ECOLOGICAL AND WETLAND BASELINE AND IMPACT ASSESSMENT REPORT FOR THE PROPOSED JAN SMUT AVENUE TO BORDEAUX RIVERSIDE PARK SEWER PIPELINE PROJECT

Bordeaux, City of Johannesburg, Gauteng Province

July 2021 (Updated 2023)

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Specialist Details

Report Name	**ECOLOGICAL AND WETLAND BASELINE AND IMPACT ASSESSMENT REPORT FOR THE PROPOSED JAN SMUT AVENUE TO BORDEAUX RIVERSIDE PARK SEWER PIPELINE PROJECT**
Submitted to	EIMS ENVIRONMENTAL IMPACT MANAGEMENT SERVICES
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Report writer/ Reviewer	**Andrew Husted**  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 for the proposed Jan Smut Avenue to Bordeaux Riverside Park sewer pipeline project. The project area is located in the Bordeaux area in the City of Johannesburg, Gauteng. The pipeline route is approximately 2 km long (Figure 3-1). The pipeline runs between the Randburg / Taxi Rank / Selkirk Municipal Clinic and the Bordeaux Riverside Park

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations. 2014 (No. 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

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”. The National Web based Environmental Screening Tool has characterised the terrestrial biodiversity for the project area as mostly “Very High sensitivity”, with a small section in the west classified as “Low”.

The purpose of the specialist studies is to provide relevant input into the impact assessment process and to provide a report for the proposed activities associated with the development. 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

CSM Consulting Services (Pty) Ltd was appointed by the Johannesburg Social Housing Company (JOSHCO) to provide professional services including Civil, Structural and Electrical Engineering for the conceptualization, planning, design, and implementation of the Selkirk Residential Project. The proposed development is located on erven 34 -39 and erven 41-50 Blairgowrie.

A report detailing the sewer flow for the JOSHCO Selkirk Development was submitted to Johannesburg Water (JW), for which feedback from Development Control was received. Based on the feedback, a sewer upgrade was required from Garden Road, across the Braamfontein Spruit stream, to a connection across Bordeaux Riverside Park.

The proposed crossing of the Braamfontein Spruit is in the upper reaches of the Bordeaux Riverside Park. The contractor will negotiate a suitable area for a camp site and the temporary stockpiling of excavated material with Bordeaux Riverside Park. The location of the crossing will be isolated by diverting current flow patterns of the water in the stream around the specified location. This will be achieved with sandbags utilizing material from the site.

The isolated areas will then be de-watered from a temporarily excavated sump. Enough working space should be allowed around the proposed crossing location. Topsoil will be removed to a depth of 500mm below the stream bed level and to the approved plan dimensions as shown on the approved construction drawings. Spoil material will be stockpiled at the designated area or at an approved site to be identified by the contractor. Excavation will be done by means of hand-

held drills and/or an excavator equipped with a hydraulic hammer, dependant on the state of the bedrock encountered. The concrete will then be cast for the encasement of the sewer pipe. Once the concrete has set, the in-situ material can be backfilled and compacted as specified.

The backfilling will be done up to the natural stream levels. The contractor should take precautions to ensure the shuttering required for construction will not pollute the site. After the sewer pipe crossing has been constructed, the stream in the construction area shall be restored to its natural condition.

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 site specific environment);
- Identification and description of any sensitive receptors in terms of relevant specialist disciplines (biodiversity and wetland) that occur in the project area, and the manner in which 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 area 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 area, based on available maps and database information;
- The delineation, classification and assessment of wetlands within 500 m of the project area;
- Conduct risk assessments relevant to the proposed activity; and
- Impact assessment, mitigation and rehabilitation measures to prevent or reduce the possible impacts as per the study.

3 Project Locality

The pipeline runs between the Randburg / Taxi Rank / Selkirk Municipal Clinic and the Bordeaux Riverside Park. The dominant land uses surrounding the project area includes urban sprawl and open land. A locality map of the project area is shown in Figure 3-1.

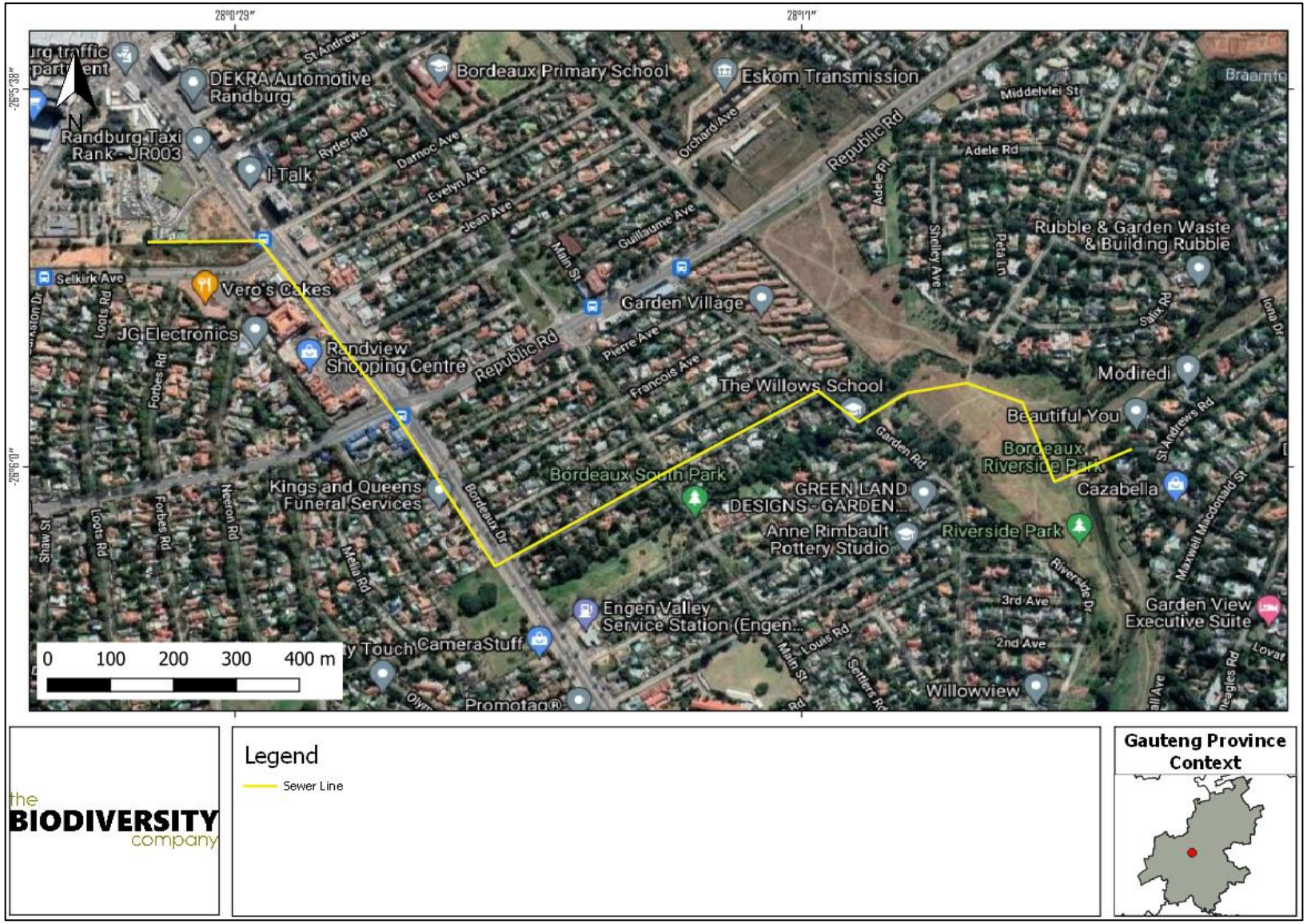


Figure 3-1 Locality of the project area

4 Key Legislative Requirements

The legislation, policies and guidelines listed below are applicable 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 4-1).

Table 4-1 A list of key legislative requirements relevant to biodiversity and conservation in Gauteng

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	GDARD Requirements for Biodiversity Assessments (Version 3, 2014a)
	Gauteng Department of Agriculture and Rural Development (GDARD): Checklist for Biodiversity Assessments

5 Limitations

The following limitations should be noted for the assessment:

- Only a single season survey was conducted, this would constitute a dry season survey;

- The exact design and specifications were not made available, as such assumptions were made by referring to standard features;
- The wetlands within the project area were the focus for the assessment, these systems were ground-truthed and further assessed. Wetland areas beyond the project area 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.

6 Methods

6.1 Terrestrial Assessment

6.1.1 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
- Gauteng Conservation Plan (2014).

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.

6.1.2 Botanical Assessment

The botanical assessment encompassed an assessment of all the vegetation units and habitat types within the project area. 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 area. 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 which 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.

6.1.3 Floristic Analysis

The fieldwork and sample sites were placed within targeted areas (i.e. target sites) perceived as ecologically sensitive based on the preliminary interpretation of satellite imagery (Google Corporation) and GIS analysis (which included the latest applicable biodiversity datasets) available prior to the fieldwork. The focus of the fieldwork was therefore to maximise coverage and navigate to each target site in the field in order to perform a rapid vegetation and ecological assessment at each sample site. Emphasis was placed on sensitive habitats, especially those overlapping with proposed project area.

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 habitat for SCC were identified according to Raimondo *et al.* (2009) and targeted as part of the timed meanders.

At each sample site 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 area.

6.1.4 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:

- Camera trapping;
- Visual observations;
- Small mammal trapping;
- Identification of tracks and signs; and
- Utilization of local knowledge.

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

6.1.5 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 was 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);
- 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 were conducted in each habitat or vegetation type within the project area, as identified from the desktop study, with a focus on those areas which will be most impacted by the proposed development (i.e. the infrastructure development and waste dumping areas).

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 who's activities occur on surfaces or for species that are difficult to detect by hand-searches or trap sampling.

6.2 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).

6.2.1 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 in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 6-1. 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 practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

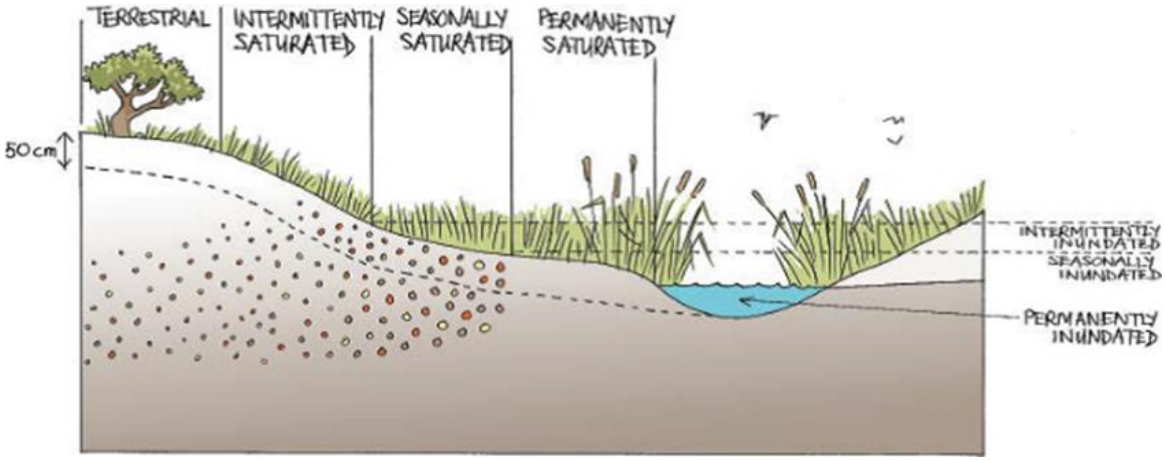


Figure 6-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013).

6.2.2 Ecosystem Services

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*., 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 6-1).

Table 6-1 Classes for determining the likely extent to which a benefit is being supplied (Kotze et al., 2009)

Score	Rating of Likely Extent to which a Benefit is Being Supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

6.2.3 Present Ecological Status

The overall approach is to quantify the impacts of human activity or clearly 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 impact of individual activities/occurrences and then separately assessing the intensity of 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 6-2.

Table 6-2 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

6.2.4 Ecological Importance and Sensitivity

The importance and sensitivity of water resources is 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 6-3 (Rountree and Kotze, 2013).

Table 6-3 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**

6.2.5 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).

6.2.6 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.

7 Receiving Environment

7.1 Desktop Spatial Assessment

The following features describes 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 their relevance to this project are listed in Table 7-1.

Table 7-1 Desktop spatial features examined.

Desktop Information Considered	Relevant/Not relevant	Section
Conservation Plan	The project area falls across both a CBA: Important and an ESA classified area	7.2
Ecosystem Threat Status	The project area is situated partly in a EN and partly in a LC ecosystem	7.3.1
Ecosystem Protection Level	The terrestrial ecosystems associated with the project area is rated as *poorly protected*	7.3.2
NFEPA Rivers and Wetlands	The project area does overlap with a true FEPA wetland.	7.3.5
NBA Wetlands	Not protected and poorly protected wetlands and rivers can be found in the project areas. These systems are classed as CR	7.3.3
SWSA	Irrelevant: The project area does not fall within a SWSA	-
NPAES	The closest NPAES (Vaal Grassland) is 22 km from the project area	-
Gauteng Ridges	The project area is in close proximity to four class 4 ridges, all of which is confirmed don't exist	7.4
Protected Areas (SAPAD & SACAD)	Irrelevant: The nearest SAPAD is 7 km from the project area and 15km from the nearest SACAD.	-
Important Bird and Biodiversity Areas	Irrelevant: The project area is 15km from the Magaliesberg IBA	-

7.2 Gauteng Conservation Plan

The Gauteng Conservation Plan (Version 3.3) (GDARD, 2014b) classified areas within the province on the basis of its contribution to reach the conservation targets within the province. These areas are classified as Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) to ensure sustainability in the long term. The CBAs are classified as either 'Irreplaceable' (must be conserved), or 'Important'.

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.

The project area falls across both CBA: Important and ESA classified area (Figure 7-1). Sections of the project area is still unclassified.

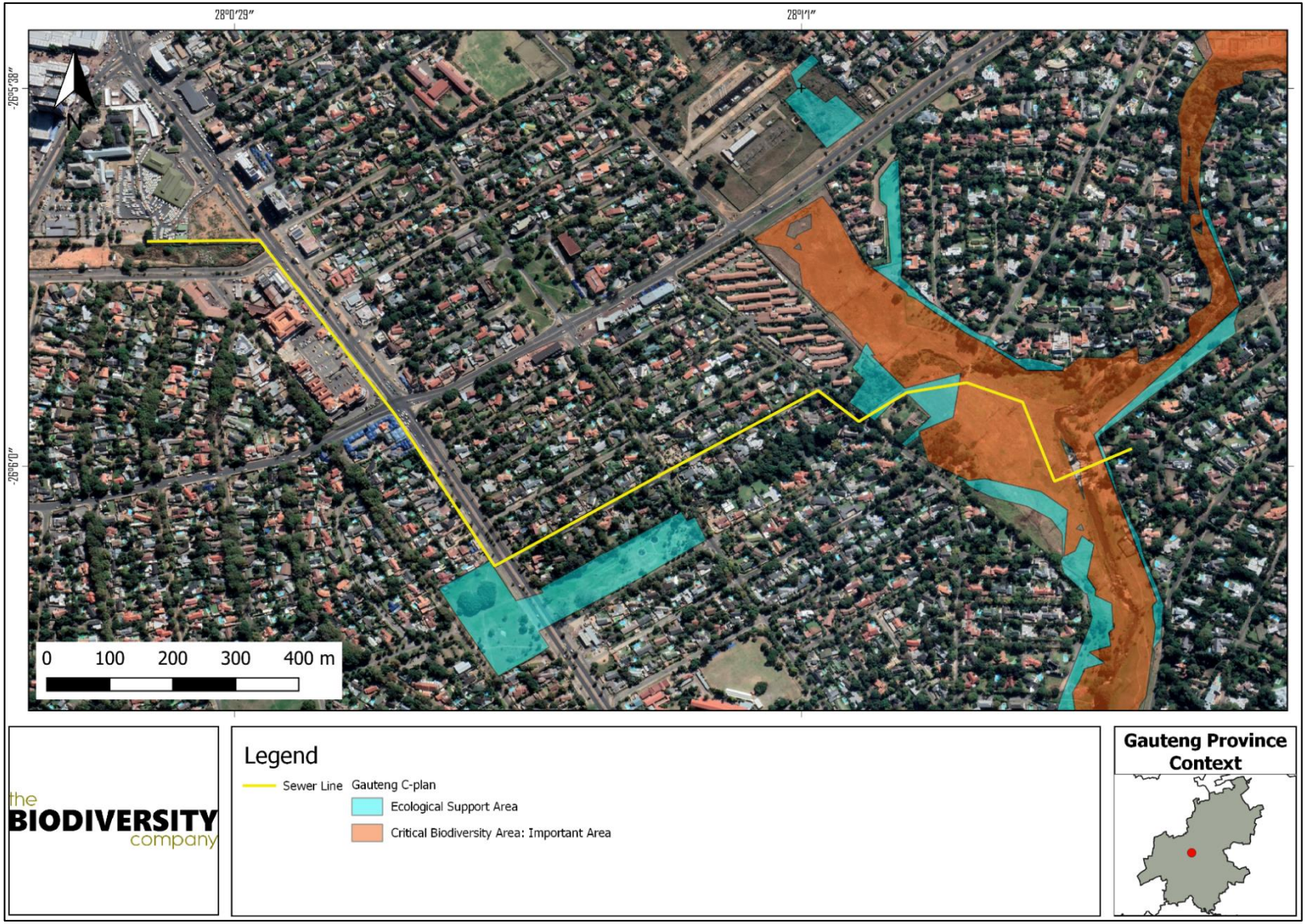


Figure 7-1 The project area superimposed on the Gauteng Conservation Plan Version 3.3

7.3 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 a three-year period (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).

7.3.1 Ecosystem Threat Status

Ecosystem threat status outlines the degree to which ecosystems are still intact or alternatively 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 area was superimposed on the terrestrial ecosystem threat status (Figure 7-2). As seen in this figure, the pipeline is situated within an ecosystem that are listed as CR (Figure 7-2).

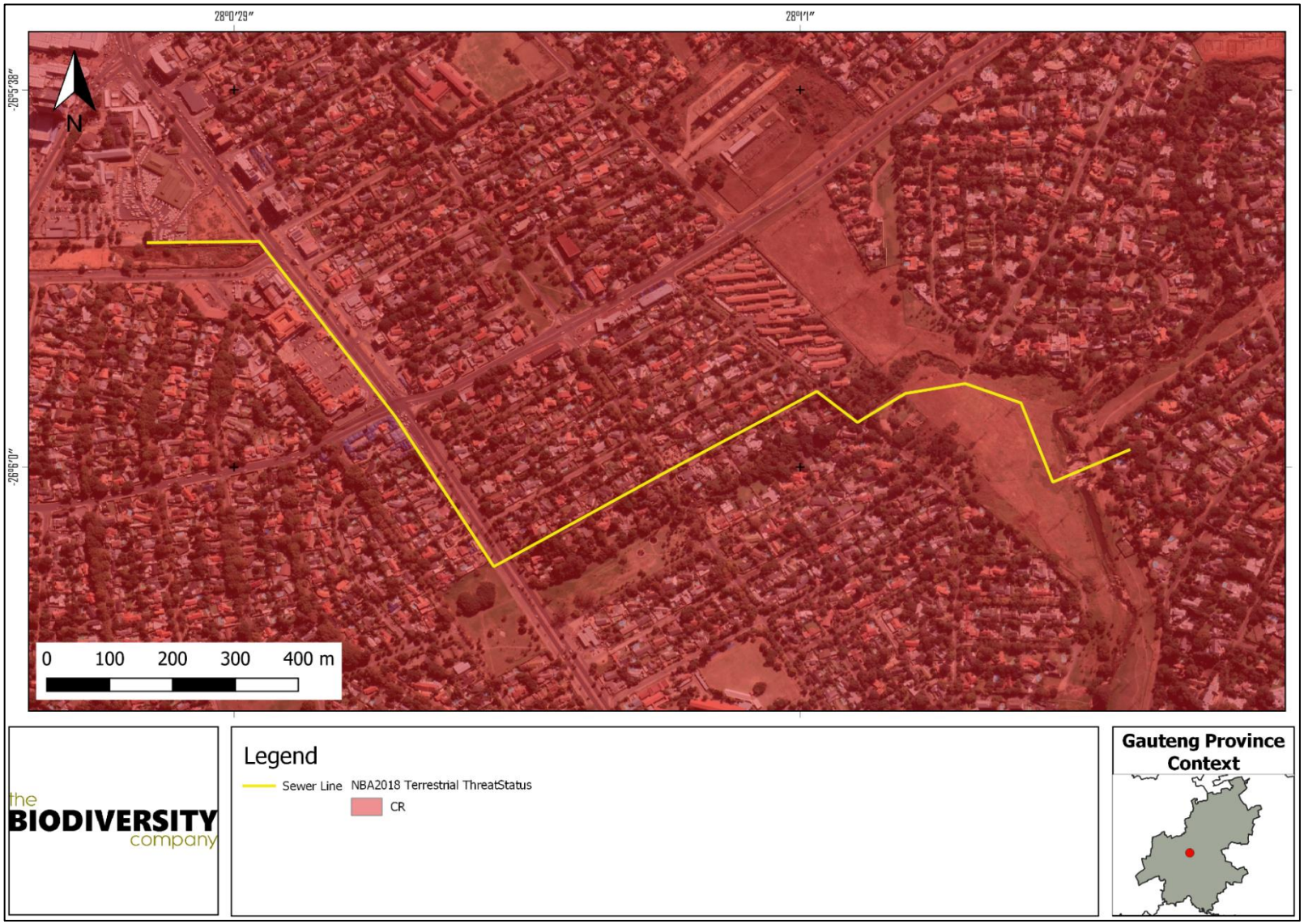


Figure 7-2 The project area showing the regional ecosystem threat status of the associated terrestrial ecosystems (NBA, 2018)

7.3.2 Ecosystem Protection Level

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 area was superimposed on the ecosystem protection level map to assess the protection status of terrestrial ecosystems associated with the development (Figure 7-3). Based on Figure 7-3 the terrestrial ecosystems associated with the development are rated as *poorly protected* for the entire project area. This means that these ecosystems are considered not to be adequately protected in areas such as national parks or other formally protected areas.

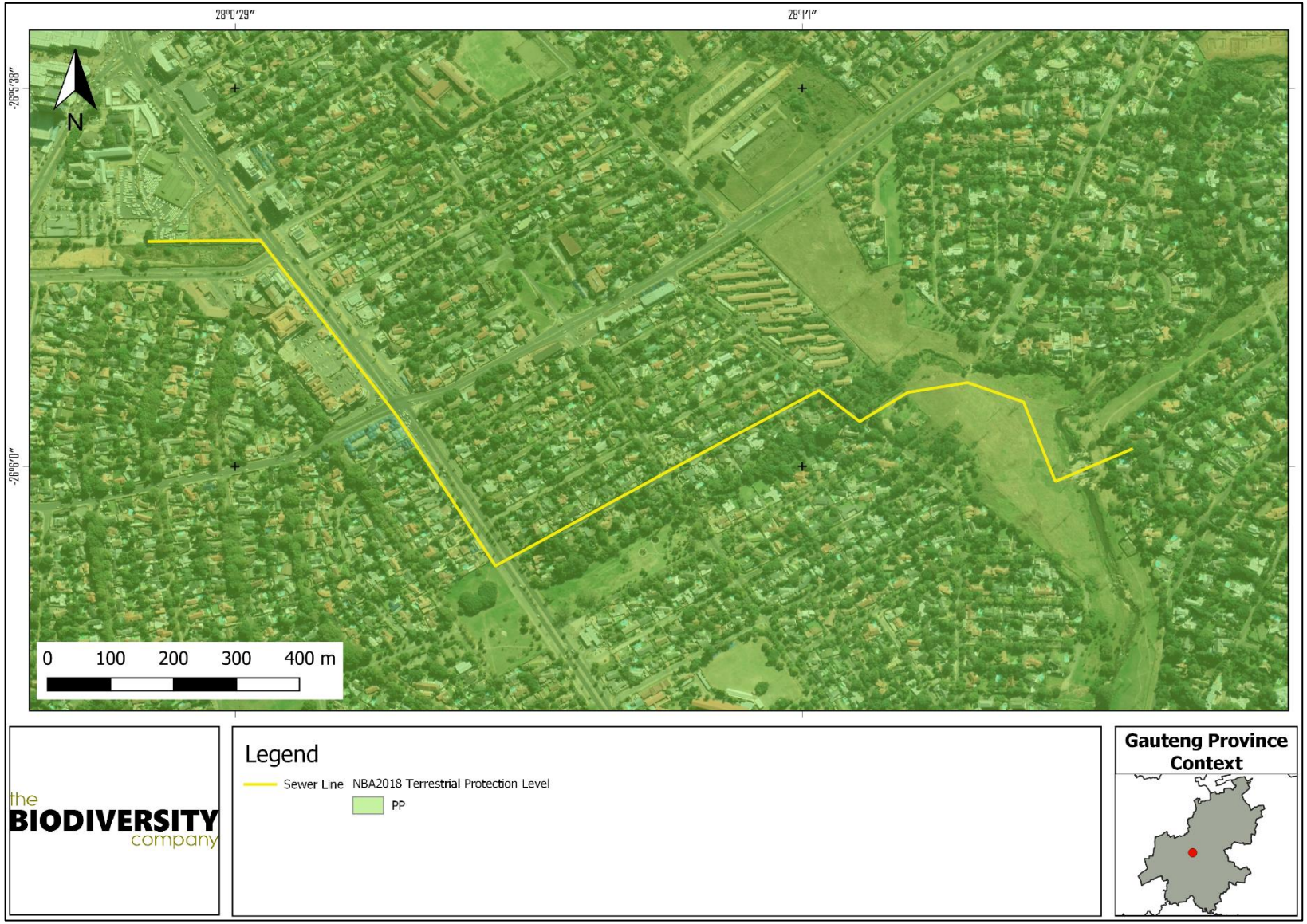


Figure 7-3 The project area showing the regional level of protection of terrestrial ecosystems (NBA, 2018)

7.3.3 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.

