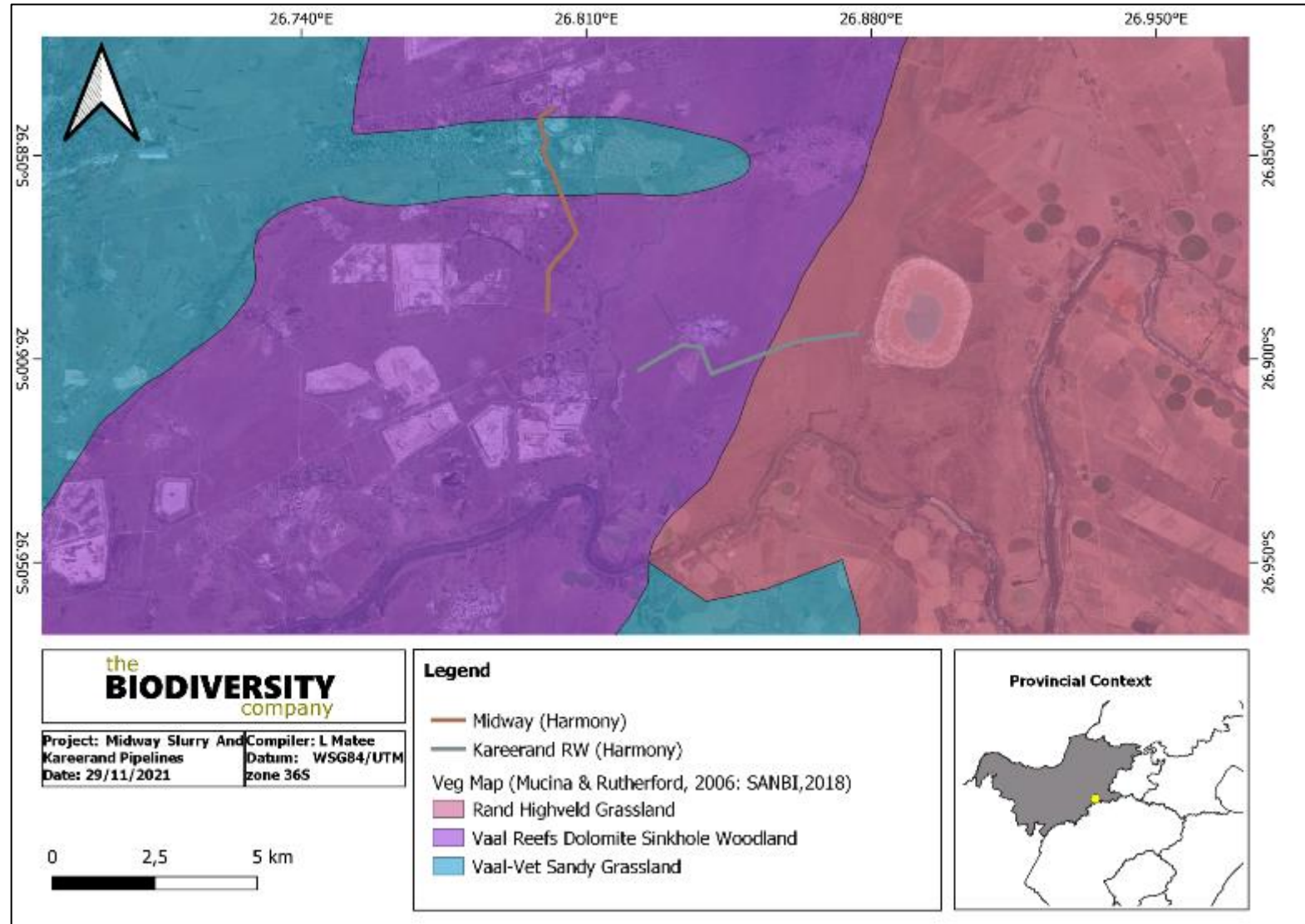


Figure 4-8 The project areas showing the vegetation type based on the Vegetation Map of South Africa, Lesotho & Swaziland (BGIS, 2018)

4.9.1.1.1 Rand Highveld Grassland

This vegetation type occurs on highly variable landscapes with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. This vegetation type can be found in Gauteng, North-West, Free State and Mpumalanga Provinces, between rocky ridges from Pretoria to Witbank, extending onto ridges in the Stoffberg and Roossenekal regions as well as west of Krugersdorp centred in the vicinity of Derby and Potchefstroom, extending southwards and north-eastwards from there (Mucina & Rutherford, 2006).

Important Plant Taxa

Important plant taxa are those species that have a high abundance, a frequent occurrence or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006).

The following species are important in the **Rand Highveld Grassland** vegetation type:

Graminoids: *Ctenium concinnum*, *Cynodon dactylon*, *Digitaria monodactyla*, *Diheteropogon amplexans*, *Eragrostis chloromelas*, *Heteropogon contortus*, *Loudetia simplex*, *Monocymbium cerasiiforme*, *Panicum natalense*, *Schizachyrium sanguineum*, *Setaria sphacelata*, *Themeda triandra*, *Trachypogon spicatus*, *Tristachya biseriata*, *T. rehmannii*, *Andropogon schirensis*, *Aristida aequiglumis*, *A. congesta*, *A. junciformis* subsp. *galpinii*, *Bewisia biflora*, *Brachiaria nigropedata*, *B. serrata*, *Bulbostylis burchellii*, *Cymbopogon caesius*, *Digitaria tricholaenoides*, *Elionurus muticus*, *Eragrostis capensis*, *E. curvula*, *E. gummiflua*, *E. plana*, *E. racemosa*, *Hyparrhenia hirta*, *Melinis nerviglumis*, *M. repens* subsp. *repens*, *Microchloa caffra*, *Setaria nigrirostris*, *Sporobolus pectinatus*, *Trichoneura grandiglumis*, *Urelytrum agropyroides*.

Herbs: *Acanthospermum australe*, *Justicia anagalloides*, *Pollichia campestris*, *Acalypha angustata*, *Chamaecrista mimosoides*, *Dicoma anomala*, *Helichrysum caespititium*, *H. nudifolium* var. *nudifolium*, *H. rugulosum*, *Ipomoea crassipes*, *Kohautia amatymbica*, *Lactuca inermis*, *Macledium zeyheri* subsp. *argyrophyllum*, *Nidorella hottentotica*, *Oldenlandia herbacea*, *Rotheca hirsuta*, *Selago densiflora*, *Senecio coronatus*, *Sonchus dregeanus*, *Vernonia oligocephala*, *Xerophyta retinervis*.

Geophytic Herbs: *Boophone disticha*, *Cheilanthes hirta*, *Haemanthus humilis* subsp. *humilis*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*, *Oxalis corniculata*.

Succulent Herb: *Aloe greatheadii* var. *davyana*.

Low Shrubs: *Anthospermum rigidum* subsp. *pumilum*, *Indigofera comosa*, *Rhus magalismontana*, *Stoebe plumosa*. **Succulent Shrub:** *Lopholaena coriifolia*.

Geoxylic Suffrutex: *Elephantorrhiza elephantina*.

Conservation Status of the Vegetation Type

According to Mucina and Rutherford (2006), this vegetation type is classified as Endangered. The national target for conservation protection for both these vegetation types is 24%, but only a few patches are protected in statutory reserves (Kwaggavoetpad, Van Riebeeck Park,

Bronkhorstspuit, Boskop Dam Nature Reserves) and in private conservation areas (e.g., Doornkop, Zemvelo, Rhenosterpoort and Mpopomeni).

Almost half of this vegetation type has been transformed mostly by cultivation, plantations, urbanisation or dam-building. Cultivation may also have had an impact on an additional portion of the surface area of the unit where old lands are currently classified as grasslands in land-cover classifications and poor land management has led to degradation of significant portions of the remainder of this unit.

4.9.1.1.2 Vaal Vet Sandy Grassland (Gh10)

This vegetation type is a plains-dominated landscape with some scattered, slightly undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element occurs here. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall (Mucina & Rutherford, 2006).

Important Taxa

Important plant taxa are those species that have a high abundance, a frequent occurrence or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006).

The following species are important in the Vaal Vet Sandy Grassland vegetation type:

Graminoids: *Antheophora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius* (d), *Cynodon dactylon* (d), *Digitaria argyrogypsa* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. plana* (d), *E. trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiaria serrata*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis curvula*, *E. obtusa*, *E. superba*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*.

Herbs: *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespititium*, *Hermannia depressa*, *Hibiscus pusillus*, *Monsonia burkeana*, *Rhynchosia adenodes*, *Selago densiflora*, *Vernonia oligocephala*.

Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*.

Low Shrubs: *Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *H. paronychioides*, *Ziziphus zeyheriana*.

Endemic Taxon

Herb: *Lessertia phillipsiana*.

Conservation status

This vegetation type is classified as Endangered according to Mucina and Rutherford (2006). The conservation target for this vegetation type is 24% with only 0.3% statutorily conserved in

the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% has been transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep.

4.9.1.1.3 Vaal Reefs Dolomite Sinkhole Woodland (Gh 12)

This vegetation type is restricted to a small area of dolomite sinkholes near Stilfontein and Orkney with the Vaal River forming its southern boundary. It is associated with chert-rich dolomite rings, forming a prominent woodland-grassland mosaic, especially near sinkholes and dolomite outcrops. (Mucina & Rutherford, 2006).

Important Plant Taxa

Important plant taxa are those species that have a high abundance, a frequent occurrence or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006).

The following species are important in the **Vaal Reefs Dolomite Sinkhole Woodland** vegetation type:

Graminoids: *Aristida congesta*, *Digitaria eriantha*, *Eragrostis curvula*, *Themeda triandra*, *Antheophora pubescens*, *Aristida canescens*, *Bewisia biflora*, *Brachiaria serrata*, *Chloris pycnothrix*, *Cymbopogon caesius*, *C. pospischilii*, *Cynodon dactylon*, *Diheteropogon amplexans*, *Elionurus muticus*, *Eragrostis chloromelas*, *E. lehmanniana*, *E. superba*, *Eustachys paspaloides*, *Heteropogon contortus*, *Melinis repens*, *Setaria sphacelata*, *Triraphis andropogonoides*.

Non-succulents: *Commelina africana*, *Barleria macrostegia*, *Euphorbia inaequilatera*, *Crabbea angustifolia*, *Dicoma anomala*, *Hermannia depressa*, *Ipomoea obscura*, *Nidorella hottentotica*, *Osteospermum muricatum*, *Pollichia campestris*, *Vernonia oligocephala hottentotica*.

Small trees: *Acacia* (= *Vachellia*) *karroo*, *Searsia lancea*.

Tall shrubs: *Diospyros lycioides* subsp. *lycioides*, *Ehretia rigida*, *Grewia flava* Low shrubs: *Asparagus suaveolens*, *Gymnosporia heterophylla*, *Sida dregei*, *Asparagus laricinus*, *Felicia muricata*, *Indigofera heterotricha*, *Triumfetta sonderi* *Geoxylic suffrutex*: *Elephantorrhiza elephantina*.

Conservation Status of the Vegetation Type

According to Mucina and Rutherford (2006), this vegetation type is classified as It is Vulnerable with a small section conserved within the Sterkfontein Caves conservation area (as part of the Cradle of Humankind World Heritage Site). This vegetation type is transformed by mining, cultivation and urban expansion, and contains the highest concentration of mines when compared to the other vegetation types.

4.9.1.2 Plant Species of Conservation Concern

According to the new Plants of Southern Africa (POSA) database underpinned by the Botanical Database of Southern Africa (BODATSA) (Figure 4-3) a total of 1048 species of indigenous plants are expected to occur within the assessment area and immediate

landscape. No species of SCC based on their conservation status could be expected to occur within the assessment area.



Figure 4-9 Map showing the grid drawn to compile an expected species list (BODATSA-POSA, 2021)

4.9.2 Faunal Assessment

4.9.2.1 Avifauna

The best recent data sets available stem from the first Southern African Bird Atlas Project (SABAP1), with a quarter-degree grid cell (QDGC) resolution and data collection that ended in 1992 (Harrison et al. 1994), while the second phase SABAP2, with a pentad resolution, commenced in 2007 and ongoing (www.sabap2.adu.org) allows comparison over this 25-year interval to detect trends in population distribution and relative abundance. The study area falls within the 2626DD (Stilfontein) QDGC. According to the South African Bird Atlas Project SABAP2 database, an average of 359 bird species have been recorded in the region based on the quarter degree grid cell that the project areas traverses. This equates to 38% of the approximate 951 species listed for the southern African subregion (www.sabap2.adu.org.za).

Of the potential bird species, nine (9) species are listed as SCC either on a regional or global scale (Table 4-3). The SCC include the following:

- Three (3) species that are listed as EN on a regional basis;
- Two (2) species that are listed as VU on a regional basis; and
- Three (3) species are listed as NT on a regional basis.

On a global scale, two (2) species as VU and one (1) species as NT (Table 4-3). All of the species had a low likelihood of occurrence based on the lack of suitable habitat and the degree of urbanization and the unsuitable habitat quality.

Table 4-3 *List of bird species of regional or global conservation importance that are expected to occur in close vicinity to the project areas*

| Scientific Names | Common Names | Conservation Status | | Likelihood of occurrence |
|--------------------------------|--------------------------|------------------------|-------------|--------------------------|
| | | Regional (SANBI, 2016) | IUCN (2017) | |
| <i>Aquila rapax</i> | Tawny Eagle | EN | LC | Low |
| <i>Polemaetus bellicosus</i> | Martial Eagle | EN | VU | Low |
| <i>Mirafra cheniana</i> | Melodious (Latakoo) Lark | LC | NT | Low |
| <i>Mycteria ibis</i> | Yellow-billed Stork | EN | LC | Low |
| <i>Coracias garrulus</i> | European Roller | NT | LC | Low |
| <i>Falco biarmicus</i> | Lanner Falcon | VU | LC | Low |
| <i>Anthropoides paradiseus</i> | Blue Crane | NT | VU | Low |
| <i>Sterna caspia</i> | Caspian Tern | VU | LC | Low |
| <i>Phoenicopterus roseus</i> | Greater Flamingo | NT | LC | Low |

Aquila rapax (Tawny Eagle) is listed as EN on a regional scale and occupies dry open habitats from sea level to 3000 m. It will occupy both woodland and wooded savannah (IUCN, 2017). Due to its large distributional range, the likelihood of occurrence of this species is rated as moderate, however, the presence of suitable prey items is low and therefore the likelihood that it will be resident in the area is also low.

Polemaetus bellicosus (Martial Eagle) is listed as EN on a regional scale and VU on a global scale. This species has an extensive range across much of sub-Saharan Africa, but populations are declining due to deliberate and incidental poisoning, habitat loss, reduction in available prey, pollution and collisions with power lines (IUCN, 2017). It inhabits open woodland, wooded savanna, bushy grassland, thorn-bush and, in southern Africa, more open country and even sub-desert (IUCN, 2017). With the presence of good grassland habitat in the project areas but an absence of large trees for roosting and nesting this species may only use the site for foraging and thus there is a moderate chance of this species occurring.

Mirafra cheniana (Melodious Lark) is seen as NT on a global scale. This species is a non-endemic species that can be found in the central South African regions. It is threatened by habitat loss and change (IUCN, 2019)

Mycteria ibis (Yellow-billed Stork) is listed as EN on a regional scale and LC on a global scale. This species is migratory and has a large distributional range which includes much of sub-Saharan Africa. It is typically associated with freshwater ecosystems, especially wetlands and the margins of lakes and dams (IUCN, 2017).

Coracias garrulus (European Roller) is a winter migrant from most of South-central Europe and Asia occurring throughout sub-Saharan Africa (IUCN, 2017). The European Roller prefers bushy plains and dry savannah areas (IUCN, 2017). There is a low chance of this species occurring in the project areas as they prefer to forage in open/disturbed agricultural areas.

Falco biarmicus (Lanner Falcon) is native to South Africa and inhabits a wide variety of habitats, from lowland deserts to forested mountains (IUCN, 2017). They may occur in groups of up to 20 individuals but have also been observed solitary. Their diet is mainly composed of

small birds such as pigeons and francolins. The likelihood of incidental records of this species in the project areas is rated as low due to the lack of natural veld conditions.

Anthropoides paradiseus (Blue Crane) is listed as NT on a regional scale and as VU on a global scale. This species has declined, largely owing to direct poisoning, power-line collisions and loss of its grassland breeding habitat owing to afforestation, mining, agriculture and development (IUCN, 2017). This species breeds in natural grass- and sedge-dominated habitats, preferring secluded grasslands at high elevations where the vegetation is thick and short. Due to the lack of open grassland areas or extensive wetlands within the project area, the likelihood of occurrence is rated as low.

Sterna caspia (Caspian Tern) is native to South Africa and are known to occur in inland freshwater systems such as large rivers, creeks, floodlands, reservoirs and sewage ponds. Habitat suitability was found to be low and thus the likelihood of occurrence is low.

Phoenicopterus roseus (Greater Flamingo) is listed as NT on a regional scale only. This species breed on large undisturbed alkaline and saline lakes, salt pans or coastal lagoons, usually far out from the shore after seasonal rains have provided the flooding necessary to isolate remote breeding sites from terrestrial predators and the soft, muddy material for nest building (IUCN, 2017). Due to the absence of its preferred habitat within the project areas, combined with the proximity of the urban area, the likelihood of occurrence is rated as low.

4.9.2.2 Mammals

The IUCN Red List Spatial Data (IUCN, 2017) lists 4 mammal species that could be expected to occur within the vicinity of the project area (Appendix C). Only three of these species is SCC (Table 4-4).

The list of potential species includes:

- One (1) that is listed as VU on a regional basis; and
- Two (2) that are listed as NT on a regional basis;

Table 4-4 SCC species that could potentially occur in the project area.

| Scientific name | Common name | Regional (SANBI, 2016) | IUCN (2017) |
|----------------------------------|---------------------------|------------------------|-------------|
| <i>Hippotragus niger</i> | Sable Antelope | VU | LC |
| <i>Atelerix frontalis</i> | Southern African Hedgehog | NT | LC |
| <i>Leptailurus serval</i> | Serval | NT | LC |

4.9.2.3 Herpetofauna (Reptiles & Amphibians)

4.9.2.3.1 Reptiles

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the ReptileMap database provided by the Animal Demography Unit (ADU, 2017) 81 reptile species are expected to occur in the project area (Appendix D). One (1) reptile SCC are expected to be present in the project area (Table 4-5).

Table 4-5 Expected reptile SCC that may occur in the project area

| Species | Common Name | Conservation Status | Likelihood of Occurrence |
|---------|-------------|---------------------|--------------------------|
|---------|-------------|---------------------|--------------------------|

| | | Regional (SANBI, 2016) | IUCN (2017) | |
|-----------------------------|----------------|------------------------|-------------|-----|
| | | | | |
| <i>Crocodylus niloticus</i> | Nile Crocodile | VU | LC | Low |

Crocodylus niloticus (Nile Crocodile) prefers permanent water bodies with suitable sandy banks for basking and egg-laying. This species is often persecuted by people. No suitable rivers are found in the project area; thus, the likelihood of occurrence is rated as low.

4.9.2.3.2 Amphibians

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the AmphibianMap database provided by the Animal Demography Unit (ADU, 2017) thirty (30) amphibian species are expected to occur in the project area (Appendix E).

One (1) amphibian SCC could be present in the project area according to the above-mentioned sources (Table 4-6).

Table 4-6 Amphibian SCC which may occur in the project area

| Species | Common Name | Conservation Status | | Likelihood of Occurrence |
|-------------------------------|----------------|------------------------|-------------|--------------------------|
| | | Regional (SANBI, 2016) | IUCN (2017) | |
| <i>Pyxicephalus adspersus</i> | Giant Bullfrog | NT | LC | Low |

5 Field Survey

5.1 Terrestrial Assessment

The field survey for flora and fauna (mammals, amphibians and reptiles) was conducted in November 2021, this would constitute a wet season survey. During the survey, the assessment of floral and faunal communities was conducted throughout the project areas and adjacent wetlands and grassland. The project areas were ground-truthed on foot, which included spot checks and meanders in pre-selected areas to validate desktop data. Photographs were recorded during the site visits, and some are provided under the results section in this report. All site photographs are available on request.

5.1.1 Vegetation Assessment

A total of 50 wood, graminoid and herbaceous plant species were recorded in the project areas during the field assessment (Table 5-1). Some of the plant species included in the species list may have not been in the immediate project areas but were in very close proximity to the servitude, thus their inclusion in the list. Plants listed as Category 1 alien or invasive species under the National Environmental Management: Biodiversity Act (NEMBA) appear in green text. Plants listed in Category 2 or as 'not indigenous' or 'naturalised' according to NEMBA, appear in blue text.

Although no SCC species were recorded within the project area, *Vachellia erioloba*, a nationally protected tree species, occurs close to the proposed Kareerand RW pipeline route and care must be taken not to remove or disturb these trees (National Forest Act, Act 84 of 1998) (NFA 2018).