Ecosystem threat status (ETS) of river ecosystem types is based on the extent to which each river ecosystem type had been altered from its natural condition. Ecosystem types are categorised as CR, EN, VU or LC, with CR, EN and VU ecosystem types collectively referred to as 'threatened' (Van Deventer *et al.,* 2019; Skowno *et al*., 2019).

The National Biodiversity shows that all the wetlands within the project area is either not protected or poorly protected (see Figure 7-4). Both a not protected and a poorly protected river can also be found in the project area. The wetlands that have been classified as CR (see Figure 7-5).

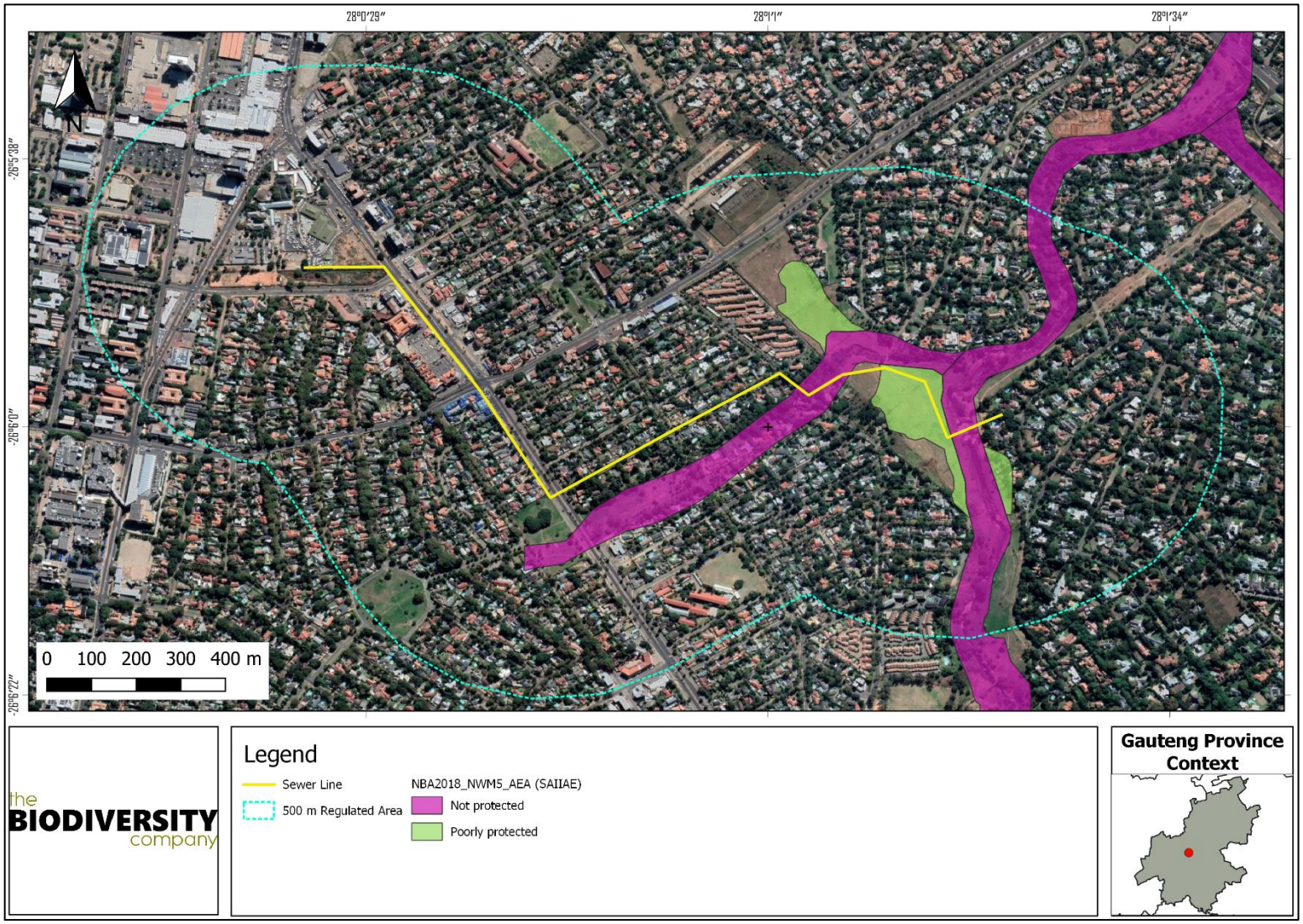


Figure 7-4 The project area in relation to the protection status of the wetland (NBA, 2018)

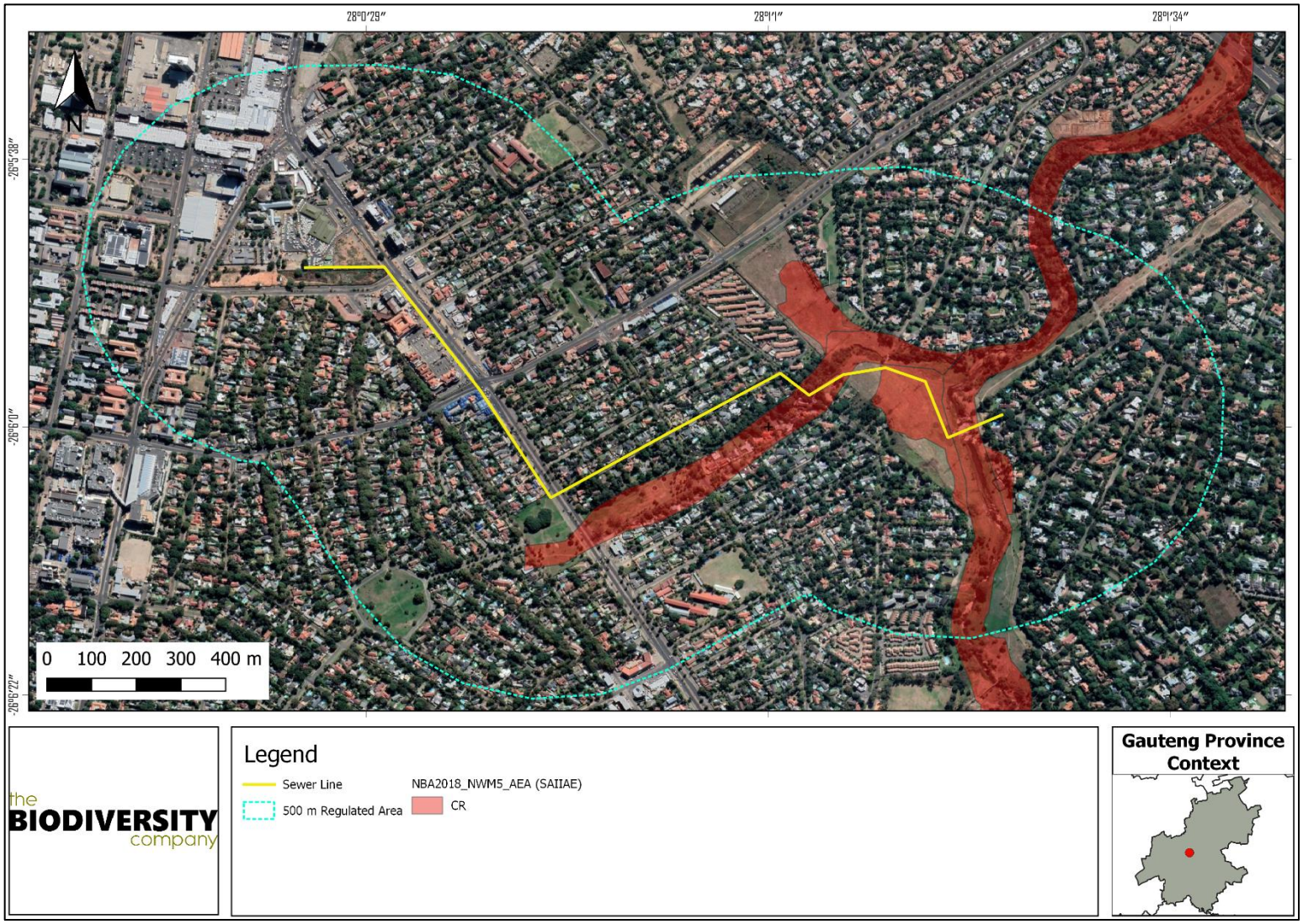


Figure 7-5 The project area in relation to the threat status of the wetland (NBA, 2018)

7.3.4 City of Johannesburg Wetlands

The City of Johannesburg (CoJ) wetlands layer was used to identify potential wetland areas within the 500 m regulated area. According to this data set, two channelled valley bottom systems and one seepage wetland that links up with the latter is located within the 500 m regulated area (see Figure 7-6).

7.3.5 NFEPA Wetlands

According to the National Freshwater Ecosystem Priority Areas (NFEPA) data set, one small patch of wetland that has been identified as being a channelled valley bottom is located towards the east of the pipeline (see Figure 7-6).

7.3.6 Topographical River Lines

The topographical river line data set from the "2628" quarter degree square was used to identify convex topographical features which potentially could indicate wetland areas. One main perennial river line has been identified towards the east of the 500 m regulated area (see Figure 7-7).

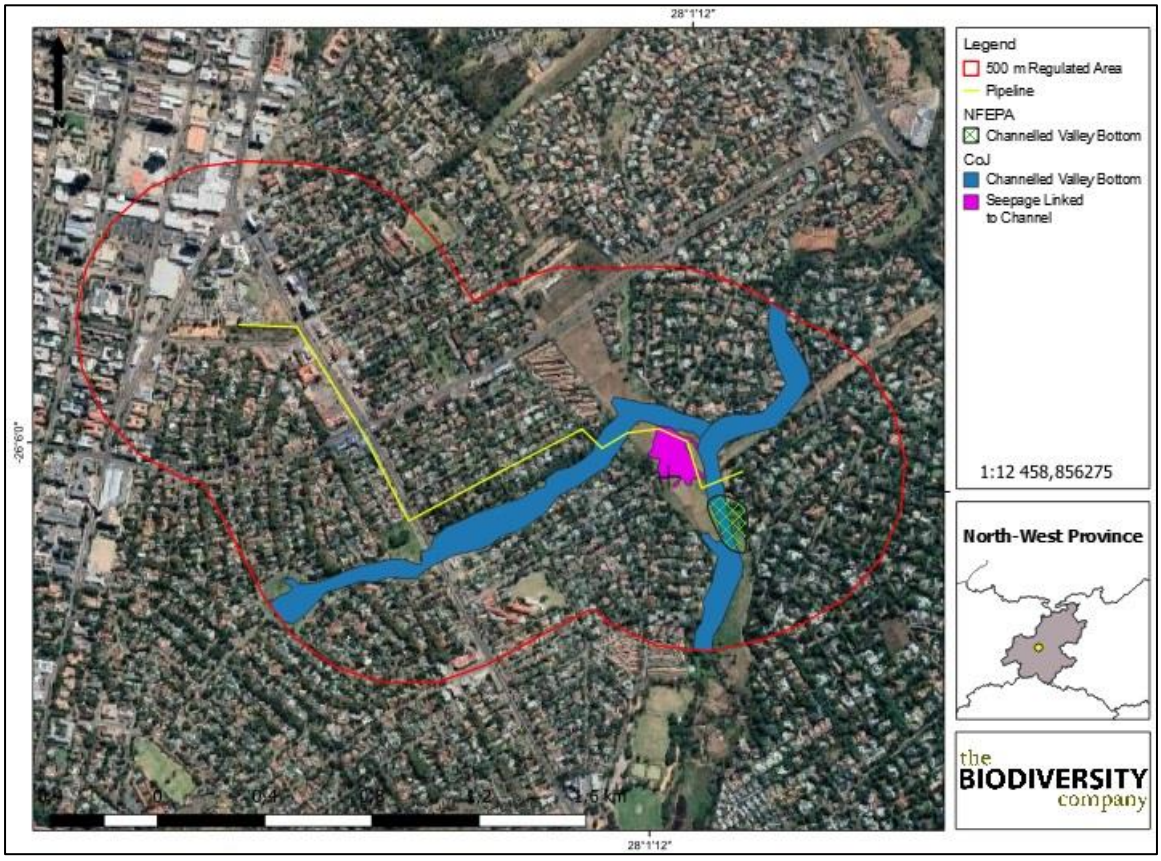


Figure 7-6 NFEPA and CoJ wetlands located within the 500 m regulated area

7.3.7 Inland Waters Data Set (DEA Screening Tool)

The DEA screening tool identified two main watercourse features located within the 500 m regulated area, namely "Inland Waters Wetlands and Estuaries" and "Inland Waters Aquatic CBA".

The exact same wetland delineation has been used for this data set as that of the SAIIAE wetlands data set. The sensitivity of these systems has been classified as being “Very High” (DEA, 2021) (see Figure 7-7).

7.3.8 Aquatics CBA

A large delineation resembling a buffer around the main watercourse to the east has been classified as an “Aquatics Critical Biodiversity Area” (CBA). The sensitivity of this system has been classified as being “Very High” (DEA, 2021) (see Figure 7-7).

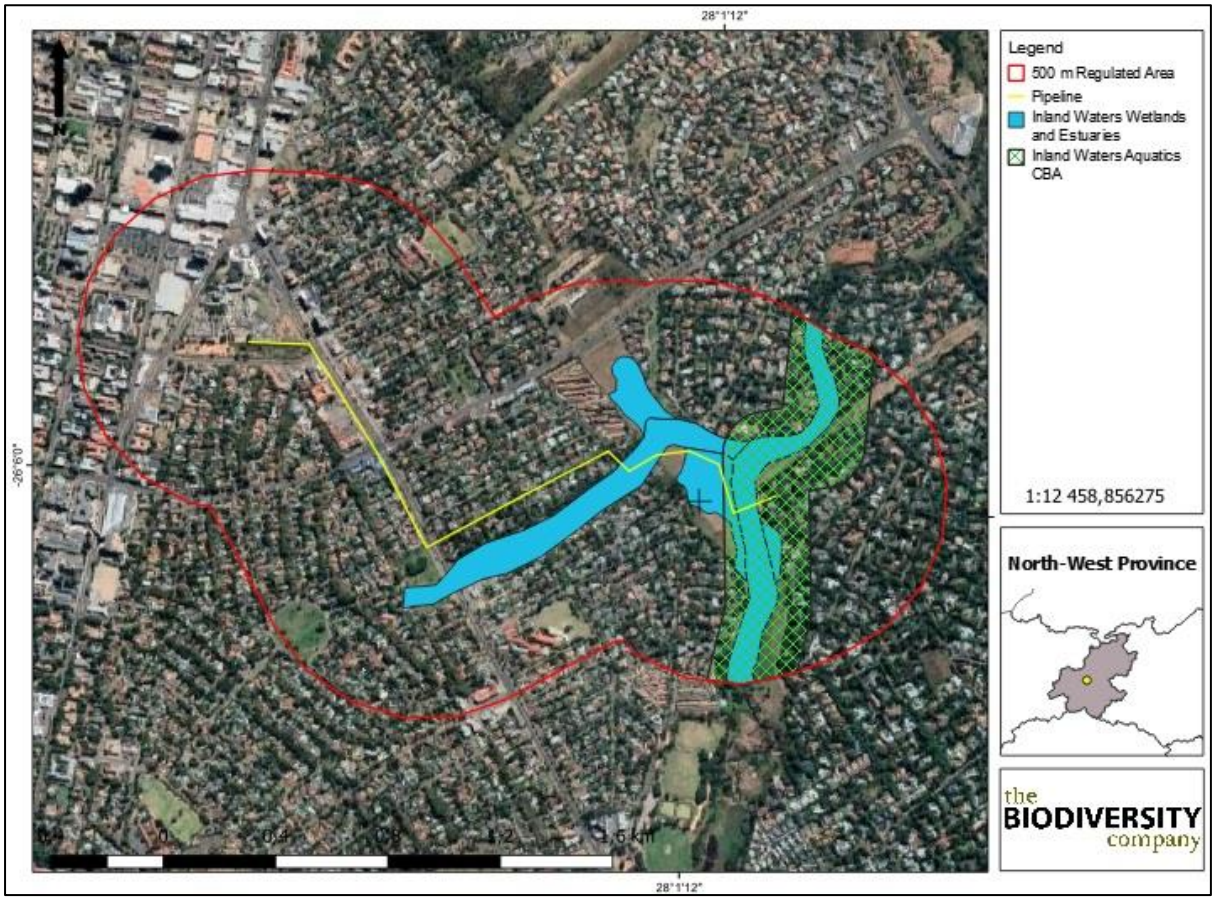


Figure 7-7 DEA Screening tool indicating inland waters data sets (DEA, 2021)

7.3.9 Digital Elevation Model

A Digital Elevation Model (DEM) has been created to identify lower laying regions as well as potential convex topographical features which could point towards preferential flow paths. The 500 m regulated area ranges from 1 490 to 1 613 Metres Above Sea Level (MASL). The lower laying areas (generally represented in dark blue) represent area that will have the highest potential to be characterised as wetlands (see Figure 7-8).

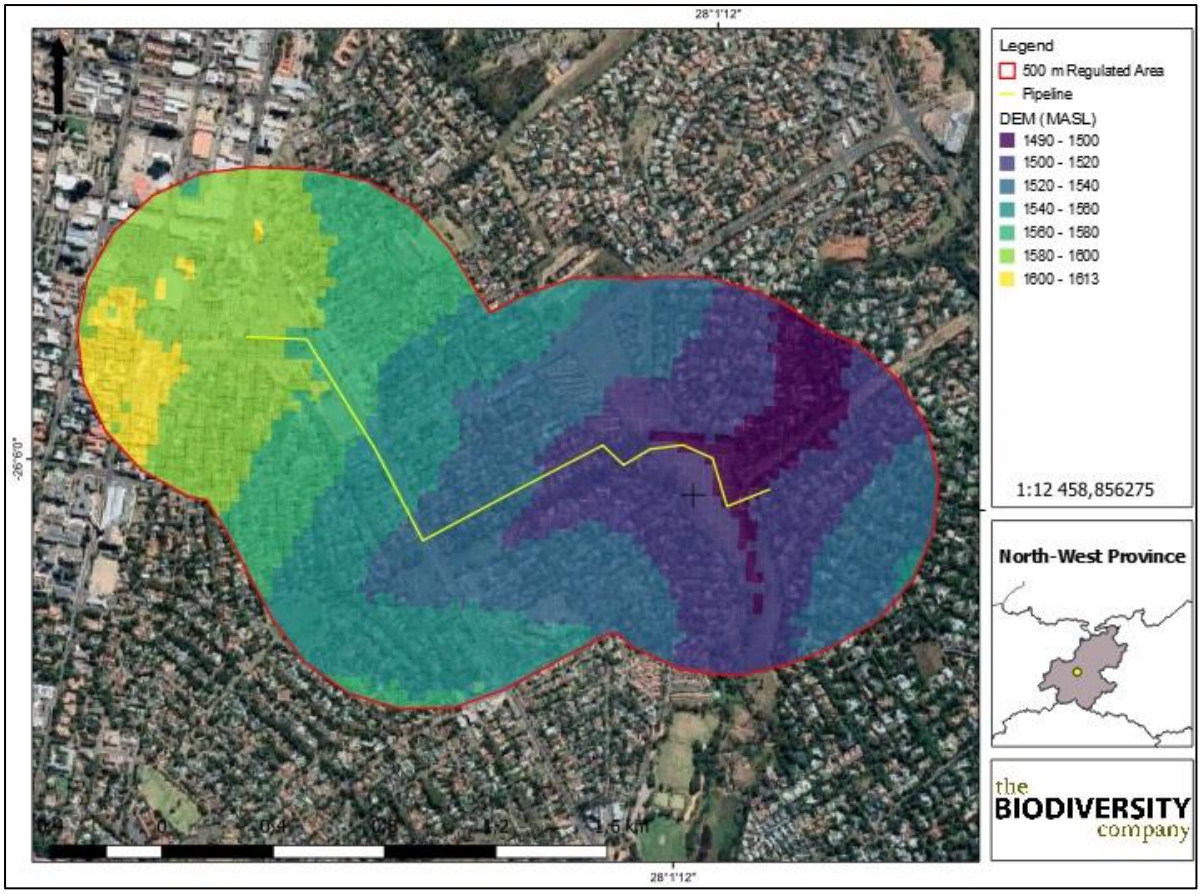


Figure 7-8 Digital Elevation Model of the 500 m regulated area

7.3.10 Slope Percentage

The slope percentage of the 500 m regulated area is illustrated in Figure 7-9. The slope percentage ranges from 0 to 6%, with majority of the 500 m regulated area being characterised by a gentler slope (between 0 and 2%). This indicates a gentle slope throughout the project area.

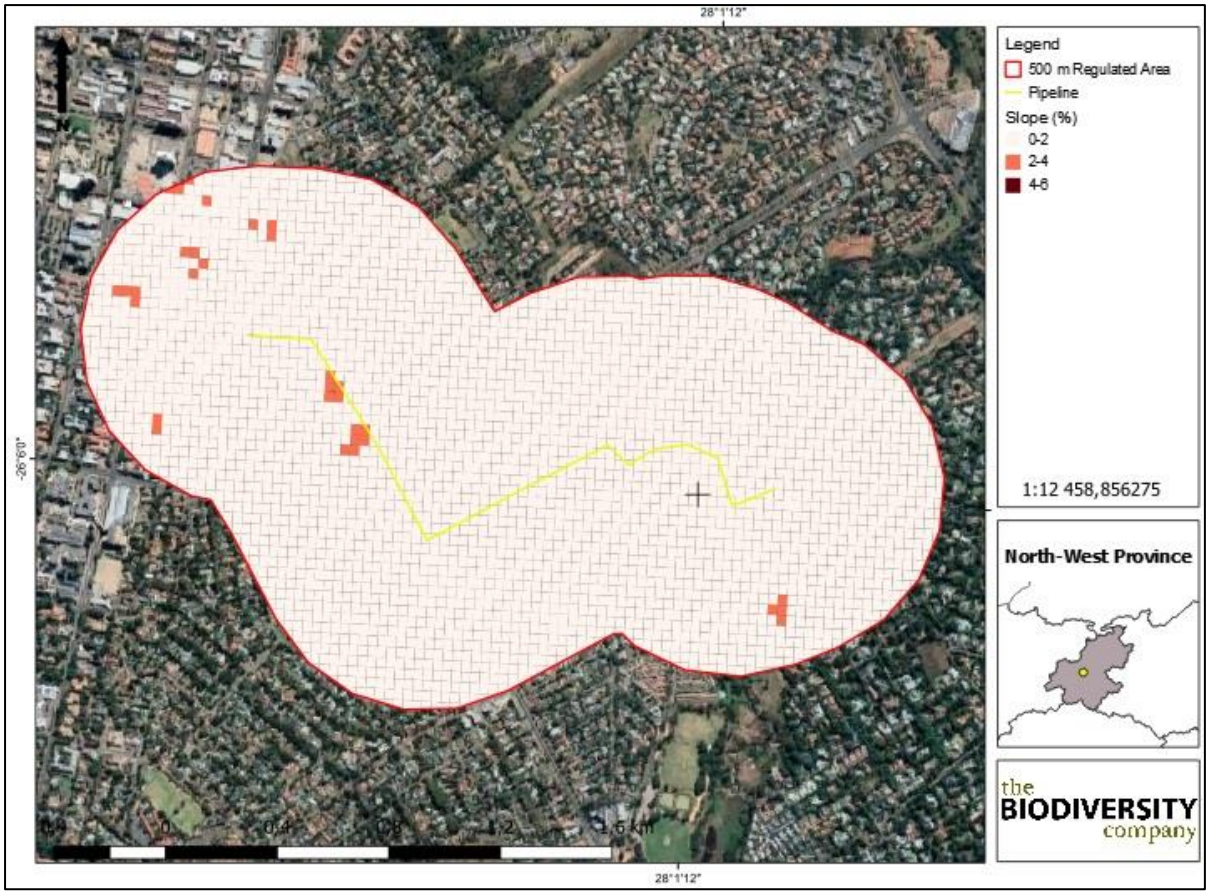


Figure 7-9 Slope percentage of the 500 m regulated area

7.4 Gauteng Ridges

The quartzite ridges of Gauteng are one of the most important natural assets in the northern province of South Africa. This is because these ridges, and the area immediately surrounding the ridges, provide habitat for a wide variety of fauna and flora, some of which are Red List, rare or endemic species or, in the case of certain of the plant species, are found nowhere else in South Africa or the world (GDARD, 2019).