Table 5-1 *Graminoids, shrubs and weeds recorded in the project areas*

| Scientific Name | Common Name | Threat Status (SANBI, 2017) | SA Endemic | Alien Category | Veld Ecological Status |
|--|--|-----------------------------|---|-------------------------|------------------------|
| <i>Aloe maculata</i> | Common Soap Aloe | LC | Not Endemic | | |
| <i>Aristida congesta subsp. barbicollis</i> | Spreading Three-awn | LC | Indigenous, Not Endemic | | Increase II |
| <i>Aristida congesta subsp. congesta</i> | Tassel Three-awn | LC | Indigenous, Not Endemic | | Increase II |
| <i>Asparagus laricus Burch.</i> | Cluster-leaf asparagus | LC | Not Endemic | | |
| <i>Bidens pilosa</i> | Blackjack | NE | Not Indigenous; Naturalized exotic weed | | |
| <i>Boophone disticha</i> | Century Plant, Poison Bulb | LC | Not Endemic | | |
| <i>Bothriochloa insculpta</i> | Pinhole Grass | LC | Indigenous, Not Endemic | | Increase II |
| <i>Celtis africana</i> | White Stinkwood, Witstinkhout | LC | Not Endemic | | |
| <i>Cenchrus ciliaris</i> | Foxtail Buffalo Grass, African Foxtail | LC | Not Endemic | | Increase II |
| <i>Chloris gayana</i> | Rhodes grass | LC | Indigenous, Not Endemic | | Increase II |
| <i>Conyza bonariensis</i> | Flax-leaf Fleabane | NE | Not Indigenous; Naturalized exotic weed | Naturalized exotic weed | |
| <i>Cynodon dactylon</i> | Couch grass | LC | Not Endemic | | Increase II |
| <i>Cyperus eragrostis</i> | Tall Flatsedge | LC | Indigenous, Not Endemic | | |
| <i>Cyperus sexangularis</i> | Flatsedge | LC | Indigenous, Not Endemic | | |
| <i>Cyperus sexangularis Nees</i> | Biesiesgras | LC | Not Endemic | | |
| <i>Datura ferox</i> | Large Thorn Apple | NE | Not Indigenous; Naturalized exotic weed | NEMBA Category 1b. | |
| <i>Dichrostachys cinerea subsp. nyassana</i> | Sickle Bush, Kalahari Christmas Tree | LC | Indigenous, Not Endemic | | |
| <i>Digitaria eriantha</i> | Finger Grass | LC | Indigenous, Not Endemic | | Decreaser |
| <i>Elionurus muticus</i> | Lemon Grass, Wire Grass | LC | Not Endemic | | |
| <i>Eragrostis chloromelas</i> | Blue Love Grass | LC | Not Endemic | | Increase II |
| <i>Eragrostis curvula</i> | Weeping Love Grass | LC | Not Endemic | | Increase II |
| <i>Eragrostis lehmanniana var. lehmanniana</i> | Eastern Province Vlei Grass, Land-Grass, Lehman Love Grass | LC | Indigenous, Not Endemic | | Increase II |

| | | | | | |
|---|--|----|---|-------------------------|--------------|
| <i>Eragrostis superba</i> | Wilman Lovegrass | LC | Not Endemic | | |
| <i>Erigeron bonariensis</i> | Flax-leaved Horseweed | LC | Indigenous, Not Endemic | | |
| <i>Eucalyptus camaldulensis</i> | Red River Gum | | | NEMBA Category 1b | |
| <i>Gomphocarpus tomentosus</i> Burch. subsp. <i>Tomentosus</i> | Woolly Milkweed | LC | Not Endemic | | |
| <i>Grewia flava</i> | Velvet Raisin | LC | Indigenous, Not Endemic | | |
| <i>Helichrysum nudifolium</i> var. <i>nudifolium</i> | Wild Tea, Kaffir Tea, Hottentot's Tea | LC | Indigenous, Not Endemic | | |
| <i>Heteropogon contortus</i> | Tanglehead, Spear Grass | LC | Indigenous, Not Endemic | | Increaser II |
| <i>Hyparrhenia hirta</i> | Common Thatching Grass, Blougras (a) | LC | Not Endemic | | Increaser I |
| <i>Hypoxis hemerocallidea</i> | Gifbol, Star Flower, Yellow Star | LC | Indigenous, Not Endemic | | |
| <i>Ledebouria inquitata</i> | Wild African Hyacinth | LC | Not Endemic | | |
| <i>Melinis repens</i> | Natal Red Top | LC | Not Endemic | | Increaser II |
| <i>Panicum maximum</i> | Guinea Grass | LC | Indigenous, Not Endemic | | None |
| <i>Pinus patula</i> | Patula Pine | | Not Indigenous; Naturalized exotic weed | NEMBA Category 2 | |
| <i>Schinus molle</i> | Peruvian Pepper Tree | | Not Indigenous; Naturalized exotic weed | Not Indigenous | |
| <i>Schkuhria pinnata</i> | Dwarf Marigold | | Not Indigenous; Naturalized exotic weed | Naturalized exotic weed | |
| <i>Searsia lancea</i> | Karee | LC | Indigenous, Not Endemic | | |
| <i>Senegalia caffra</i> | Hook-Thorn | LC | Not Endemic | | |
| <i>Senegalia mellifera</i> (Vahl) Seigel & Ebinger subsp. <i>detinens</i> | Black Thorn | LC | Indigenous, Not Endemic | | |
| <i>Senna didymobotrya</i> | Peanut butter cassia | NE | Not Indigenous; Naturalized exotic weed | NEMBA Category 1b. | |
| <i>Sesbania bispinosa</i> (Jacq.) W. Wight var. <i>bispinosa</i> | Spiny Sesbania | NE | Not Endemic | | |
| <i>Setaria sphacelata</i> var. <i>sphacelata</i> | Common bristle grass; Golden Timothy Grass | LC | Indigenous, Not Endemic | | Decreaser |
| <i>Tagetes minuta</i> | Khaki Bush, Khaki Weed, African Marigold | NE | Not Indigenous; Naturalized exotic weed | | |
| <i>Themeda triandra</i> | Angle Grass | LC | Not Endemic | | Decreaser |

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| | | | | | |
|---|--|----|--|-----------------------|--|
| <i>Vachellia karroo</i> | Sweet Thorn, Cape Gum | LC | Indigenous, Not Endemic | | |
| <i>Vachellia erioloba</i> | Camel Thorn | LC | Indigenous, Not Endemic | | |
| <i>Vachellia tortilis</i> (Forssk.) Gallaso & Banfi <i>subsp. heteracantha</i> | Curly-pod Acacia | LC | Indigenous, Not Endemic | | |
| <i>Verbena bonariensis</i> | Wild Verbena, Tall Verbena, Purple Top | | Not Indigenous; Naturalized exotic weed | NEMBA Category 1b. | |
| <i>Ziziphus mucronata subsp. mucronata</i> | Buffalo Thorn, Wait-a-bit | LC | Indigenous, Not Endemic | | |

5.1.1.1 Alien and Invasive Plants

Invasive Alien Plants (IAPs) tend to dominate or replace indigenous flora, thereby transforming the structure, composition and functioning of ecosystems. Therefore, these plants must be controlled through an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species.

NEMBA is the most recent legislation pertaining to alien invasive plant species. In August 2014, the list of Alien Invasive Species was published in terms of the NEMBA. The Alien and Invasive Species Regulations were published in Government Gazette No. 43726, 18 September 2020. The legislation calls for the removal and/or control of IAP species (Category 1 species). In addition, unless authorised thereto in terms of the NWA, no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within proximity to a watercourse. Below is a brief explanation of the three categories in terms of the NEMBA:

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government-sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

Note that according to the Alien and Invasive Species Regulations, a person who has under his or her control a category 1b listed invasive species must immediately:

- Notify the competent authority in writing
- Take steps to manage the listed invasive species in compliance with:
 - Section 75 of the NEMBA;
 - The relevant invasive species management programme developed in terms of regulation 4; and
 - Any directive issued in terms of section 73(3) of the NEMBA.

Five (5) IAP species were recorded within the study area. These species are listed under the Alien and Invasive Species List 2020, Government Gazette No. GN1003 as Category 1b as

well as Category 2. These IAP species must be controlled by implementing an IAP Management Programme, in compliance with section 75 of the NEMBA, as stated above.

5.1.2 Faunal Assessment

The faunal assessment was carried out concurrently with the vegetation assessment. Faunal records were gathered using visual cues such as sightings, tracks and scats, active searching as well as auditory recognition but no intensive faunal surveys were carried out due to time constraints.

5.1.2.1 Avifauna

A total of twenty-three (23) bird species were recorded in the project areas during the survey based on either direct observations or the presence of visual tracks & signs (Table 5-2). None of these was SCC species.

Table 5-2 Avifaunal species recorded in the project areas

| Species | Common Name | Conservation Status | |
|----------------------------------|---------------------------|------------------------|-------------|
| | | Regional (SANBI, 2016) | IUCN (2017) |
| <i>Acridotheres tristis</i> | Myna, Common | Unlisted | LC |
| <i>Amadina erythrocephala</i> | Finch, Red-headed | Unlisted | LC |
| <i>Apus affinis</i> | Swift, Little | Unlisted | LC |
| <i>Bostrychia hagedash</i> | Ibis, Hadedda | Unlisted | LC |
| <i>Buteo buteo</i> | Buzzard, Common (Steppe) | Unlisted | LC |
| <i>Coracias caudatus</i> | Roller, Lilac-breasted | Unlisted | LC |
| <i>Corvus albus</i> | Crow, Pied | Unlisted | LC |
| <i>Elanus caeruleus</i> | Kite, Black-shouldered | Unlisted | LC |
| <i>Euplectes orix</i> | Bishop, Southern Red | Unlisted | LC |
| <i>Himantopus himantopus</i> | Stilt, Black-winged | Unlisted | LC |
| <i>Lamprotornis nitens</i> | Starling, Cape Glossy | Unlisted | LC |
| <i>Lanius collaris</i> | Fiscal, Common (Southern) | Unlisted | LC |
| <i>Merops pusillus</i> | Bee-eater, Little | Unlisted | LC |
| <i>Mirafr africana</i> | Lark, Rufous-naped | Unlisted | LC |
| <i>Numida meleagris</i> | Guineafowl, Helmeted | Unlisted | LC |
| <i>Pternistis swainsonii</i> | Spurfowl, Swainson's | Unlisted | LC |
| <i>Pycnonotus tricolor</i> | Bulbul, Dark-capped | Unlisted | Unlisted |
| <i>Streptopelia capicola</i> | Turtle-dove, Cape | Unlisted | LC |
| <i>Streptopelia senegalensis</i> | Dove, Laughing | Unlisted | LC |
| <i>Tchagra australis</i> | Tchagra, Brown-crowned | Unlisted | LC |
| <i>Uraeginthus angolensis</i> | Waxbill, Blue | Unlisted | LC |
| <i>Vanellus armatus</i> | Lapwing, Blacksmith | Unlisted | LC |
| <i>Vanellus coronatus</i> | Lapwing, Crowned | Unlisted | LC |

5.1.2.2 Mammals

Four (4) mammal species were recorded in the project areas during the surveys based on either direct observation or the presence of visual tracks & signs. This can also be attributed to the disturbed nature of the project areas and their location in an area with human settlement, mining-related activities such as tailings reprocessing and the presence of the old pipelines.

Table 5-3 Mammal species recorded in the project areas

| Species | Common Name | Conservation Status | |
|--|-------------------------------|------------------------|-------------|
| | | Regional (SANBI, 2016) | IUCN (2017) |
| <i>Herpestes sanguineus</i> | Slender Mongoose | LC | LC |
| <i>Hystrix africaeaustralis</i> | Cape Porcupine | LC | LC |
| <i>Lepus saxatilis</i> | Scrub Hare | LC | LC |
| <i>Geosciurus inauris</i> , <i>Xerus inauris</i> | South African ground squirrel | LC | LC |

5.1.2.3 Herpetofauna

No reptile or amphibian species were recorded in the project areas during the surveys. This can also be attributed to the disturbed nature of the project areas and their location in an area with dense human settlements, mining-related practices such as tailings reprocessing as well as the presence of the existing pipelines. All reptile species are sensitive to major habitat alteration and fragmentation. As a result of human presence in the area as well as in the project areas; coupled with habitat destruction and high levels of disturbances, alterations to the original reptilian fauna are expected to have already occurred. Further to this, no pitfall trapping was done, surveys relied on opportunistic sightings as opposed to intensive and active sampling methods. The only other method utilised was refuge examinations using visual scanning of terrains to record smaller herpetofauna species that often conceal themselves under rocks, in fallen logs, rotten tree stumps, in leaf litter, rodent burrows, ponds and old termite mounds.

5.2 Wetland Assessment

5.2.1 Wetland Delineation and Description

The wetland areas were delineated per the DWAF (2005) guidelines (see Figure 5-1). Five HGM units were identified within the 500 m regulated area, which have all been classified as unchanneled valley bottom (UVB) wetlands except for HGM 2, which has been classified as a floodplain wetland. Additionally, some artificial wetlands and drainage features were identified, which do not classify as wetland habitat.

Of the delineated wetlands, only one wetland system is expected to be impeded on by the proposed pipeline. It is however worth noting that an existing servitude already exists within the delineated wetland which will be used for the proposed pipeline, therefore minimising impacts.



Figure 5-1 **Examples of wetlands identified. A) Artificial wetland. B) Floodplain. C and D) Unchannelled valley bottoms**

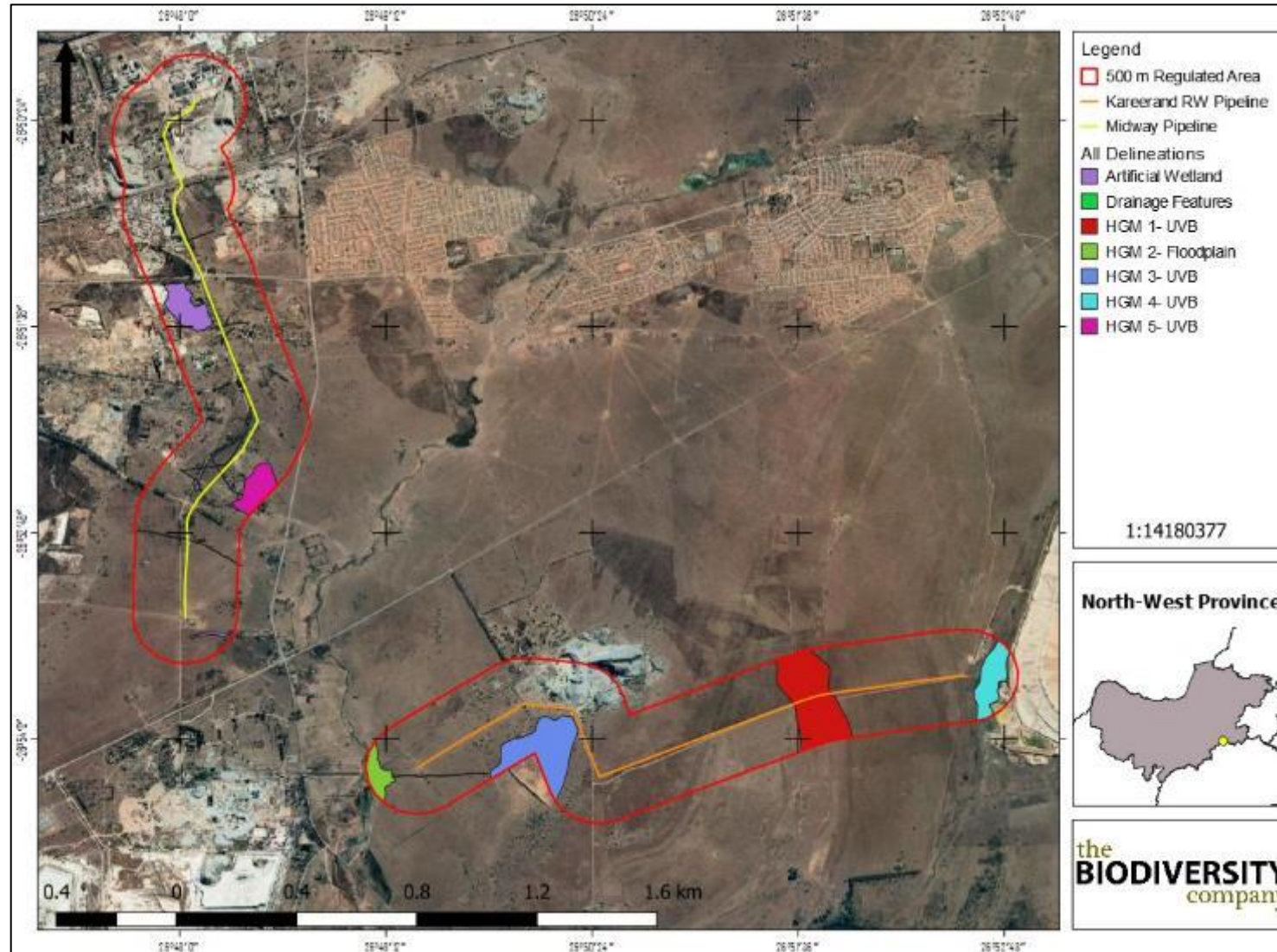


Figure 5-2 Delineation of wetlands within project area

5.2.2 Wetland Unit Identification

The wetland classification as per SANBI guidelines (Ollis *et al.*, 2013) is presented in Table 5-4. All three systems share the same level 1 classification, DWS ecoregion and NFEPA wet veg groups.

Table 5-4 Wetland classification as per SANBI guideline (Ollis *et al.* 2013)

| Wetland System | Level 1 | | Level 2 | | Level 3 | | Level 4 | |
|----------------|---------|-----------------|--------------------------------|--|----------------|------------|-----------------------|-----|
| | System | DWS Ecoregion/s | NFEPA Wet Veg Group/s | | Landscape Unit | 4A (HGM) | 4B | 4C |
| HGM 1 | Inland | Highveld | Dry highveld Grassland Group 3 | | Valley Bottom | UVB | N/A | N/A |
| HGM 2 | | | | | Valley Bottom | Floodplain | Floodplain Depression | N/A |
| HGM 3 | | | | | Valley Bottom | UVB | N/A | N/A |
| HGM 4 | | | | | Valley Bottom | UVB | N/A | N/A |
| HGM 5 | | | | | Valley Bottom | UVB | N/A | N/A |

5.2.3 Wetland Unit Setting

Unchanneled valley bottom wetlands are typically found on valley floors where the landscape does not allow high energy flows. Figure 5-3 presents a diagram of the relevant HGM units, showing the dominant movement of water into, through and out of the system.

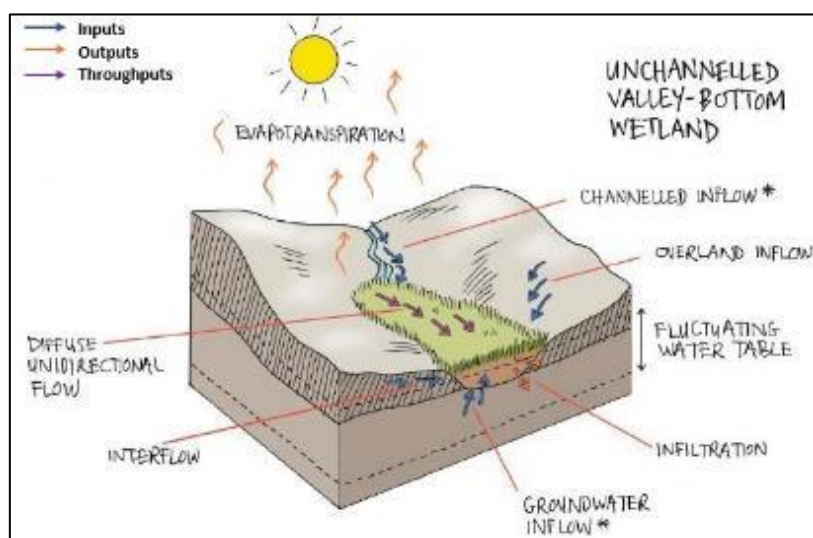


Figure 5-3 Amalgamated diagram of a typical unchanneled valley bottom, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis *et al.* 2013)

Floodplain wetlands are located on valley floors and are characterised by a well-defined stream channel with typical floodplain features, including levees, scroll bars and oxbows. The water inputs of this wetland are mainly from overflows from the stream channel's banks during flooding events. Figure 5-4 presents a diagram of the delineated floodplain, showing the dominant movement of water into, through and out of the system.

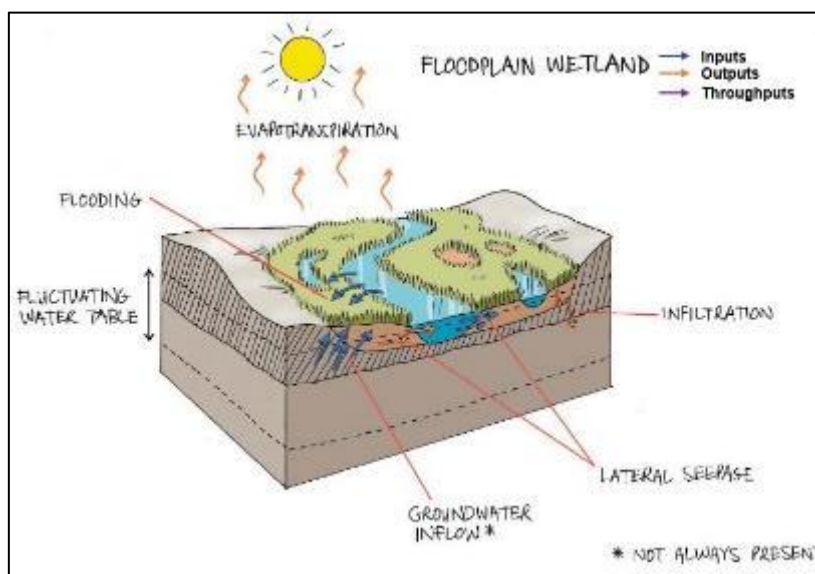


Figure 5-4 Amalgamated diagram of a typical floodplain system, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

5.2.4 Wetland Indicators

5.2.4.1 Hydromorphic Soils

According to (DWAF, 2005), soils are the most important characteristic of wetlands in order to accurately identify and delineate wetland areas. Three dominant soil forms were identified within the identified wetland, namely the Katspruit, Longlands and Westleigh soil form.

The Westleigh soil form consists of an orthic topsoil on top of a soft plinthic horizon. The soil family group identified for the Westleigh soil form on-site has been classified as the “2100” soil family group due to the chromic colouring of the topsoil and the alluvial characteristics of the soft plinthic horizon.

The Longlands soil form consists of an orthic topsoil on top of an albic horizon. The soil family group identified for the Longlands soil form on-site has been classified as the “1000” soil family due to the grey colour of the soil in wet conditions.

The Katspruit soil form consists of an Orthic topsoil on top of a Gleyic horizon. The 2210 family group is applicable to this soil form given the grey colours, the firm texture and structure of the soil form and the absence of lime.

Orthic topsoils are mineral horizons that have been exposed to biological activities and varying intensities of mineral weathering. The climatic conditions and parent material ensure a wide range of properties differing from one orthic topsoil to another (i.e., colouration, structure etc) (Soil Classification Working Group, 2018).

Gley horizons that are well developed and have homogenous dark to light grey colours with smooth transitions. Stagnant and reduced water over long periods is the main factor responsible for the formation of a Gley horizon and could be characterised by green or blue tinges due to the presence of a mineral called Fougerite which includes sulphate and carbonate complexes. Even though grey colours are dominant, yellow and/or red striations can be noticed throughout a gley horizon. The structure of a gley horizon mostly is

characterised as strong pedal, with low hydraulic conductivities and a clay texture, although sandy gley horizons are known to occur. The gley soil form commonly occurs at the toe of hillslopes (or benches) where lateral water inputs (sub-surface) are dominant and the underlying geology is characterised by a low hydraulic conductivity. The gley horizon usually is second in diagnostic sequence in shallow profiles yet is known to be lower down in sequence and at greater depths (Soil Classification Working Group, 2018).

The accumulations of iron (and in some cases manganese) as hydroxides and oxides with the presence of high chroma striations and concretions with black matrixes are associated with the Soft Plinthic horizon. This diagnostic horizon forms due to fluctuating levels of saturation. The iron and manganese concentration result in soft marks within the soil matrix which transform in concretions with high consistencies (Soil Classification Working Group, 1991).

If this process continues for long enough periods, a massive continuous impermeable layer of hard plinthite forms. A Soft Plinthic horizon and a Hard Plinthic horizon can be distinguished from one another by means of a simple spade test. A Soft Plinthic horizon can be penetrated by means of a spade in wet conditions whereas a Hard Plinthic horizon cannot (Soil Classification Working Group, 1991).

According to Soil Classification Working Group (2018), this horizon commonly occurs as a result of hillslope hydrology in flat, sandy landscapes. This horizon is known to have an apedal structure together with the presence of concretions.

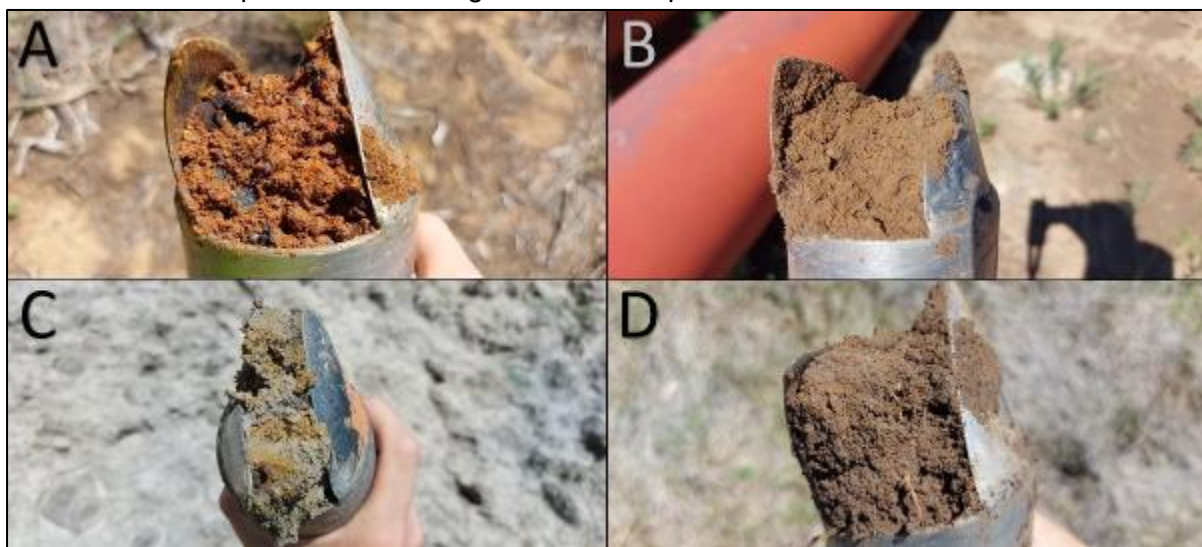


Figure 5-5 Soils identified within delineated watercourses. A) Soft plinthic horizon. B) Orthic topsoil with signs of wetness. C) Gley horizon. D) Albic horizon with signs of wetness.

5.2.4.2 Hydrophytes

Vegetation plays a considerable role in identifying, classifying and accurately delineating wetlands (DWAF, 2005). During the site visit, various hydrophytic species were identified (including facultative species). Examples include *Juncus spp.*, *Phragmites australis*, *Schoenoplectus spp.* and *Typha capensis*.



Figure 5-6 *Hydrophytic vegetation identified within delineated watercourses. A) Phragmites australis. B) Typha capensis. C) Juncus spp. D) Schoenoplectus sp.*

5.2.5 General Functional Description

Unchanneled valley bottoms are characterised by sediment deposition, a gentle gradient with streamflow generally being spread diffusely across the wetland, ultimately ensuring prolonged saturation levels and high levels of organic matter. The assimilation of toxicants, nitrates and phosphates are usually high for unchanneled valley bottom wetlands, especially in cases where the valley is fed by sub-surface interflow from slopes. The shallow depths of surface water within this system adds to the degradation of toxic contaminants by means of sunlight penetration.

Floodplains generally are formed during high flow events which subsequently cause water to overspill its banks. Due to the topographic setting of floodplains, flood attenuation for these systems is very high, especially during seasons where the soil within the wetland is not yet saturated and before the oxbows are filled. Seeing that floodplains usually are characterised by clayey soils which retain water for long periods and are susceptible to vast amounts of evapotranspiration, very little streamflow regulation is expected for floodplains. In hindsight, floodplains with coarse soil types are ideal in regulating streamflow. Floodplains are excellent in assimilating phosphates due to the decrease in velocity during the overspill of banks. During this process, lateral deposition of sediment is prone to happen. Phosphorus tends to bound strongly to mineral particles which ensures that the phosphorus is retained on the floodplain after the deposition of these particles. Denitrification does occur to a lesser extent due to little exposure of large amounts of water seeing that these water masses are dependent on floods. Additionally, sub-surface flows are rare for floodplains which decrease the possibility of denitrification even more so.

It is however important to note that the descriptions of the above-mentioned functions are merely typical expectations. All wetland systems are unique and therefore, the ecosystem services rated high for these systems on site might differ slightly to those expectations.

5.2.6 General Functionality

Unchanneled valley bottoms are characterised by sediment deposition, a gentle gradient with streamflow generally being spread diffusely across the wetland, ultimately ensuring prolonged saturation levels and high levels of organic matter. The assimilation of toxicants, nitrates and phosphates are usually high for unchanneled valley bottom wetlands, especially in cases where the valley is fed by sub-surface interflow from slopes. The shallow depths of surface water within this system adds to the degradation of toxic contaminants by means of sunlight penetration.

Hillslope seeps are well documented by (Kotze *et al.*, 2009) to be associated with sub-surface ground water flows. These systems tend to contribute to flood attenuation given their diffuse nature. This attenuation only occurs while the soil within the wetland is not yet fully saturated. The accumulation of organic material and sediment contributes to prolonged levels of saturation due to this deposition slowing down the sub-surface movement of water. Water typically accumulates in the upper slope (above the seep). The accumulation of organic matter additionally is essential in the denitrification process involved with nitrate assimilation. Seeps generally also improve the quality of water by removing excess nutrient and inorganic pollutants originating from agriculture, industrial or mine activities. The diffuse nature of flows ensures the assimilation of nitrates, toxicants and phosphates with erosion control being one of the Eco Services provided very little by the wetland given the nature of a typical seep's position on slopes.

Channelled valley bottom wetlands tend to contribute less to sediment trapping and flood attenuation than other systems. Channelled valley bottom wetlands are well known to improve the assimilation of toxicants, nitrates and sulphates, especially in cases where sub-surface flows contribute to the system's water source (Kotze *et al.*, 2009).

It is however important to note that the descriptions of the above-mentioned functions are merely typical expectations. All wetland systems are unique and therefore, the ecosystem services rated high for these systems on site might differ slightly to those expectations.

5.2.7 Ecological Functional Assessment

The ecosystem services provided by the wetland units identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al.*, 2008). The average ecosystem service scores for the delineated systems are illustrated in Table 5-5 and Figure 5-7. HGM 1 and 5 have been scored the lowest ecosystem services scores ("Moderately Low") with HGM 4 being scored the highest ("Moderately High").

Table 5-5 Average ecosystem service scores for delineated watercourses

| Not Applicable | Moderately Low | Intermediate | Moderately High |
|---------------------|----------------|--------------|-----------------|
| Drainage Features | HGM 1 | HGM 2 | HGM 4 |
| Artificial Wetlands | HGM 5 | HGM 3 | |

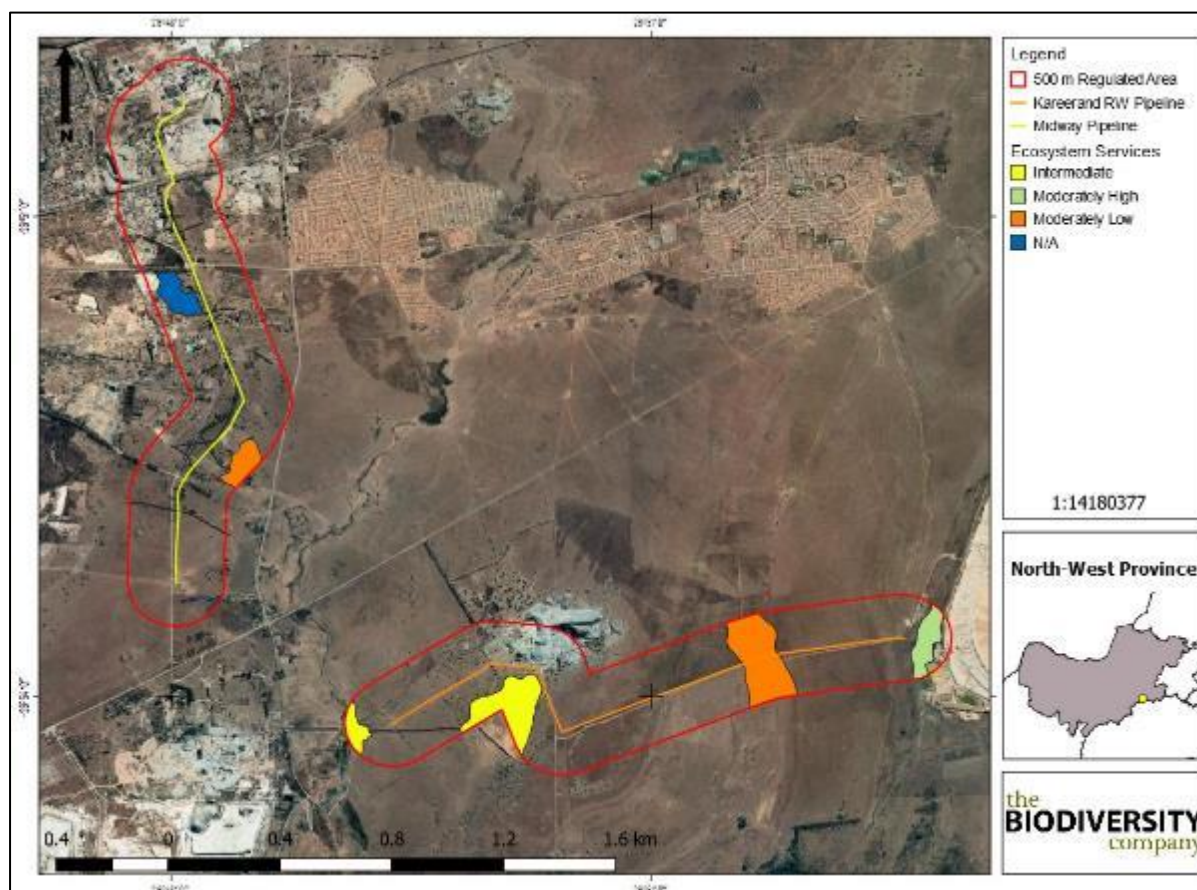


Figure 5-7 Average ecosystem service scores for delineated watercourses

Ecosystem services contributing to these scores include flood attenuation, streamflow regulation, sediment trapping, phosphate assimilation, nitrate assimilation, toxicant assimilation and erosion control.

Flood attenuation is important to ensure the structural and geomorphological integrity of the watercourse/s downstream. The slope of the wetland, the surface roughness of wetlands, the presence of seasonally saturated soils etc. contribute to “Moderately High” scores. Streamflow regulation correlates well with flood attenuation, the ability of a wetland to attenuate floods is directly associated with those parameters responsible for high flood attenuation.

The ability of a wetland system to trap sediments is crucial, especially since large river systems are located downstream of the delineated wetland systems. All sediments trapped by wetland systems ensure less sedimentation entering the main river system. The ability to trap sediments also increases the assimilation ability of wetlands. The assimilation of toxicants, phosphates and nitrates have all been scored “Moderately High” due to the diffuse nature of wetlands, the concentration of vegetation as well as the ability to trap sediments. These factors ensure that contaminants are trapped, assimilated by soil and vegetation with the outcome being a less-concentrated cleaner water flowing downstream.

The key difference between wetlands that have been scored high and low ecosystem service scores can therefore be described by the presence and lack of permanently saturated soils (permanently saturated equals higher ecosystem services), dense vegetation cover and diffuse flows.

5.2.8 The Ecological Health Assessment

The PES for the assessed HGM units is presented in Figure 5-8 and Table 5-6. The delineated wetland systems have been scored overall PES ratings ranging from largely modified (class D) to seriously modified (class E). The noticeable difference between the wetlands scored largely modified and those scored seriously modified can be explained by the presence of mine related infrastructure (i.e.) tailings facilities as well as leaking pipelines which contribute to higher modification scores.

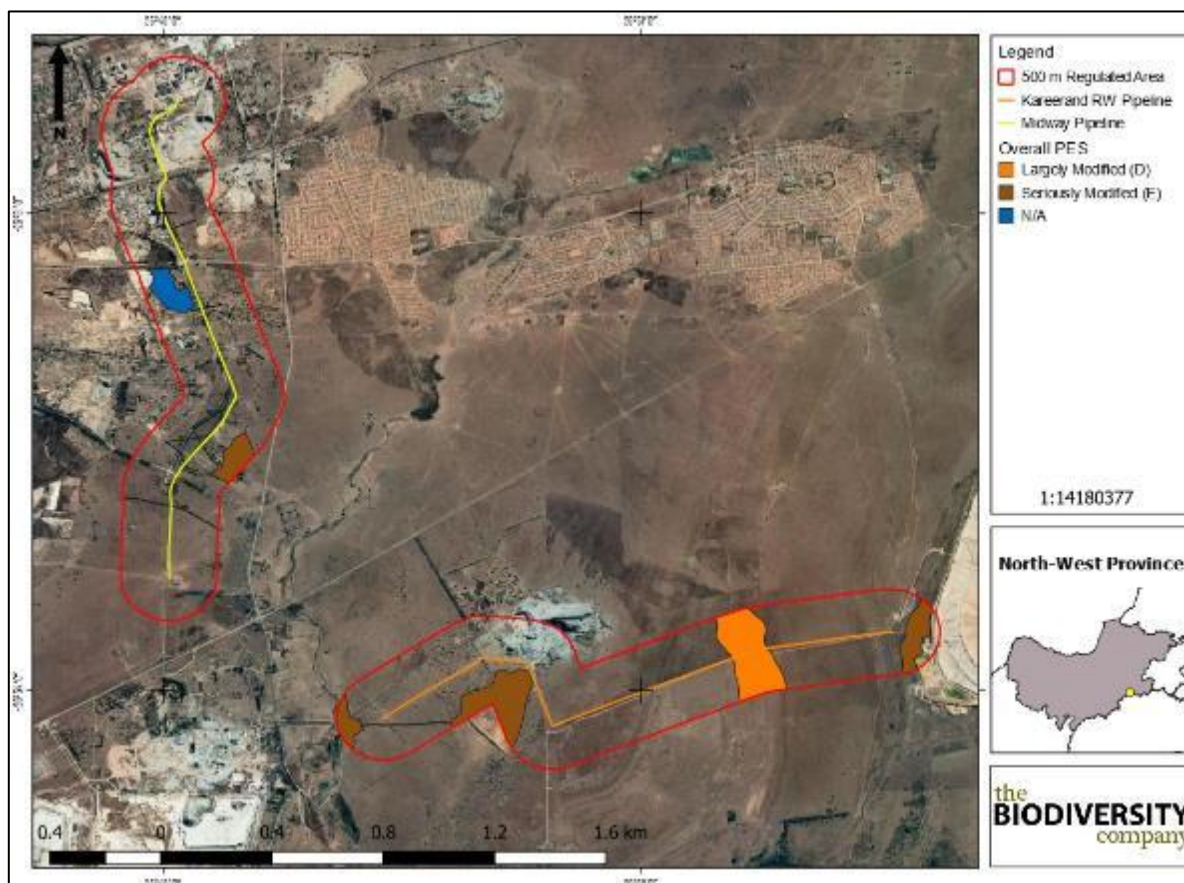


Figure 5-8 Overall present ecological state of delineated wetlands

Table 5-6 Summary of the scores for the wetland PES

| Not Applicable | Largely Modified (D) | Seriously Modified (E) |
|---------------------|----------------------|------------------------|
| Drainage Features | HGM 1 | HGM 2 |
| Artificial Wetlands | | HGM 3 |
| | | HGM 4 |
| | | HGM 5 |

Some notable impacts (Figure 5-9) include;

- Alien invasive vegetation;
- Clearance of vegetation;
- Erosion;

- Eucalyptus trees;
- Dirt roads;
- Leaking pipelines;
- Presence of stockpiles/tailings facilities;
- Dumping of building material and refuse; and
- A high presence of drains and gullies.



Figure 5-9 Evidence of leaking pipelines

5.2.9 The Importance & Sensitivity Assessment

The results of the ecological IS assessment are shown in Table 5-7. Various components pertaining to the protection status of a wetland is considered for the IS, including Strategic Water Source Areas (SWSA), the NFEPA wet veg protection status and the protection status of the wetland itself considering the NBA wetland data set. The IS for HGM 2 and 4 have been calculated to be “High”, which combines all parameters listed in Table 5-7. The remainder of the wetland units have been scored “Low” due to the fact that these systems aren’t classified by the SAI/AE wetland layer.

Table 5-7 The IS results for the delineated HGM unit

| HGM Type | Wet Veg | | | NBA Wetlands | | SWSA (Y/N) | Calculated IS |
|----------------|--------------------------------|-------------------------|----------------------------|-------------------|------------------------------|------------|---------------|
| | Type | Ecosystem Threat Status | Ecosystem Protection Level | Wetland Condition | Ecosystem Threat Status 2018 | | |
| HGM 1, 3 and 5 | Dry Highveld Grassland Group 3 | Least Threatened | Not Protected | N/A | N/A | N | Low |
| HGM 2 and 4 | Dry Highveld Grassland Group 3 | Least Threatened | Not Protected | D/E/F | Critically Endangered | N | High |

5.2.10 Buffer Requirements

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane *et al.*, 2014) was used to determine the appropriate buffer zone for the proposed activity. A pre-mitigation buffer zone of 22 m is recommended for the identified wetlands, which can likely be decreased to 15 m if suitable avoidance and mitigation measures are implemented (see Table 5-6 and Figure 5-10).

Table 5-8 *pre-and post-mitigation buffer sizes*

| | Buffer Widths |
|------------------------|---------------|
| Pre-mitigation buffer | 30 m |
| Post-mitigation buffer | 22 m |

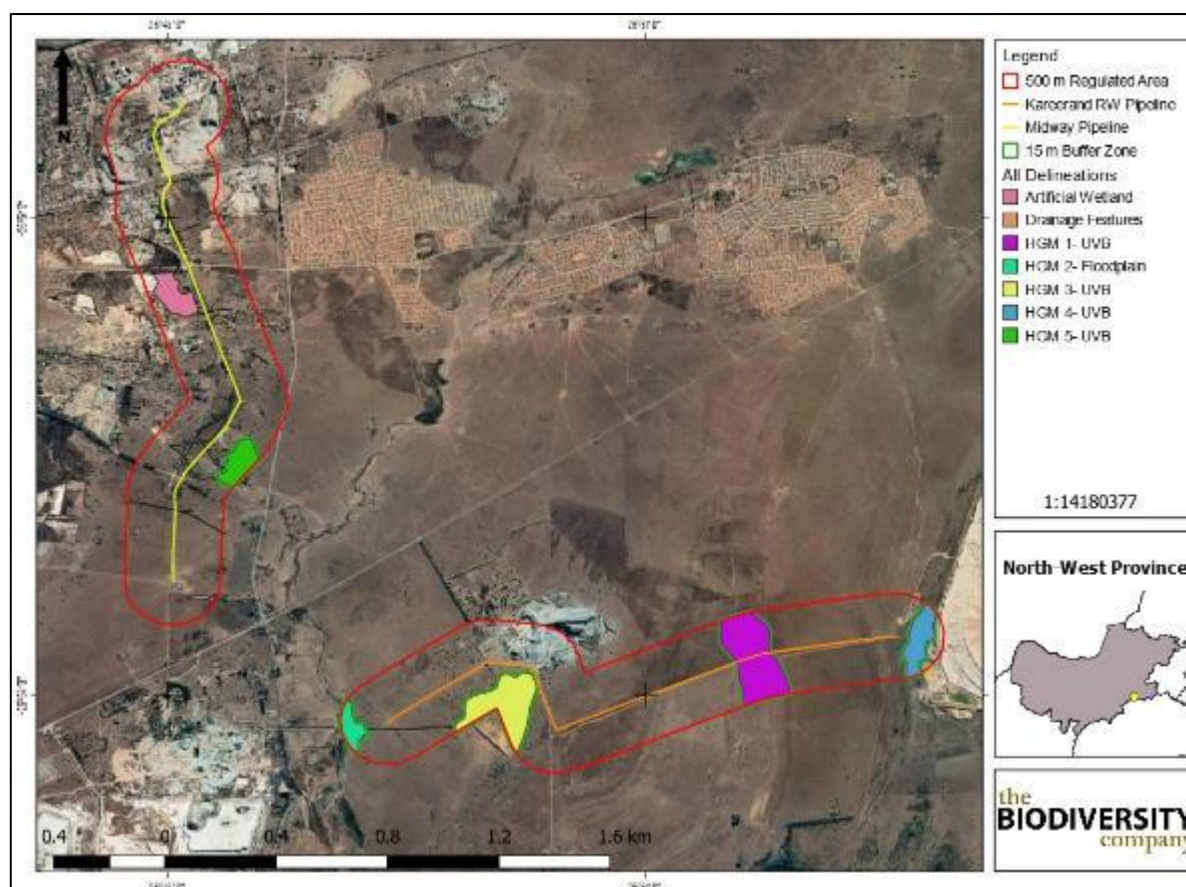


Figure 5-10 *Illustration of recommended buffer requirement*

5.3 Habitats Assessment

The shapefiles received and the site visit along with the client interaction indicated that both the Kareerand RW pipeline and Midway ST line will be laid along the existing pipeline in the existing servitude which has been transformed already. The main habitats main habitat types identified across the Kareerand RW pipeline are transformed habitat and an unchannelled Valley Bottom wetland system (HGM1) whilst the Midway ST line traverses transformed habitat and a couple of drainage features. These main habitat types were refined based on

the field coverage and data collected during the survey; the delineated habitats can be seen in Figure 5-11 and Figure 5-12 is an illustration of these habitats from the project areas.