The project area is in close proximity to four class 4 ridges, all of which is confirmed don't exist (Figure 7-10).

Figure 7-10 The Gauteng ridges associated with the project area.

7.5 Desktop Assessment

7.5.1 Geology and Soils

This region is characterised by the Halfway House Granite's Archaean granite and gneiss which is located at the core of the Johannesburg Dome. These geological features support shallow, leached, coarsely grained, sandy soils that are nutrient poor and are commonly associated with the Glenrosa soil form. A small area within this region is characterised by ultramafic geology, which supports Ba and Bb land types, (Mucina & Rutherford, 2006).

The dominant land type has been identified to be the Bb1 land type, which consists of plinthic catena. Upland duplex and margalitic soils are rare and dystrophic and/or mesotrophic red soils are not widespread. The terrain units and expected soil forms are illustrated in Figure 7-11 and Table 7-2 respectively.

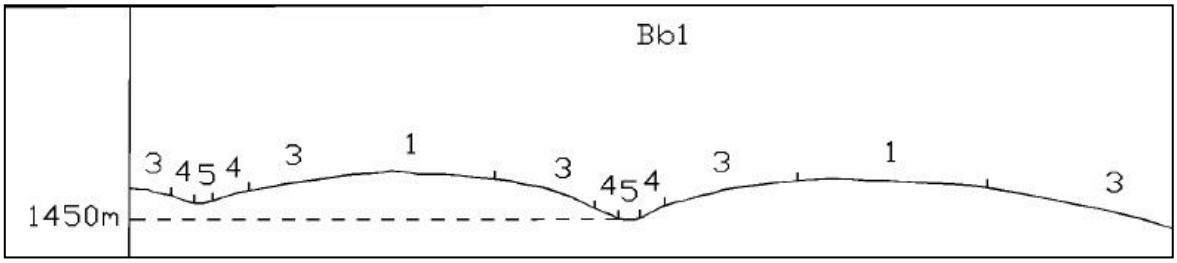


Figure 7-11 Illustration of land type Bb 1 terrain units (Land Type Survey Staff, 1972 – 2006

Table 7-2 Soils expected at the respective terrain units within the Bb 1 land type (Land Type Survey Staff, 1972 - 2006)

Terrain units							
1 (40%)		**3 (55%)**		**4 (3%)**		**5 (3%)**	
Hutton	35%	Wasbank	25%	Longlands	40%	Kroonstad	50%
Avalon	25%	Avalon	20%	Wasbank	30%	Dundee	30%
Glenrosa	20%	Glenrosa	15%	Westleigh	20%	Westleigh	20%
Wasbank	10%	Hutton	10%	Kroonstad	10%		
Mispah	5%	Longlands	10%				
Glencoe	5%	Mispah	10%				
		Rock	5%				
		Glencoe	5%				

7.5.2 Climate

This region is characterised by a summer rainfall and very dry winters. The mean annual precipitation is 680 mm with frost frequently occurring throughout winter months and more frequently occurs to the southern parts of the vegetation type than the northern parts. See Figure 7-12 for more detail regarding the climate of the region.

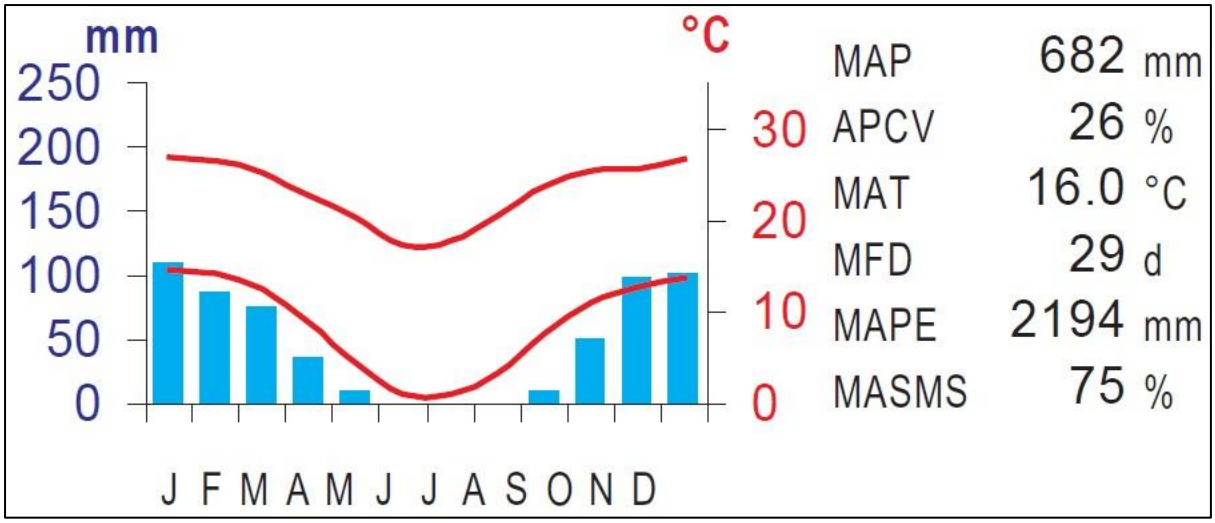


Figure 7-12 Climate for the region, Mucina & Rutherford (2006)

7.5.3 Vegetation Assessment

The project area is situated within the grassland biome. This biome is centrally located in southern Africa, and adjoins all except the desert, fynbos and 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. 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.

7.5.3.1 Vegetation Types

The grassland biome comprises many different vegetation types. The project area is situated within Egoli Granite Grassland vegetation type according to Mucina & Rutherford (2006) (Figure 7-13).

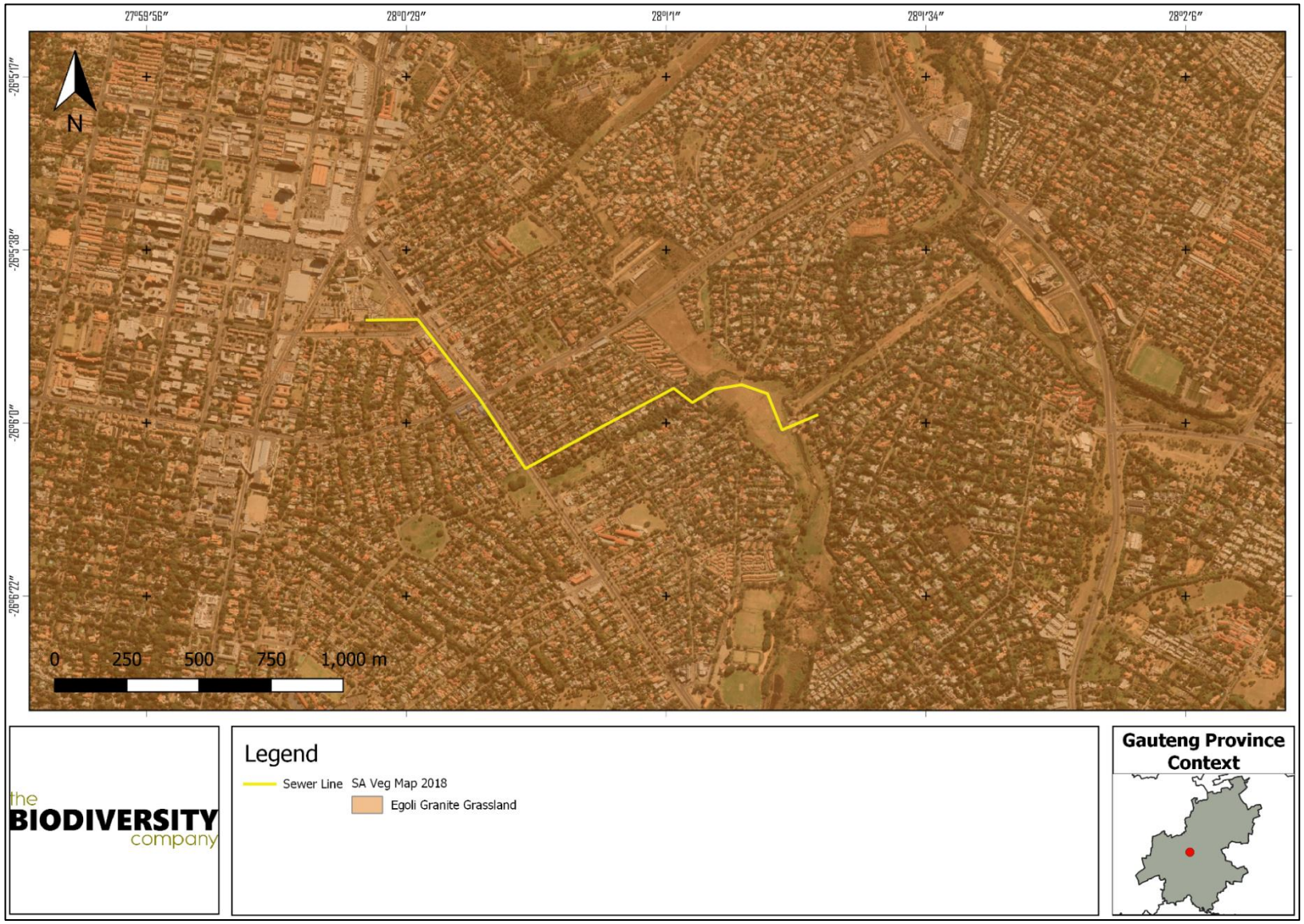


Figure 7-13 The project area showing the vegetation type based on the Vegetation Map of South Africa, Lesotho & Swaziland (BGIS, 2018)

7.5.3.1.1 Egoli Granite Grassland

Egoli Granite Grassland (EGG) occurs only in the Gauteng province, and less than 32% of this vegetation type remains untransformed. The province has a target to conserve and protect 25% of the remaining vegetation type.

Egoli Granite Grassland is characterised by a high species richness with a patchy dominance of various grass species, and a large variety of forbs (broad leafed herbaceous plant, other than grass), representing a climax or close to climax condition.

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 **Egoli Granite Grassland** vegetation type:

Graminoids: *Aristida canescens, A. congesta, Cynodon dactylon, Digitaria monodactyla, Eragrostis capensis, E. chloromelas, E. curvula, E. racemosa, Heteropogon contortus, Hyparrhenia hirta, Melinis repens subsp. repens, Monocymbium ceresiiforme, Setaria sphacelata, Themeda triandra, Tristachya leucothrix, Andropogon eucomus, Aristida aequiglumis, A. diffusa, A. scabrivalvis subsp. borumensis, Bewsia biflora, Brachiaria serrata, Bulbostylis burchellii, Cymbopogon caesius, Digitaria tricholaenoides, Diheteropogon amplectens, Eragrostis gummiflua, E. sclerantha, Panicum natalense, Schizachyrium sanguineum, Setaria nigrirostris, Tristachya rehmannii, Urelytrum agropyroides.*

Herbs: *Acalypha angustata, A. peduncularis, Becium obovatum, Berkheya insignis, Crabbea hirsuta, Cyanotis speciosa, Dicoma anomala, Helichrysum rugulosum, Justicia anagalloides, Kohautia amatymbica, Nidorella hottentotica, Pentanisia prunelloides subsp. latifolia, Pseudognaphalium luteo-album* and *Senecio venosus.*

Geophytic Herbs: *Cheilanthes deltoidea, C. hirta.*

Low Shrubs*: Anthospermum hispidulum, A. rigidum subsp. pumilum, Gnidia capitata, Helichrysum kraussii, Ziziphus zeyheriana.*

Tall Shrub: *Searsia pyroides.*

Succulent Shrub: *Lopholaena coriifolia*

Conservation Status of the Vegetation Type

According to SANBI (2019), this vegetation type is classified as Critically Endangered (CR). The national target for conservation protection for both these vegetation types is 24%, but only 3% is conserved in statutory reserves (Diepsloot and Melville Koppies Nature Reserves). More than two thirds of this vegetation unit have already undergone transformation mostly due to urbanisation, cultivation or building of roads.

7.5.3.2 Plant Species of Conservation Concern

Based on the Plants of Southern Africa (BODATSA-POSA, 2019) database, 1203 plant species have the potential to occur in the project area and its surroundings (Figure 7-14 and Table 7-3).

Of these 718 plant species (Appendix B), eleven (11) species are listed as being Species of Conservation Concern (SCC) (Figure 7-14).

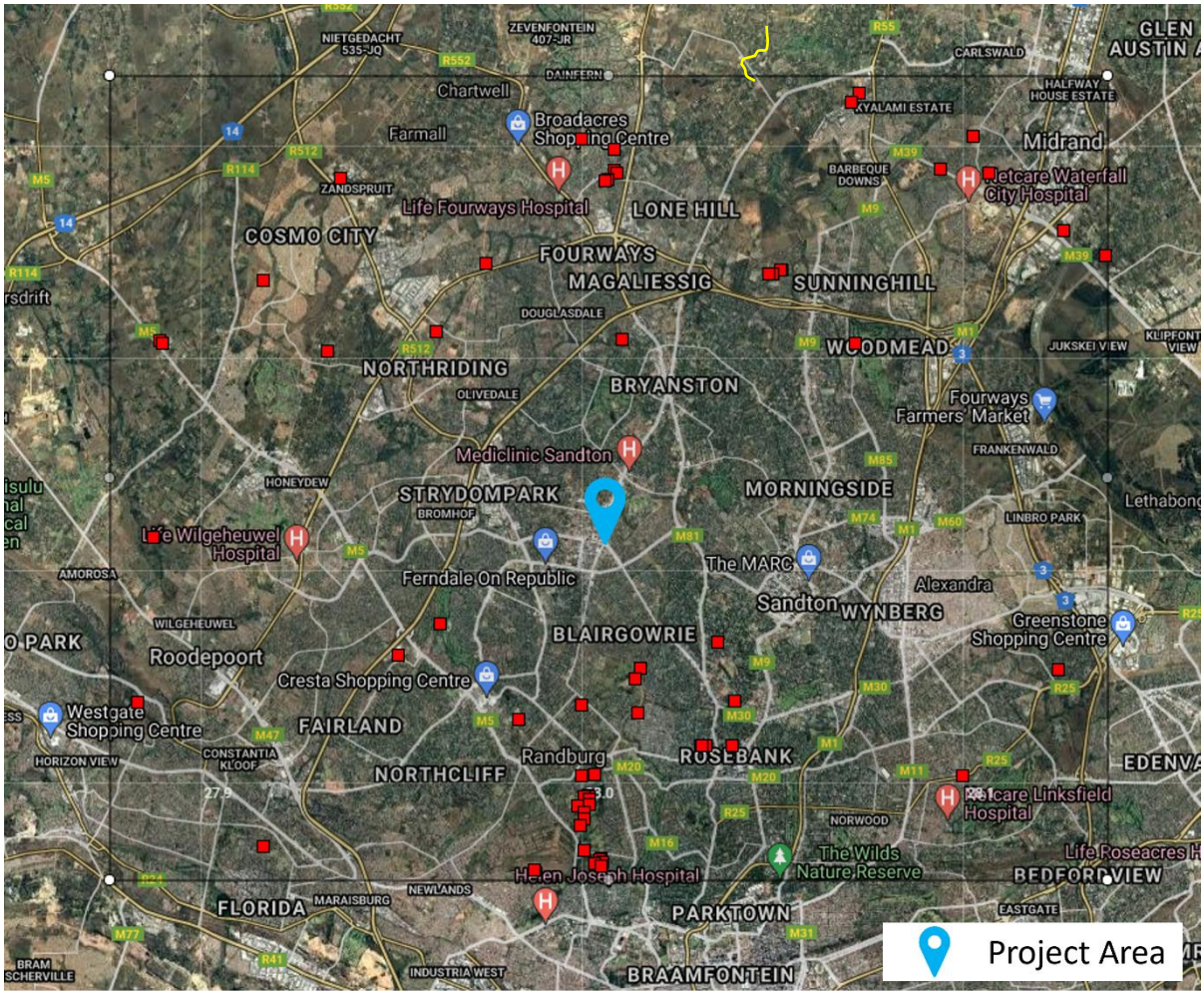


Figure 7-14 Map showing the grid drawn in order to compile an expected plant species list (BODATSA-POSA, 2019)

Table 7-3 Plant Species of Conservation Concern with the potential to occur in the project area.

Family	Taxon	IUCN	Ecology
Fabaceae	*Pearsonia bracteata*	NT	Indigenous; Endemic
Orchidaceae	*Holothrix randii*	NT	Indigenous
Asteraceae	*Cineraria austrotransvaalensis*	NT	Indigenous; Endemic
Fabaceae	*Melolobium subspicatum*	VU	Indigenous; Endemic
Fabaceae	*Argyrolobium longifolium*	VU	Indigenous; Endemic
Crassulaceae	*Adromischus umbraticola*	NT	Indigenous; Endemic
Apocynaceae	*Stenostelma umbelluliferum*	NT	Indigenous; Endemic

Fabaceae	*Indigofera hybrida*	VU	Indigenous; Endemic
Proteaceae	*Leucospermum saxosum*	EN	Indigenous
Proteaceae	*Protea compacta*	NT	Indigenous; Endemic
Ericaceae	*Erica jasminiflora*	CR	Indigenous; Endemic

7.5.4 Faunal Assessment

7.5.4.1 Avifauna

Based on the South African Bird Atlas Project, Version 2 (SABAP2) database 331 species have been observed in the area, of these 16 species are species of conservation concern. The full list of potential bird species is provided in Appendix C.

Of the potential bird species, fifteen (16) species are listed as SCC either on a regional or global scale (Table 7-4). The SCC include the following:

- Three (3) species that are listed as EN on a regional basis;
- Three (3) species that are listed as VU on a regional basis; and
- Nine (9) species that are listed as NT on a regional basis.

On a global scale, one (1) species as EN, one (1) species as VU and four (4) species as NT (Table 7-4). 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 7-4 List of bird species of regional or global conservation importance that are expected to occur in close vicinity to the project area

Species	Common Name	Conservation Status		Likelihood of occurrence
		Regional (SANBI, 2016)	IUCN (2017)	
Anthropoides paradiseus	Crane, Blue	NT	VU	Low
Aquila verreauxii	Eagle, Verreaux's	VU	LC	Low
Calidris ferruginea	Sandpiper, Curlew	LC	NT	Low
Ciconia abdimii	Stork, Abdim's	NT	LC	Low
Circus ranivorus	Marsh-harrier, African	EN	LC	Low
Coracias garrulus	Roller, European	NT	LC	Low
Falco biarmicus	Falcon, Lanner	VU	LC	Low
Falco vespertinus	Falcon, Red-footed	NT	NT	Low
Glareola nordmanni	Pratincole, Black-winged	NT	NT	Low
Gyps coprotheres	Vulture, Cape	EN	EN	Low
Leptoptilos crumeniferus	Stork, Marabou	NT	LC	Low
Mycteria ibis	Stork, Yellow-billed	EN	LC	Low
Oxyura maccoa	Duck, Maccoa	NT	NT	Low
Phoenicopterus roseus	Flamingo, Greater	NT	LC	Low
Rostratula benghalensis	Painted-snipe, Greater	NT	LC	Low
Tyto capensis	Grass-owl, African	VU	LC	Low

7.5.4.2 Mammals

The IUCN Red List Spatial Data (IUCN, 2017) lists 74 mammal species that could be expected to occur within the project area. Species that are generally restricted to protected areas such as game reserves have been excluded from the list (Appendix D).

Of the 74 small to medium sized mammal species, thirteen (13) are listed as being of conservation concern on a regional or global basis (Table 7-5). The list of potential species includes:

- One (1) that are listed as EN on a regional basis;
- Five (5) that are listed as VU on a regional basis; and
- Six (6) that are listed as NT on a regional scale.

On a global scale, 1 species is listed as EN, 2 are listed as VU and 4 as NT (Table 7-5). 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 7-5 List of mammal species of conservation concern that may occur in the project area as well as their global and regional conservation statuses.

Species	Common Name	Conservation Status		Likelihood of occurrence
		Regional (SANBI, 2016)	IUCN (2017)	
Aonyx capensis	Cape Clawless Otter	NT	NT	Low
Atelerix frontalis	South Africa Hedgehog	NT	LC	Low
Crocidura maquassiensis	Makwassie musk shrew	VU	LC	Low
Dasymys incomtus	African Marsh rat	NT	LC	Low
Eidolon helvum	African Straw-colored Fruit Bat	LC	NT	Low
Felis nigripes	Black-footed Cat	VU	VU	Low
Hydrictis maculicollis	Spotted-necked Otter	VU	NT	Low
Leptailurus serval	Serval	NT	LC	Low
Mystromys albicaudatus	White-tailed Rat	VU	EN	Low
Ourebia ourebi	Oribi	EN	LC	Low
Panthera pardus	Leopard	VU	VU	Low
Parahyaena brunnea	Brown Hyaena	NT	NT	Low
Poecilogale albinucha	African Striped Weasel	NT	LC	Low

7.5.4.3 Herpetofauna (Reptiles & Amphibians)

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the ReptileMap database provided by the Animal Demography Unit (ADU, 2021) 76 reptile species have the potential to occur in the project area (Appendix E). Four of the expected species are SCCs (IUCN, 2017). All SCCs have a low likelihood of disturbance, this is based on the known habitat requirements of these species that is not fulfilled in the area.

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the AmphibianMap database provided by the Animal Demography Unit (ADU, 2021) 21 amphibian species have the

potential to occur in the project area (Appendix F). No amphibian SCCs are expected to occur in the project area (Table 7-6).

Table 7-6 Reptiles species of conservation concern that may occur in the project area as well as their global and regional conservation statuses (IUCN, 2017; SANBI, 2016).

Species	Common Name	Conservation Status		Likelihood of occurrence
		Regional (SANBI, 2016)	IUCN (2017)	
Chamaesaura aenea	Coppery Grass Lizard	NT	NT	Low
Crocodylus niloticus	Nile Crocodile	VU	LC	Low
Homoroselaps dorsalis	Striped Harlequin Snake	NT	LC	Low
Kinixys lobatsiana	Lobatse hinged-back Tortoise	LC	VU	Low

7.5.4.4 Lepidoptera

The screening tool indicated the potential occurrence of the *Aloeides dentatis dentatis* for the area. The assigned sensitivity for this taxa was medium. According to the South African National Biodiversity Institute (http://speciesstatus.sanbi.org/taxa/detail/200/) this species habitat preference is fairly flat, rocky highveld grassland above 1,500 m, along or below ridges. Due to the disturbance to the grassland and the absence of ridges for the area, the likelihood of occurrence of this species is expected to be low.

8 Field Survey

8.1 Terrestrial Assessment

The field survey for flora and fauna (mammals, amphibians and reptiles) was conducted in July 2021. During the survey the assessment of floral and faunal communities was conducted throughout the extent the 50-meter survey corridor from the centre of the pipeline, referred to the project area. The project area was 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.

8.1.1 Vegetation Assessment

A total of 28 tree, shrub and herbaceous plant species were recorded in the project area during the field assessment (Table 8-1). The low diversity can be attributed to the dry season survey conditions when most plants are dormant resulting in less above ground plant parts to assist with identification, like flowers. The project area was also found to be recently burnt. 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.