Emphasis was placed on limiting timed meander searches within the natural habitats and the habitats with a higher potential of hosting SCC. Each of the habitats identified is discussed in the sub-sections below.

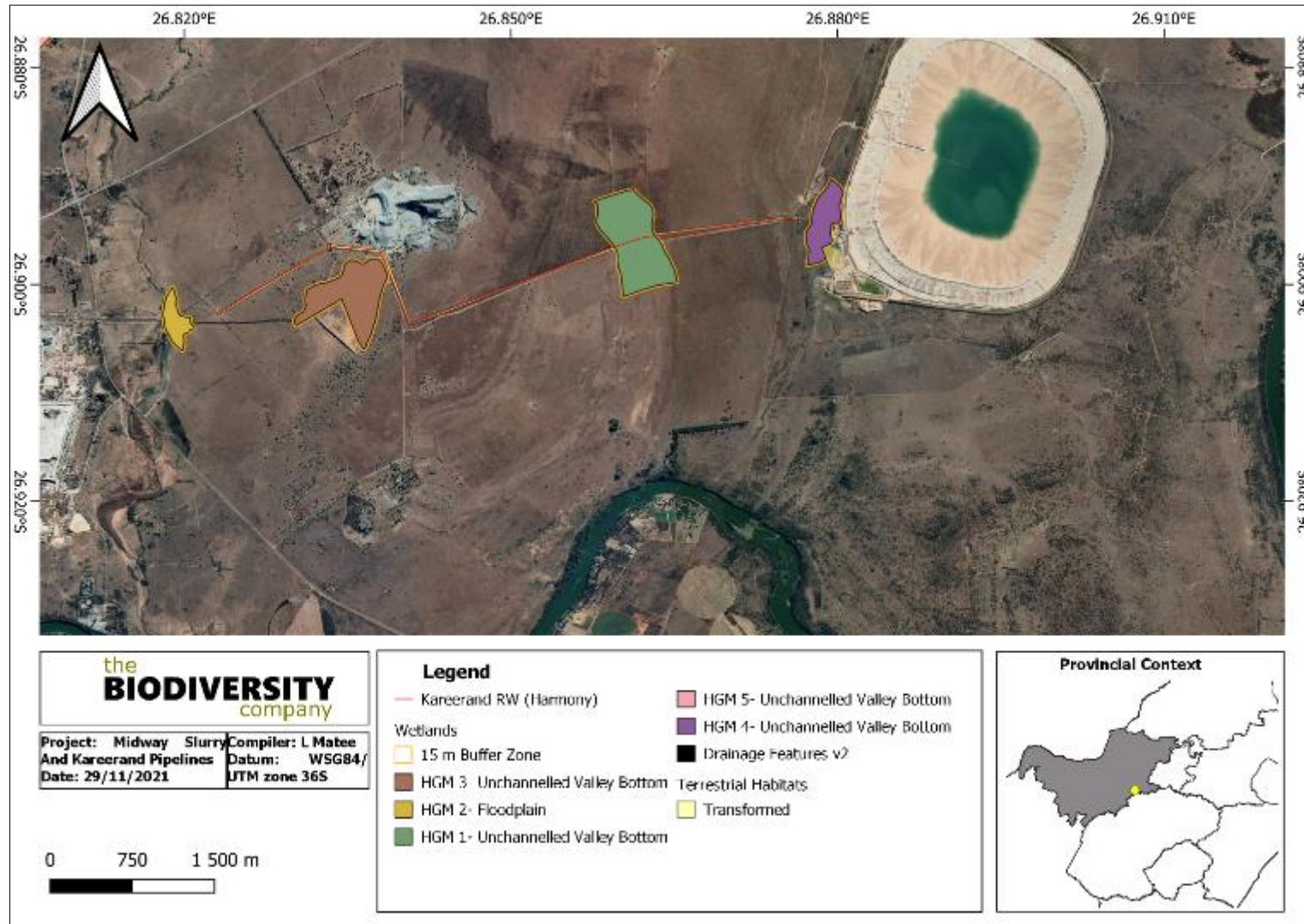


Figure 5-11 Habitats identified along the Kareerand RW pipeline.

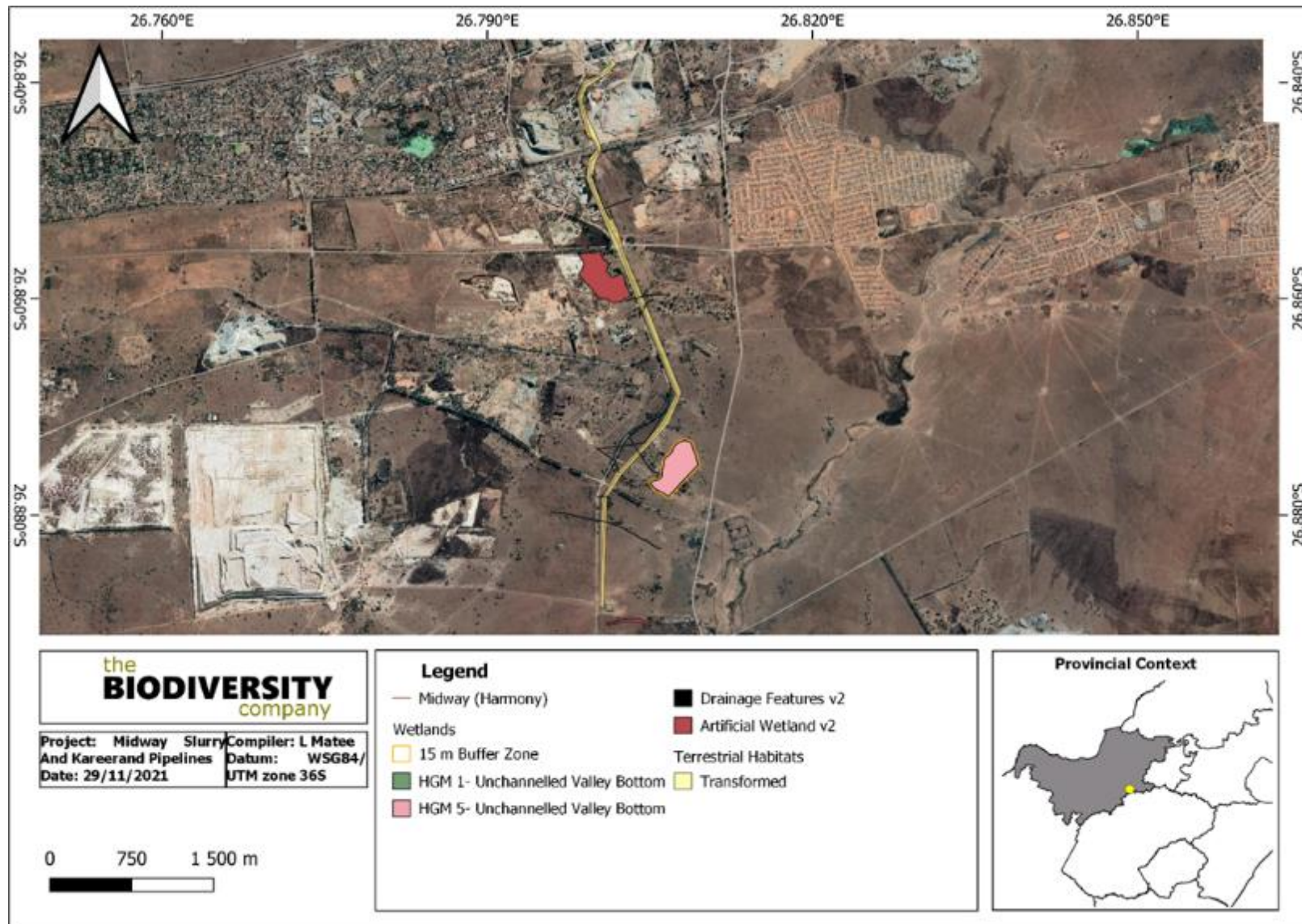


Figure 5-12 Habitats identified along the Midway ST pipeline.



Figure 5-13 **Habitats observed in the project areas and its vicinity: A & B) Transformed Habitat, C & D) Channelled valley bottom wetland (HGM1), D&E) Drainage lines**

5.3.1 Transformed

This habitat unit represents the area that has been cleared of vegetation or has transformed secondary grasslands and is dominated by IAPs. This habitat is regarded as transformed due to the nature of the modification of the area as it is currently used as access road for maintenance of the existing pipelines in both the Kareerand and Midway ST lines, it has been modified to an extent where it would not be able to return to its previous state. Due to the transformed nature of this habitat, it is regarded as having low sensitivity.

5.3.2 Freshwater resources

One channelled valley bottom wetland (HGM1) habitat unit was found within the Kareerand RW line and drainage features were found within the Midway ST line. Refer to the wetlands section below for further detail on the wetlands and drainage features found on site.

5.4 Hydropedological Assessment

A hydropedological component was included in this assessment to ensure a holistic understanding of the hillslope hydrology and potential impacts towards the vadose zone properties. The entire hillslope is characterised by the interflow (between soil and bedrock) hydropedological type in the form of the Westleigh and Longlands soil form besides the main receptor (wetlands), which are characterised by a responsive hydropedological type (mainly Katspruit).

It is clear from the cross profile depicted in Figure 5-14 that the proposed pipeline will not have any effect on the hillslope hydrology or vadose zone properties of the relevant hillslope. Therefore, zero percent loss of total moisture content to the depression is expected.

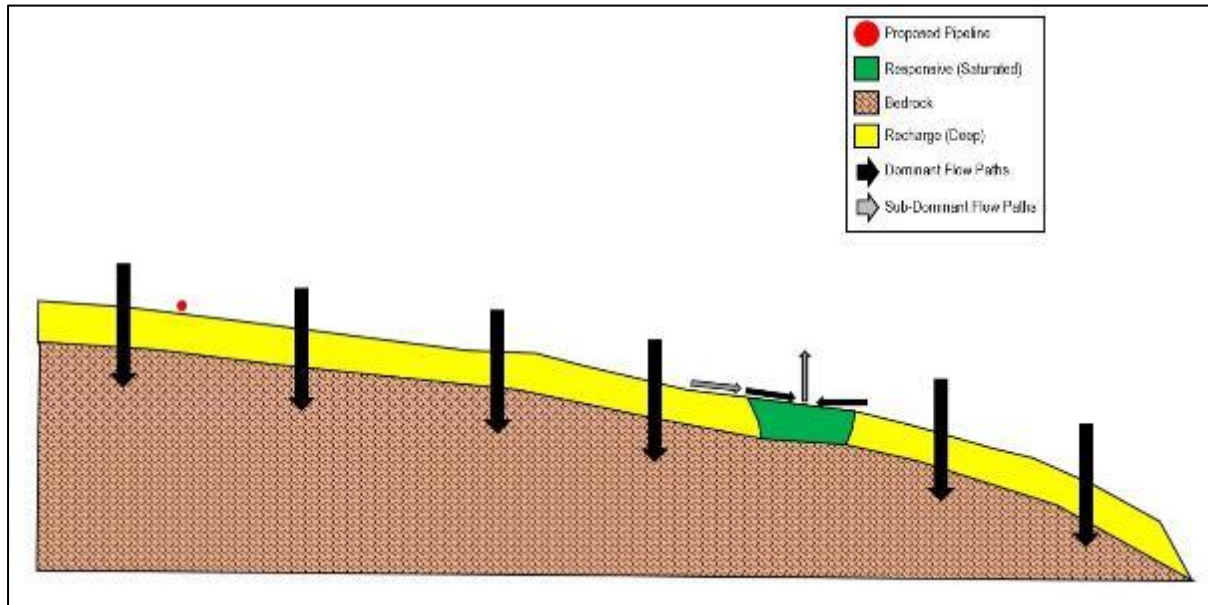


Figure 5-14 Conceptual cross profile of the hillslope associated with the relevant pipeline

6 Sensitivity Assessment

6.1 Sensitivity Approach

6.1.1 Overall sensitivity

All habitats within both project areas were assigned a very low sensitivity due to the impacted nature of these areas collectively. The major driving forces of the disturbed and degraded state of these areas are anthropogenic, such as clearing of vegetation, presence of a large amount of alien and invasive plant species, and fragmentation due to the presence of the existing pipelines including service roads. The least concern sensitivities are those areas that were deemed by the specialists to not have any features that are considered significant ecologically important or sensitive (Figure 6-5 and Figure 6-6).

It is important to note that this map does not replace any local, provincial or government legislation relating to these areas or the land use capabilities or sensitivities of these environments but is done in relation to the legislation.

6.1.2 Legislative Constraints

The following is deduced from the National Web-based Environmental Screening Tool:

- Terrestrial Biodiversity Theme is Very High, with an Ecological Support Area, CBA 2 and Threatened and Vulnerable Ecosystems being indicated as being present (Figure 6-1);
- Plant Species Theme is Medium and Low for both pipelines with floral species conservation concern indicated as possibly occurring in the vicinity of the site (Figure 6-2); and
- Animal Species Theme is Low/ Medium/High with possible species including a single bird, The African Marsh Harrier (*Circus ranivorus*) (Figure 6-3).

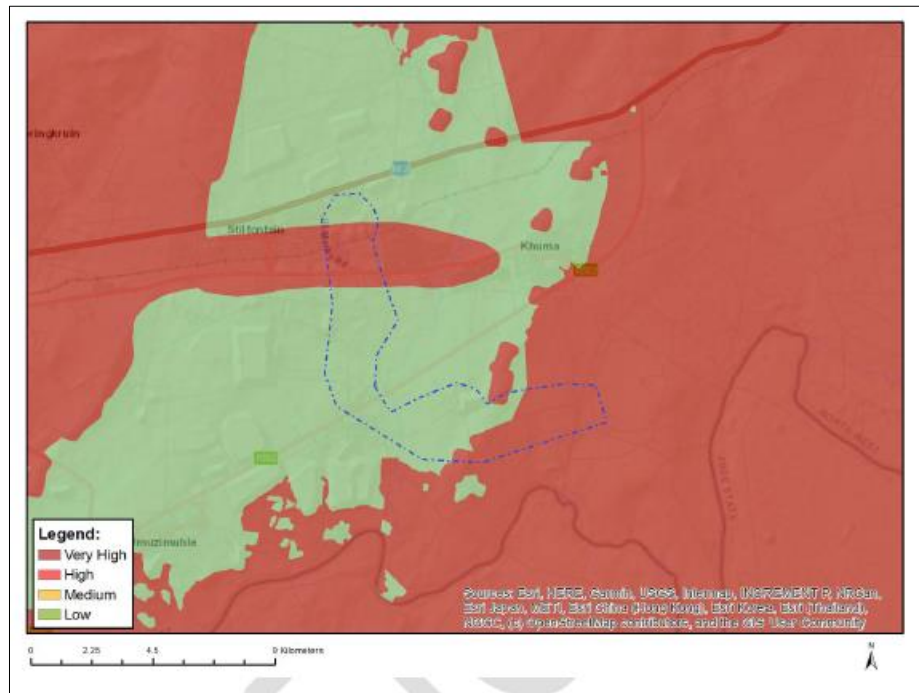


Figure 6-1 *Biodiversity Sensitivity of the project areas*

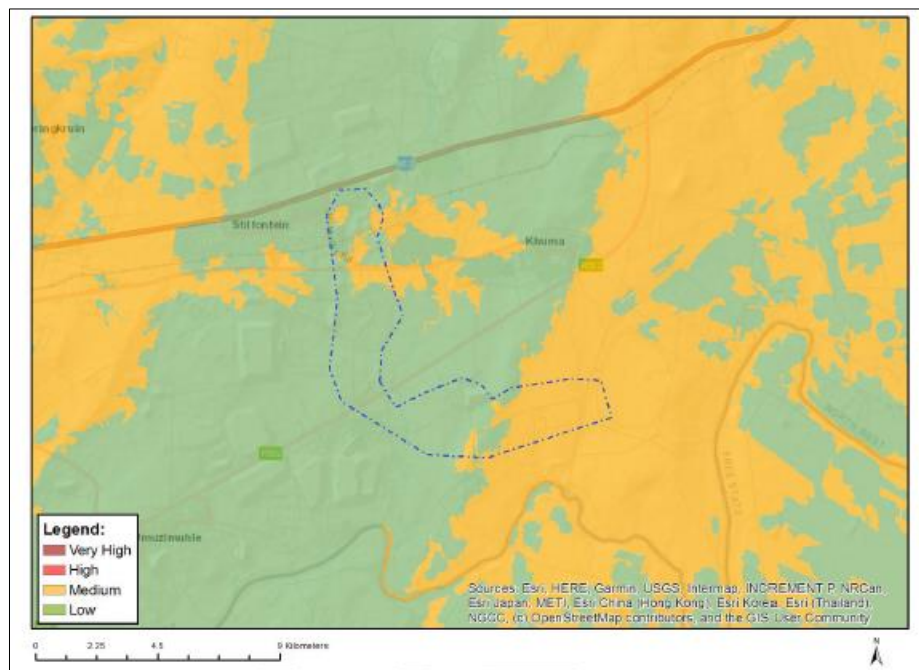


Figure 6-2 *Plant Species Sensitivity of the project areas*

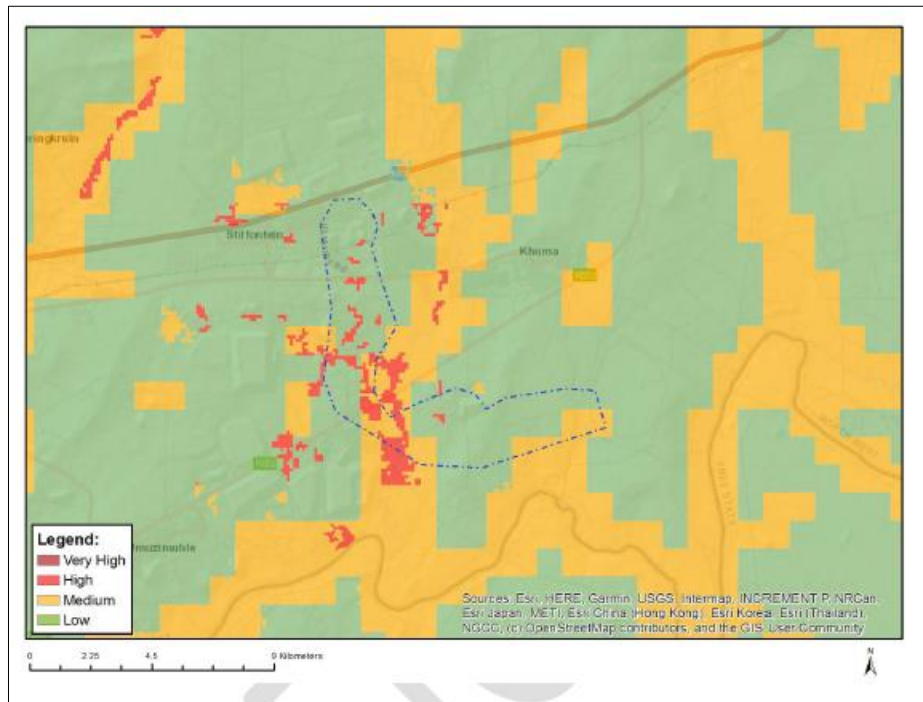


Figure 6-3 *Animal Biodiversity Sensitivity of the project areas*

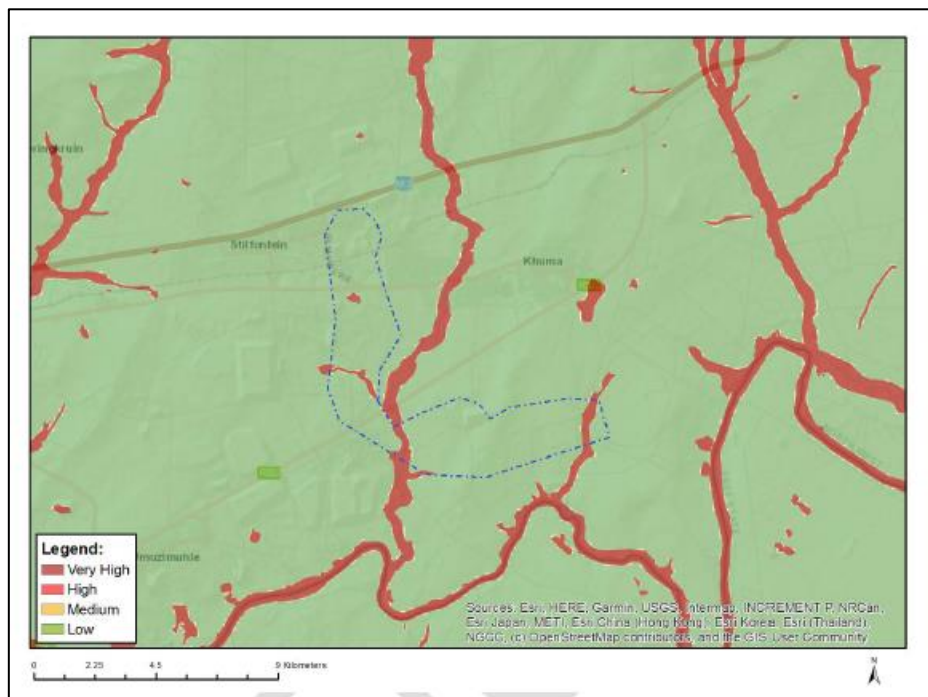


Figure 6-4 *Aquatics Biodiversity Sensitivity of the project areas*

The completion of the terrestrial biodiversity assessment disputes the very high and medium sensitivities of the screening report as the project areas were found to be in a transformed and disturbed state and both pipelines will be laid along the existing pipelines in areas that have been transformed. The CBA/ESA status of the area is no longer relevant, the ecosystem has been altered and the area cannot contribute as a protected area unless significant rehabilitation takes place.

Table 6-1 *Summary of habitat types delineated within the project area.*

| Habitat | Conservation Importance | Functional Integrity | Biodiversity Importance | Receptor Resilience | Site Ecological Importance |
|-------------------------------------|-------------------------|----------------------|-------------------------|---------------------|----------------------------|
| Valley Bottom wetland system (HGM1) | Low | Very Low | Very Low | High | Very Low |
| Transformed habitat | Very Low | Very Low | Very Low | High | Very Low |
| Drainage lines | Low | Very Low | Very Low | High | Very Low |

It is important to note that this map does not replace any local, provincial or government legislation relating to these areas or the land use capabilities or sensitivities of these environments but is done in relation to the legislation.

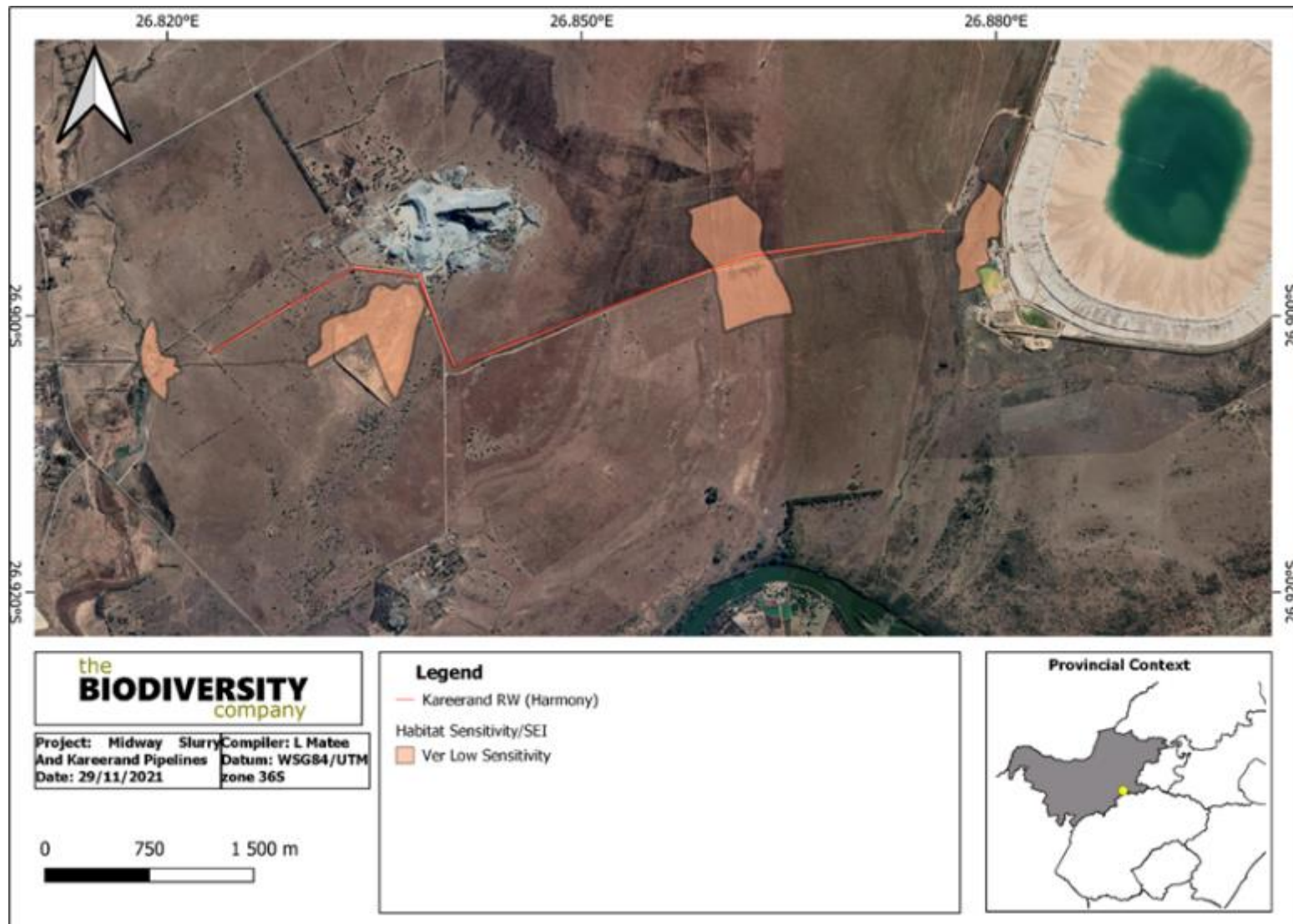


Figure 6-5 Habitat sensitivity relevant to the Kareerand pipeline

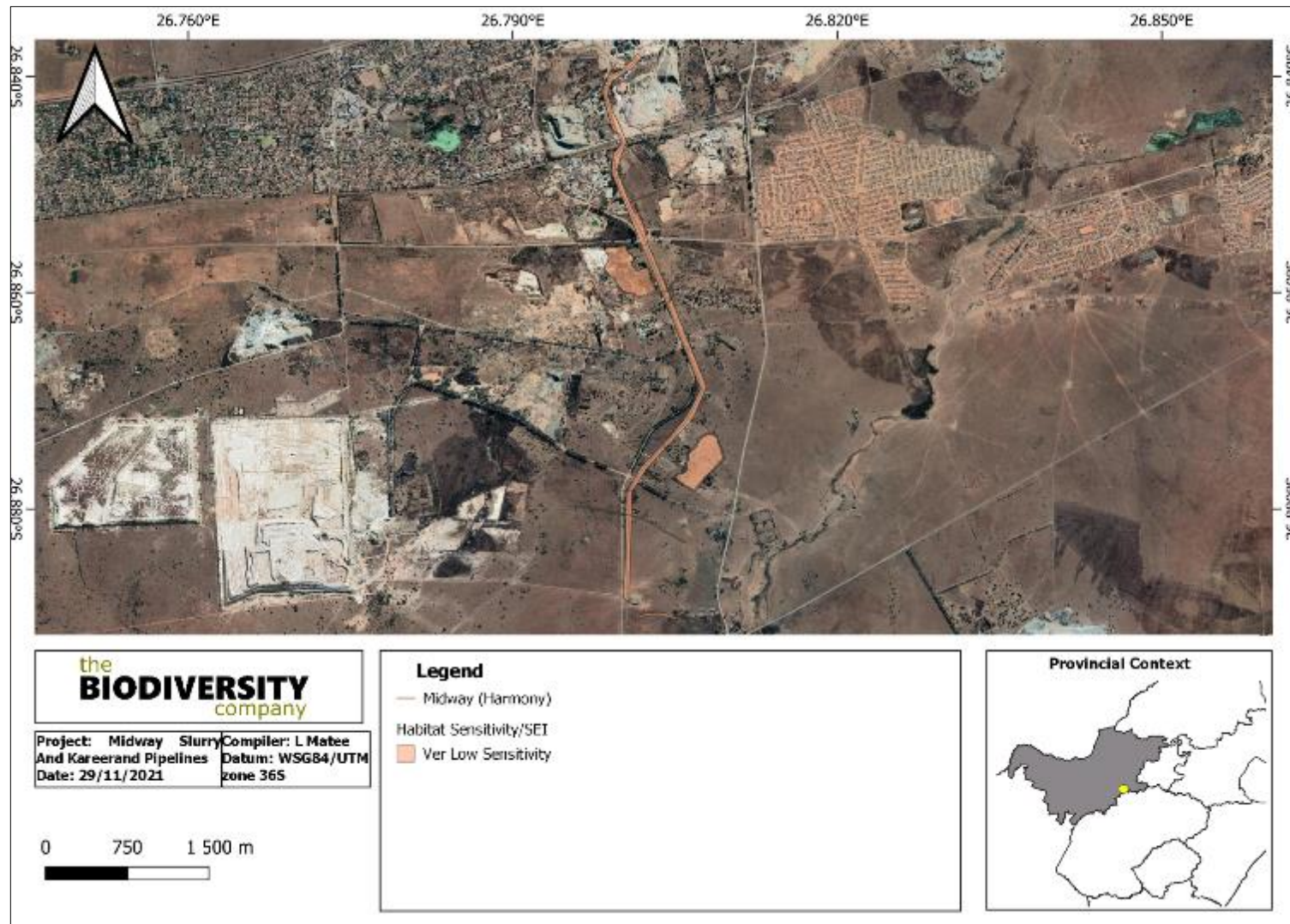


Figure 6-6 *Habitat sensitivity relevant to the Midway ST pipeline*

7 Risk Assessment

The risk assessment considered both direct and indirect impacts, to the wetland system. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 7-1). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts. It is evident from the buffer illustrations that the proposed pipelines will intersect wetland systems directly. This phenomenon therefore eliminates the feasibility of the first step. The second step (minimising) will be focussed on during the risk assessment to determine the possibility of significance ratings being decreased by means of mitigation.

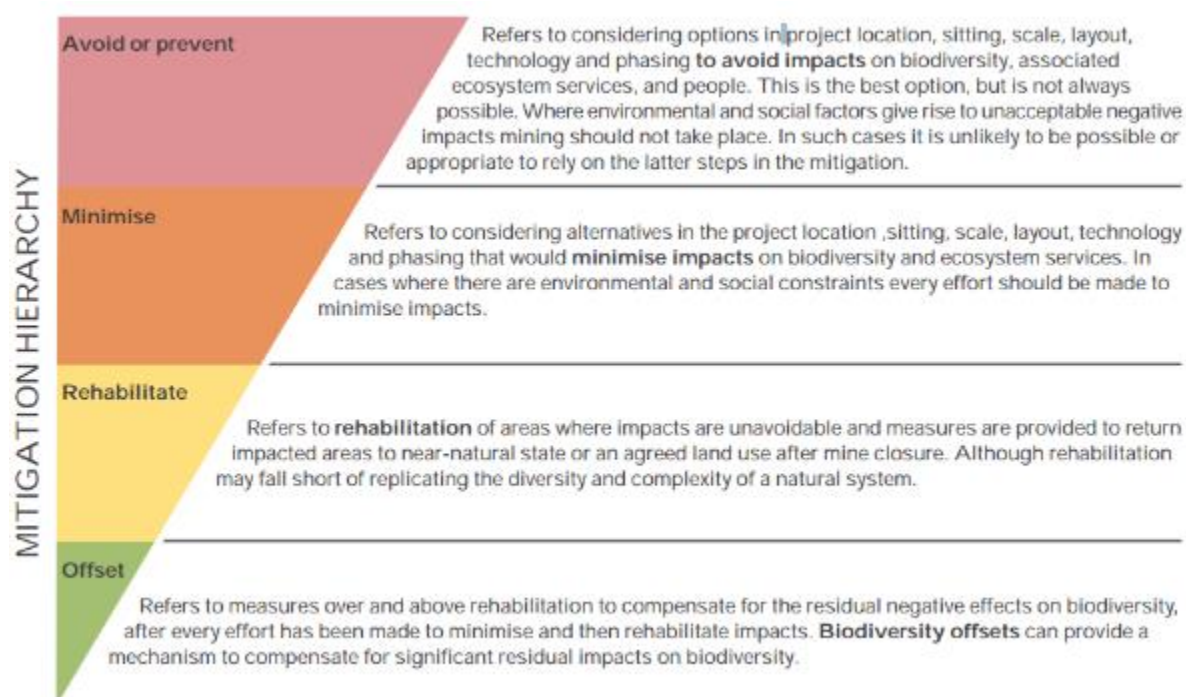


Figure 7-1 The mitigation hierarchy as described by the DEA (2013)

7.1 Potential Impacts Anticipated

Table 7-1 illustrates the potential aspects expected to threaten the integrity of sensitive receptors during the proposed activities. The pre- and post- mitigation significance ratings have been calculated considering various parameters, these results are illustrated in Table 7-2 and Table 7-3.

Table 7-1 Aspects and impacts relevant to the proposed activity

| Phase | Activity | Aspect | Impact |
|--------------------|--------------|--|--|
| Proposed Pipelines | Construction | Clearing of vegetation to facilitate the pipeline servitude | <ul style="list-style-type: none"> • Indirect loss of wetlands; • Erosion of wetland; • Loss of vegetation; • Decrease in functionality; • Water quality impairment; • Compaction; • Altering hydromorphic soils; |
| | | Stripping and stockpiling topsoil | |
| | | Operation of heavy machinery and equipment in close proximity to the watercourse | |
| | | Installation of pipelines | |

| | | | |
|--|-----------|--------------------------------------|---|
| | | Excavations | <ul style="list-style-type: none"> • Drainage patterns change; • Altering overland flow characteristics; and • Deposition of dust. |
| | | Ablution facilities | |
| | | Domestic and industrial waste | |
| | | Storage of chemicals, mixes and fuel | |
| | Operation | Maintenance of pipelines | |
| | | Alteration of sub-surface flows | |

The findings from Table 7-2 and Table 7-3 indicate that the majority of aspects involved with the construction and operation of the proposed pipelines have been scored a “Moderate” pre-mitigation significance rating. All of these ratings are expected to decrease to “Low” with the application of mitigation measures considering the fact that the wetland crossing will be carried out on an existing crossing servitude.

Therefore, it is the specialist’s opinion that the second step in the mitigation hierarchy (namely minimising impacts) could successfully be met. Considering the “Low” post-mitigation significance ratings, only a General Authorisation will be required.

Table 7-2 DWS Risk Impact Matrix for the proposed project (Andrew Husted Pr Sci Nat 400213/11)

| Severity | | | | | | | | |
|--|-------------|--------------------------------------|-----------------------------------|-------|----------|---------------|----------|-------------|
| Aspect | Flow Regime | Physico and Chemical (Water Quality) | Habitat (Geomorph and Vegetation) | Biota | Severity | Spatial scale | Duration | Consequence |
| Proposed Pipelines | | | | | | | | |
| Construction Phase | | | | | | | | |
| Clearing of vegetation to facilitate the pipeline servitude | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 9 |
| Stripping and stockpiling topsoil | 5 | 5 | 5 | 5 | 5 | 2 | 1 | 8 |
| Operation of heavy machinery and equipment in close proximity to the watercourse | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 9 |
| Installation of pipelines | 5 | 5 | 5 | 5 | 5 | 2 | 1 | 8 |
| Excavations | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 9 |
| Ablution facilities | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 9 |
| Stripping and stockpiling of soil | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 9 |
| Domestic and industrial waste | 5 | 5 | 5 | 5 | 5 | 2 | 1 | 8 |
| Storage of chemicals, mixes and fuel | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 9 |
| Operational Phase | | | | | | | | |
| Maintenance of pipelines | 2 | 2 | 1 | 1 | 1,5 | 1 | 1 | 3,5 |
| Alteration of sub-surface flows | 2 | 2 | 1 | 1 | 1,5 | 2 | 5 | 8,5 |

Table 7-3 DWS Risk Assessment Continued

| Aspect | Frequency of activity | Frequency of impact | Legal Issues | Detection | Likelihood | Sig. | Without Mitigation | With Mitigation |
|--|-----------------------|---------------------|--------------|-----------|------------|------|--------------------|-----------------|
| Proposed Pipelines | | | | | | | | |
| Construction Phase | | | | | | | | |
| Clearing of vegetation to facilitate the pipeline servitude | 1 | 2 | 5 | 1 | 9 | 72 | Moderate | Low |
| Stripping and stockpiling topsoil | 3 | 3 | 1 | 3 | 10 | 90 | Moderate | Low |
| Operation of heavy machinery and equipment in close proximity to the watercourse | 1 | 3 | 5 | 2 | 11 | 88 | Moderate | Low |
| Installation of pipelines | 1 | 2 | 5 | 1 | 9 | 81 | Moderate | Low |
| Excavations | 1 | 2 | 5 | 3 | 11 | 88 | Moderate | Low |
| Ablution facilities | 2 | 3 | 5 | 1 | 11 | 99 | Moderate | Low |
| Domestic and industrial waste | 2 | 2 | 5 | 1 | 10 | 90 | Moderate | Low |
| Storage of chemicals, mixes and fuel | 2 | 2 | 5 | 1 | 10 | 90 | Moderate | Low |
| Operation Phase | | | | | | | | |
| Maintenance of pipelines | 1 | 1 | 1 | 2 | 5 | 17,5 | Low | Low |
| Alteration of sub-surface flows | 3 | 1 | 1 | 2 | 7 | 59,5 | Moderate | Low |

(*) denotes - In accordance with General Notice 509 "Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below."

8 Impact Assessment

Potential impacts were evaluated against the data captured during the fieldwork to identify relevance to the project areas, specifically the proposed development footprint area. The relevant impacts were then subjected to a prescribed impact assessment methodology. The details of this methodology can be provided on request.

Impacts were assessed in terms of the construction/operational, decommissioning/rehabilitation and closure phases. Mitigation measures were only applied to impacts deemed relevant based on the impact analysis and can be seen in section 13.

8.1 Impact Assessment Methodology

An impact assessment methodology was provided by EIMS to determine the environmental risk associated with various aspects related to the proposed activities. This impact assessment considers the following components.

- The nature of the associated impact (positive or negative);
- The extent of the proposed activities;
- The duration of the proposed activities;
- The magnitude of the effects caused by the proposed activities;
- The reversibility of associated impacts; and
- The probability of relevant aspects affecting sensitive receptors.

Each one of the above-mentioned components is given a rating, which cumulatively provides the specialist with a pre-mitigation environmental risk rating. These components are then scored again taking into consideration mitigating factors. The cumulative impact and irreplaceable loss to sensitive receptors are then scored to ultimately indicate a “Priority Factor” score.

8.2 Current Impacts

The current impacts observed during surveys are listed below. Photographic evidence of a selection of these impacts is shown in Figure 8-1.

- Overgrazing and trampling of natural vegetation and wetlands by livestock;
- Erosion;
- Excavation and remnants of mining;
- Alien and/or Invasive Plants (IAP);
- Servitudes and infrastructure (powerlines)
- Vegetation removal for access roads/maintenance roads

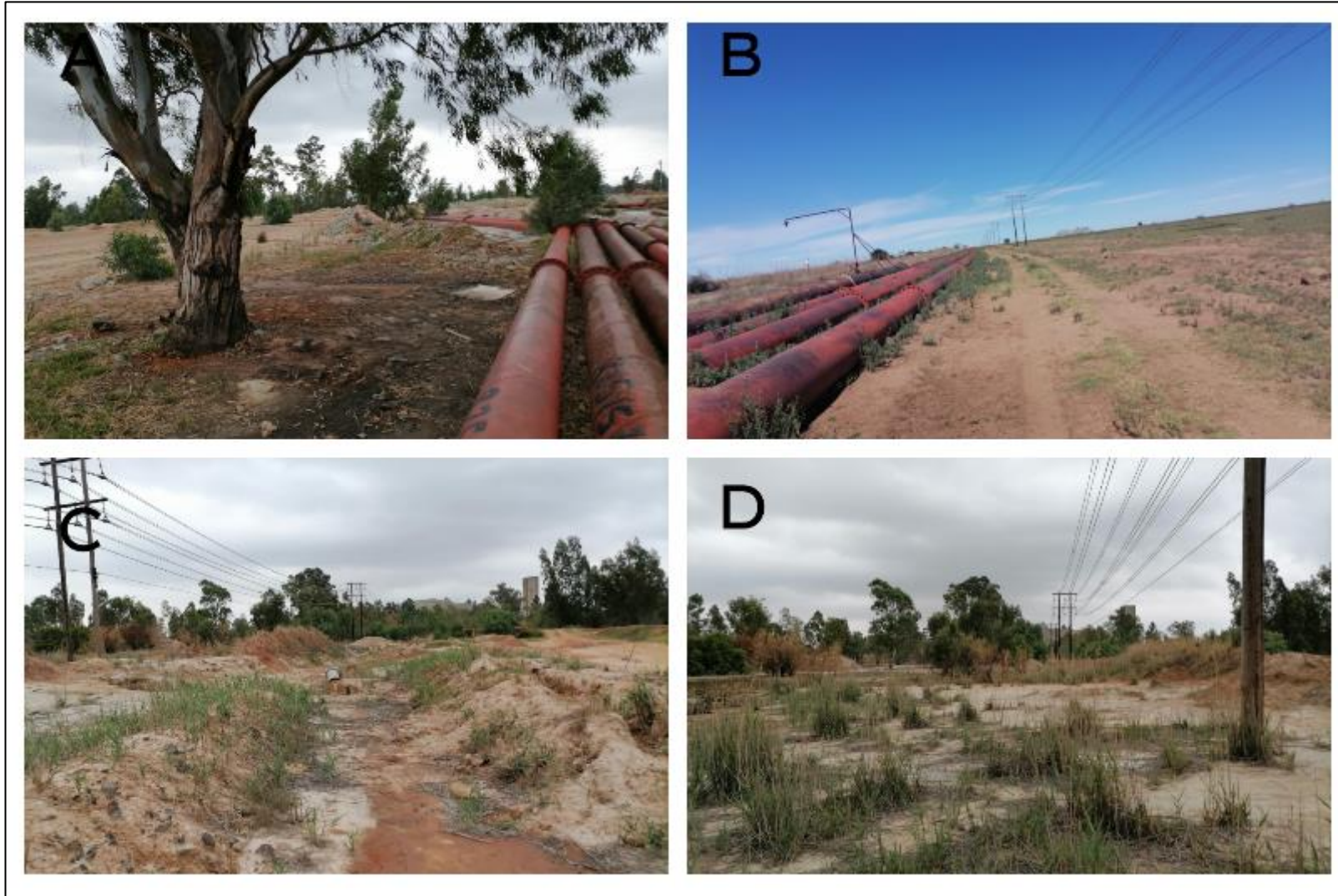


Figure 8-1 Some of the identified impacts within the project areas; A) Alien invasive plants, B) Old Pipeline and existing service roads, C) Excavation, D) Servitudes and infrastructure (powerlines).

8.3 Anticipated Impacts

The impacts anticipated for the proposed activities are considered to predict and quantify these impacts and assess & evaluate the magnitude of the identified terrestrial biodiversity.

Table 8-1 Anticipated impacts for the proposed activities on terrestrial biodiversity

| Main Impact | Project activities that can cause loss of habitat (especially with regard to the construction of the pipeline): | Secondary impacts anticipated |
|--|---|--|
| 1. Destruction, fragmentation and degradation of habitats and ecosystems | Physical removal of vegetation (Pipeline construction) | Displacement/loss of flora & fauna (including SCC) Increased potential for soil erosion Habitat fragmentation Increased potential for the establishment of alien & invasive vegetation |
| | Access roads and servitudes | |
| | Soil dust precipitation | |
| | Water/Sewage leakages | |
| | Dumping of waste products | |
| | Random events such as fire (cooking fires or cigarettes) | |
| 2. Spread and/or establishment of alien and/or invasive species | Vegetation removal | Habitat loss for native flora & fauna (including SCC) Spreading of potentially dangerous diseases due to invasive and pest species Alteration of fauna assemblages due to habitat modification |
| | Vehicles potentially spreading seed | |
| | Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive rodents | |
| | Creation of infrastructure suitable for breeding activities of alien and/or invasive birds | |
| 3. Direct mortality of fauna | Clearing of vegetation | Loss of ecosystem services Increase in rodent populations and associated disease risk |
| | Pollution of water resources due to dust effects, chemical spills or sewage leakages | |
| 4.. Reduced dispersal/migration of fauna | Loss of landscape used as a corridor | Loss of ecosystem services Reduced plant seed dispersal |
| | Compacted roads | |
| | Removal of vegetation | |
| | Light, noise and dust disturbance | |
| 5. Environmental pollution due to water/ mine drainage runoff | Chemical (organic/inorganic) spills | Faunal mortality (direct and indirectly) Groundwater pollution Loss of ecosystem services |
| | Erosion | |
| 6. Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, dust and light pollution. | Operation of machinery (Large earthmoving machinery, generators) | Loss of ecosystem services |
| | Vehicles | |
| 8. Staff and others interacting directly with fauna (potentially dangerous) or poaching of animals | All unregulated/supervised activities outdoors | Harm to fauna and/or staff |

8.4 Unplanned Events

The planned activities will have anticipated impacts as discussed; however, unplanned events may occur on any project and may have potential impacts which will need management.