Table 8-1 Trees, shrubs and weeds recorded in the project area

Scientific Name	Common Name	Threat Status (SANBI, 2017)	SA Endemic	Alien Category
Acacia mearnsii	Black Wattle			NEMBA Category 2
Alternanthera pungens	Kakiedubbeltjie			Not indigenous; Naturalised
Amaranthus hybridus	Smooth pigweed			Not indigenous; Naturalised
Arundo donax	Spanish Reed			NEMBA Category 1b
Bidens pilosa	Blackjack			Not indigenous; Naturalised
Conyza bonariensis	Hairy Fleabane			Not indigenous; Naturalised
Cymbopogon caesius	Broad Leaved Turpentine Grass	LC	Not Endemic	
Cynodon dactylon	Couch Grass, Quick Grass	LC	Not Endemic	
Eragrostis chloromelas	Blue Love Grass	LC	Not Endemic	
Eragrostis curvula	Weeping Love Grass	LC	Not Endemic	
Gomphrena celosioides	Bachelor's button			Not indigenous; Naturalised
Hyparrhenia hirta	Common Thatching Grass	LC	Not Endemic	
Melia azedarach	"Syringa", Persian Lilac			NEMBA Category 1b.
Melinis repens	Natal Red Top	LC	Not Endemic	
Morus alba	Mulberry			NEMBA Category 3
Pennisetum clandestinum	Kikuyu Grass			NEMBA Category 1b in protected areas and wetlands.
Persicaria lapathifolia	Pale smartweed			Not indigenous; Naturalised
Plantago lanceolata		LC	Not Endemic	
Populus alba				Not indigenous; Naturalised
Schoenoplectus corymbosus	Matjiesgoed	LC	Not Endemic	
Sporobolus africanus	Ratstail Dropseed	LC	Not Endemic	
Tagetes minuta	Khaki Bush			Not indigenous; Naturalised
Tecoma stans	Yellow bells			NEMBA Category 1b
Themeda triandra	Red Grass	LC	Not Endemic	
Tipuana tipu	Tipa			Not indigenous; Naturalised
Tribulus terrestris	Devil's Thorn	LC	Not Endemic	
Typha capensis	Bulrush, Common Cattail	LC	Not Endemic	
Verbena bonariensis	Wild Verbena			NEMBA Category 1b.

8.1.1.1 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, it is important that these plants are controlled by means of 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 the Government Gazette No. 43726, 18 September 2020. The legislation calls for the removal and / or control of AIP 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.

Four (4) 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.

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

8.1.2 Faunal Assessment

The faunal assessment was completed based on the desktop review and intensive biodiversity surveys which were conducted across the project area.

8.1.2.1 Avifauna

A total of seventeen (17) bird species were recorded in the project area during the survey based on either direct observations, or the presence of visual tracks & signs (Figure 8-1 and Table 8-2).

Table 8-2 Avifaunal species recorded in the project area.

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Acridotheres tristis	Myna, Common	Unlisted	LC
Alopochen aegyptiacus	Goose, Egyptian	Unlisted	LC
Ardea melanocephala	Heron, Black-headed	Unlisted	LC
Bostrychia hagedash	Ibis, Hadeda	Unlisted	LC
Charadrius tricollaris	Plover, Three-banded	Unlisted	LC
Motacilla capensis	Wagtail, Cape	Unlisted	LC
Passer domesticus	Sparrow, House	Unlisted	LC
Passer melanurus	Sparrow, Cape	Unlisted	LC
Ploceus velatus	Masked-weaver, Southern	Unlisted	LC
Pycnonotus tricolor	Bulbul, Dark-capped	Unlisted	Unlisted
Saxicola torquatus	Stonechat, African	Unlisted	LC
Streptopelia capicola	Turtle-dove, Cape	Unlisted	LC
Streptopelia senegalensis	Dove, Laughing	Unlisted	LC
Threskiornis aethiopicus	Ibis, African Sacred	Unlisted	LC
Turdus olivaceus	Thrush, Olive	Unlisted	LC
Vanellus coronatus	Lapwing, Crowned	Unlisted	LC
Vanellus senegallus	Lapwing, African Wattled	Unlisted	LC

Figure 8-1 Some of the avifaunal species recorded on site: A) African Stonechat (Saxicola torquatus), B) Egyptian Goose (Alopochen aegyptiacus), C) African Wattled Lapwing, (Vanellus senegallus), D) Southern Masked Weaver (Ploceus velatus,)

8.1.2.2 Mammals

No mammal species were recorded in the project area during the surveys based on either direct observation or the presence of visual tracks & signs. This can be attribute to the winter survey fauna are generally more inactive. The area was also in a disturbed state and had a lack of suitable quality habitat and the species has most likely been persecuted due to the urban area and its associated disturbances.

8.1.2.3 Herpetofauna

No reptile or amphibian species were recorded in the project area during the surveys. This can be attribute to the winter survey when herpetofauna are inactive die to them being ectothermic (cold-blooded).

8.1.3 Habitats Assessment

The main habitat types identified across the project area were initially identified largely based on aerial imagery. 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 8-2 and Figure 8-3 is an illustration of these habitats from the project area. 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 are discussed in the sub-sections below.

Figure 8-2 Habitats identified in the project area.

Figure 8-3 Habitats observed in the project area: Water Resources, B & C) Disturbed Grassland, D) Transformed

8.1.3.1 Water resources (Wetlands and Watercourses)

This habitat has been identified in the wetland Assessment section. Even though somewhat disturbed, the ecological integrity, importance and functioning of these areas play a crucial role as a water resource system and an important habitat for various fauna and flora. The preservation of this system is a crucial aspect to consider for the proposed development, even more so due to the very high sensitivity of the area according to the wetland assessment and various ecological datasets. This habitat needs to be protected and improved due to the role of this habitat as a water resource.

8.1.3.2 Transformed

This habitat unit represents all areas of urban area and recently cleared areas and the associated tar and secondary roads. This habitat is regarded as transformed due to the nature of the modification of the area 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 a low concern sensitivity.

8.1.3.3 Disturbed Grassland

This habitat is regarded as areas that has been impacted by edge effects of transformed areas as well as fragmentation and direct impacts from littering, dumping and infringement. These habitats are not entirely transformed but is in a constant disturbed state. It cannot recover to a more natural state due to ongoing disturbances and impacts from the surrounding transformed areas. This habitat has been infested with AIP , especially Kikuyu which dominated a large portion of the herbaceous layer. These areas are considered to have a low/poor sensitivity due to the fact that these areas may be used as a movement corridor and in many cases form a barrier between the water resources and the disturbed/transformed areas. This area does not represent the CBA; Important it is classified as due to the extent of modification due to the impacts.

8.2 Wetland Assessment

The wetland areas were delineated in accordance with the DWAF (2005) guidelines (see Figure 8-5). Two wetland HGM types were identified and delineated for the 500 m regulated area. These include a channelled valley bottom wetland (HGM 1) and a hillslope seep (HGM 2). Two seepage areas were delineated, but these are connected with overland flow and have been jointly considered for the assessment. It is apparent that the seepage areas are being partially sustained by artificial flows, the source of which is unknown. The upper reach of the channelled valley bottom wetland is a straightened stormwater channel, flowing into the wetland. These systems are adjacent to the Braamfonteinspruit which is classified as a riverine system. A series of stormwater channels were also identified throughout the regulation area, this are classified as artificial systems. A photograph collage of the identified systems is presented in Figure 8-4. This system is significantly modified and has been subject to various impacts associated with hydrology, geomorphology and vegetation.

Figure 8-4 Systems identified for the project. A) Channelled valley bottom - HGM 1, B) Seep – HGM 2, C) Braamfonteinspruit, D) Stormwater channel

Figure 8-5 Delineation of wetlands within 500 m regulated area

8.2.1 Wetland Unit Identification

The wetland classification as per SANBI guidelines (Ollis *et al.,* 2013) is presented in Table 8-3. One wetland type was identified within the 500 m regulated area, namely a channelled valley bottom wetland (HGM 1).

Table 8-3 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	Mesic Highveld Grassland Group 3	Valley Floor	Channelled Valley Bottom	N/A	N/A
HGM 2	Inland	Highveld	Mesic Highveld Grassland Group 3	Slope	Hillslope Seep	With Channel Outflow	N/A

8.2.2 Wetland Unit Setting

Channelled valley bottom wetlands are typically found on valley floors with a clearly defined, finite stream channel and lacks floodplain features, referring specifically to meanders. Channelled valley bottom wetlands are known to undergo loss of sediment in cases where the wetlands' slope is steep and the deposition thereof in cases of low relief. Figure 8-6 presents a diagram of a typical channelled valley bottom, showing the dominant movement of water into, through and out of the system.

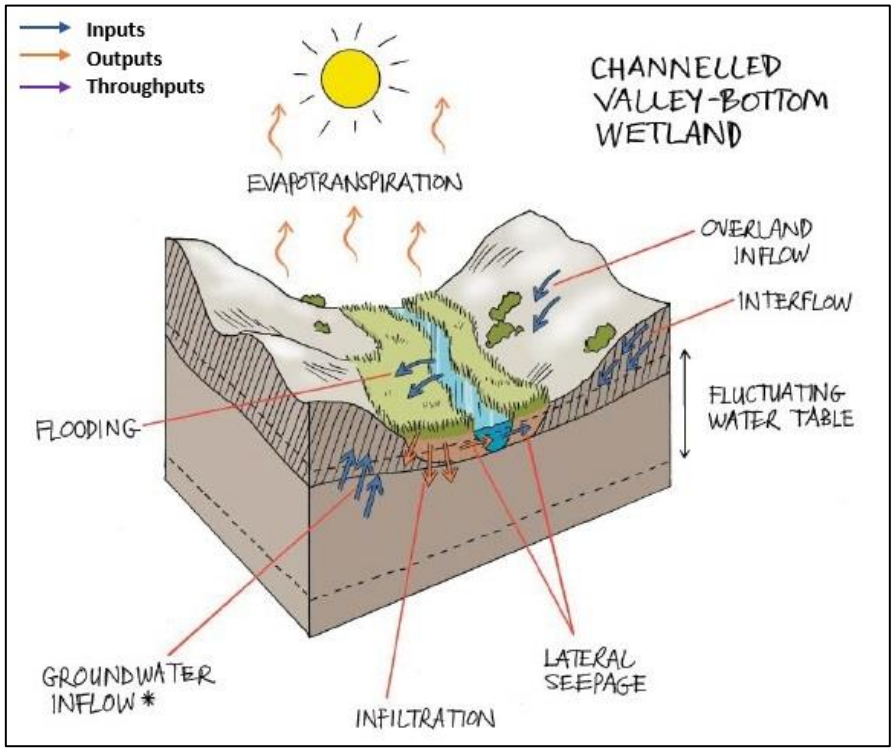


Figure 8-6 Amalgamated diagram of a typical channeled valley bottom, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

Hillslope seeps are characterised by colluvial movement of material. These systems are fed by very diffuse sub-surface flows which seep out at very slow rates, ultimately ensuring that

no direct surface water connects this wetland with other water courses within the valleys. The diagram of the hillslope seeps, showing the dominant movement of water into, through and out of the system can be seen in Figure 8-7.

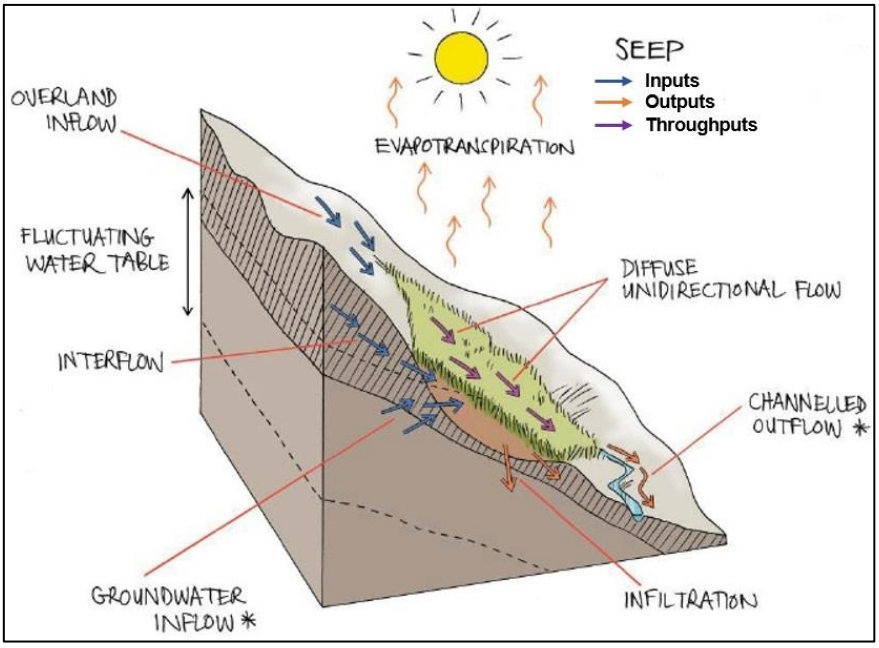


Figure 8-7 Amalgamated diagram of the HGM type, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

8.2.3 Hydromorphic Soils

According to (DWAF, 2005), soils are the most important characteristic of wetlands in order to accurately identify and delineate wetland areas. Two dominant soil forms were identified within the identified wetlands, namely the Dundee and Rensburg soil forms.

The Dundee soil form consists of an Orthic topsoil on top of a stratified alluvium horizon. The soil family group identified for the Dundee soil form is “2222” due to the chromic colour of the topsoil, the brown colour of the subsoil, the non-calcareous nature of the soil form as well as the presence of alluvial wetness.

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).

The stratified alluvium horizon is formed via alluvial or colluvial processes. This soil type is stratified and closely resembles the parent material of this soil type. Stratified alluvium generally is fertile and is often therefore used for cultivation purposes.

The Rensburg soil form consists of a vertic topsoil on top of a gley horizon. The soil family group identified for the Rensburg soil form on-site has been classified as the “1000” soil family due to the non-calcareous nature of the gley horizon.

Vertic topsoils have high clay content with smectic clay particles being dominant (Soil Classification Working Group, 2018). The smectic clays have swell and shrink properties during wet and dry periods respectively. Peds will be shiny, well-developed with a highly plastic

consistency during wet periods as a result of the dominance of smectic clays. During shrinking periods, cracks form on the surface and rarely occurs in shallow vertic clays.

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 underlaying 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).

8.2.4 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 summarised results are shown in Table 8-4. The average ecosystem service score has been determined to be "Moderately Low" for both units.

Table 8-4 The ecosystem services being provided by the HGM type

Wetland Unit					HGM 1	HGM 2
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		1.3	1.1
			Streamflow regulation		0.8	1.0
			Water Quality enhancement benefits	Sediment trapping	0.7	0.6
				Phosphate assimilation	0.6	0.6
				Nitrate assimilation	0.8	0.7
				Toxicant assimilation	0.7	0.7
				Erosion control	0.7	0.8
			Carbon storage		0.5	0.7
	Direct Benefits	**Biodiversity maintenance**			0.6	0.9
		Provisioning benefits	Provisioning of water for human use		0.4	0.0
			Provisioning of harvestable resources		0.0	0.0
			Provisioning of cultivated foods		0.0	0.0
		Cultural benefits	Cultural heritage		0.0	0.0
			Tourism and recreation		0.7	1.4
			Education and research		0.2	0.3
Average Eco Services Score					0.5	0.6

8.2.5 The Ecological Health Assessment

The PES for the assessed HGM types is presented in Table 8-5 and Table 8-6. The overall Present Ecological State (PES) for HGM 1 has been determined to be "Seriously Modified"

which indicates a high level of modification towards these systems. The ecological classification for HGM 2 was determined to be “Largely Modified”. Photographs of several aspects which have contributed to the altered state of the systems is presented in Figure 8-8.

This assessment identified numerous aspects which have contributed to the altered state of the wetlands. The dominant land uses identified for the project area contributing to the altered integrity of the wetlands includes access urban development, routes, stormwater networks and linear infrastructure. The changes to the catchment area are reflected in the modified statuses of the wetland systems. These changes have resulted in some level of degradation of wetland habitats, typically through:

- Erosion of preferred flow channels and the formation of drainage channels. There is evidence of scouring and head cut erosion;
- Altered surface flow dynamics caused by the changes in land use and the development of the catchment area. This has resulted in increased flow velocities and volumes flowing through the systems;
- Presence of sewage system; and
- The establishment of alien vegetation in these areas.

Table 8-5 Summary of the scores for the wetland PES – HGM 1

Component	PES Rating	Description
Hydrology	E	**Seriously Modified:** Aspects which have altered the hydrology predominantly include: i) development of the catchment area, increasing surface run-off and velocities, ii) crossing infrastructure, iii) stormwater inputs altering flow regimes and flooding, iv) loss catchment infiltration, v) leaking infrastructure contributing to volumes and alerting regimes, vi) erosion of the system, and bank collapse
Geomorphology	E	**Seriously Modified:** Development has caused changes to the embankments. Embankments are also eroded and have collapsed in some reaches. The upper reaches of the system are straightened and concrete.
Vegetation	E	**Seriously Modified:** Vegetation has been cleared to accommodate development of the area, and the installation of infrastructure. Residential disturbances and other impacts have also contributed to the encroachment of alien vegetation. Alien vegetation is established in the low reaches.
Overall	E	**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.**

Table 8-6 Summary of the scores for the wetland PES – HGM 2

Component	PES Rating	Description
Hydrology	E	**Seriously Modified:** Aspects which have altered the hydrology predominantly include: i) artificial water / interflow contributions likely from underground infrastructure, ii) drainage up the upper seepage area, iii) development or excavations of the area, changing the topography of the catchment and the associated hydrology.
Geomorphology	D	**Largely Modified:** Development of the area has altered the structure of the seeps, with portions being developed over, or excavated through. The seeps are connected by an excavated channel. It is apparent the upper seep is being sustained artificially and this has likely contributed to the increased extent of the wetland area.
Vegetation	C	**Moderately Modified:** Vegetation has been cleared but largely represents grassland. Activities in the area have trampled the vegetation, and alien vegetation is notable throughout the area.
Overall	D	**Largely Modified. Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred**.

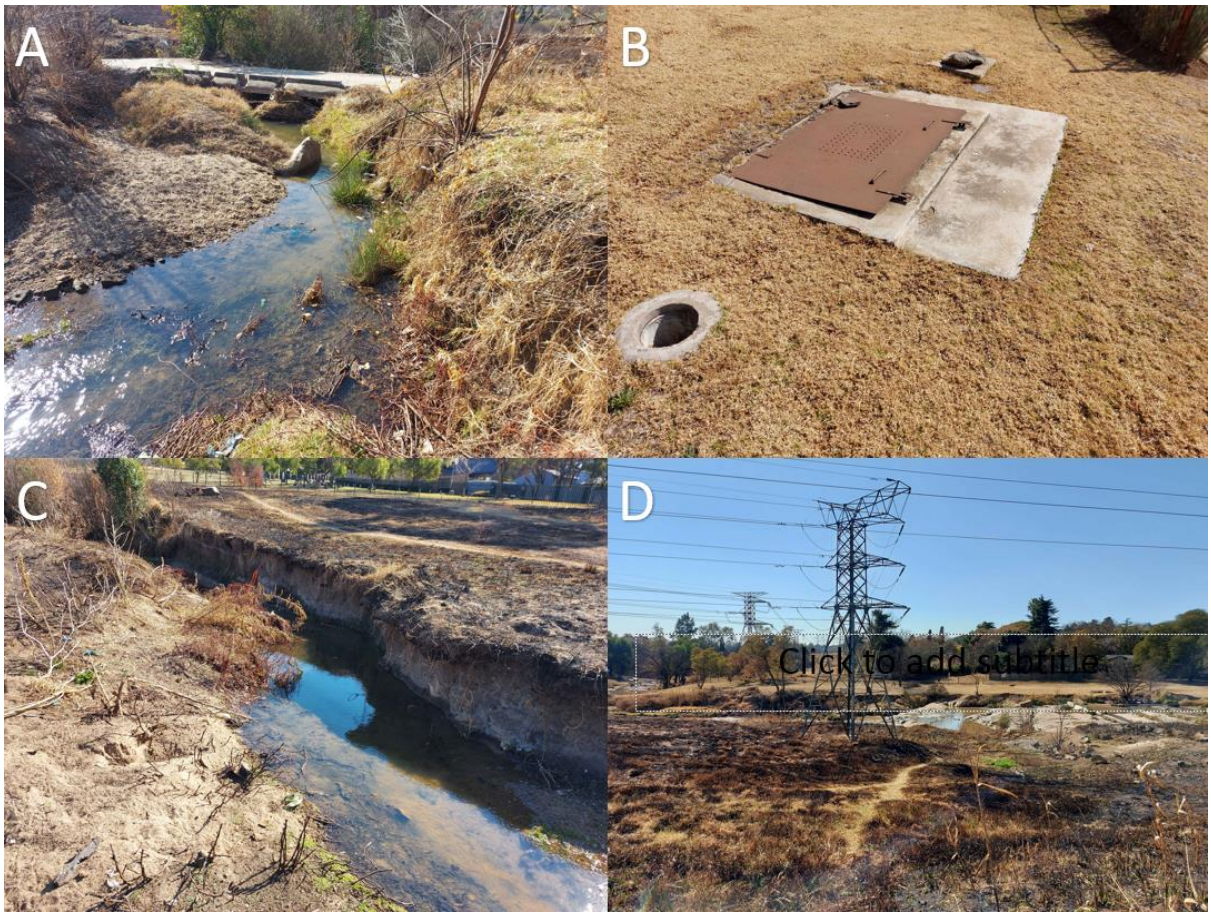


Figure 8-8 Aspects contributing to modifications to wetlands. A) Bridge crossings. B) Stormwater inputs. C) Erosion and bank collapse. D) Construction in and on the periphery of wetlands.

8.2.6 The Importance & Sensitivity Assessment

The results of the ecological IS assessment are shown in Table 8-7. 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 both wetland units has been calculated to be “Moderate”, which combines the relatively high protection status of the wet vegetation type and the low protection status of the wetlands.

Table 8-7 The IS results for the delineated HGM units

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	Mesic Highveld Grassland Group 3	CR	PP	D/E/F Seriously Modified	CR	N	Moderate
HGM 2	Mesic Highveld Grassland Group 3	CR	PP	D/E/F Seriously Modified	CR	N	Moderate

8.2.7 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 30 m is recommended for the identified wetland, which can be decreased to 15 m with the addition of all prescribed mitigation measures (see Table 8-8).

Table 8-8 Pre-and post-mitigation buffer sizes

Phase	Buffer Widths
Pre-mitigation buffer	30 m
Post-mitigation buffer	15 m

9 Sensitivity Assessment

9.1 Methodology

As part of the EIMS environmental mapping methodology, specialists are required to identify all features in terms of the specific field of expertise within the study area. This methodology includes the compilation of detailed shapefiles with specific attributes. Three main components form part of this methodology, namely;

- Feature layer;
- Overall sensitivity layer; and
- Legislative constraint layer.

All identified features will be rated according to the sensitivity of the feature as well as threats posed by proposed activities. These sensitivity rankings are described and illustrated in Table 9-1).

Table 9-1 Sensitivities relevant to the EIMS methodology

	Sensitivities				
	Least Concern	Low	Medium	High	No-Go
Broad Class Description	The inherent feature status and sensitivity is already degraded. The proposed development will not affect the current status and/or may result in a positive impact. These features would be the preferred alternative for the project or infrastructure placement.	The proposed development will have not had a significant effect on the inherent feature status and sensitivity.	The proposed development will negatively influence the current status of the feature.	The proposed development will negatively significantly influence the current status of the feature.	The proposed development cannot legally or practically take place.
Scoring	0	1	2	3	+99

9.2 Sensitivity Approach Terrestrial Biodiversity

9.2.1 Feature Layer

Various features make part of the terrestrial habitats/sensitivity, however due to the degraded state of these features do not have any buffer zones, however the wetland features identified

as well as buffers calculated by means of the DWS buffer tool (for infrastructure) from the Wetland section in this report we incorporated into the terrestrial sensitivity map.