Table 8-2 is a summary of the findings of an unplanned event assessment from a terrestrial ecology perspective. Note, not all potential unplanned events may be captured herein, and this must therefore be managed throughout all phases according to recorded events.

Table 8-2 Summary of unplanned events for terrestrial biodiversity

| Unplanned Event | Potential Impact | Mitigation |
|--|---|---|
| Hydrocarbon spills into the surrounding environment | Contamination of habitat as well as water resources associated with return water and slurry spillage. | A spill response kit must be available at all times. The incident must be reported on and if necessary, a biodiversity specialist must investigate the extent of the impact and provide rehabilitation recommendations. |
| Fire | Uncontrolled/unmanaged fire that spreads to the surrounding natural grassland and wetlands | An appropriate/Adequate fire management plan needs to be implemented. |
| Leaking pipeline | Contamination of habitat as well as water resources associated with return water and slurry spillage. | An alert or alarm system otherwise regular monitoring or the pipeline weekly. |

8.5 Construction Phase

The following potential impacts on biodiversity were considered for the construction phase of the pipeline project. This phase refers to the period during construction when the proposed infrastructure is constructed or upgraded. This phase usually has the largest direct impact on biodiversity. The following potential impacts to terrestrial biodiversity were considered.

8.5.1 Destruction, further loss and fragmentation of the vegetation community

The vegetation communities are classed as EN and VU, through site clearing beyond the site footprint or of the existing servitude/ cleared areas that are currently utilised as service roads, more of the vegetation communities will be lost. Unmitigated, this will also lead to habitat fragmentation and the establishment of alien invasive species as well as soil erosion.

Activities that will contribute to this impact:

- Driving/ moving outside of designated areas;
- Physical removal of vegetation outside of the existing servitude/ cleared areas that are currently utilised as service roads;
- Temporary site establishment (laydown, chemical toilets etc.);
- Soil dust precipitation as a result of site establishment;
- Dumping of waste products;
- Hydrocarbon storage and leakages; and
- Random events such as fire (cooking fires or cigarettes).

8.5.1.1 Cumulative Impacts

- Further loss of EN and VU vegetation type;

8.5.1.2 Irreplaceable Loss of Resources

- Loss of EN and VU vegetation type

8.5.1.3 Impacts on Alternatives Considered

No alternatives were assessed.

8.5.2 Loss of CBA and ESA.

Portions of the project areas are classified as CBA2, ESA1.

- Driving/ infringing outside of designated areas;
- Physical removal of vegetation;
- Temporary site establishment (laydown, chemical toilets etc.);
- Soil dust precipitation as a result of site establishment;
- Dumping of waste products;
- Hydrocarbon storage and leakages; and
- Random events such as fire (cooking fires or cigarettes).

8.5.2.1 Cumulative Impacts

- Loss of movement corridors; and
- Loss of habitat for species including migratory species.

8.5.2.2 Irreplaceable Loss of Resources

- Loss of CBA: important habitat; and
- Loss of wetland habitat;

8.5.2.3 Impacts on Alternatives Considered

No alternatives were assessed.

8.5.3 Introduction of alien invader species, impacting on the floral characteristics of the project site and adjacent natural areas

Although alien invasive species are currently common along the proposed pipeline routes, additional disturbances caused by construction activities will cause the further establishment and spread of invasive plants. Although initiated during the construction phase, this impact will persist throughout all phases of the proposed project unless correctly managed, and therefore has a long-term duration. It has a high magnitude and probability of occurrence and will occur in all sites that are disturbed by construction, resulting in an impact significance of Moderate before mitigation. Provided that the proposed mitigation measures are implemented as part of the construction phase, the potential impact may be reduced to Low significance. Activities that will contribute to this impact:

- Vegetation removal outside of the existing servitude/ cleared areas that are currently utilised as service roads and disturbance of soil;
- Vehicles potentially spreading seed;
- Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive; and

- Eating areas increase pest species such as rats and flies.

8.5.3.1 Cumulative Impacts

- Loss of habitat for indigenous species; and
- Spread of disease to surrounding areas.

8.5.3.2 Irreplaceable Loss of Resources

- Loss of CBA: important and ESA habitat.

8.5.3.3 Impacts on Alternatives Considered

No alternatives were assessed.

8.5.4 Soil erosion and sedimentation

Disturbance to existing vegetation during construction coupled with soil mobilisation from earthworks may cause erosion, which could lead to increases in sediment load adjacent wetland systems. This may result in a reduction in wetland ecosystem integrity. Furthermore, Erosion will lead to the loss of vegetation, the removal/ relocation of the topsoil and the destruction of habitat. Activities that will contribute to this impact:

- Soil mobilisation from earthworks
- Vehicles driving outside demarcated areas;
- Footpaths outside demarcated areas;
- Clearing of vegetation;
- Water runoff from areas with bare soil; and
- Compacting of roads.

8.5.4.1 Cumulative Impacts

- Removal of topsoil; and
- Loss of habitat for indigenous species.

8.5.4.2 Irreplaceable Loss of Resources

- Loss of CBA area.

8.5.4.3 Impacts on Alternatives Considered

No alternatives were assessed.

8.5.5 Displacement of faunal community due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, dust, vibration and poaching).

The faunal community will be influenced in several ways, including the loss of habitat, disturbances that will either make them move out of the area if possible or have to adapt and possible deaths due to physical harm or indirect harm. Smaller and less mobile fauna species may be trapped, injured and killed during vegetation clearing and earthworks. Several Ground

Squirrel individuals and some porcupines were found to be burrowing and foraging along and underneath the existing pipeline routes and these may be impacted. Activities that will contribute to this impact:

- Clearing of vegetation;
- Roadkill due to vehicle collision;
- Pollution of water resources due to dust effects and run-off;
- Intentional killing of fauna for food (hunting) or otherwise (killing of snakes);
- Disease caused by increased dust levels;
- Increase in pest species in the area due to new food source created; and
- Vibrations, noise and rock chips skidding out due to the construction activities.

8.5.5.1 Cumulative Impacts

- Loss of habitat for indigenous species.

8.5.5.2 Irreplaceable Loss of Resources

- Loss of faunal SCCs.

8.5.5.3 Impacts on Alternatives Considered

No alternatives were assessed.

8.5.6 Potential leaks, discharges, pollutants from machinery and storage leaching into the surrounding environment.

In the event of hydrocarbon spills from machinery used in the construction, contaminated pollutants may likely enter into the adjacent natural habitat thus impacting the vegetation and nearby aquatic resources and thus resulting in the loss of usable water resources, the loss of fauna and flora species. This will also result in the contamination of the topsoil and reduce the likelihood of successful rehabilitation of an area.

Activities that will contribute to this impact:

- Loss of vegetation; and
- Loss of topsoil.

8.5.6.1 Cumulative Impacts

- Loss of usable water resources for fauna species; and
- Loss of viable habitat.

8.5.6.2 Irreplaceable Loss of Resources

- Loss of usable water resources for fauna species resulting in loss of SCC and other species.

8.5.6.3 Impacts on Alternatives Considered

No alternatives were assessed.

8.5.7 Loss of wetland functionality from the Kareerand pipeline

The Kareerand Pipeline is proposed to cross through a delineated wetland (namely HGM 1). It is however worth noting that this pipeline will traverse the wetland system through an existing servitude crossing the system. Even though current impacts from this servitude are evident, only impacts from the proposed construction will be considered for this impact assessment.

During the construction phase, heavy vehicles will be used to transport and lay the pipelines over the existing servitude. It is assumed that the current servitude is wide enough for vehicles to stay completely clear of the surrounding wetland areas.

8.5.7.1 Mitigation Measures

The main mitigation measure includes vehicles being restricted to current access roads and servitudes. No laydown yards or parking areas are permitted within the wetland buffer zones. More mitigation measures are listed in Section 9.

8.5.7.2 Cumulative Impacts

The cumulative impacts have been scored “High” due to the fact that the current pipelines located on the same servitude as the proposed pipeline is subject to current and historic leaks and spills.

8.5.7.3 Irreplaceable Loss of Resources

The construction phase of the relevant activities is unlikely to result in a loss of natural resources owing to the fact that it is assumed that best practice engineering protocols will be undertaken to avoid spills and leaks.

8.5.7.4 Impacts on Alternatives Considered

No alternatives were assessed.

8.6 Operational Phase

This phase will initially involve the removal of the backfilling of the excavations if any have been made. Followed by the rehabilitation of the areas, construction has been completed and the proposed infrastructure has been laid down and is functional.

8.6.1 Continued encroachment of an indigenous and EN/VU vegetation community by alien invasive plant species as well as erosion due to disturbed soils

The spread of alien invasive species will result in the loss of habitat and water for indigenous fauna and flora. Overall, the fauna assemblage will be changed. Erosion will also disrupt the vegetation in the surrounding areas and result in habitat loss. Activities that will contribute to this impact:

- Vehicles potentially spreading seed;

- Unsanitary conditions during infrastructure removal promoting the establishment of alien and/or invasive;
- Stormwater runoff from roads, and other bare areas;
- Increased introduction and proliferation of alien plant species due to a lack of maintenance activities, or poorly implemented and monitored IAP Management programme, leading to the ongoing displacement of natural vegetation outside of the footprint area; and
- Footpaths outside demarcated areas.

8.6.1.1 Cumulative Impacts

- Loss of habitat; and
- Loss of indigenous flora species due to competition.

8.6.1.2 Irreplaceable Loss of Resources

- Loss of flora SCCs; and
- Loss of habitat and food sources for Fauna SCCs.

8.6.1.3 Impacts on Alternatives Considered

No alternatives were assessed.

8.6.2 Continued displacement and fragmentation of the faunal community (including threatened species) due to ongoing anthropogenic disturbances (noise, dust and vibrations) and habitat degradation/loss (litter, road mortalities and/or poaching).

The new pipelines might lead to increased human presence in the area once operational, potentially leading to the persecution of fauna in the adjacent natural habitat, or an increased risk of fire frequency impacting on floral and faunal communities outside of the development footprint;

- Increased anthropogenic disturbances (noise, human presence, litter and poaching/snaring);
- Intentional killing of fauna for food (hunting) or otherwise (killing of snakes);
- The disruption of natural faunal movement corridors.

8.6.2.1 Cumulative Impacts

- Loss of suitable habitat.

8.6.2.2 Irreplaceable Loss of Resources

- Loss of faunal SCCs.

8.6.2.3 Impacts on Alternatives Considered

No alternatives were assessed.

8.6.3 Potential Impact as a result of tailings spill or return water spills from the pipeline damage spreading into the surrounding environment.

The risk associated with the operation of the pipelines would be spills or leaks associated with either poor seals or more significant faults such as breaks/bursts. This could lead to contamination of water resources when the slurry enters the stream or wetland which will result in the loss of usable water resources, the loss of fauna and flora species and the associated habitat.

Activities that will contribute to this impact:

- Pipeline leakages or damage

8.6.3.1 Cumulative Impacts

- Loss of usable water resources for fauna species; and
- Loss of viable habitat.

8.6.3.2 Irreplaceable Loss of Resources

- Loss of usable water resources for fauna species resulting in loss of SCC and other species.

8.6.3.3 Impacts on Alternatives Considered

No alternatives were assessed.

8.6.4 Loss of Wetland Functionality from the Kareerand Pipeline

During the operational phase, the existing servitude will continue to impact upon the hydrology and surface/sub-surface flow dynamics. Further to existing impacts, very little additional impacts are foreseen.

8.6.4.1 Mitigation Measures

All mitigation measures are listed in Section 9.

8.6.4.2 Cumulative Impacts

The cumulative impacts have been scored “High” due to the fact that the current pipelines located on the same servitude as the proposed pipeline is subject to current and historic leaks and spills.

8.6.4.3 Irreplaceable Loss of Resources

The construction phase of the relevant activities is unlikely to result in a loss of natural resources owing to the fact that it is assumed that best practice engineering protocols will be undertaken to avoid spills and leaks.

8.6.4.4 Impacts on Alternatives Considered

No alternatives were assessed.

8.7 Assessment of Significance

Table 8-3 shows the significance of potential impacts associated with the proposed activities, on biodiversity before and after the implementation of mitigation measures as well as cumulative and irreplaceable loss.

Table 8-3 *Assessment of the significance of potential impacts on terrestrial biodiversity associated with the project.*

| Impact | Pre-mitigation ER | Post-mitigation ER | Confidence | Cumulative Impact | Irreplaceable loss | Priority Factor | Final score |
|---|-------------------|--------------------|------------|-------------------|--------------------|-----------------|-------------|
| Construction Phase | | | | | | | |
| Destruction, further loss and fragmentation of the vegetation community | -14 | -3,5 | High | 2 | 2 | 1,00 | -3,50 |
| Loss of CBA and ESA | 18,75 | -4,5 | High | 3 | 2 | 1,17 | -5,25 |
| Introduction of alien invader species, impacting on the floral characteristics of the project site and adjacent natural areas | -20 | -6 | Medium | 2 | 2 | 1,00 | -6,00 |
| Soil erosion and sedimentation | -9 | -6 | Medium | 2 | 2 | 1,17 | -7,00 |
| Displacement of faunal community due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, dust, vibration and poaching). | -13 | -6,75 | High | 2 | 2 | 1,17 | -7,88 |
| Potential leaks, discharges, a pollutant from machinery and storage leaching into the surrounding environment | -14 | -3,5 | Medium | 2 | 2 | 1,17 | -4,08 |
| Loss of wetland functionality | -3,5 | -3,5 | Medium | 3 | 1 | 1,17 | -4,08 |
| Operational Phase | | | | | | | |
| Continued encroachment of an indigenous and EN/VU vegetation community by alien invasive plant species as well as erosion due to disturbed soils | -16 | -6,75 | Medium | 2 | 2 | 1,17 | -7,88 |
| Continued displacement and fragmentation of the faunal community (including threatened species) due to ongoing anthropogenic disturbances (noise, dust and vibrations) and habitat degradation/loss (litter, road mortalities and/or poaching). | -14 | -4 | Medium | 2 | 2 | 1,00 | -4,00 |
| Potential Impact as a result of tailings spill or return water spills from the pipeline damage spreading into the surrounding environment. | -14 | -4 | High | 2 | 2 | 1,17 | -4,67 |
| Loss of wetland functionality | -5 | -5 | Medium | 3 | 1 | 1,17 | -5,83 |

9 Specialist Management Plan

Table 9-1 presents the recommended mitigation measures and the respective timeframes, targets and performance indicators for the respective studies. The mitigations within this section have been taken into consideration during the impact assessment in cases where the post-mitigation environmental risk is lower than that of the pre-mitigation environmental risk.

The focus of mitigation measures is to reduce the significance of potential impacts associated with the development and thereby to:

- Ensure an approach that will provide the necessary confidence in terms of environmental compliance;
- Prevent the further loss and fragmentation of vegetation communities and the CBA areas in the vicinity of the project areas;
- Conserve sensitive receptors linked with wetland habitats to ensure that the functional integrity of all delineated systems is ensured;
- As far as possible, reduce the negative fragmentation effects of the linear development and enable safe movement of faunal species; and
- Prevent the direct and indirect loss and disturbance of faunal species and community (including occurring and potentially occurring species of conservation concern).

Table 9-1 Mitigation measures including requirements for timeframes, roles and responsibilities for the wetlands and terrestrial.

| Management outcome: Vegetation and Habitats | | | | |
|--|------------------------------------|---|---|---|
| Impact Management Actions | Implementation | | Monitoring | |
| | Phase | Responsible Party | Aspect | Frequency |
| The construction and final development footprints should be demarcated, and all proposed activities should be restricted to the proposed development areas | Planning | Project manager, Environmental Officer | Number of contractors within the area | Ongoing |
| Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed further. Clearing of vegetation should be minimized and avoided where possible. Maintain small patches of natural vegetation within the construction site to accelerate restoration and succession of cleared patches. All activities must be restricted to the very low sensitivity areas. No further loss of medium sensitivity areas should be permitted. It is recommended that areas to be developed be specifically demarcated so that during the construction phase, only the demarcated areas be impacted upon (Demarcation must be clearly visible and effective and the no-go area must remain demarcated throughout the construction phase); | Life of operation | Project manager, Environmental Officer | Areas of indigenous vegetation (Medium Sensitivity) | Ongoing |
| All construction/operational and access must make use of the existing access and maintenance roads; | Construction/Operational Phase | Environmental Officer & Design Engineer | Roads and paths used | Ongoing |
| All laydown, chemical toilets etc. should be restricted to least concern sensitivity areas. Any materials may not be stored for extended periods and must be removed from the project areas once the construction/closure phase has been concluded. No permanent structures should be permitted at laydown area. No storage of vehicles or equipment will be allowed outside of the designated project areas. | Construction/Operational Phase | Environmental Officer & Design Engineer | Laydown areas and material storage & placement. | Ongoing |
| Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events. This will also reduce the likelihood of encroachment by alien invasive plant species | Closure Phase/Rehabilitation phase | Environmental Officer & Contractor | Assess the state of rehabilitation and encroachment of alien vegetation | Quarterly for up to two years after the closure |
| All footprints are to be rehabilitated and landscaped after construction is complete. Rehabilitation of the disturbed areas existing in the project areas must be made a priority. Topsoil must also be utilised, and any disturbed area must be re-vegetated with plant and grass species that are endemic to this vegetation type; | Operational Phase | Environmental Officer & Contractor | Footprint rehabilitation | Quarterly monitoring |
| A hydrocarbon spill management plan must be put in place to ensure that should there be any chemical spill out or over that, it does not run into the surrounding areas. The Contractor shall be in possession of an emergency spill kit that must always be complete and available on site. Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and | Life of operation | Environmental Officer & Contractor | Spill events, Vehicles dripping. | Ongoing |

| equipment when not in use. No servicing of equipment on-site unless necessary. All contaminated soil/yard stone shall be treated in situ or removed and be placed in containers | | | | |
|---|--------------------------------|--|---------------------------------------|-----------|
| Leaking equipment and vehicles must be repaired immediately or be removed from the project areas to facilitate the repair. | Life of operation | Environmental Officer & Contractor | Leaks and spills | Ongoing |
| Storm Water discharge must be managed and restricted in such a manner that it does not cause erosion or flooding (flow paths, velocity and effects) and the water quality must be managed. | Life of operation | Environmental Officer & Design Engineer | Flooding and Water Quality | Monthly |
| It should be made an offence for any staff to /take bring any plant species into/out of any portion of the project areas. No plant species whether indigenous or exotic should be brought into/taken from the project areas, to prevent the spread of exotic or invasive species or the illegal collection of plants. | Life of operation | Project manager, Environmental Officer & Contractor | Any instances | Ongoing |
| A fire action plan needs to be complied with and implemented to restrict the impact unplanned fires might have on the surrounding areas. | Life of operation | Environmental Officer & Contractor | Fire Management | Ongoing |
| Management outcome: Fauna | | | | |
| Impact Management Actions | Implementation | | Monitoring | |
| | Phase | Responsible Party | Aspect | Frequency |
| An Environmental Control Officer (ECO) that is qualified and competent within the field of environmental management must be on site when construction begins to identify faunal species that will be directly disturbed and to relocate fauna/flora that is found during the activities. | Life of operation | Environmental Officer, Contractor | Presence of any floral or faunal SCC. | Ongoing |
| No trapping, killing, or poisoning of any wildlife is to be allowed. • Signs must be put up to enforce this; | Life of operation | Environmental Officer & Contractor | Evidence of trapping etc | Ongoing |
| The duration of the construction should be minimized to as short term as possible, to reduce the period of disturbance on fauna | Construction/Operational Phase | Project manager, Environmental Officer & Design Engineer | Construction/Closure Phase | Ongoing |
| All construction and maintenance motor vehicle operators should undergo an environmental induction that includes instruction on the need to comply with speed limits, to respect all forms of wildlife. Speed limits must still be enforced to ensure that road killings and erosion is limited. | Life of operation | Health and Safety Officer | Compliance with the training. | Ongoing |
| The areas to be developed must be specifically demarcated to prevent movement of staff or any individual into highly sensitive areas outside of the project area (i.e., Nature Reserve) and the surrounding environments, i.e. the wetlands; • Signs must be put up to enforce this | Construction/Operational Phase | Project manager, Environmental Officer | Infringement into these areas | Ongoing |
| Management outcome: Alien Vegetation | | | | |
| Impact Management Actions | Implementation | | Monitoring | |

| | Phase | Responsible Party | Aspect | Frequency |
|--|--------------------------------|---|---|----------------------|
| Implementation of existing Harmony/MWS IAP management plan is highly recommended | Life of operation | Project manager, Environmental Officer & Contractor | Assess presence and encroachment of alien vegetation | Quarterly monitoring |
| The footprint area of the construction should be kept to a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas | Construction/Operational Phase | Project manager, Environmental Officer & Contractor | Footprint Area | Life of operation |
| Management outcome: Waste management | | | | |
| Impact Management Actions | Implementation | | Monitoring | |
| | Phase | Responsible Party | Aspect | Frequency |
| Waste management must be a priority and all waste must be collected and stored effectively. | Life of operation | Environmental Officer & Contractor | Waste Removal | Weekly |
| A minimum of one toilet must be provided per 15 persons. Portable toilets must be pumped dry to ensure the system does not degrade over time and spill into the surrounding area. | Life of operation | Environmental Officer & Health and Safety Officer | Number of toilets per staff member. Waste levels | Daily |
| The Contractor should supply sealable and properly marked domestic waste collection bins and all solid waste collected shall be disposed of at a licensed disposal facility | Life of operation | Environmental Officer & Health and Safety Officer | Availability of bins and the collection of the waste. | Ongoing |
| Refuse bins will be emptied and secured Temporary storage of domestic waste shall be in covered waste skips. Maximum domestic waste storage period will be 7 days. | Life of operation | Environmental Officer, Contractor & Health and Safety Officer | Management of bins and collection of waste | Ongoing |
| Management outcome: Environmental awareness training | | | | |
| Impact Management Actions | Implementation | | Monitoring | |
| | Phase | Responsible Party | Aspect | Frequency |
| All personnel and contractors to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the project areas to inform contractors and site staff of the presence of Red / Orange List species, their identification, conservation status and importance, biology, habitat requirements and management requirements the Environmental Authorisation and within the EMP. | Life of operation | EO | Compliance to the training. | Ongoing |
| Management outcome: Erosion | | | | |
| Impact Management Actions | Implementation | | Monitoring | |
| | Phase | Responsible Party | Aspect | Frequency |

| | | | | |
|---|--|---|---|---------------|
| Where possible, existing access routes and walking paths must be made use of, and the development of new routes limited. | Life of operation | Project manager, Environmental Officer | Routes used within the area | Ongoing |
| Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events. | Life of operation | Project manager, Environmental Officer | Re-establishment of indigenous vegetation | Progressively |
| Wetlands | | | | |
| Impact Management Actions | Implementation | | Monitoring | |
| | Phase | Responsible Party | Aspect | Frequency |
| Existing roads must be used as much as possible. | Planning, Construction and Operational | Project manager, Environmental Officer & Contractor | Roads and paths used | Ongoing |
| Proper stripping and stockpiling techniques must be followed. | Construction | Project manager, Environmental Officer & Contractor | Stockpiling | Ongoing |
| Avoid unnecessary vegetation clearing and avoid preferential surface flow paths. | Construction | Project manager, Environmental Officer & Contractor | Rehabilitation | Ongoing |
| Storage of potential contaminants in bunded areas | Construction | Project manager, Environmental Officer & Contractor | Construction | Ongoing |
| All contractors must have spill kits available and be trained in the correct use thereof. | Construction | Contractor | Construction | Ongoing |
| All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping". | Planning, Construction and Operational | Project manager, Environmental Officer & Contractor | Environment | Ongoing |
| No cleaning or servicing of vehicles, machines, and equipment in water resources. | Planning, Construction and Operational | Project manager, Environmental Officer & Contractor | | Ongoing |
| Adequate sanitary facilities and ablutions must be provided for all personnel throughout the project area. | Construction | Project manager, Environmental Officer & Contractor | Construction | Ongoing |
| Have action plans on site, and training for contractors and employees in the event of spills, leaks, and other impacts to the aquatic systems. | Construction | Project manager, Environmental Officer & Contractor | Construction | Ongoing |
| All waste generated on-site must be adequately managed and separated and recycled of different waste materials should be supported. | Construction | Project manager, Environmental Officer & Contractor | Recycle | Ongoing |
| Demarcate footprint areas to be cleared to avoid unnecessary clearing. | Construction | Project manager, Environmental Officer & Contractor | Construction | Ongoing |

| | | | | |
|--|--------------|---|----------------|---------|
| Exposed areas must be ripped and vegetated to increase surface roughness. | Construction | Project manager, Environmental Officer & Contractor | Rehabilitation | Ongoing |
| All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site. | Construction | Project manager, Environmental Officer & Contractor | Construction | Ongoing |