9.2.2 Overall sensitivity

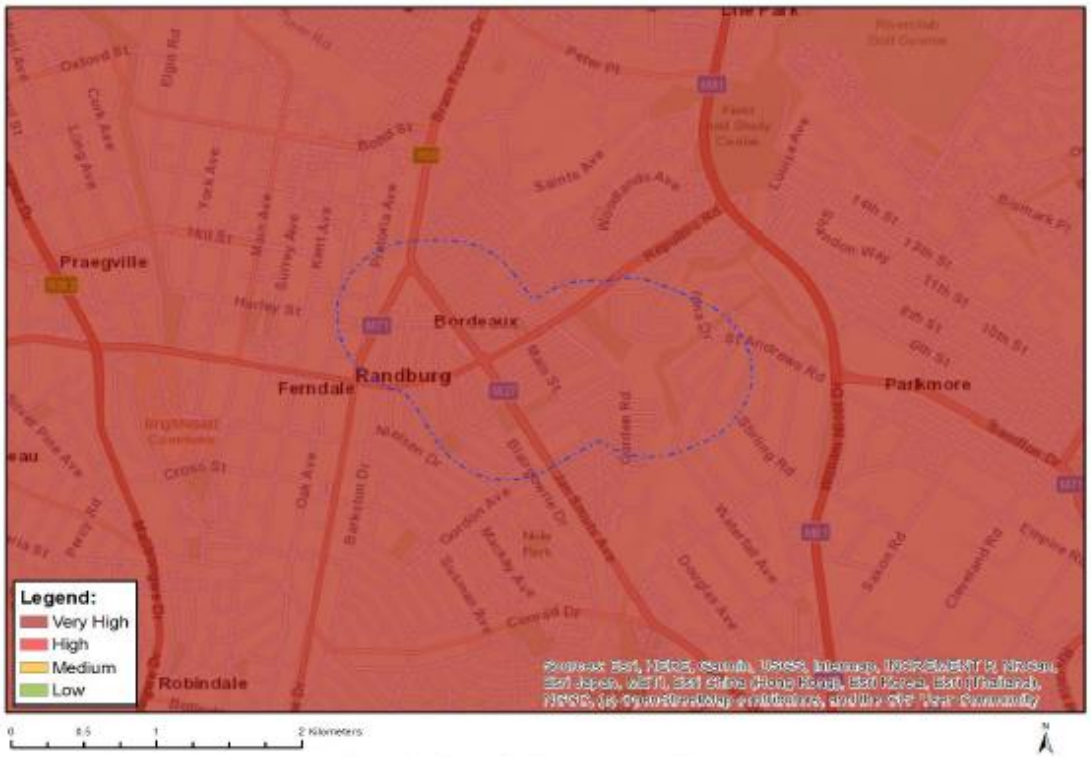
The water resources habitats were classed according to the wetland section, which include the high sensitivity. The disturbed grasslands were rated as low because of the impacted nature of these areas collectively. The major driving forces of the disturbed and degraded state of these areas are anthropogenic, such as clearing of vegetation, presence of a large amount of alien and invasive plant species, and fragmentation. The least concern sensitivities are those areas which were deemed by the specialists to not have any features that are considered significant ecologically important or sensitive (Figure 9-2).

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.

9.2.3 Legislative Constraints

The biodiversity theme sensitivity as indicated in the screening report was derived to be Very High (Figure 9-1).

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Critical Biodiversity Area 2
Very High	Ecological Support Area
Very High	Focus Areas for land-based protected areas expansion
Very High	Endangered ecosystem

Figure 9-1 Biodiversity Sensitivity of the project area

The completion of the terrestrial biodiversity assessment disputes the very high sensitivity of the screening report as the project area was found in a transformed and disturbed state. The CBA/ESA status of the area is no longer relevant, the ecosystem has been altered and affected and the area cannot contribute as a protected area unless significant rehabilitation takes place.

Figure 9-2 Biodiversity sensitivity relevant to the project area

9.3 Wetland Sensitivity

9.3.1 Overall Sensitivity

All features have been scored a sensitivity rating as per the EIMS methodology. The HGM units have been scored “Medium” sensitivity ratings given the fact that these systems provide some level of services and the fact that the proposed pipeline will impede into these systems (see Figure 9-3). The sensitivity rating for the Braamfonteinspruit was determined to be “High”.

Various artificial wetland systems / stormwater channels within the 500 m regulated area around the pipeline have been scored “Least concerned” sensitivities. These systems are artificial, which decreases their sensitivity significantly.

9.3.2 Legislative Constraints

In accordance with the GA in terms of section 39 of the NWA, for water uses as defined in section 21 (c) or section 21 (i) a GA does not apply *“to any water use in terms of section 21 (c) or (i) of the Act associated with the construction, installation or maintenance of any sewer pipelines, pipelines carrying hazardous materials and to raw water and waste water treatment works”.* Since this project will include the installation of sewerage services to accommodate the proposed development, a water use license will be required.

Figure 9-3 Overall sensitivity of the project area

10 Impact Assessment

Potential impacts were evaluated against the data captured during the fieldwork to identify relevance to the project area, 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.

10.1 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 takes the following components into consideration.

- 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 are 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.

10.2 Current Impacts

The current impacts observed during surveys are listed below. Photographic evidence of a selection of these impacts is shown in Figure 10-1.

- Powerlines and their associated servitude;
- Dumping and litter;
- Roads (and associated traffic and wildlife road mortalities);
- Footpaths and litter associated with the human infringement;
- Feral animals such as dogs and cats;
- Alien and/or Invasive Plants (AIP);
- Water contamination and sewage; and
- Unregulated Fire and Erosion .

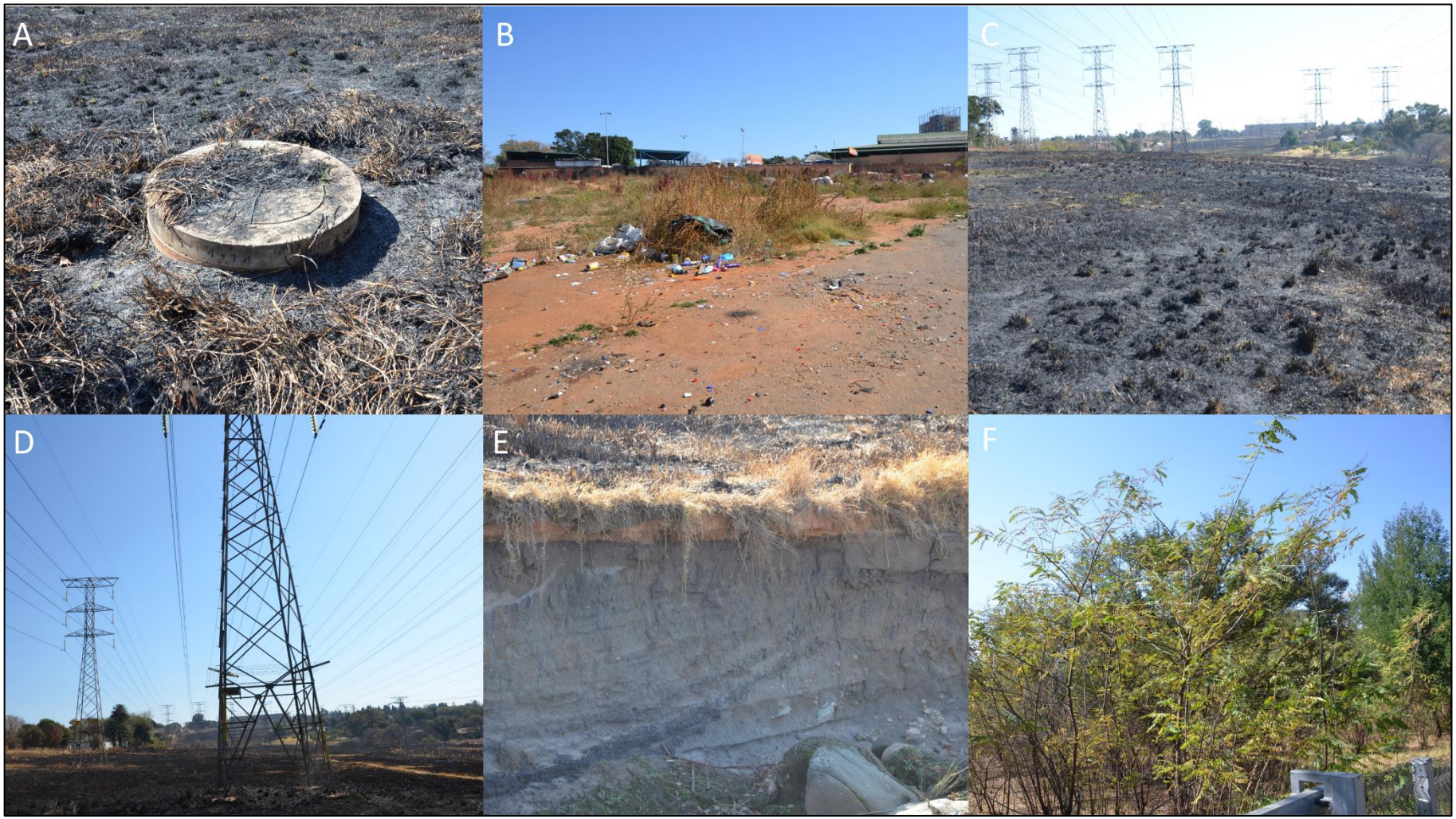


Figure 10-1 Some of the identified impacts within the project area; A) Existing Infrastructure, B) Transformation of areas C)Unregulated burning, D) Powerline servitude, E) Erosion and F) Alien Plants

10.3 Terrestrial Impact Assessment

The impacts regarding the proposed development were assessed for planning, construction and the operational stages, no decommission/rehabilitation phases were considered.

10.3.1 Anticipated Impacts

In the impacts anticipated for the proposed activities are considered in order to predict and quantify these impacts and assess & evaluate the magnitude on the identified terrestrial biodiversity (Table 10-1).

Table 10-1 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 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)	
Main Impact	**Project activities that can cause the spread and/or establishment of alien and/or invasive species**	**Secondary impacts anticipated**
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	
Main Impact	**Project activities that can cause the Direct mortality of fauna**	**Secondary impacts anticipated**
3. Direct mortality of fauna	Clearing of vegetation	Loss of ecosystem services Increase in rodent populations and associated disease risk
	Roadkill due to vehicle collision	
	Pollution of water resources due to dust effects, chemical spills or sewage leakages	
Main Impact	**Project activities that can cause reduced dispersal/migration of fauna**	**Secondary impacts anticipated**
4.. Reduced dispersal/migration of fauna	Loss of landscape used as corridor	Loss of ecosystem services Reduced plant seed dispersal
	Compacted roads	
	Removal of vegetation	
	Light, noise and dust disturbance	
Main Impact	**Project activities that can cause pollution in water courses and the surrounding environment**	**Secondary impacts anticipated**
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	
Main Impact	**Project activities that can cause disruption/alteration of ecological life cycles due to sensory disturbance and dust.**	**Secondary impacts anticipated**
6.Disruption/alteration of ecological life cycles	Operation of machinery (Large earth moving machinery, generators)	Loss of ecosystem services

(breeding, migration, feeding) due to noise, dust and light pollution.	Vehicles	
Main Impact	Project activities that can cause staff to interact directly with potentially dangerous fauna	**Secondary impacts anticipated**
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

10.3.2 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 10-2 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 10-2 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 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	Appropriate/Adequate fire management plan need to be implemented.
Leaking pipeline	Contamination of habitat as well as water resources associated with sewage spillage.	An alert or alarm system otherwise regular monitoring or the pipeline on a weekly basis.

10.3.3 Planning Phase Impacts

The planning phase activities are considered a low risk as they typically involve desktop assessments and initial site inspections. This would include compiling of a waste management plans, obtaining of necessary permits, environmental and social impact assessments, characterisation of baseline site conditions, finalising layouts and facilities and consultation with various contractors involved with a diversity of proposed project related activities going forward. Only one minor impact was assessed regarding the planning phase:

10.3.3.1 Temporary disturbance of wildlife due to increased human presence and possible use of machinery and/or vehicles.

As more vehicles will be driving in the area to survey various components of the project, the wildlife will be disturbed. The possible use of heavy machinery can also lead to the trampling of both vegetation and faunal species.

10.3.4 Construction Phase

The following potential impacts on the 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.

10.3.4.1 Destruction, further loss and fragmentation of the vegetation community

The vegetation communities are classed as CR, through site clearing, 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;
- 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).

10.3.4.1.1 Cumulative Impacts

- Further loss of CR vegetation type;

10.3.4.1.2 Irreplaceable Loss of Resources

- Loss of CR vegetation type.

10.3.4.1.3 Impacts on Alternatives Considered

No alternatives assessed.

10.3.4.2 Loss of CBA and ESA.

Portions of the project area is classified as a CBA, ESA.

- 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).

10.3.4.2.1 Cumulative Impacts

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

10.3.4.2.2 Irreplaceable Loss of Resources

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

10.3.4.2.3 Impacts on Alternatives Considered

No alternatives assessed.

10.3.4.3 Introduction of alien species, especially plants

The spread of alien invasive species will result in the loss of habitat and water for indigenous fauna and flora. It can also contribute to the spreading of potentially dangerous diseases due to invasive - and pest species. Overall, the fauna assemblage will be changed. Activities that will contribute to this impact:

- Vegetation removal and disturbance of soil;
- Vehicles potentially spreading seed;
- Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive; and
- Eating area increasing pest species such as rats and flies.

10.3.4.3.1 Cumulative Impacts

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

10.3.4.3.2 Irreplaceable Loss of Resources

- Loss of CBA: important and ESA habitat.

10.3.4.3.3 Impacts on Alternatives Considered

No alternatives assessed.

10.3.4.4 Erosion due to storm water runoff and wind

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:

- Storm water runoff from roads, and other paved areas;
- Vehicles driving outside demarcated areas;
- Footpaths outside demarcated areas;
- Clearing of vegetation;
- Water runoff from areas with bare soil; and
- Compacting of roads.

10.3.4.4.1 Cumulative Impacts

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

10.3.4.4.2 Irreplaceable Loss of Resources

- Loss of CBA area; and
- Loss of wetland habitat;

10.3.4.4.3 Impacts on Alternatives Considered

No alternatives assessed.

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

Faunal community will be influenced in a number of 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. 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.

10.3.4.5.1 Cumulative Impacts

- Loss of habitat for indigenous species.

10.3.4.5.2 Irreplaceable Loss of Resources

- Not applicable.

10.3.4.5.3 Impacts on Alternatives Considered

No alternatives assessed.

10.3.4.6 Potential leaks, discharges, pollutant from machinery and storage leaching into the surrounding environment.

Hydrocarbons leaching into the surrounding area will result 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.

10.3.4.6.1 Cumulative Impacts

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

10.3.4.6.2 Irreplaceable Loss of Resources

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

10.3.4.6.3 Impacts on Alternatives Considered

No alternatives assessed.

10.3.5 Operational Phase

This phase will initially involve the removal of the backfilling of the excavations. Followed by the rehabilitation of the areas, construction has been completed and the proposed infrastructure has been built and is functional.

10.3.5.1 Continued encroachment of an indigenous and CR 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;
- Storm water runoff from roads, and other bare areas;
- Vehicles driving outside demarcated areas; and
- Footpaths outside demarcated areas.

10.3.5.1.1 Cumulative Impacts

- Loss of habitat, CR vegetation type;; and
- Loss of indigenous flora species due to competition.

10.3.5.1.2 Irreplaceable Loss of Resources

- Further loss of CR vegetation type; .

10.3.5.1.3 Impacts on Alternatives Considered

No alternatives assessed.

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

The cleared pipeline servitude will form a new easier way for local people to move through the area that may lead to;

- 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

10.3.5.2.1 Cumulative Impacts

- Loss of suitable habitat.

10.3.5.2.2 Irreplaceable Loss of Resources

- Not applicable

10.3.5.2.3 Impacts on Alternatives Considered

No alternatives assessed.

10.3.5.3 Potential leaks, discharges, pollutant from sewage pipeline overflowing or leak due to damage spreading into the surrounding environment.

Sewage spilling or leaking into the surrounding area 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:

- Overflowing sewage line
- Pipeline leakages or damage

10.3.5.3.1 Cumulative Impacts

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

10.3.5.3.2 Irreplaceable Loss of Resources

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

10.3.5.3.3 Impacts on Alternatives Considered

No alternatives assessed.

10.3.6 Assessment of Significance

Table 10-3 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 10-3 Assessment of significance of potential impacts on terrestrial biodiversity associated with the project.

Identifier	Impact	Pre-mitigation ER	Post-mitigation ER	Confidence	Cumulative Impact	Irreplaceable loss	Priority Factor	Final score
Planning								
11.3.3.1	Temporary disturbance of wildlife due to increased human presence and possible use of machinery and/or vehicles.	-12	-3.5	High	1	2	1.13	-3.94
Construction Phase								
11.3.4.1	Destruction, further loss and fragmentation of the vegetation community	-14	-5.25	High	2	2	1.25	-6.56
11.3.4.2	Loss of CBA and ESA.	-16.25	-4.5	Medium	3	2	1.38	-6.19
11.3.4.3	Introduction of alien species, especially plants	-15	-4	High	2	2	1.25	-5.00
11.3.4.4	Erosion due to storm water runoff and wind	-13	-6.75	High	2	2	1.25	-8.44
11.3.4.5	Displacement of faunal community due to habitat loss, direct mortalities and disturbance (road collisions, noise, light, dust, vibration and poaching).	-12	-6	High	2	2	1.25	-7.50
11.3.4.6	Potential leaks, discharges, pollutant from machinery and storage leaching into the surrounding environment.	-14	-4	High	2	2	1.25	-5.00
Operational Phase								
11.3.5.1	Continued encroachment of an indigenous and CR vegetation community by alien invasive plant species as well as erosion due to disturbed soils	-13	-6.75	Medium	2	2	1.25	-8.44
11.3.5.2	Continued displacement and fragmentation of the faunal community (including threatened or protected species) due to ongoing anthropogenic disturbances (noise, dust and vibrations) and habitat degradation/loss (litter, road mortalities and/or poaching).	-15	-6.75	Medium	2	2	1.25	-8.44
11.3.5.3	Potential leaks, discharges, pollutant from sewage pipeline overflowing or leak due to damage spreading into the surrounding environment.	-17	-6	High	2	2	1.25	-7.50

11 Wetland Risk Assessment

The impact assessment considered both direct and indirect impacts, to the wetland systems. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 11-1). 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 that the service pipeline will impede into wetland systems. This phenomenon therefore eliminates the feasibility of the first step (avoidance). 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.

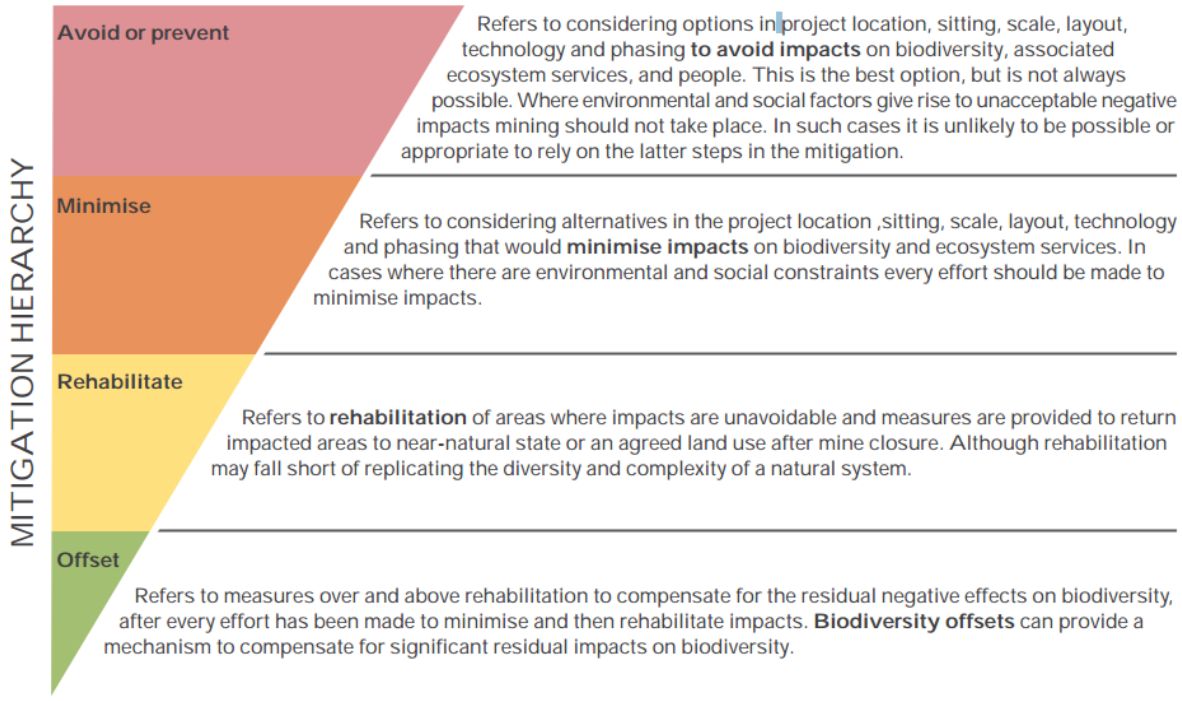


Figure 11-1 The mitigation hierarchy as described by the DEA (2013)

11.1 Potential Impacts Anticipated

Table 11-1 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. The proposed service includes a sewer pipeline.

The project is for the installation of a sewer pipeline. This will result in direct risks being posed to the systems, and also indirect risks. The placement of the pipeline will result in impacts to the hydrology, water quality and habitat during the construction phase of the project. The most notable direct risk posed during the operational phase of the project is the altered (or obstructed) sub-surface flows and river hydrology caused by the pipeline.

In accordance with the General Authorisation in terms of section 39 of the NWA, 1998 (Act No. 36 of 1998) for water uses as defined in section 21 (c) or section 21 (i) a General Authorisation does not apply *"to any water use in terms of section 21 (c) or (i) of the Act*

associated with the construction, installation or maintenance of any sewerage pipelines, pipelines carrying hazardous materials and to raw water and waste water treatment works".

As has been illustrated in Table 10-4, most of the expected impacts are expected to have "Moderate" significance ratings prior to mitigation and this is attributed to the direct risks being posed by the project. Several residual significance ratings are expected to be decreased by applying the prescribed mitigation measures and adhering to recommendations, with the significance of the aspects being reduced to a "Low" level of risk. "Low" and "Moderate" post-mitigation risks persist for the operational phase of the project, and this is based on the assumption the prescribed mitigation measures will be implemented.

Table 11-1 Aspects and impacts relevant to the proposed activity

Activity	Aspect	Impact
Andrew Husted	**Pr Sci Nat**	**400213/11**
Construction (or replacement) of sewer pipeline	Removal of vegetation	• Siltation of wetland; • Erosion of wetland; • Loss of indigenous vegetation; • Direct loss of wetland area; • Decrease in functionality; • Water quality impairment; • Altering hydromorphic soils; • Drainage patterns change; • Altering overland flow characteristics;
	Removal of top soil and stockpiling	
	Excavations	
	Removal and installation of pipes	
	Temporary access routes and working areas	
	Construction of stormwater systems	
	Domestic and industrial waste	
	Storage of chemicals, mixes and fuel	
	Spills and leaks	
	Erosion from disturbances within the wetland	
Operation of sewer pipeline	Placement of pipeline	
	Leakages (impaired water quality)	

Table 11-2 DWS Risk Impact Matrix for the proposed pipeline construction (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**
Construction Phase								
Removal of vegetation	3	2	3	3	2.75	2	2	6.75
Removal of top soil and stockpiling	3	3	3	2	2.75	2	2	6.75
Excavations	4	3	3	3	3.25	2	1	6.25
Removal and installation of pipes	1	3	1	2	1.75	2	1	4.75
Temporary access routes and working areas	2	2	3	3	2.5	2	2	6.5
Construction of stormwater systems	3	2	3	3	2.75	2	2	6.75
Domestic and industrial waste	1	3	3	3	2.5	2	2	6.5
Storage of chemicals, mixes and fuel	1	3	2	3	2.25	2	2	6.25
Spills and leaks	1	4	3	3	2.75	2	2	6.75
Erosion from disturbances within the wetland	1	3	3	3	2.5	2	2	6.5
Operational Phase								
Placement of pipeline	3	1	1	2	1.75	2	5	8.75
Leakages (impaired water quality)	1	4	3	3	2.75	2	5	9.75

Table 11-3 DHSWS Risk Assessment Continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Removal of vegetation	**3**	**4**	**5**	**2**	14	94.5	Moderate	Moderate
Removal of top soil and stockpiling	**3**	4	5	2	14	94.5	Moderate	Moderate
Excavations	**3**	3	5	2	13	81.25	Moderate	Moderate
Removal and installation of pipes	**1**	3	1	2	7	33.25	Low	Low
Temporary access routes and working areas	**3**	4	5	2	14	91	Moderate	Low
Construction of stormwater systems	**2**	3	5	2	12	81	Moderate	Low
Domestic and industrial waste	**2**	2	1	2	7	45.5	Low	Low
Storage of chemicals, mixes and fuel	**2**	2	1	2	7	43.75	Low	Low
Spills and leaks	**2**	3	1	2	8	54	Low	Low
Erosion from disturbances within the wetland	**2**	3	1	2	8	52	Low	Low
Operation Phase								
Placement of pipeline	3	3	1	4	11	96.25	Moderate	Moderate
Leakages (impaired water quality)	3	3	1	4	11	107.25	Moderate	Low
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								

11.2 Unplanned Events

The pipeline is for the transportation of sewage. Even though leaks and bursts on well-engineered sewerage pipelines are unlikely, an action plan must be set in place for such an event. The manager or any other responsible individual must be tasked with reporting any sudden bad smells from the wetland that might indicate leaks or bursts as well as any leaking pipes in general. Stormwater measures and structures must be implemented to adequately manage storm events. These structures are assumed to be appropriate and for the demands of the project.