10 Conclusion

10.1 Terrestrial

It is the opinion of the ecologists that this assessment provides the relevant information required to implement Integrated Environmental Management and to ensure that the best long-term use of the ecological resources in the project area will be made in support of the principle of sustainable development. The proposed infrastructure project is not anticipated to pose significant threats to the receiving environment provided the mitigation measures are effectively applied, thus the proposed development can obtain approval.

The shapefiles received and the site visit along with the client interaction indicated that both the Kareerand RW pipeline and Midway ST line will be laid along the existing pipeline in the existing servitude which has been transformed already. Thus, both project areas can be considered transformed and significantly degraded due to IAP infestation of the existing pipeline and service roads as well as ongoing human disturbance.

The vegetation and ecology within the proposed pipeline areas have been heavily disturbed for a long time, both currently and historically. No significant patches of intact natural vegetation remain within the project areas. Terrestrial botanical diversity within the project areas is very low.

The temporary alteration of vegetation and soil structure in the affected areas of the proposed Kareerand RW pipeline as well as the Kareerand ST pipeline may however still impact the fauna and flora directly within the proposed pipeline alignments/servitudes and potentially in the immediate surrounding area. Minimal vegetation clearance and disturbances must occur along the proposed pipeline routes. Vegetation clearance should be restricted to the pipeline servitude especially within the existing access roads/ maintenance roads and areas that are already denuded of vegetation within the pipeline servitude. With that being said, both the pipelines are seen as acceptable from an ecological perspective. The proposed project would have an overall low negative impact.

Although no SCC species were recorded within the project area, *Vachellia erioloba*, a nationally protected tree species, occurs close to the proposed Kareerand RW pipeline route and care must be taken not to remove or disturb these trees (National Forest Act, Act 84 of 1998) (NFA 2018). It must be also noted that the two project areas are highly infested with IAP species which could easily spread with more disturbance, thus the proponent is advised to address this before the developments to ensure no further spread.

10.2 Wetlands

Five wetland systems were identified within the 500 m regulated area, of which four have been classified as unchannelled valley bottom wetlands and one being classified a floodplain. These systems have been determined to range from “Largely Modified” to “Seriously Modified” with the average ecosystem service scores being scored “Moderately Low” to “Moderately High”. The importance and sensitivity of these systems have been scored “Low” and “Moderate” with the calculated buffer determined to be 15 m.

The associated risks posed to wetlands could be mitigated to an appreciable level, posing a “low” post-mitigation risk to the wetlands. Considering the “Low” post-mitigation significance ratings, a General Authorisation is permissible for the project.

10.3 Impact statement

No fatal flaws are evident for the proposed project. It is the opinion of the specialists that the project may be favourably considered for authorisation. All prescribed mitigation measures and supporting recommendations must be considered by the issuing authority. Mitigation measures as described in this report will reduce the significance of the risk to an acceptable level.

11 References

- ADU (Animal Demography Unit). (2021). Virtual Museum. (Accessed: November 2021).
- Alexander, G. & Marais, J. (2007). A guide to the Reptiles of Southern Africa. Struik, Cape Town.
- Barbour, M.T., Gerritsen, J. & White, J.S. (1996). Development of a stream condition index (SCI) for Florida. Prepared for Florida Department of Environmental Protection: Tallahassee, Florida.
- Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J & de Villiers, M.S. (Eds). (2014). Atlas and Red List of Reptiles of South Africa, Lesotho, and Swaziland. Suricata 1. South African Biodiversity Institute, Pretoria.
- BGIS (Biodiversity GIS). (2018). <http://bgis.sanbi.org/> (Accessed: November 2021).
- Birdlife South Africa. (2015). Checklist of Birds - List of Threatened Species. <https://www.birdlife.org.za/publications> (Accessed: November 2019).
- BODATSA-POSA. (2019). Plants of South Africa - an online checklist. POSA ver. 3.0. <http://newposa.sanbi.org/>. (Accessed: November 2021).
- Branch, W.R. (1998). Field Guide to Snakes and Other Reptiles of Southern Africa. Struik, Cape Town.
- DEA. (2015). National land cover data for SA. https://egis.environment.gov.za/national_land_cover_data_sa (Accessed: November 2021).
- Department of Human Settlement and Water and Sanitation (DHSWS). (2021). A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Draft. Compiled by RQS-RDM.
- Driver, A., Nel, J.L., Snaddon, K., Murray, K., Roux, D.J., Hill, L., Swartz, E.R., Manuel, J. & Funke, N. (2011). Implementation Manual for Freshwater Ecosystem Priority Areas. Report to the Water Research Commission, Pretoria.
- Du Preez, L. & Carruthers, V. (2009) A Complete Guide to the Frogs of Southern Africa. Struik Nature, Cape Town.
- Eskom. (2015). Taylor, M.R., Peacock, F. & Wanless, R.M. (Eds). The 2015 Eskom Red Data Book of birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.
- EWT. (2016). Mammal Red List 2016. www.ewt.org.za (Accessed: March 2020).
- Fish, L., Mashau, A.C., Moeaha, M.J. & Nembudani, M.T. (2015). Identification Guide to Southern African Grasses: An Identification Manual with Keys, Descriptions, and Distributions. SANBI, Pretoria.
- Friedmann, Y. & Daly, B. 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG South Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.

FrogMap. (2017). The Southern African Frog Atlas Project (SAFAP, now FrogMAP). <http://vmus.adu.org.za> (Accessed: November 2021).

GDARD. (2014). Requirements for biodiversity assessments: Version 3. Gauteng Department of Agriculture and Rural Development, Johannesburg.

GDARD. (2014). Technical Report for the Gauteng Conservation Plan (Gauteng C-Plan v3.3). Gauteng Department of Agriculture and Rural Development: Nature Conservation Directorate. 60 pages.

Goff, F., Dawson, G., & Rochow, J. (1982). Site examination for threatened and endangered plant species. *Environmental Management*, 6(4), 307-316.

Griffiths, C., Day, J. & Picker, M. (2016). Freshwater Life: A Field Guide to the Plants and Animals of Southern Africa. Struik Nature, Cape Town.

Holmes, P. & Meadows, M. (2012). Southern African Geomorphology. Recent trends and new directions. ISBN: 978-1-920382-02-5.

International Union for Conservation of Nature (IUCN). (2021). The IUCN Red List of Threatened Species. www.iucnredlist.org (Accessed: February 2021).

Johnson, S. & Bytebier, B. (2015). Orchids of South Africa: A Field Guide. Struik publishers, Cape Town. .

Kotze, D.C., Marneweck, G.C., Batchelor, A.L., Lindley, D.C. & Collins, N.B. (2009). A Technique for rapidly assessing ecosystem services supplied by wetlands. Mondi Wetland Project.

Land Type Survey Staff. (1972 - 2006). Land Types of South Africa: Digital Map (1:250 000 Scale) and Soil Inventory Databases. Pretoria: ARC-Institute for Soil, Climate, and Water.

Macfarlane DM and Bredin IP. 2017. Part 1: technical manual. Buffer zone guidelines for wetlands, rivers and estuaries

Macfarlane, D.M., Bredin, I.P., Adams, J.B., Zungu, M.M., Bate, G.C., Dickens, C.W.S. (2014). Preliminary guideline for the determination of buffer zones for rivers, wetlands and estuaries. Final Consolidated Report. WRC Report No TT 610/14, Water Research Commission, Pretoria.

Macfarlane, D.M., Dickens, J. & Von Hase, F. (2009). Development of a methodology to determine the appropriate buffer zone width and type for developments associated with wetlands, watercourses and estuaries Deliverable 1: Literature Review. INR Report No: 400/09.

MammalMap. (2017). <http://mammalmap.adu.org.za/> (Accessed: November 2021).

McMillan, P.H. (1998). An Integrated Habitat Assessment System (IHASv2), for the Rapid Biological Assessment of Rivers and Streams. A CSIR research project, number ENV – P-I 98132 for the Water Resource Management Program, CSIR. li + 44p.

Measey, G.J. (2011). Ensuring a Future for South Africa's Frogs: A Strategy for Conservation Research. South African National Biodiversity Institute, Pretoria.

Minter, L., Burger, M., Harrison, J.A. & Kloefer, D. (2004). Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. Smithsonian Institute Avian Demography Unit, Washington; Cape Town.

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

NBA. (2018). Terrestrial Ecosystem Threat Status 2018. <http://bgis.sanbi.org/>. (Accessed: March 2020).

Pooley, E. (1998). A Field Guide to Wild Flowers: KwaZulu-Natal and Eastern Region. The Flora Publications Trust; ABC Bookshop, Durban.

Raimonde, D. (2009). Red list of South African Plants. SANBI, Pretoria.

Republic of South Africa (RSA). (2016). Classes and resource quality objectives of water resources for catchments of the Upper Vaal. 4. No. 468.

Rountree, M.W., Malan, H. & Weston, B. (Eds.). (2012). Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study. Report No 1788/1/12. Water Research Commission, Pretoria.

SABAP2 (Bird Atlas Project). (2017). <http://vmus.adu.org.za/>. (Accessed: March 2020).

SACAD (South Africa Conservation Areas Database) and SADAP (South Africa Protected Areas Database) (2020). <http://egis.environment.gov.za>

SANBI & SAMBF (2012). SANBI: Mining and Biodiversity Guidelines: Biodiversity priority areas sensitive to the impacts of mining categorized into four categories. bgis.sanbi.org

SANBI. (2016). Red List of South African Plants version 2017.1. Redlist.sanbi.org (Accessed: March 2020).

SANBI. (2017). Technical guidelines for CBA Maps: Guidelines for developing a map of Critical Biodiversity Areas & Ecological Support Areas using systematic biodiversity planning. Driver, A., Holness, S. & Daniels, F. (Eds). 1st Edition. South African National Biodiversity Institute, Pretoria.

SANBI. 2013. Grasslands Ecosystem Guidelines: landscape interpretation for planners and managers. Compiled by Cadman, M., de Villiers, C., Lechmere-Oertel, R. and D. McCulloch. South African National Biodiversity Institute, Pretoria. 139 pages.

Schaller, R. and Desmet, P.G. (2015) North West Biodiversity Sector Plan Technical Report. North West Provincial Government, Mahikeng. November 2015.

Skinner, J.D. & Chimimba, C.T. (2005). The Mammals of the Southern African Subregion (New Edition). Cambridge University Press, South Africa.

Skowno, A.L., Raimondo, D.C., Poole, C.J., Fizzotti, B. & Slingsby, J.A. (eds.). (2019). South African National Biodiversity Assessment 2018 Technical Report Volume 1: Terrestrial Realm. South African National Biodiversity Institute, Pretoria.

Smith, G.F., Chesselet, P., van Jaarsveld, E.J., Hartmann, H., Hammer, S., van Wyk, B., Burgoyne, P., Klak, C. & Kurzweil, H. (1998). Mesembs of the world. Briza Publishers, Pretoria.

South African National Biodiversity Institute, 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report, South Africa: Freshwater Consulting Group (FCG) for SANBI.

Van Oudtshoorn, F. (2004). Guide to the Grasses of Southern Africa. Second Edition. Briza Publikasies, Pretoria.

Van Wyk, B. & Malan, S. (1997). Field Guide to the Wild Flowers of the Highveld: Also Useful in Adjacent Grassland and Bushveld, Struik Publishers, Cape Town.

Van Wyk, B. & Van Wyk, P. (1997). Field guide to trees of Southern Africa. Struik Publishers, Cape Town.

Van Wyk, B-E., Van Oudtshoorn, B. & Gericke, N. (2013). Medicinal Plants of South Africa. Briza Publications, Pretoria.

12 Appendices

Appendix A Specialist declarations

DECLARATION

I, Lusanda Matee, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Lusanda Matee

Terrestrial Biodiversity Specialist

The Biodiversity Company

December 2021

DECLARATION

I, Andrew Husted, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Andrew Husted

Freshwater Specialist

The Biodiversity Company

December 2021

DECLARATION

I, Ivan Baker, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Ivan Baker

Wetland Ecologist

The Biodiversity Company

December 2021

Appendix B Flora species expected in the project areas and surrounds

| Family | Genus | Sp1 | Author1 | Ran k1 | IU CN | Ecology |
|------------------|-----------------------|------------------------|--|-----------|----------|---|
| Poaceae | <i>Aristida</i> | <i>adscensionis</i> | L. | | LC | Indigenous |
| Poaceae | <i>Triraphis</i> | <i>andropogonoides</i> | (Steud.) E.Phillips | | LC | Indigenous |
| Malvaceae | <i>Hermannia</i> | <i>grandistipula</i> | (Buchinger ex Hochst.) K.Schum. | | LC | Indigenous |
| Poaceae | <i>Phragmites</i> | <i>mauritanus</i> | Kunth | | LC | Indigenous |
| Fabaceae | <i>Listia</i> | <i>bainesii</i> | (Baker) B.-E.van Wyk & Boatwr. | | LC | Indigenous |
| Apocynaceae | <i>Raphionacme</i> | <i>hirsuta</i> | (E.Mey.) R.A.Dyer | | LC | Indigenous |
| Asphodelaceae | <i>Aloe</i> | <i>ferox</i> | Mill. | | LC | Indigenous |
| Phrymaceae | <i>Mimulus</i> | <i>gracilis</i> | R.Br. | | LC | Indigenous |
| Poaceae | <i>Setaria</i> | <i>incrassata</i> | (Hochst.) Hack. | | LC | Indigenous |
| Apocynaceae | <i>Raphionacme</i> | <i>velutina</i> | Schltr. | | LC | Indigenous |
| Iridaceae | <i>Dierama</i> | <i>reynoldsii</i> | I.Verd. | | LC | Indigenous; Endemic |
| Hyacinthaceae | <i>Daubenya</i> | <i>comata</i> | (Burch. ex Baker) J.C.Manning & A.M. van der Merwe | | LC | Indigenous; Endemic |
| Gisekiaceae | <i>Gisekia</i> | <i>africana</i> | (Lour.) Kuntze | var. | LC | Indigenous |
| Santalaceae | <i>Thesium</i> | <i>impeditum</i> | A.W.Hill | | LC | Indigenous |
| Marsileaceae | <i>Marsilea</i> | <i>sp.</i> | | | | |
| Asteraceae | <i>Helichrysum</i> | <i>callicomum</i> | Harv. | | LC | Indigenous |
| Lythraceae | <i>Nesaea</i> | <i>anagalloides</i> | (Sond.) Koehne | | LC | Indigenous |
| Poaceae | <i>Schizachyrium</i> | <i>sanguineum</i> | (Retz.) Alston | | LC | Indigenous |
| Cyperaceae | <i>Eleocharis</i> | <i>dregeana</i> | Steud. | | LC | Indigenous |
| Hypoxidaceae | <i>Hypoxis</i> | <i>argentea</i> | Harv. ex Baker | var. | LC | Indigenous |
| Cyperaceae | <i>Schoenoplectus</i> | <i>muriculatus</i> | (Kuk.) Browning | | LC | Indigenous |
| Rubiaceae | <i>Pavetta</i> | <i>zeyheri</i> | Sond. | sub sp. | LC | Indigenous |
| Fabaceae | <i>Crotalaria</i> | <i>lotoides</i> | Benth. | | LC | Indigenous |
| Poaceae | <i>Panicum</i> | <i>maximum</i> | Jacq. | | LC | Indigenous |
| Asteraceae | <i>Galinsoga</i> | <i>parviflora</i> | Cav. | | | Not indigenous; Naturalised; Invasive |
| Asteraceae | <i>Helichrysum</i> | <i>caespititium</i> | (DC.) Harv. | | LC | Indigenous |
| Resedaceae | <i>Oligomeris</i> | <i>dregeana</i> | (Mull.Arg.) Mull.Arg. | | LC | Indigenous |
| Orchidaceae | <i>Bonatea</i> | <i>antennifera</i> | Rolfe | | LC | Indigenous |
| Malvaceae | <i>Corchorus</i> | <i>schimperi</i> | Cufod. | | LC | Indigenous |
| Poaceae | <i>Brachiaria</i> | <i>eruciformis</i> | (Sm.) Griseb. | | LC | Indigenous |
| Haloragaceae | <i>Myriophyllum</i> | <i>spicatum</i> | L. | | | Not indigenous; Cultivated; Naturalised; Invasive |
| Scrophulariaceae | <i>Aptosimum</i> | <i>elongatum</i> | (Hiern) Engl. | | LC | Indigenous |
| Fabaceae | <i>Pearsonia</i> | <i>cajanifolia</i> | (Harv.) Polhill | | | Indigenous |
| Poaceae | <i>Ischaemum</i> | <i>afrum</i> | (J.F.Gmel.) Dandy | | LC | Indigenous |
| Scrophulariaceae | <i>Nemesia</i> | <i>fruticans</i> | (Thunb.) Benth. | | LC | Indigenous |
| Poaceae | <i>Eragrostis</i> | <i>superba</i> | Peyr. | | LC | Indigenous |

| | | | | | | |
|-------------------------|-------------------------|--------------------------|----------------------------|---------|----|---------------------|
| Euphorbiaceae | <i>Leidesia</i> | <i>procumbens</i> | (L.) Prain | | LC | Indigenous |
| Acanthaceae | <i>Barleria</i> | <i>macrostegia</i> | Nees | | LC | Indigenous |
| Acanthaceae | <i>Crabbea</i> | <i>angustifolia</i> | Nees | | LC | Indigenous; Endemic |
| Apocynaceae | <i>Stenostelma</i> | <i>capense</i> | Schltr. | | LC | Indigenous |
| Marsileaceae | <i>Marsilea</i> | <i>farinosa</i> | Launert | sub sp. | LC | Indigenous |
| Poaceae | <i>Harpochloa</i> | <i>falx</i> | (L.f.) Kuntze | | LC | Indigenous |
| Apocynaceae | <i>Cordylogyne</i> | <i>globosa</i> | E.Mey. | | LC | Indigenous |
| Fabaceae | <i>Elephantorrhiza</i> | <i>elephantina</i> | (Burch.) Skeels | | LC | Indigenous |
| Poaceae | <i>Tragus</i> | <i>berteronianus</i> | Schult. | | LC | Indigenous |
| Poaceae | <i>Cynodon</i> | <i>dactylon</i> | (L.) Pers. | | LC | Indigenous |
| Amaryllidaceae | <i>Nerine</i> | <i>krigei</i> | W.F. Barker | | LC | Indigenous; Endemic |
| Scrophulariaceae | <i>Selago</i> | <i>welwitschii</i> | Rolfe | var. | LC | Indigenous |
| Potamogetonaceae | <i>Potamogeton</i> | <i>pectinatus</i> | L. | | LC | Indigenous |
| Apocynaceae | <i>Asclepias</i> | <i>aurea</i> | (Schltr.) Schltr. | | LC | Indigenous |
| Poaceae | <i>Pogonarthria</i> | <i>squarrosa</i> | (Roem. & Schult.) Pilg. | | LC | Indigenous |
| Ceratophyllaceae | <i>Ceratophyllum</i> | <i>muricatum</i> | Cham. | sub sp. | LC | Indigenous |
| Poaceae | <i>Perotis</i> | <i>patens</i> | Gand. | | LC | Indigenous |
| Campanulaceae | <i>Wahlenbergia</i> | <i>denticulata</i> | (Burch.) A.DC. | var. | LC | Indigenous; Endemic |
| Asteraceae | <i>Geigeria</i> | <i>brevifolia</i> | (DC.) Harv. | | LC | Indigenous |
| Verbenaceae | <i>Chascanum</i> | <i>adenostachyum</i> | (Schauer) Moldenke | | LC | Indigenous |
| Poaceae | <i>Aristida</i> | <i>congesta</i> | Roem. & Schult. | sub sp. | LC | Indigenous |
| Hypoxidaceae | <i>Hypoxis</i> | <i>acuminata</i> | Baker | | LC | Indigenous |
| Poaceae | <i>Hemarthria</i> | <i>altissima</i> | (Poir.) Stapf & C.E. Hubb. | | LC | Indigenous |
| Poaceae | <i>Eragrostis</i> | <i>curvula</i> | (Schrud.) Nees | | LC | Indigenous |
| Poaceae | <i>Stipagrostis</i> | <i>uniplumis</i> | (Licht.) De Winter | var. | LC | Indigenous |
| Asteraceae | <i>Helichrysum</i> | <i>dregeanum</i> | Sond. & Harv. | | LC | Indigenous |
| Campanulaceae | <i>Wahlenbergia</i> | <i>magaliesbergensis</i> | Lammers | | LC | Indigenous; Endemic |
| Asteraceae | <i>Pseudognaphalium</i> | <i>oligandrum</i> | (DC.) Hilliard & B.L. Burt | | LC | Indigenous |
| Pedaliaceae | <i>Pterodiscus</i> | <i>speciosus</i> | Hook. | | LC | Indigenous |
| Phyllanthaceae | <i>Phyllanthus</i> | <i>maderaspatensis</i> | L. | | LC | Indigenous |
| Fabaceae | <i>Rhynchosia</i> | <i>totta</i> | (Thunb.) DC. | var. | LC | Indigenous |
| Fabaceae | <i>Senna</i> | <i>italica</i> | Mill. | sub sp. | LC | Indigenous |
| Salicaceae | <i>Salix</i> | <i>mucronata</i> | Thunb. | sub sp. | LC | Indigenous |
| Fabaceae | <i>Neorautanenia</i> | <i>ficifolia</i> | (Benth.) C.A.Sm. | | LC | Indigenous |
| Euphorbiaceae | <i>Acalypha</i> | <i>caperonioides</i> | Baill. | var. | DD | Indigenous |

| | | | | | | |
|-------------------------|---------------------|-----------------------|---|---------|----|---------------------------------------|
| Verbenaceae | <i>Verbena</i> | <i>officinalis</i> | L. | | | Not indigenous; Naturalised |
| Poaceae | <i>Eragrostis</i> | <i>gummiflua</i> | Nees | | LC | Indigenous |
| Scrophulariaceae | <i>Gomphostigma</i> | <i>virgatum</i> | (L.f.) Baill. | | LC | Indigenous |
| Malvaceae | <i>Grewia</i> | <i>occidentalis</i> | L. | var. | LC | Indigenous |
| Poaceae | <i>Leersia</i> | <i>hexandra</i> | Sw. | | LC | Indigenous |
| Asteraceae | <i>Cineraria</i> | <i>lyratiformis</i> | Cron | | LC | Indigenous |
| Poaceae | <i>Eragrostis</i> | <i>sp.</i> | | | | |
| Malvaceae | <i>Hermannia</i> | <i>stellulata</i> | (Harv.) K. Schum. | | LC | Indigenous |
| Poaceae | <i>Setaria</i> | <i>sphacelata</i> | (Schumach.) Stapf & C.E. Hubb. ex M.B. Moss | var. | LC | Indigenous |
| Cyperaceae | <i>Cyperus</i> | <i>obtusiflorus</i> | Vahl | var. | LC | Indigenous |
| Malvaceae | <i>Corchorus</i> | <i>asplenifolius</i> | Burch. | | LC | Indigenous |
| Araceae | <i>Lemna</i> | <i>minor</i> | L. | | LC | Indigenous |
| Poaceae | <i>Andropogon</i> | <i>appendiculatus</i> | Nees | | LC | Indigenous |
| Hypoxidaceae | <i>Hypoxis</i> | <i>hemerocallidea</i> | Fisch., C.A. Mey. & Ave-Lall. | | LC | Indigenous |
| Fabaceae | <i>Vigna</i> | <i>unguiculata</i> | (L.) Walp. | sub sp. | LC | Indigenous |
| Convolvulaceae | <i>Seddera</i> | <i>capensis</i> | (E. Mey. ex Choisy) Hallier f. | | LC | Indigenous |
| Caryophyllaceae | <i>Silene</i> | <i>burchellii</i> | Oth ex DC. | sub sp. | | Indigenous |
| Poaceae | <i>Panicum</i> | <i>coloratum</i> | L. | | LC | Indigenous |
| Poaceae | <i>Antheophora</i> | <i>pubescens</i> | Nees | | LC | Indigenous |
| Euphorbiaceae | <i>Jatropha</i> | <i>zeyheri</i> | Sond. | | LC | Indigenous |
| Salviniaceae | <i>Azolla</i> | <i>filiculoides</i> | Lam. | | NE | Not indigenous; Naturalised; Invasive |
| Scrophulariaceae | <i>Selago</i> | <i>burkei</i> | Rolfe | | LC | Indigenous; Endemic |
| Molluginaceae | <i>Phamaceum</i> | <i>sp.</i> | | | | |
| Cyperaceae | <i>Cyperus</i> | <i>sphaerospermus</i> | Schrad. | | LC | Indigenous |
| Poaceae | <i>Aristida</i> | <i>canescens</i> | Henrard | sub sp. | LC | Indigenous |
| Malvaceae | <i>Hibiscus</i> | <i>calyphyllus</i> | Cav. | | LC | Indigenous |
| Asteraceae | <i>Artemisia</i> | <i>afra</i> | Jacq. ex Willd. | var. | LC | Indigenous |
| Asteraceae | <i>Helichrysum</i> | <i>zeyheri</i> | Less. | | LC | Indigenous |
| Malvaceae | <i>Pavonia</i> | <i>burchellii</i> | (DC.) R.A. Dyer | | LC | Indigenous |
| Asteraceae | <i>Geigeria</i> | <i>ornativa</i> | O. Hoffm. | | | Indigenous |
| Thymelaeaceae | <i>Lasiosiphon</i> | <i>burchellii</i> | Meisn. | | LC | Indigenous |
| Iridaceae | <i>Babiana</i> | <i>bainesii</i> | Baker | | LC | Indigenous |
| Malvaceae | <i>Hibiscus</i> | <i>microcarpus</i> | Garcke | | LC | Indigenous |
| Phyllanthaceae | <i>Phyllanthus</i> | <i>incurvus</i> | Thunb. | | LC | Indigenous |
| Acanthaceae | <i>Dicliptera</i> | <i>leistneri</i> | K. Balkwill | | LC | Indigenous; Endemic |
| Poaceae | <i>Digitaria</i> | <i>eriantha</i> | Steud. | | LC | Indigenous |
| Poaceae | <i>Eragrostis</i> | <i>trichophora</i> | Coss. & Durieu | | LC | Indigenous |
| Euphorbiaceae | <i>Euphorbia</i> | <i>serpens</i> | Kunth | | NE | Not indigenous; Naturalised |

| | | | | | | |
|--------------------|----------------------|----------------------|--------------------------|---------|----|------------|
| Fabaceae | <i>Vachellia</i> | <i>robusta</i> | (Burch.) Kyal. & Boatwr. | sub sp. | LC | Indigenous |
| Juncaceae | <i>Juncus</i> | <i>rigidus</i> | Desf. | | LC | Indigenous |
| Poaceae | <i>Agrostis</i> | <i>lachnantha</i> | Nees | var. | LC | Indigenous |
| Lamiaceae | <i>Leonotis</i> | <i>pentadentata</i> | J.C. Manning & Goldblatt | | LC | Indigenous |
| Apocynaceae | <i>Aspidoglossum</i> | <i>biflorum</i> | E. Mey. | | LC | Indigenous |
| Cyperaceae | <i>Cyperus</i> | <i>margaritaceus</i> | Vahl | var. | LC | Indigenous |

Appendix C Mammals expected in the project areas

| Scientific name | Common name | Regional (SANBI, 2016) | IUCN (2017) |
|--|--|------------------------|-------------|
| <i>Cryptomys hottentotus</i> | Southern African Mole-rat | LC | LC |
| <i>Aepyceros melampus</i> | Impala | LC | LC |
| <i>Alcelaphus buselaphus</i> | Hartebeest | LC | LC |
| <i>Alcelaphus buselaphus caama</i> | Red Hartebeest | LC | LC |
| <i>Antidorcas marsupialis</i> | Springbok | LC | LC |
| <i>Connochaetes gnou</i> | Black Wildebeest | LC | LC |
| <i>Connochaetes taurinus taurinus</i> | | LC | LC |
| <i>Damaliscus pygargus phillipsi</i> | Blesbok | LC | LC |
| <i>Hippotragus niger</i> | Sable Antelope | LC | LC |
| <i>Hippotragus niger niger</i> | | VU | LC |
| <i>Kobus ellipsiprymnus</i> | Waterbuck | LC | LC |
| <i>Kobus ellipsiprymnus ellipsiprymnus</i> | | LC | LC |
| <i>Oryx gazella</i> | Gemsbok | LC | LC |
| <i>Raphicerus campestris</i> | Steenbok | LC | LC |
| <i>Redunca arundinum</i> | Southern Reedbuck | LC | LC |
| <i>Redunca fulvorufula</i> | Mountain Reedbuck | LC | LC |
| <i>Sylvicapra grimmia</i> | Bush Duiker | LC | LC |
| <i>Taurotragus oryx</i> | Common Eland | LC | LC |
| <i>Tragelaphus angasii</i> | Nyala | LC | LC |
| <i>Tragelaphus scriptus</i> | Bushbuck | LC | LC |
| <i>Tragelaphus strepsiceros</i> | Greater Kudu | LC | LC |
| <i>Canis mesomelas</i> | Black-backed Jackal | LC | LC |
| <i>Chlorocebus pygerythrus</i> | Vervet Monkey | LC | LC |
| <i>Chlorocebus pygerythrus pygerythrus</i> | Vervet Monkey (subspecies pygerythrus) | LC | LC |
| <i>Equus quagga</i> | Plains Zebra | LC | LC |
| <i>Atelerix frontalis</i> | Southern African Hedgehog | NT | LC |
| <i>Caracal caracal</i> | Caracal | LC | LC |
| <i>Leptailurus serval</i> | Serval | NT | LC |
| <i>Giraffa giraffa</i> | South African Giraffe | LC | LC |
| <i>Cynictis penicillata</i> | Yellow Mongoose | LC | LC |
| <i>Galerella sp.</i> | Slender Mongooses | LC | LC |
| <i>Herpestes sanguineus</i> | Slender Mongoose | LC | LC |

| | | | |
|--------------------------------|-------------------------------|----|----|
| <i>Ichneumia albicauda</i> | White-tailed Mongoose | LC | LC |
| <i>Suricata suricatta</i> | Meerkat | LC | LC |
| <i>Lepus capensis</i> | Cape Hare | LC | LC |
| <i>Lepus saxatilis</i> | Scrub Hare | LC | LC |
| <i>Rhabdomys pumilio</i> | Xeric Four-striped Grass Rat | LC | LC |
| <i>Aonyx capensis</i> | African Clawless Otter | LC | LC |
| <i>Pedetes capensis</i> | South African Spring Hare | LC | LC |
| <i>Procavia capensis</i> | Cape Rock Hyrax | LC | LC |
| <i>Paraxerus cepapi</i> | Smith's Bush Squirrel | LC | LC |
| <i>Xerus inauris</i> | South African Ground Squirrel | LC | LC |
| <i>Phacochoerus africanus</i> | Common Warthog | LC | LC |
| <i>Thryonomys swinderianus</i> | Greater Cane Rat | LC | LC |
| <i>Neoromicia capensis</i> | Cape Serotine | LC | LC |

Appendix D Reptiles species expected in the project areas

| Species | Common Name | Conservation Status | |
|--|-------------------------------|------------------------|-------------|
| | | Regional (SANBI, 2016) | IUCN (2017) |
| <i>Acanthocercus atricollis</i> | Southern Tree Agama | LC | LC |
| <i>Acontias gracilicauda</i> | Thin-tailed Legless Skink | LC | LC |
| <i>Acontias occidentalis</i> | Savanna Legless Skink | LC | Unlisted |
| <i>Afroedura nivaria</i> | Drakensberg Flat Gecko | LC | LC |
| <i>Afrotyphlops bibronii</i> | Bibron's Blind Snake | LC | LC |
| <i>Agama aculeata distantii</i> | Eastern Ground Agama | LC | LC |
| <i>Agama atra</i> | Southern Rock Agama | LC | LC |
| <i>Amblyodipsas polylepis</i> | Purple Gloss Snake | Unlisted | Unlisted |
| <i>Amblyodipsas ventrimaculata</i> | Kalahari purple-glossed snake | Unlisted | LC |
| <i>Aparallactus capensis</i> | Black-headed Centipede-eater | LC | LC |
| <i>Aspidelaps scutatus scutatus</i> | Common Shield Snake | LC | Unlisted |
| <i>Atractaspis bibronii</i> | Bibron's Stiletto Snake | LC | Unlisted |
| <i>Bitis arietans arietans</i> | Puff Adder | LC | Unlisted |
| <i>Boaedon capensis</i> | Brown House Snake | LC | LC |
| <i>Causus defilippii</i> | Snouted Night Adder | LC | Unlisted |
| <i>Chamaeleo dilepis</i> | Common Flap-neck Chameleon | LC | LC |
| <i>Chondrodactylus turneri</i> | Turner's Gecko | LC | Unlisted |
| <i>Cordylus jonesii</i> | Jones' Girdled Lizard | LC | Unlisted |
| <i>Cordylus vittifer</i> | Common Girdled Lizard | LC | LC |
| <i>Crocodylus niloticus</i> | Nile Crocodile | VU | LC |
| <i>Crotaphopeltis hotamboeia</i> | Red-lipped Snake | LC | Unlisted |
| <i>Dasypeltis scabra</i> | Rhombic Egg-eater | LC | LC |
| <i>Dendroaspis polylepis</i> | Black Mamba | LC | LC |
| <i>Dispholidus typus</i> | Boomslang | LC | Unlisted |
| <i>Gerrhosaurus flavigularis</i> | Yellow-throated Plated Lizard | LC | Unlisted |
| <i>Gracililima nyassae</i> | Black File Snake | LC | LC |
| <i>Heliobolus lugubris</i> | Bushveld Lizard | LC | Unlisted |
| <i>Hemidactylus mabouia</i> | Common Tropical House Gecko | LC | Unlisted |
| <i>Hemirhagerrhis nototaenia</i> | Eastern Bark Snake | LC | Unlisted |
| <i>Homopholis wahlbergii</i> | Wahlberg's Velvet Gecko | LC | LC |
| <i>Ichnotropis capensis</i> | Ornate Rough-scaled Lizard | LC | Unlisted |
| <i>Kinixys lobatsiana</i> | Lobatse hinged-back Tortoise | LC | LC |
| <i>Kinixys spekii</i> | Speke's Hinged-Back Tortoise | LC | Unlisted |
| <i>Lamprophis aurora</i> | Aurora House Snake | LC | LC |
| <i>Leptotyphlops scutifrons scutifrons</i> | Peters' Thread Snake | LC | Unlisted |
| <i>Limaformosa capensis</i> | Common File Snake | LC | Unlisted |
| <i>Lycodonomorphus rufulus</i> | Brown Water Snake | LC | Unlisted |
| <i>Lycophidion capense capense</i> | Cape Wolf Snake | LC | Unlisted |
| <i>Lygodactylus capensis capensis</i> | Common Dwarf Gecko | LC | Unlisted |
| <i>Matobosaurus validus</i> | Common Giant Plated Lizard | LC | Unlisted |
| <i>Meroles squamulosus</i> | Common Rough-scaled Lizard | LC | Unlisted |
| <i>Mochlus sundevallii</i> | Sundevall's Writhing Skink | LC | LC |
| <i>Monopeltis capensis</i> | Cape Worm Lizard | LC | LC |

| | | | |
|---|--------------------------------|---------------|----------|
| <i>Naja annulifera</i> | Snouted Cobra | LC | Unlisted |
| <i>Naja mossambica</i> | Mozambique Spitting Cobra | LC | Unlisted |
| <i>Nucras holubi</i> | Holub's Sandveld Lizard | LC | Unlisted |
| <i>Nucras intertexta</i> | Spotted Sandveld Lizard | LC | Unlisted |
| <i>Pachydactylus affinis</i> | Transvaal Gecko | LC | LC |
| <i>Panaspis wahlbergi</i> | Wahlberg's Snake-eyed Skink | LC | Unlisted |
| <i>Pedioplanis lineocellata</i> | Spotted Sand Lizard | LC | Unlisted |
| <i>Pelomedusa galeata</i> | South African Marsh Terrapin | Not evaluated | Unlisted |
| <i>Pelusios sinuatus</i> | Serrated Hinged Terrapin | LC | Unlisted |
| <i>Philothamnus semivariegatus</i> | Spotted Bush Snake | LC | Unlisted |
| <i>Platysaurus guttatus</i> | Dwarf Flat Lizard | LC | LC |
| <i>Platysaurus minor</i> | Waterberg Flat Lizard | LC | LC |
| <i>Prosymna ambigua</i> | Angolan Shovel-snout | Unlisted | LC |
| <i>Prosymna bivittata</i> | Two-Striped Shovel-Snout | LC | Unlisted |
| <i>Psammobates oculifer</i> | Serrated Tent Tortoise | LC | Unlisted |
| <i>Psammophis angolensis</i> | Dwarf Sand Snake | LC | Unlisted |
| <i>Psammophis brevirostris</i> | Short-snouted Grass Snake | LC | Unlisted |
| <i>Psammophis jallae</i> | Jalla's Sand Snake | LC | Unlisted |
| <i>Psammophis subtaeniatus</i> | Stripe-bellied Sand Snake | LC | LC |
| <i>Psammophylax tritaeniatus</i> | Striped Grass Snake | LC | LC |
| <i>Pseudaspis cana</i> | Mole Snake | LC | Unlisted |
| <i>Python natalensis</i> | Southern African Python | LC | Unlisted |
| <i>Rhinotyphlops lalandei</i> | Delalande's Beaked Blind Snake | LC | Unlisted |
| <i>Scelotes limpopoensis</i> | Limpopo Dwarf Burrowing Skink | LC | Unlisted |
| <i>Smaug breyeri</i> | Waterberg Dragon Lizard | LC | LC |
| <i>Stigmochelys pardalis</i> | Leopard Tortoise | LC | LC |
| <i>Telescopus semiannulatus semiannulatus</i> | Eastern Tiger Snake | LC | Unlisted |
| <i>Thelotornis capensis</i> | Southern Twig Snake | LC | LC |
| <i>Trachylepis capensis</i> | Cape Skink | LC | Unlisted |
| <i>Trachylepis damarana</i> | Damara skink | Unlisted | LC |
| <i>Trachylepis margaritifera</i> | Rainbow Skink | LC | LC |
| <i>Trachylepis punctatissima</i> | Speckled Rock Skink | LC | LC |
| <i>Trachylepis striata</i> | Striped Skink | LC | Unlisted |
| <i>Trachylepis varia</i> | Variable Skink | LC | LC |
| <i>Varanus albigularis albigularis</i> | Southern Rock Monitor | LC | Unlisted |
| <i>Varanus niloticus</i> | Water Monitor | LC | Unlisted |
| <i>Xenocalamus bicolor australis</i> | Waterberg Quill-snouted Snake | LC | Unlisted |

Appendix E Amphibians expected in the project areas

| Species | Common Name | Conservation Status | |
|------------------------------------|-------------------------|------------------------|-------------|
| | | Regional (SANBI, 2016) | IUCN (2017) |
| <i>Amietia angolensis</i> | Angola River Frog | LC | LC |
| <i>Amietia delalandii</i> | Delalande's River Frog | LC | Unlisted |
| <i>Breviceps adspersus</i> | Bushveld Rain Frog | LC | LC |
| <i>Breviceps mossambicus</i> | Mozambique Rain Frog | LC | LC |
| <i>Cacosternum boettgeri</i> | Common Caco | LC | LC |
| <i>Chiromantis xerampelina</i> | Southern Foam Nest Frog | LC | LC |
| <i>Hildebrandtia ornata</i> | Southern Ornate Frog | LC | LC |
| <i>Hyperolius marmoratus</i> | Painted Reed Frog | LC | LC |
| <i>Kassina senegalensis</i> | Bubbling Kassina | LC | LC |
| <i>Phrynobatrachus mababiensis</i> | Dwarf Puddle Frog | LC | LC |
| <i>Phrynobatrachus natalensis</i> | Snoring Puddle Frog | LC | LC |
| <i>Phrynomantis bifasciatus</i> | Banded Rubber Frog | LC | LC |
| <i>Poyntonophrynus fenoulheti</i> | Northern Pygmy Toad | LC | LC |
| <i>Ptychadena anchietae</i> | Plain Grass Frog | LC | LC |
| <i>Ptychadena mossambica</i> | Mozambique Ridged Frog | LC | LC |
| <i>Ptychadena porosissima</i> | Striped Grass Frog | LC | LC |
| <i>Pyxicephalus adspersus</i> | Giant Bullfrog | NT | LC |
| <i>Pyxicephalus edulis</i> | African Bullfrog | LC | LC |
| <i>Schismaderma carens</i> | African Red Toad | LC | LC |
| <i>Sclerophrys capensis</i> | Raucous Toad | LC | LC |
| <i>Sclerophrys garmani</i> | Olive Toad | LC | LC |
| <i>Sclerophrys gutturalis</i> | Guttural Toad | LC | LC |
| <i>Sclerophrys poweri</i> | Power's Toad | LC | LC |
| <i>Sclerophrys pusilla</i> | Flatbacked Toad | LC | LC |
| <i>Strongylopus fasciatus</i> | Striped Stream Frog | LC | LC |
| <i>Strongylopus grayii</i> | Clicking Stream Frog | LC | LC |
| <i>Tomopterna cryptotis</i> | Tremelo Sand Frog | LC | LC |
| <i>Tomopterna krugerensis</i> | Knocking Sand Frog | LC | LC |
| <i>Tomopterna natalensis</i> | Natal Sand Frog | LC | LC |
| <i>Tomopterna tandyi</i> | Tandy's Sand Frog | LC | LC |
| <i>Xenopus laevis</i> | Common Platanna | LC | LC |