11.3 Mitigation Measures

The following mitigation measures will be required to ensure the decrease in those significance ratings expected to decrease from “Moderate” to “Low””.

11.3.1 General

The following mitigation measures are aimed at the conservation of wetlands in general;

- Adhere to the buffer area where relevant. Only essential services, machinery and personnel are permitted within the wetland and buffer for installation of the pipeline;
- The contractors used for the construction should have spill kits available prior to construction to ensure that any fuel, oil or hazardous substance spills are cleaned-up and discarded correctly;
- All construction activities must be restricted to the development footprint area. This includes laydown and storage areas, ablutions, offices etc.;
- During construction activities, all rubble generated must be removed from the site;
- Construction vehicles and machinery must make use of existing access routes;
- All chemicals and toxicants to be used for the construction must be stored in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;
- 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”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- All removed soil and material stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;

- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No dumping of construction material on site may take place; and
- All waste generated on site during construction must be adequately managed. Separation and recycling of different waste materials should be supported.

11.3.2 Stripping and Stockpiling Topsoil

- The first 300 mm of soil must be stockpiled separate from the soil excavated deeper than 300 mm; and
- The proposed pipeline system must be divided up into 100 m intervals. Each interval's soil must be stockpiled and filled back up (in the correct order) to avoid long periods of stockpiling.

11.3.3 Operation of Heavy Machinery

- No heavy machinery must be allowed within the delineated wetland. All excavations must be carried out via manual labour instead of heavy machinery/vehicles; and
- Lighter vehicles (small trucks and other vehicles) required for the proposed activities should only be allowed to use existing roads (including dirt roads).

11.4 Recommendations

The following recommendation has been made to ensure the conservation of the delineated wetland during the construction and operational phase;

- A rehabilitation plan must be compiled and implemented for the project, prioritise the wetland and buffer areas.

12 Specialist Management Plan

Table 12-1 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:

- Prevent the further loss and fragmentation of vegetation communities and the high sensitivity areas in the vicinity of the project area;
- 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 12-1 Mitigation measures including requirements for timeframes, roles and responsibilities for the wetlands, terrestrial and aquatics study.

Management outcome: Wetlands				
Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Proper stripping and stockpiling techniques must be followed.	Construction	Project manager, Environmental Officer & Contractor	Stockpiling	Ongoing
Concurrent rehabilitation must be carried out rather than full rehabilitation after construction.	Construction	Project manager, Environmental Officer & Contractor	Rehabilitation	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
Management outcome: Vegetation and Habitats				
Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
Reduce the amount of unnecessary people and restrict vehicle access as much as possible on the property by making use of spatial data.	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 too within the least concern/low sensitivity areas. No further loss of high 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 (including fencing off the defined project area);	Life of operation	Project manager, Environmental Officer	Areas of indigenous vegetation (Moderate and High Sensitivity sites)	Ongoing
When vegetation is cleared, hand cutting techniques should be used as far possible in order to avoid the use of heavy machinery.	Construction/Operational Phase	Environmental Officer	Clearing method	Daily
All construction/operational and access must make use of the existing 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 of time and must be removed from the project area once the construction/closure phase has been concluded. No permanent structures should be permitted at drill sites.. 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 to be rehabilitated and landscaped after construction is complete. Rehabilitation of the disturbed areas existing in the project area must be made a priority. Topsoil must also be utilised, and any disturbed area must be re-vegetated with plant and grass species which are endemic to this vegetation type;	Operational Phase	Environmental Officer & Contractor	Footprint rehabilitation	Quarterly monitoring

Progressive rehabilitation will enable topsoil to be returned more rapidly, thus ensuring more recruitment from the existing seedbank Any woody material removed can be shredded and used in conjunction with the topsoil to augment soil moisture and prevent further erosion.	Operational Phase	Environmental Officer & Contractor	Footprint rehabilitation	During Phase
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 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	Life of operation	Environmental Officer & Contractor	Spill events, Vehicles dripping.	Ongoing
Leaking equipment and vehicles must be repaired immediately or be removed from project area to facilitate repair	Life of operation	Environmental Officer & Contractor	Leaks and spills	Ongoing
Storm Water run-off (flow paths, velocity and effects) monitoring and the water quality.	Life of operation	Environmental Officer & Design Engineer	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 area. No plant species whether indigenous or exotic should be brought into/taken from the project area, to prevent the spread of exotic or invasive species or the illegal collection of plants.	Life of operation	Project manager, Environmental Officer	Any instances	Ongoing
Any topsoil that is removed during construction must be appropriately removed and stored according to the national and provincial guidelines. This includes on-going maintenance of such topsoil piles so that they can be utilised during decommissioning phases and re-vegetation	Construction/Operational Phase	Project manager, Environmental Officer	Topsoil removal and storage	Ongoing
A fire action plan needs to be complied and implemented to restrict the impact unplanned fires might have on the surrounding areas.	Construction Phase	Environmental Officer & Contractor	Fire Management	During Phase
Management outcome: Fauna				
Impact Management Actions	Implementation		Monitoring	
	Phase	Responsible Party	Aspect	Frequency
A qualified environmental control officer must be on site when construction begins to identify faunal species that will be directly disturbed and to relocate fauna/flora that are found during the activities. The Bordeaux Riverside Park area must be walked though prior to construction to ensure no faunal species remain in the habitat and get killed. Should animals not move out of the area on their own relevant specialists must be contacted to advise on how the species can be relocated.	Life of operation	Environmental Officer, Contractor	Presence of any floral or faunal SCC.	Ongoing
Noise must be kept to an absolute minimum during the evenings and at night surrounding the Bordeaux Riverside Park area to minimize all possible disturbances to amphibian species and nocturnal mammals	Construction/Operational Phase	Environmental Officer	Noise levels	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	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 to the training.	Ongoing
Schedule activities and operations during least sensitive periods, to avoid migration, nesting and breeding seasons in relation to the Bordeaux Riverside Park area	Life of operation	Project manager, Environmental Officer & Design Engineer	Activities should take place during the day in the case.	Ongoing
Excavations need to be sealed to ensure that no fauna species can fall into excavations, especially around the Bordeaux Riverside Park area	Construction/Operational Phase	Environmental Officer & Design Engineer	Sealing of holes	After each sit, progressively.
The areas to be developed must be specifically demarcated to prevent movement of staff or any individual into highly sensitive areas 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
Compilation of and implementation of an alien vegetation management plan within the Bordeaux Riverside Park area	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
Waste management must be a priority and all waste must be collected and stored adequately. It is recommended that all waste be removed from site on a weekly basis to prevent rodents and pests entering the site	Life of operation	Environmental Officer & Health and Safety Officer	Presence of waste	Life of operation
A pest control plan must be put in place and implemented; it is imperative that poisons not be used due to the likely presence of indigenous faunal species	Life of operation	Environmental Officer & Health and Safety Officer	Evidence or presence of pests	Ongoing
Management outcome: Dust				
Impact Management Actions	Implementation		Monitoring	

	Phase	Responsible Party	Aspect	Frequency
Dust-reducing mitigation measures must be put in place and must be strictly adhered to, for all roads and dumps especially. This includes wetting of exposed soft soil surfaces and not conducting activities on windy days which will increase the likelihood of dust being generated.	Life of operation	Contractor	Dustfall	As per the air quality report and the dust monitoring program.
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
Litter, spills, fuels, chemicals and human waste in and around the project area.	Construction/Closure Phase	Environmental Officer & Health and Safety Officer	Presence of Waste	Daily
A minimum of one toilet must be provided per 10 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
Where a registered disposal facility is not available close to the project area, the Contractor shall provide a method statement with regard to waste management. Under no circumstances may domestic waste be burned on site	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Collection/handling 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 10 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 area 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 EMPr.	Life of operation	Health and Safety Officer	Compliance to the training.	Ongoing
Management outcome: Sewage spill				

Impact Management Actions	Implementation	Monitoring	Monitoring	
	Phase	Responsible Party	Aspect	Frequency
An early overflow alarm system must be installed.	Life of operation	Environmental Officer, Contractor & Health and Safety Officer	Assess that alarm is working and sewage is not spilling.	Ongoing

13 Conclusion

13.1 Terrestrial

The project area has been altered both currently and historically. The proximity and prevalence of the urban area has had an impact on both the fauna and the flora in the area, which is evident in the disturbed and transformed habitats. However, the wetland habitats can be regarded as important, not only within the local landscape, but also regionally; as they are used for habitat, foraging and movement corridors for fauna within a fragmented landscape to more natural areas where they may reproduce. The Grassland was rated with a moderate sensitivity because it:

The ecological integrity, importance and functioning of these wetland areas provide a variety of ecological services considered beneficial, with one key service being the maintenance of biodiversity. The preservation of these systems is the most important aspect to consider for the proposed project.

13.2 Wetlands

Two wetland types were identified and delineated for the 500 m regulated area. These include a channelled valley bottom wetland (HGM 1) and a hillslope seep (HGM 2). These systems are adjacent to the Braamfonteinspruit which is classified as a riverine system. The ecological status of the wetlands was determined to be seriously modified (class E) and largely modified (class D). The level of benefit provided for ecosystem services was determined to be moderately low (class D). The overall ecological importance and sensitivity for the systems was also determined to be moderate (class C).

A buffer zone of 15 m has been calculated for all wetlands based on the extent and impacts of the construction and operation of the pipeline.

14 Impact Statement

14.1 Terrestrial

An impact statement is required as per the NEMA regulations with regards to the proposed development.

Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinions of the specialists that the project, may be favourably considered, on condition all prescribed mitigation measures and supporting recommendations are implemented.

14.2 Wetlands

The project is for the installation of a sewer pipeline. This will result in direct risks being posed to the systems, and also indirect risks. The placement of the pipeline will result in impacts (or risks) to the hydrology, water quality and habitat during the construction phase of the project. The most notable direct risk posed during the operational phase of the project is the altered (or obstructed) sub-surface flows and hydrology of the river caused by the pipeline.

Most of the expected impacts are expected to have “Moderate” significance ratings prior to mitigation and this is attributed to the direct risks being posed by the project. Several residual significance ratings are expected to be decreased by applying the prescribed mitigation measures and adhering to recommendations, with the significance of the aspects being reduced to a “Low” level of risk. “Low” and “Moderate” post-mitigation risks persist for the operational phase of the project.

In accordance with the GA in terms of section 39 of the NWA, for water uses as defined in section 21 (c) or section 21 (i) a GA does not apply *“to any water use in terms of section 21 (c) or (i) of the Act associated with the construction, installation or maintenance of any sewer pipelines, pipelines carrying hazardous materials and to raw water and waste water treatment works”.* Owing to the fact that this project will include the installation of sewerage services to accommodate the proposed development, a water use license will be required.

It is recommended that a rehabilitation plan to be compiled and implemented for the project. The plan must be implemented from the onset of the project.

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16 Appendices

Appendix A Specialist declarations

DECLARATION

I, Martinus Erasmus, 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.

Martinus Erasmus

Terrestrial Ecologist

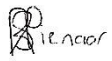
The Biodiversity Company

February 2021

DECLARATION

I, Rian Pienaar, 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.



Rian Pienaar

Wetland Ecologist

The Biodiversity Company

February 2021

DECLARATION

I, Khethokuhle Hlatshwayo, 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.

Khethokuhle Hlatshwayo

Aquatic Ecologist

The Biodiversity Company

February 2021

Appendix B Flora species expected in the project area and surrounds

Family	Species	Author1	IUCN	Ecology
Papaveraceae	*Argemone ochroleuca*	Sweet		Not indigenous; Naturalised; Invasive
Fabaceae	*Eriosema squarrosum*	(Thunb.) Walp.	LC	Indigenous
Cleomaceae	*Cleome gynandra*	L.	LC	Indigenous
Oleaceae	*Olea europaea*	L.		Indigenous
Moraceae	*Ficus abutilifolia*	(Miq.) Miq.	LC	Indigenous
Pteridaceae	*Pellaea calomelanos*	(Sw.) Link	LC	Indigenous
Poaceae	*Aristida adscensionis*	L.	LC	Indigenous
Polygonaceae	*Persicaria decipiens*	(R.Br.) K.L.Wilson	LC	Indigenous
Poaceae	*Eragrostis nindensis*	Ficalho & Hiern	LC	Indigenous
Boraginaceae	*Lappula heteracantha*	Ledeb.		Not indigenous; Naturalised
Ranunculaceae	*Clematis brachiata*	Thunb.	LC	Indigenous
Hyacinthaceae	*Drimia elata*	Jacq. ex Willd.	DD	Indigenous
Verbenaceae	*Verbena bonariensis*	L.		Not indigenous; Naturalised; Invasive
Asphodelaceae	*Aloe transvaalensis*	Kuntze		Indigenous
Fabaceae	*Leobordea eriantha*	(Benth.) B.-E.van Wyk & Boatwr.	LC	Indigenous
Pinaceae	*Pinus radiata*	D.Don		Not indigenous; Naturalised; Invasive
Poaceae	*Acroceras macrum*	Stapf	LC	Indigenous
Crassulaceae	*Crassula capitella*	Thunb.	LC	Indigenous
Thymelaeaceae	*Lasiosiphon canoargenteus*	C.H.Wright	LC	Indigenous; Endemic
Asteraceae	*Othonna natalensis*	Sch.Bip.	LC	Indigenous
Orchidaceae	*Orthochilus leontoglossus*	(Rchb.f.) Bytebier	LC	Indigenous
Polytrichaceae	*Pogonatum capense*	(Hampe) A.Jaeger		Indigenous
Commelinaceae	*Commelina africana*	L.	LC	Indigenous
Amaranthaceae	*Dysphania ambrosioides*	(L.) Mosyakin & Clemants		Not indigenous; Naturalised; Invasive
Asteraceae	*Afroaster serrulatus*	(Harv.) J.C.Manning & Goldblatt	LC	Indigenous
Cyperaceae	*Isolepis setacea*	(L.) R.Br.	LC	Indigenous
Lamiaceae	*Plectranthus hereroensis*	Engl.	LC	Indigenous
Poaceae	*Imperata cylindrica*	(L.) P.Beauv.		Indigenous
Poaceae	*Andropogon huillensis*	Rendle	LC	Indigenous
Malvaceae	*Hermannia grandistipula*	(Buchinger ex Hochst.) K.Schum.	LC	Indigenous
Campanulaceae	*Wahlenbergia dieterlenii*	(E.Phillips) Lammers	LC	Indigenous
Brassicaceae	*Erucastrum austroafricanum*	Al-Shehbaz & Warwick	LC	Indigenous
Poaceae	*Aristida junciformis*	Trin. & Rupr.	LC	Indigenous
Anacardiaceae	*Searsia leptodictya*	(Diels) T.S.Yi, A.J.Mill. & J.Wen	NE	Indigenous
Polygonaceae	*Persicaria lapathifolia*	(L.) Delarbre		Not indigenous; Naturalised; Invasive
Fabaceae	*Listia bainesii*	(Baker) B.-E.van Wyk & Boatwr.	LC	Indigenous
Apocynaceae	*Raphionacme hirsuta*	(E.Mey.) R.A.Dyer	LC	Indigenous
Proteaceae	*Protea caffra*	Meisn.	LC	Indigenous
Fabaceae	*Acacia elata*	A.Cunn. ex Benth.	NE	Not indigenous; Naturalised; Invasive

Malvaceae	*Sparrmannia africana*	L.f.	LC	Indigenous; Endemic
Cyperaceae	*Kyllinga erecta*	Schumach.	LC	Indigenous
Asteraceae	*Lopholaena coriifolia*	(Sond.) E.Phillips & C.A.Sm.	LC	Indigenous
Scrophulariaceae	*Hebenstretia comosa*	Hochst.	LC	Indigenous
Asteraceae	*Gerbera piloselloides*	(L.) Cass.	LC	Indigenous
Asteraceae	*Hilliardiella sutherlandii*	(Harv.) H.Rob.		Indigenous
Fabaceae	*Tephrosia elongata*	E.Mey.	LC	Indigenous
Polygalaceae	*Polygala hottentotta*	C.Presl	LC	Indigenous
Apocynaceae	*Araujia sericifera*	Brot.		Not indigenous; Naturalised; Invasive
Rhamnaceae	*Rhamnus prinoides*	L'Her.	LC	Indigenous
Myrtaceae	*Eucalyptus robusta*	Sm.		Not indigenous; Cultivated; Naturalised
Hypoxidaceae	*Hypoxis argentea*	Harv. ex Baker	LC	Indigenous
Asteraceae	*Ambrosia psilostachya*	DC.		Not indigenous; Naturalised; Invasive
Lamiaceae	*Plectranthus verticillatus*	(L.f.) Druce	LC	Indigenous
Fabaceae	*Pearsonia cajanifolia*	(Harv.) Polhill	LC	Indigenous; Endemic
Cyperaceae	*Fuirena coerulescens*	Steud.	LC	Indigenous
Valerianaceae	*Valeriana capensis*	Thunb.	LC	Indigenous
Asparagaceae	*Asparagus africanus*	Lam.	LC	Indigenous
Poaceae	*Panicum natalense*	Hochst.	LC	Indigenous
Myrtaceae	*Kunzea ericoides*	(A.Rich.) Joy Thomps.		Not indigenous; Naturalised
Asteraceae	*Senecio subcoriaceus*	Schltr.	LC	Indigenous
Poaceae	*Echinochloa crus-galli*	(L.) P.Beauv.	LC	Indigenous
Fabaceae	*Indigofera oxytropis*	Benth. ex Harv.	LC	Indigenous
Brassicaceae	*Lepidium africanum*	(Burm.f.) DC.	LC	Indigenous
Poaceae	*Paspalum distichum*	L.	LC	Not indigenous; Naturalised; Invasive
Cyperaceae	*Fuirena leptostachya*	Oliv.	NE	Indigenous
Orchidaceae	*Schizochilus zeyheri*	Sond.	LC	Indigenous
Cyperaceae	*Carex glomerabilis*	V.I.Krecz.	LC	Indigenous
Cleomaceae	*Cleome monophylla*	L.	LC	Indigenous
Aizoaceae	*Mesembryanthemum lancifolium*	(L.Bolus) Klak		Indigenous; Endemic
Poaceae	*Briza minor*	L.	NE	Not indigenous; Naturalised; Invasive
Fabaceae	*Trifolium africanum*	Ser.	NE	Indigenous
Fabaceae	*Macrotyloma axillare*	(E.Mey.) Verdc.	LC	Indigenous
Fabaceae	*Dichilus lebeckioides*	DC.	LC	Indigenous
Casuarinaceae	*Casuarina cunninghamiana*	Miq.	NE	Not indigenous; Naturalised; Invasive
Hyacinthaceae	*Ledebouria revoluta*	(L.f.) Jessop	LC	Indigenous
Poaceae	*Sorghum bicolor*	(L.) Moench	LC	Indigenous
Asteraceae	*Campuloclinium macrocephalum*	(Less.) DC.		Not indigenous; Naturalised; Invasive
Malvaceae	*Triumfetta pilosa*	Roth	NE	Indigenous
Asteraceae	*Nidorella anomala*	Steetz	LC	Indigenous
Cyperaceae	*Kyllinga pulchella*	Kunth	LC	Indigenous
Euphorbiaceae	*Acalypha angustata*	Sond.	LC	Indigenous
Hypericaceae	*Hypericum lalandii*	Choisy	LC	Indigenous

Cyperaceae	*Coleochloa setifera*	(Ridl.) Gilly	LC	Indigenous
Eriocaulaceae	*Eriocaulon abyssinicum*	Hochst.	LC	Indigenous
Asteraceae	*Senecio erubescens*	Aiton	NE	Indigenous; Endemic
Poaceae	*Pennisetum clandestinum*	Hochst. ex Chiov.	NE	Not indigenous; Naturalised; Invasive
Hyacinthaceae	*Ledebouria leptophylla*	(Baker) S.Venter	LC	Indigenous
Pteridaceae	*Cheilanthes involuta*	(Sw.) Schelpe & N.C.Anthony	LC	Indigenous
Lamiaceae	*Vitex zeyheri*	Sond.	LC	Indigenous
Fabaceae	*Pearsonia bracteata*	(Benth.) Polhill	NT	Indigenous; Endemic
Poaceae	*Aristida transvaalensis*	Henrard	LC	Indigenous
Verbenaceae	*Lantana rugosa*	Thunb.	LC	Indigenous
Crassulaceae	*Crassula setulosa*	Harv.	NE	Indigenous
Caryophyllaceae	*Paronychia brasiliana*	DC.		Not indigenous; Naturalised
Poaceae	*Poa trivialis*	L.	NE	Not indigenous; Naturalised
Phrymaceae	*Mimulus gracilis*	R.Br.	LC	Indigenous
Malvaceae	*Hermannia floribunda*	Harv.	LC	Indigenous
Fabaceae	*Acacia baileyana*	F.Muell.	NE	Not indigenous; Naturalised; Invasive
Asphodelaceae	*Aloe bergeriana*	(Dinter) Boatwr. & J.C.Manning	DD	Indigenous
Sematophyllaceae	*Sematophyllum sphaeropyxis*	(Mull.Hal.) Broth.		Indigenous
Asteraceae	*Euryops laxus*	(Harv.) Burtt Davy	LC	Indigenous
Crassulaceae	*Crassula decumbens*	Thunb.	LC	Indigenous; Endemic
Cyperaceae	*Cyperus uitenhagensis*	(Steud.) C.Archer & Goetgh.	LC	Indigenous
Anacardiaceae	*Searsia discolor*	(E.Mey. ex Sond.) Moffett	LC	Indigenous
Verbenaceae	*Verbena rigida*	Spreng.		Not indigenous; Naturalised; Invasive
Poaceae	*Chloris pycnothrix*	Trin.	LC	Indigenous
Anacardiaceae	*Searsia undulata*	(Jacq.) T.S.Yi, A.J.Mill. & J.Wen	LC	Indigenous
Lentibulariaceae	*Utricularia livida*	E.Mey.	LC	Indigenous
Poaceae	*Setaria incrassata*	(Hochst.) Hack.	LC	Indigenous
Lamiaceae	*Ocimum labiatum*	(N.E.Br.) A.J.Paton	LC	Indigenous
Loranthaceae	*Agelanthus natalitius*	(Meisn.) Polhill & Wiens	LC	Indigenous
Polygonaceae	*Rumex acetosella*	L.		Not indigenous; Naturalised
Aizoaceae	*Khadia acutipetala*	(N.E.Br.) N.E.Br.	LC	Indigenous; Endemic
Apocynaceae	*Asclepias albens*	(E.Mey.) Schltr.	LC	Indigenous
Fabaceae	*Tephrosia capensis*	(Jacq.) Pers.	LC	Indigenous
Asteraceae	*Conyza ulmifolia*	(Burm.f.) Kuntze		Indigenous
Asteraceae	*Cotula anthemoides*	L.	LC	Indigenous
Poaceae	*Setaria italica*	(L.) P.Beauv.	NE	Not indigenous; Naturalised
Stilbaceae	*Halleria lucida*	L.	LC	Indigenous
Asteraceae	*Gazania sp.*			
Rosaceae	*Prunus sp.*			
Fabaceae	*Indigofera hirsuta*	L.	NE	Indigenous
Fissidentaceae	*Fissidens submarginatus*	Bruch		Indigenous
Iridaceae	*Iris pseudacorus*	L.		Not indigenous; Cultivated; Naturalised; Invasive
Fabaceae	*Lessertia stricta*	L.Bolus	LC	Indigenous

Cyperaceae	*Cyperus obtusiflorus*	Vahl	LC	Indigenous
Fabaceae	*Leobordea foliosa*	(Bolus) B.-E.van Wyk & Boatwr.	LC	Indigenous
Urticaceae	*Obetia tenax*	(N.E.Br.) Friis	LC	Indigenous
Molluginaceae	*Pharnaceum dichotomum*	L.f.	LC	Indigenous
Poaceae	*Panicum schinzii*	Hack.	LC	Indigenous
Asteraceae	*Polydora angustifolia*	(Steetz) H.Rob.	LC	Indigenous
Agavaceae	*Chlorophytum fasciculatum*	(Baker) Kativu	LC	Indigenous
Pottiaceae	*Leptophascum leptophyllum*	(Mull.Hal.) J.Guerra & Cano		Indigenous
Euphorbiaceae	*Euphorbia indica*	Lam.	NE	Not indigenous; Naturalised
Poaceae	*Stiburus sp.*			
Hypoxidaceae	*Hypoxis galpinii*	Baker	LC	Indigenous
Asteraceae	*Helichrysum miconiifolium*	DC.	LC	Indigenous
Poaceae	*Panicum sp.*			
Rubiaceae	*Richardia brasiliensis*	Gomes	NE	Not indigenous; Naturalised
Asteraceae	*Helichrysum mundtii*	Harv.	LC	Indigenous
Cyperaceae	*Pycreus macranthus*	(Boeckeler) C.B.Clarke	LC	Indigenous
Asteraceae	*Berkheya radula*	(Harv.) De Wild.	LC	Indigenous
Poaceae	*Echinochloa jubata*	Stapf	LC	Indigenous
Brassicaceae	*Lepidium schinzii*	Thell.	LC	Indigenous
Poaceae	*Sorghum halepense*	(L.) Pers.	NE	Not indigenous; Naturalised; Invasive
Rutaceae	*Calodendrum capense*	(L.f.) Thunb.	LC	Indigenous
Poaceae	*Tripogon minimus*	(A.Rich.) Steud.	LC	Indigenous
Brassicaceae	*Sisymbrium capense*	Thunb.	LC	Indigenous
Apocynaceae	*Cryptolepis oblongifolia*	(Meisn.) Schltr.	LC	Indigenous
Fabaceae	*Pearsonia sessilifolia*	(Harv.) Dummer	LC	Indigenous
Asteraceae	*Senecio othonniflorus*	DC.	LC	Indigenous
Lobeliaceae	*Monopsis decipiens*	(Sond.) Thulin	LC	Indigenous
Asteraceae	*Senecio erubescens*	Aiton	NE	Indigenous
Hypoxidaceae	*Hypoxis rigidula*	Baker	LC	Indigenous
Asteraceae	*Helichrysum callicomum*	Harv.	LC	Indigenous
Fabaceae	*Rhynchosia adenodes*	Eckl. & Zeyh.	LC	Indigenous
Asteraceae	*Helichrysum difficile*	Hilliard	LC	Indigenous
Poaceae	*Oropetium capense*	Stapf	LC	Indigenous
Acanthaceae	*Hypoestes forskaolii*	(Vahl) R.Br.	LC	Indigenous
Fabaceae	*Medicago falcata*	L.	NE	Not indigenous; Naturalised
Polygalaceae	*Polygala gerrardii*	Chodat	LC	Indigenous; Endemic
Brassicaceae	*Nasturtium officinale*	W.T.Aiton		Not indigenous; Naturalised; Invasive
Asteraceae	*Denekia capensis*	Thunb.	LC	Indigenous
Asteraceae	*Sonchus integrifolius*	Harv.	LC	Indigenous
Poaceae	*Schizachyrium sanguineum*	(Retz.) Alston	LC	Indigenous
Chrysobalanaceae	*Parinari capensis*	Harv.	LC	Indigenous
Hypoxidaceae	*Hypoxis sp.*			
Asteraceae	*Helichrysum aureonitens*	Sch.Bip.	LC	Indigenous

Cucurbitaceae	*Cucumis zeyheri*	Sond.	LC	Indigenous
Hyacinthaceae	*Albuca setosa*	Jacq.	LC	Indigenous
Fabaceae	*Rhynchosia sp.*			
Asteraceae	*Hertia sp.*			
Fabaceae	*Tephrosia multijuga*	R.G.N.Young	LC	Indigenous
Orchidaceae	*Holothrix randii*	Rendle	NT	Indigenous
Poaceae	*Enneapogon scoparius*	Stapf	LC	Indigenous
Phyllanthaceae	*Phyllanthus sp.*			
Cyperaceae	*Eleocharis dregeana*	Steud.	LC	Indigenous
Hyacinthaceae	*Albuca glauca*	Baker	LC	Indigenous; Endemic
Ruscaceae	*Eriospermum flagelliforme*	(Baker) J.C.Manning	LC	Indigenous
Iridaceae	*Hesperantha longicollis*	Baker	LC	Indigenous
Malvaceae	*Sida dregei*	Burtt Davy	LC	Indigenous
Cyperaceae	*Schoenoplectus muriculatus*	(Kuk.) Browning	LC	Indigenous
Solanaceae	*Solanum nigrum*	L.		Not indigenous; Naturalised
Fabaceae	*Neonotonia wightii*	(Wight ex Arn.) J.A.Lackey	LC	Indigenous
Poaceae	*Cynodon bradleyi*	Stent	LC	Indigenous; Endemic
Fabaceae	*Medicago sativa*	L.	NE	Not indigenous; Cultivated; Naturalised; Invasive
Convolvulaceae	*Ipomoea bathycolpos*	Hallier f.	LC	Indigenous; Endemic
Asteraceae	*Coreopsis lanceolata*	L.		Not indigenous; Cultivated; Naturalised; Invasive
Fissidentaceae	*Fissidens bryoides*	Hedw.		Indigenous
Lamiaceae	*Aeollanthus buchnerianus*	Briq.	LC	Indigenous
Rubiaceae	*Canthium suberosum*	Codd	LC	Indigenous
Asteraceae	*Taraxacum breviscapum*	A.J.Richards		Not indigenous; Naturalised
Acanthaceae	*Justicia anagalloides*	(Nees) T.Anderson	LC	Indigenous
Poaceae	*Andropogon schirensis*	Hochst. ex A.Rich.	LC	Indigenous
Solanaceae	*Solanum rubetorum*	Dunal	LC	Indigenous; Endemic
Anthocerotaceae	*Anthoceros natalensis*	Steph.		Indigenous
Asteraceae	*Tagetes minuta*	L.		Not indigenous; Naturalised; Invasive
Agapanthaceae	*Agapanthus inapertus*	Beauverd	LC	Indigenous
Dipsacaceae	*Cephalaria zeyheriana*	Szabo	LC	Indigenous
Fabaceae	*Tephrosia semiglabra*	Sond.	LC	Indigenous
Aizoaceae	*Delosperma sp.*	L.Bolus		
Orchidaceae	*Orthochilus foliosus*	(Lindl.) Bytebier	LC	Indigenous
Asteraceae	*Sonchus oleraceus*	L.		Not indigenous; Naturalised; Invasive
Leucobryaceae	*Campylopus pyriformis*	(F.W.Schultz) Brid.		Indigenous
Potamogetonaceae	*Potamogeton trichoides*	Cham. & Schltdl.	LC	Indigenous
Poaceae	*Hyparrhenia sp.*			
Poaceae	*Panicum maximum*	Jacq.	LC	Indigenous
Asteraceae	*Galinsoga parviflora*	Cav.		Not indigenous; Naturalised; Invasive
Asteraceae	*Geigeria aspera*	Harv.	LC	Indigenous

Polygalaceae	*Polygala transvaalensis*	Chodat	LC	Indigenous
Commelinaceae	*Cyanotis speciosa*	(L.f.) Hassk.	LC	Indigenous
Poaceae	*Hyparrhenia hirta*	(L.) Stapf	LC	Indigenous
Asteraceae	*Cineraria austrotransvaalensis*	Cron	NT	Indigenous; Endemic
Iridaceae	*Gladiolus dalenii*	Van Geel	LC	Indigenous
Hyacinthaceae	*Drimia multisetosa*	(Baker) Jessop	LC	Indigenous
Fabaceae	*Dichilus strictus*	E.Mey.	LC	Indigenous
Orobanchaceae	*Striga gesnerioides*	(Willd.) Vatke	LC	Indigenous
Apocynaceae	*Parapodium costatum*	E.Mey.	LC	Indigenous
Bryaceae	*Bryum dichotomum*	Hedw.		Indigenous
Cyperaceae	*Schoenoplectus muricinux*	(C.B.Clarke) J.Raynal	LC	Indigenous
Santalaceae	*Viscum combreticola*	Engl.	LC	Indigenous
Ericaceae	*Erica taxifolia*	Dryand.	LC	Indigenous; Endemic
Melianthaceae	*Melianthus major*	L.	LC	Indigenous; Endemic
Malvaceae	*Triumfetta annua*	L.	NE	Indigenous
Rubiaceae	*Kohautia amatymbica*	Eckl. & Zeyh.	LC	Indigenous
Asteraceae	*Nidorella hottentotica*	DC.	LC	Indigenous
Asteraceae	*Helichrysum caespititium*	(DC.) Harv.	LC	Indigenous
Gentianaceae	*Sebaea filiformis*	Schinz	LC	Indigenous
Fabaceae	*Leobordea arida*	(Dummer) B.-E.van Wyk & Boatwr.	LC	Indigenous; Endemic
Poaceae	*Themeda triandra*	Forssk.	LC	Indigenous
Poaceae	*Eragrostis capensis*	(Thunb.) Trin.	LC	Indigenous
Poaceae	*Alloteropsis semialata*	(R.Br.) Hitchc.	LC	Indigenous
Fabaceae	*Listia heterophylla*	E.Mey.	LC	Indigenous
Amaranthaceae	*Chenopodium sp.*			
Poaceae	*Eragrostis racemosa*	(Thunb.) Steud.	LC	Indigenous
Hypericaceae	*Hypericum aethiopicum*	Thunb.	LC	Indigenous
Agavaceae	*Chlorophytum cooperi*	(Baker) Nordal	LC	Indigenous
Lamiaceae	*Plectranthus ornatus*	Codd		Not indigenous; Naturalised
Fabaceae	*Eriosema burkei*	Benth. ex Harv.	LC	Indigenous
Cyperaceae	*Fimbristylis complanata*	(Retz.) Link	LC	Indigenous
Orchidaceae	*Bonatea antennifera*	Rolfe	LC	Indigenous
Poaceae	*Aristida stipitata*	Hack.	LC	Indigenous
Scrophulariaceae	*Selago canescens*	L.f.	LC	Indigenous; Endemic
Poaceae	*Aristida aequiglumis*	Hack.	LC	Indigenous
Ranunculaceae	*Ranunculus dregei*	J.C.Manning & Goldblatt	LC	Indigenous
Caryophyllaceae	*Silene undulata*	Aiton		Indigenous
Fabaceae	*Rhynchosia cooperi*	(Harv. ex Baker f.) Burtt Davy	LC	Indigenous
Combretaceae	*Combretum erythrophyllum*	(Burch.) Sond.	LC	Indigenous
Cyperaceae	*Pycreus mundii*	Nees	LC	Indigenous
Cyperaceae	*Cyperus congestus*	Vahl	LC	Indigenous
Fabaceae	*Dichilus pilosus*	Conrath ex Schinz	LC	Indigenous; Endemic
Asteraceae	*Cirsium vulgare*	(Savi) Ten.		Not indigenous; Naturalised; Invasive

Hyacinthaceae	*Bowiea volubilis*	Harv. ex Hook.f.		Indigenous
Bartramiaceae	*Philonotis dregeana*	(Mull.Hal.) A.Jaeger		Indigenous
Gentianaceae	*Chironia palustris*	Burch.	LC	Indigenous
Scrophulariaceae	*Diclis rotundifolia*	(Hiern) Hilliard & B.L.Burtt	LC	Indigenous
Orchidaceae	*Bonatea boltonii*	(Harv.) Bolus	LC	Indigenous; Endemic
Fabaceae	*Melolobium subspicatum*	Conrath	VU	Indigenous; Endemic
Orobanchaceae	*Striga asiatica*	(L.) Kuntze	LC	Indigenous
Hypoxidaceae	*Hypoxis neliana*	Schinz	LC	Indigenous
Poaceae	*Digitaria sp.*			
Fabaceae	*Lotus discolor*	E.Mey.	LC	Indigenous
Anacardiaceae	*Searsia pallens*	(Eckl. & Zeyh.) Moffett	LC	Indigenous
Verbenaceae	*Glandularia aristigera*	(S.Moore) Tronc.		Not indigenous; Naturalised; Invasive
Scrophulariaceae	*Aptosimum elongatum*	(Hiern) Engl.	LC	Indigenous
Asteraceae	*Senecio oxyriifolius*	DC.	LC	Indigenous
Frullaniaceae	*Frullania sp.*			
Orchidaceae	*Habenaria falcicornis*	(Burch. ex Lindl.) Bolus	LC	Indigenous
Crassulaceae	*Crassula setulosa*	Harv.	NE	Indigenous
Asphodelaceae	*Trachyandra saltii*	(Baker) Oberm.	LC	Indigenous
Cyperaceae	*Bolboschoenus sp.*			
Araceae	*Zantedeschia albomaculata*	(Hook.) Baill.	LC	Indigenous
Capparaceae	*Maerua cafra*	(DC.) Pax	LC	Indigenous
Marchantiaceae	*Marchantia polymorpha*	L.		Not indigenous; Naturalised
Asteraceae	*Emilia sp.*			
Scrophulariaceae	*Nemesia fruticans*	(Thunb.) Benth.	LC	Indigenous
Fabaceae	*Rhynchosia pentheri*	Schltr. ex Zahlbr.	LC	Indigenous
Malvaceae	*Dombeya sp.*			
Salicaceae	*Salix babylonica*	L.		Not indigenous; Naturalised
Apocynaceae	*Stapelia leendertziae*	N.E.Br.	LC	Indigenous
Asteraceae	*Senecio serratuloides*	DC.	LC	Indigenous
Solanaceae	*Solanum lichtensteinii*	Willd.	LC	Indigenous
Lamiaceae	*Plectranthus ciliatus*	E.Mey. ex Benth.	LC	Indigenous
Cleomaceae	*Tarenaya hassleriana*	(Chodat) Iltis		Not indigenous; Naturalised; Invasive
Brassicaceae	*Heliophila rigidiuscula*	Sond.	LC	Indigenous
Geraniaceae	*Erodium cicutarium*	(L.) L'Her.		Not indigenous; Naturalised; Invasive
Pteridaceae	*Cheilanthes viridis*	(Forssk.) Sw.	LC	Indigenous
Poaceae	*Tristachya leucothrix*	Trin. ex Nees	LC	Indigenous
Orchidaceae	*Eulophia ovalis*	Lindl.	LC	Indigenous
Amaryllidaceae	*Haemanthus humilis*	Jacq.	LC	Indigenous
Oxalidaceae	*Oxalis obliquifolia*	Steud. ex A.Rich.	LC	Indigenous
Lamiaceae	*Leonotis randii*	S.Moore	LC	Indigenous
Fabaceae	*Chamaecrista mimosoides*	(L.) Greene	LC	Indigenous
Asteraceae	*Gazania krebsiana*	Less.	LC	Indigenous

Iridaceae	*Hesperantha leucantha*	Baker	LC	Indigenous
Scrophulariaceae	*Manulea parviflora*	Benth.	LC	Indigenous
Ranunculaceae	*Clematis oweniae*	Harv.		Indigenous
Fossombroniaceae	*Fossombronia sp.*			
Hyacinthaceae	*Dipcadi sp.*			
Brassicaceae	*Lobularia maritima*	(L.) Desv.		Not indigenous; Naturalised
Anacardiaceae	*Searsia lancea*	(L.f.) F.A.Barkley	LC	Indigenous
Poaceae	*Andropogon eucomus*	Nees	LC	Indigenous
Poaceae	*Brachiaria advena*	Vickery	NE	Not indigenous; Naturalised
Rubiaceae	*Rothmannia capensis*	Thunb.	LC	Indigenous
Proteaceae	*Protea roupelliae*	Meisn.	LC	Indigenous
Polygonaceae	*Polygonum aviculare*	L.		Not indigenous; Naturalised
Lentibulariaceae	*Utricularia bisquamata*	Schrank	LC	Indigenous
Asteraceae	*Hypochaeris radicata*	L.		Not indigenous; Naturalised
Cyperaceae	*Cyperus latifolius*	Poir.	LC	Indigenous
Fabaceae	*Vigna unguiculata*	(L.) Walp.	NE	Indigenous
Vitaceae	*Cissus cactiformis*	Gilg	LC	Indigenous
Hydrocharitaceae	*Lagarosiphon muscoides*	Harv.	LC	Indigenous
Scrophulariaceae	*Nemesia umbonata*	(Hiern) Hilliard & B.L.Burtt	LC	Indigenous
Cyperaceae	*Cyperus squarrosus*	L.	LC	Indigenous
Rubiaceae	*Afrocanthium gilfillanii*	(N.E.Br.) Lantz	LC	Indigenous
Scrophulariaceae	*Selago sp.*			
Asteraceae	*Senecio albanensis*	DC.	LC	Indigenous
Crassulaceae	*Crassula campestris*	(Eckl. & Zeyh.) Endl. ex Walp.	LC	Indigenous
Fabaceae	*Sesbania punicea*	(Cav.) Benth.	NE	Not indigenous; Naturalised; Invasive
Fabaceae	*Trifolium pratense*	L.	NE	Not indigenous; Naturalised
Cyperaceae	*Lipocarpha nana*	(A.Rich.) Cherm.	LC	Indigenous
Vitaceae	*Cyphostemma sandersonii*	(Harv.) Desc.	LC	Indigenous
Fabaceae	*Indigofera alternans*	DC.	LC	Indigenous
Solanaceae	*Solanum chenopodioides*	Lam.		Not indigenous; Naturalised; Invasive
Orobanchaceae	*Alectra orobanchoides*	Benth.	LC	Indigenous
Juncaceae	*Juncus exsertus*	Buchenau	LC	Indigenous
Aizoaceae	*Mossia intervallaris*	(L.Bolus) N.E.Br.	LC	Indigenous
Fabaceae	*Trifolium repens*	L.	NE	Not indigenous; Naturalised
Cyperaceae	*Pycreus nitidus*	(Lam.) J.Raynal	LC	Indigenous
Asteraceae	*Kleinia longiflora*	DC.	LC	Indigenous
Acanthaceae	*Crabbea angustifolia*	Nees	LC	Indigenous; Endemic
Poaceae	*Sporobolus conrathii*	Chiov.	LC	Indigenous
Funariaceae	*Funaria hygrometrica*	Hedw.		Indigenous
Scrophulariaceae	*Melanospermum foliosum*	(Benth.) Hilliard	LC	Indigenous
Lamiaceae	*Plectranthus elegantulus*	Briq.	LC	Indigenous; Endemic
Poaceae	*Tristachya rehmannii*	Hack.	LC	Indigenous

Lamiaceae	*Tetradenia riparia*	(Hochst.) Codd	LC	Indigenous
Poaceae	*Sorghum sp.*			
Juncaceae	*Juncus dregeanus*	Kunth	LC	Indigenous
Potamogetonaceae	*Potamogeton octandrus*	Poir.	LC	Indigenous
Campanulaceae	*Wahlenbergia prostrata*	A.DC.	LC	Indigenous
Bartramiaceae	*Philonotis africana*	(Mull.Hal.) Rehmann ex Paris		Indigenous
Asparagaceae	*Asparagus angusticladus*	(Jessop) J.-P.Lebrun & Stork	LC	Indigenous
Asteraceae	*Brachylaena sp.*			
Asteraceae	*Senecio oxyriifolius*	DC.		Indigenous
Onagraceae	*Oenothera rosea*	L'Her. ex Aiton		Not indigenous; Naturalised; Invasive
Mniaceae	*Pohlia baronii*	Wijk & Margad.		Indigenous
Fabaceae	*Indigofera daleoides*	Benth. ex Harv.	NE	Indigenous
Acanthaceae	*Blepharis innocua*	C.B.Clarke	LC	Indigenous; Endemic
Asteraceae	*Cotula sp.*			
Convolvulaceae	*Xenostegia tridentata*	(L.) D.F.Austin & Staples	LC	Indigenous
Rubiaceae	*Vangueria pygmaea*	Schltr.	LC	Indigenous
Rhamnaceae	*Phylica karroica*	Pillans	LC	Indigenous; Endemic
Hydrocharitaceae	*Lagarosiphon major*	(Ridl.) Moss ex Wager	LC	Indigenous
Agavaceae	*Chlorophytum trichophlebium*	(Baker) Nordal	LC	Indigenous; Endemic
Rubiaceae	*Vangueria infausta*	Burch.	LC	Indigenous
Lamiaceae	*Salvia runcinata*	L.f.	LC	Indigenous
Apocynaceae	*Stapelia gigantea*	N.E.Br.	LC	Indigenous
Boraginaceae	*Lithospermum cinereum*	A.DC.	LC	Indigenous
Orchidaceae	*Satyrium hallackii*	Bolus	LC	Indigenous
Asphodelaceae	*Bulbine capitata*	Poelln.	LC	Indigenous
Asteraceae	*Senecio consanguineus*	DC.	LC	Indigenous
Apocynaceae	*Gomphocarpus sp.*			
Hypoxidaceae	*Hypoxis filiformis*	Baker	LC	Indigenous
Apocynaceae	*Aspidoglossum lamellatum*	(Schltr.) Kupicha	LC	Indigenous
Campanulaceae	*Wahlenbergia androsacea*	A.DC.	LC	Indigenous
Plantaginaceae	*Plantago lanceolata*	L.	LC	Indigenous
Scrophulariaceae	*Buddleja saligna*	Willd.	LC	Indigenous
Poaceae	*Koeleria capensis*	(Steud.) Nees	LC	Indigenous
Geraniaceae	*Monsonia angustifolia*	E.Mey. ex A.Rich.	LC	Indigenous
Apiaceae	*Heteromorpha arborescens*	(Spreng.) Cham. & Schltdl.	LC	Indigenous
Proteaceae	*Protea welwitschii*	Engl.	LC	Indigenous
Apocynaceae	*Pachycarpus schinzianus*	(Schltr.) N.E.Br.	LC	Indigenous
Scrophulariaceae	*Nemesia sp.*			
Apocynaceae	*Stenostelma periglossoides*	(Schltr.) Bester & Nicholas		Indigenous; Endemic
Cyperaceae	*Cyperus sp.*			
Boraginaceae	*Heliotropium amplexicaule*	Vahl		Not indigenous; Naturalised; Invasive

Apocynaceae	*Ceropegia rendallii*	N.E.Br.	LC	Indigenous
Apocynaceae	*Brachystelma circinatum*	E.Mey.	LC	Indigenous
Santalaceae	*Thesium ericaefolium*	A.DC.	LC	Indigenous; Endemic
Asphodelaceae	*Aloe subspicata*	(Baker) Boatwr. & J.C.Manning		Indigenous
Asteraceae	*Helichrysum rugulosum*	Less.	LC	Indigenous
Commelinaceae	*Commelina modesta*	Oberm.	LC	Indigenous
Poaceae	*Cortaderia selloana*	(Schult.) Asch. & Graebn.	NE	Not indigenous; Naturalised; Invasive
Fabaceae	*Chamaecrista biensis*	(Steyaert) Lock	LC	Indigenous
Fabaceae	*Indigofera jucunda*	Schrire	LC	Indigenous; Endemic
Poaceae	*Harpochloa falx*	(L.f.) Kuntze	LC	Indigenous
Rubiaceae	*Richardia scabra*	L.	NE	Not indigenous; Naturalised
Poaceae	*Digitaria natalensis*	Stent	LC	Indigenous
Hyacinthaceae	*Ledebouria luteola*	Jessop	LC	Indigenous
Fabaceae	*Indigofera cryptantha*	Benth. ex Harv.	LC	Indigenous
Fabaceae	*Leobordea mucronata*	(Conrath) B.-E.van Wyk & Boatwr.		Indigenous
Asteraceae	*Osteospermum muricatum*	E.Mey. ex DC.	LC	Indigenous
Cyperaceae	*Cyperus difformis*	L.	LC	Indigenous
Fabaceae	*Elephantorrhiza elephantina*	(Burch.) Skeels	LC	Indigenous
Asphodelaceae	*Bulbine abyssinica*	A.Rich.	LC	Indigenous
Myrtaceae	*Melaleuca quinquenervia*	(Cav.) S.T.Blake		Not indigenous; Cultivated; Naturalised; Invasive
Brassicaceae	*Cardamine hirsuta*	L.		Not indigenous; Naturalised
Apiaceae	*Centella asiatica*	(L.) Urb.	LC	Indigenous
Amaranthaceae	*Achyranthes aspera*	L.		Indigenous
Poaceae	*Hordeum sp.*			
Pallaviciniaceae	*Symphyogyna brasiliensis*	Nees & Mont.		Indigenous
Fabaceae	*Styphnolobium japonicum*	(L.) Schott		Not indigenous; Cultivated; Naturalised; Invasive
Fabaceae	*Leobordea divaricata*	Eckl. & Zeyh.	LC	Indigenous
Fabaceae	*Indigofera setiflora*	Baker	LC	Indigenous
Asteraceae	*Berkheya subulata*	Harv.	LC	Indigenous
Asphodelaceae	*Trachyandra erythrorrhiza*	(Conrath) Oberm.	LC	Indigenous; Endemic
Cucurbitaceae	*Trochomeria macrocarpa*	(Sond.) Hook.f.	LC	Indigenous
Hypoxidaceae	*Hypoxis rigidula*	Baker	LC	Indigenous
Poaceae	*Digitaria brazzae*	(Franch.) Stapf	LC	Indigenous
Fabaceae	*Crotalaria distans*	Benth.	LC	Indigenous
Poaceae	*Bewsia biflora*	(Hack. ex Schinz) Gooss.	LC	Indigenous
Asteraceae	*Pseudoconyza viscosa*	(Mill.) D'Arcy	LC	Indigenous
Hypodontiaceae	*Hypodontium dregei*	(Hornsch.) Mull.Hal.		Indigenous
Convolvulaceae	*Ipomoea obscura*	(L.) Ker Gawl.	LC	Indigenous
Rosaceae	*Potentilla indica*	(Andrews) Th.Wolf		Not indigenous; Cultivated; Naturalised; Invasive
Celastraceae	*Gymnosporia buxifolia*	(L.) Szyszyl.	LC	Indigenous
Asteraceae	*Cineraria aspera*	Thunb.	LC	Indigenous

Potamogetonaceae	*Potamogeton nodosus*	Poir.	LC	Indigenous
Asteraceae	*Callilepis leptophylla*	Harv.	LC	Indigenous
Poaceae	*Cynodon dactylon*	(L.) Pers.	LC	Indigenous
Amaryllidaceae	*Nerine krigei*	W.F.Barker	LC	Indigenous; Endemic
Asteraceae	*Schkuhria pinnata*	(Lam.) Kuntze ex Thell.		Not indigenous; Naturalised
Euphorbiaceae	*Euphorbia hirsuta*	L.		Not indigenous; Naturalised; Invasive
Anacardiaceae	*Searsia pyroides*	(Burch.) Moffett	LC	Indigenous
Moraceae	*Ficus salicifolia*	Vahl	LC	Indigenous
Fabaceae	*Indigofera zeyheri*	Spreng. ex Eckl. & Zeyh.	LC	Indigenous
Agavaceae	*Chlorophytum bowkeri*	Baker	LC	Indigenous
Apocynaceae	*Brachystelma ramosissimum*	(Schltr.) N.E.Br.	LC	Indigenous
Asteraceae	*Launaea rarifolia*	(Oliv. & Hiern) Boulos	LC	Indigenous
Dicranaceae	*Leptotrichella minuta*	(Hampe) Ochyra		Indigenous
Poaceae	*Microchloa kunthii*	Desv.	LC	Indigenous
Poaceae	*Arundinella nepalensis*	Trin.	LC	Indigenous
Colchicaceae	*Colchicum melanthioides*	(Willd.) J.C.Manning & Vinn.	LC	Indigenous
Poaceae	*Tragus koelerioides*	Asch.	LC	Indigenous
Hyacinthaceae	*Schizocarphus nervosus*	(Burch.) Van der Merwe	LC	Indigenous
Convolvulaceae	*Ipomoea ommanneyi*	Rendle	LC	Indigenous
Santalaceae	*Thesium costatum*	A.W.Hill	LC	Indigenous
Anacampserotaceae	*Anacampseros subnuda*	Poelln.	LC	Indigenous
Fabaceae	*Lotus corniculatus*	L.	NE	Not indigenous; Naturalised
Apiaceae	*Cyclospermum leptophyllum*	(Pers.) Sprague ex Britton & P.Wilson		Not indigenous; Naturalised
Fabaceae	*Indigofera hedyantha*	Eckl. & Zeyh.	LC	Indigenous
Asteraceae	*Senecio infirmus*	C.Jeffrey	DD	Indigenous; Endemic
Orchidaceae	*Habenaria galpinii*	Bolus	LC	Indigenous
Amaryllidaceae	*Apodolirion buchananii*	(Baker) Baker	LC	Indigenous
Asteraceae	*Helichrysum acutatum*	DC.	LC	Indigenous
Solanaceae	*Solanum capense*	L.	LC	Indigenous
Asteraceae	*Helichrysum cephaloideum*	DC.	LC	Indigenous
Asteraceae	*Senecio glanduloso-pilosus*	Volkens & Muschl.	LC	Indigenous; Endemic
Fabaceae	*Lessertia frutescens*	(L.) Goldblatt & J.C.Manning	LC	Indigenous
Asteraceae	*Curio cicatricosus*	(Sch.Bip.) P.V.Heath	DD	Indigenous
Amaranthaceae	*Dysphania pumilio*	(R.Br.) Mosyakin & Clemants		Not indigenous; Naturalised; Invasive
Apocynaceae	*Asclepias fulva*	N.E.Br.	LC	Indigenous
Malvaceae	*Malva verticillata*	L.		Not indigenous; Naturalised
Potamogetonaceae	*Potamogeton pectinatus*	L.	LC	Indigenous
Poaceae	*Brachiaria serrata*	(Thunb.) Stapf	LC	Indigenous
Scrophulariaceae	*Zaluzianskya katharinae*	Hiern	LC	Indigenous; Endemic
Poaceae	*Rendlia altera*	(Rendle) Chiov.	LC	Indigenous
Hypoxidaceae	*Hypoxis argentea*	Harv. ex Baker		Indigenous
Iridaceae	*Gladiolus woodii*	Baker	LC	Indigenous

Orobanchaceae	*Sopubia cana*	Harv.	LC	Indigenous
Asteraceae	*Felicia muricata*	(Thunb.) Nees	LC	Indigenous
Acanthaceae	*Dyschoriste costata*	(Nees) Kuntze	LC	Indigenous; Endemic
Verbenaceae	*Chascanum incisum*	(H.Pearson) Moldenke	LC	Indigenous
Apocynaceae	*Asclepias aurea*	(Schltr.) Schltr.	LC	Indigenous
Asteraceae	*Hilliardiella aristata*	(DC.) H.Rob.	LC	Indigenous
Asteraceae	*Hilliardiella hirsuta*	(DC.) H.Rob.	LC	Indigenous
Amaranthaceae	*Amaranthus deflexus*	L.		Not indigenous; Naturalised
Asphodelaceae	*Bulbine favosa*	(Thunb.) Schult. & Schult.f.	LC	Indigenous
Poaceae	*Aristida sp.*			
Orobanchaceae	*Harveya sp.*			
Polygonaceae	*Oxygonum dregeanum*	Meisn.	NE	Indigenous
Rubiaceae	*Pentanisia prunelloides*	(Klotzsch ex Eckl. & Zeyh.) Walp.	LC	Indigenous
Peraceae	*Clutia natalensis*	Bernh.	LC	Indigenous
Poaceae	*Eragrostis patens*	Oliv.	LC	Indigenous
Polygonaceae	*Persicaria madagascariensis*	(Meisn.) S.Ortiz & Paiva		Indigenous
Orchidaceae	*Disperis micrantha*	Lindl.	LC	Indigenous
Poaceae	*Pogonarthria squarrosa*	(Roem. & Schult.) Pilg.	LC	Indigenous
Poaceae	*Paspalum urvillei*	Steud.	NE	Not indigenous; Naturalised; Invasive
Poaceae	*Sporobolus africanus*	(Poir.) Robyns & Tournay	LC	Indigenous
Fabaceae	*Rhynchosia pedunculata*	M.M.le Roux & Moteetee		Indigenous; Endemic
Asteraceae	*Phymaspermum athanasioides*	(S.Moore) Kallersjo	LC	Indigenous
Poaceae	*Digitaria ternata*	(A.Rich.) Stapf	LC	Indigenous
Lamiaceae	*Salvia schlechteri*	Briq.	DD	Indigenous; Endemic
Apocynaceae	*Aspidoglossum interruptum*	(E.Mey.) Bullock	LC	Indigenous
Asteraceae	*Conyza aegyptiaca*	(L.) Aiton		Indigenous
Fabaceae	*Indigofera confusa*	Prain & Baker f.	LC	Indigenous
Amaranthaceae	*Atriplex suberecta*	I.Verd.	LC	Not indigenous; Naturalised; Invasive
Poaceae	*Phalaris aquatica*	L.	NE	Not indigenous; Naturalised
Lunulariaceae	*Lunularia cruciata*	(L.) Dumort. ex Lindb.		Indigenous
Leucobryaceae	*Campylopus pilifer*	Brid.		Indigenous
Anacardiaceae	*Searsia rigida*	(Mill.) F.A.Barkley	LC	Indigenous; Endemic
Asteraceae	*Ursinia montana*	DC.	LC	Indigenous
Asteraceae	*Helichrysum stenopterum*	DC.	LC	Indigenous
Poaceae	*Eragrostis sclerantha*	Nees	LC	Indigenous
Malvaceae	*Sida chrysantha*	Ulbr.	LC	Indigenous
Fagaceae	*Quercus robur*	L.		Not indigenous; Cultivated; Naturalised; Invasive
Hyacinthaceae	*Dipcadi gracillimum*	Baker	LC	Indigenous
Sapindaceae	*Pappea capensis*	Eckl. & Zeyh.	LC	Indigenous
Asteraceae	*Ursinia nana*	DC.	LC	Indigenous
Gentianaceae	*Exochaenium grande*	(E.Mey.) Griseb.	LC	Indigenous
Dipsacaceae	*Scabiosa columbaria*	L.	LC	Indigenous
Leucobryaceae	*Campylopus robillardei*	Besch.		Indigenous

Fabaceae	*Zornia milneana*	Mohlenbr.	LC	Indigenous
Amaryllidaceae	*Haemanthus montanus*	Baker	LC	Indigenous
Solanaceae	*Withania somnifera*	(L.) Dunal	LC	Indigenous
Crassulaceae	*Crassula arborescens*	(Mill.) Willd.	LC	Indigenous; Endemic
Cyperaceae	*Cyperus esculentus*	L.	LC	Indigenous
Asteraceae	*Athrixia elata*	Sond.	LC	Indigenous
Poaceae	*Cymbopogon pospischilii*	(K.Schum.) C.E.Hubb.	NE	Indigenous
Asteraceae	*Sonchus nanus*	Sond. ex Harv.	LC	Indigenous
Caryophyllaceae	*Dianthus mooiensis*	F.N.Williams	NE	Indigenous; Endemic
Hyacinthaceae	*Albuca shawii*	Baker	LC	Indigenous
Crassulaceae	*Kalanchoe thyrsiflora*	Harv.	LC	Indigenous
Asteraceae	*Pseudopegolettia tenella*	(DC.) H.Rob., Skvarla & V.A.Funk		Indigenous
Amaranthaceae	*Amaranthus hybridus*	L.		Not indigenous; Naturalised
Crassulaceae	*Cotyledon orbiculata*	L.	LC	Indigenous
Cucurbitaceae	*Cucumis africanus*	L.f.	LC	Indigenous
Santalaceae	*Thesium goetzeanum*	Engl.	LC	Indigenous
Rhamnaceae	*Ziziphus zeyheriana*	Sond.	LC	Indigenous
Fabaceae	*Eriosema salignum*	E.Mey.	LC	Indigenous
Solanaceae	*Solanum retroflexum*	Dunal	LC	Indigenous
Aizoaceae	*Mesembryanthemum cordifolium*	L.f.		Indigenous; Endemic
Asteraceae	*Helichrysum setosum*	Harv.	LC	Indigenous
Commelinaceae	*Commelina africana*	L.	LC	Indigenous
Euphorbiaceae	*Acalypha peduncularis*	E.Mey. ex Meisn.	LC	Indigenous
Alliaceae	*Tulbaghia acutiloba*	Harv.	LC	Indigenous
Malvaceae	*Hibiscus aethiopicus*	L.	LC	Indigenous
Cannabaceae	*Celtis africana*	Burm.f.	LC	Indigenous
Asphodelaceae	*Trachyandra asperata*	Kunth	LC	Indigenous
Hypoxidaceae	*Hypoxis multiceps*	Buchinger ex Baker	LC	Indigenous
Juncaceae	*Juncus lomatophyllus*	Spreng.	LC	Indigenous
Myrothamnaceae	*Myrothamnus flabellifolius*	Welw.	DD	Indigenous
Cyperaceae	*Bulbostylis densa*	(Wall.) Hand.-Mazz.	LC	Indigenous
Asphodelaceae	*Aloe jeppeae*	Klopper & Gideon F.Sm.	LC	Indigenous
Malvaceae	*Sphaeralcea bonariensis*	(Cav.) Griseb.		Not indigenous; Naturalised
Scrophulariaceae	*Limosella longiflora*	Kuntze	LC	Indigenous
Fabaceae	*Mundulea sericea*	(Willd.) A.Chev.	LC	Indigenous
Rhabdoweisiaceae	*Oreoweisia erosa*	(Hampe ex Mull.Hal.) Kindb.		Indigenous
Poaceae	*Aristida congesta*	Roem. & Schult.	LC	Indigenous
Fabaceae	*Tephrosia sp.*			
Elatinaceae	*Elatine triandra*	Schkuhr	LC	Indigenous
Poaceae	*Lolium temulentum*	L.	NE	Not indigenous; Naturalised; Invasive
Poaceae	*Stiburus conrathii*	Hack.	LC	Indigenous
Hyacinthaceae	*Dipcadi marlothii*	Engl.	LC	Indigenous
Rubiaceae	*Bridsonia chamaedendrum*	(Kuntze) Verstraete & A.E.van Wyk		Indigenous

Asteraceae	*Helichrysum polycladum*	Klatt	LC	Indigenous
Lamiaceae	*Plectranthus ambiguus*	(Bolus) Codd	LC	Indigenous
Asteraceae	*Geigeria burkei*	Harv.	NE	Indigenous; Endemic
Asphodelaceae	*Aloe davyana*	Schonland		Indigenous; Endemic
Aizoaceae	*Delosperma herbeum*	(N.E.Br.) N.E.Br.	LC	Indigenous
Leucobryaceae	*Campylopus atroluteus*	(Mull.Hal.) Paris		Indigenous
Fabaceae	*Indigofera hilaris*	Eckl. & Zeyh.	LC	Indigenous
Apocynaceae	*Xysmalobium undulatum*	(L.) W.T.Aiton	LC	Indigenous
Poaceae	*Eleusine tristachya*	(Lam.) Lam.	NE	Not indigenous; Naturalised
Asteraceae	*Cosmos bipinnatus*	Cav.		Not indigenous; Naturalised
Rubiaceae	*Pentanisia angustifolia*	(Hochst.) Hochst.	LC	Indigenous
Poaceae	*Digitaria monodactyla*	(Nees) Stapf	LC	Indigenous
Pottiaceae	*Weissia controversa*	Hedw.		Indigenous
Thymelaeaceae	*Lasiosiphon capitatus*	(L.f.) Burtt Davy	LC	Indigenous
Ericaceae	*Erica pinea*	Thunb.	LC	Indigenous; Endemic
Rubiaceae	*Oldenlandia herbacea*	(L.) Roxb.	LC	Indigenous
Fabaceae	*Rhynchosia totta*	(Thunb.) DC.		Indigenous
Fabaceae	*Chamaecrista comosa*	E.Mey.	LC	Indigenous
Phytolaccaceae	*Phytolacca heptandra*	Retz.	LC	Indigenous
Ranunculaceae	*Clematis sp.*			
Cyperaceae	*Cyperus longus*	L.	NE	Indigenous
Polygonaceae	*Rumex crispus*	L.		Not indigenous; Naturalised; Invasive
Cyperaceae	*Kyllinga melanosperma*	Nees	LC	Indigenous
Araceae	*Spirodela punctata*	(G.Mey.) C.H.Thomps.	LC	Indigenous
Asteraceae	*Helichrysum nudifolium*	(L.) Less.	LC	Indigenous
Celastraceae	*Pterocelastrus echinatus*	N.E.Br.	LC	Indigenous
Fabaceae	*Argyrolobium longifolium*	(Meisn.) Walp.	VU	Indigenous; Endemic
Cyperaceae	*Carex acutiformis*	Ehrh.		Not indigenous; Naturalised
Ranunculaceae	*Ranunculus multifidus*	Forssk.	LC	Indigenous
Apocynaceae	*Asclepias crispa*	P.J.Bergius	LC	Indigenous; Endemic
Poaceae	*Eragrostis curvula*	(Schrad.) Nees	LC	Indigenous
Lamiaceae	*Plectranthus rubropunctatus*	Codd	LC	Indigenous
Convolvulaceae	*Ipomoea purpurea*	(L.) Roth		Not indigenous; Naturalised; Invasive
Asteraceae	*Senecio burchellii*	DC.	LC	Indigenous; Endemic
Malpighiaceae	*Sphedamnocarpus pruriens*	(A.Juss.) Szyszyl.	LC	Indigenous
Crassulaceae	*Adromischus umbraticola*	C.A.Sm.	NT	Indigenous; Endemic
Iridaceae	*Dierama pulcherrimum*	(Hook.f.) Baker	LC	Indigenous; Endemic
Lamiaceae	*Ajuga ophrydis*	Burch. ex Benth.	LC	Indigenous
Myrtaceae	*Eucalyptus sp.*			
Asteraceae	*Erigeron canadensis*	L.		Not indigenous; Naturalised; Invasive
Poaceae	*Pennisetum thunbergii*	Kunth	LC	Indigenous
Fabaceae	*Lessertia frutescens*	(L.) Goldblatt & J.C.Manning	LC	Indigenous
Iridaceae	*Watsonia watsonioides*	(Baker) Oberm.	LC	Indigenous

Convolvulaceae	*Cuscuta suaveolens*	Ser.		Not indigenous; Naturalised; Invasive
Asteraceae	*Haplocarpha scaposa*	Harv.	LC	Indigenous
Malvaceae	*Hibiscus sp.*			
Santalaceae	*Thesium sp.*			
Apocynaceae	*Stenostelma umbelluliferum*	(Schltr.) Bester & Nicholas	NT	Indigenous; Endemic
Asteraceae	*Xanthium spinosum*	L.		Not indigenous; Naturalised; Invasive
Orobanchaceae	*Graderia subintegra*	Mast.	LC	Indigenous
Poaceae	*Loudetia simplex*	(Nees) C.E.Hubb.	LC	Indigenous
Asteraceae	*Berkheya speciosa*	(DC.) O.Hoffm.	LC	Indigenous
Asteraceae	*Senecio scitus*	Hutch. & Burtt Davy	LC	Indigenous
Ebenaceae	*Euclea crispa*	(Thunb.) Gurke	LC	Indigenous
Poaceae	*Pennisetum villosum*	R.Br. ex Fresen.	NE	Not indigenous; Naturalised; Invasive
Amaryllidaceae	*Cyrtanthus breviflorus*	Harv.	LC	Indigenous
Solanaceae	*Cestrum parqui*	L'Her.		Not indigenous; Naturalised; Invasive
Poaceae	*Eragrostis lappula*	Nees	LC	Indigenous
Cucurbitaceae	*Peponium caledonicum*	(Sond.) Engl.	LC	Indigenous
Poaceae	*Diheteropogon amplectens*	(Nees) Clayton	LC	Indigenous
Convolvulaceae	*Ipomoea simplex*	Thunb.	LC	Indigenous
Poaceae	*Fingerhuthia sesleriiformis*	Nees	LC	Indigenous
Asteraceae	*Helichrysum dregeanum*	Sond. & Harv.	LC	Indigenous
Fagaceae	*Quercus sp.*			
Asteraceae	*Cineraria saxifraga*	DC.	LC	Indigenous; Endemic
Crassulaceae	*Crassula alba*	Forssk.	NE	Indigenous
Solanaceae	*Solanum tomentosum*	L.		Indigenous
Agavaceae	*Chlorophytum sp.*			
Amaranthaceae	*Guilleminea densa*	(Humb. & Bonpl. ex Schult.) Moq.		Not indigenous; Naturalised; Invasive
Cyperaceae	*Scirpoides burkei*	(C.B.Clarke) Goetgh., Muasya & D.A.Simpson	LC	Indigenous
Apocynaceae	*Aspidoglossum restioides*	(Schltr.) Kupicha	LC	Indigenous; Endemic
Hyacinthaceae	*Ledebouria marginata*	(Baker) Jessop	LC	Indigenous
Scrophulariaceae	*Manulea paniculata*	Benth.	LC	Indigenous
Fabaceae	*Indigofera hybrida*	N.E.Br.	VU	Indigenous; Endemic
Anemiaceae	*Mohria vestita*	Baker	LC	Indigenous
Pontederiaceae	*Pontederia cordata*	L.		Not indigenous; Naturalised
Orobanchaceae	*Sopubia cana*	Harv.	LC	Indigenous
Poaceae	*Sporobolus pectinatus*	Hack.	LC	Indigenous; Endemic
Cyperaceae	*Bulbostylis scleropus*	C.B.Clarke	LC	Indigenous
Anacardiaceae	*Schinus molle*	L.	NE	Not indigenous; Naturalised; Invasive
Poaceae	*Lophacme digitata*	Stapf	LC	Indigenous
Asteraceae	*Cineraria albicans*	N.E.Br.	LC	Indigenous
Cyperaceae	*Pycreus flavescens*	(L.) P.Beauv. ex Rchb.	LC	Indigenous

Asteraceae	*Seriphium plumosum*	L.		Indigenous
Ebenaceae	*Diospyros austroafricana*	De Winter	LC	Indigenous
Lobeliaceae	*Lobelia erinus*	L.	LC	Indigenous
Potamogetonaceae	*Potamogeton pusillus*	L.	LC	Indigenous
Scrophulariaceae	*Limosella sp.*			
Cyperaceae	*Kyllinga alba*	Nees	LC	Indigenous
Pottiaceae	*Gymnostomum sp.*			
Anacardiaceae	*Searsia rigida*	(Mill.) F.A.Barkley	LC	Indigenous; Endemic
Poaceae	*Loudetia flavida*	(Stapf) C.E.Hubb.	LC	Indigenous
Iridaceae	*Gladiolus permeabilis*	D.Delaroche	LC	Indigenous
Scrophulariaceae	*Zaluzianskya ovata*	(Benth.) Walp.	LC	Indigenous
Ulmaceae	*Ulmus parvifolia*	Jacq.		Not indigenous; Cultivated; Naturalised; Invasive
Thymelaeaceae	*Gnidia gymnostachya*	(C.A.Mey.) Gilg	LC	Indigenous
Poaceae	*Aristida diffusa*	Trin.	LC	Indigenous
Gentianaceae	*Sebaea leiostyla*	Gilg	LC	Indigenous
Solanaceae	*Solanum mauritianum*	Scop.		Not indigenous; Naturalised; Invasive
Asteraceae	*Pulicaria scabra*	(Thunb.) Druce	LC	Indigenous
Apocynaceae	*Gomphocarpus fruticosus*	(L.) W.T.Aiton	LC	Indigenous
Brassicaceae	*Heliophila carnosa*	(Thunb.) Steud.	LC	Indigenous
Malvaceae	*Triumfetta sonderi*	Ficalho & Hiern	LC	Indigenous; Endemic
Fumariaceae	*Fumaria muralis*	Sond. ex W.D.J.Koch		Not indigenous; Naturalised; Invasive
Orobanchaceae	*Striga elegans*	Benth.	LC	Indigenous
Poaceae	*Digitaria tricholaenoides*	Stapf	LC	Indigenous
Iridaceae	*Gladiolus crassifolius*	Baker	LC	Indigenous
Asteraceae	*Senecio glaberrimus*	DC.	LC	Indigenous
Asteraceae	*Helichrysum oreophilum*	Klatt	LC	Indigenous
Menyanthaceae	*Nymphoides thunbergiana*	(Griseb.) Kuntze	LC	Indigenous
Asteraceae	*Pseudognaphalium oligandrum*	(DC.) Hilliard & B.L.Burtt	LC	Indigenous
Acanthaceae	*Crabbea acaulis*	N.E.Br.	LC	Indigenous
Thymelaeaceae	*Lasiosiphon microcephalus*	(Meisn.) J.C.Manning & Magee		Indigenous
Fabaceae	*Dolichos falciformis*	E.Mey.	LC	Indigenous
Poaceae	*Melinis repens*	(Willd.) Zizka	LC	Indigenous
Asteraceae	*Berkheya setifera*	DC.	LC	Indigenous
Lophocoleaceae	*Lophocolea difformis*	Nees		Indigenous
Poaceae	*Eragrostis planiculmis*	Nees	LC	Indigenous
Bryaceae	*Bryum argenteum*	Hedw.		Indigenous
Fabaceae	*Rhynchosia totta*	(Thunb.) DC.	LC	Indigenous
Poaceae	*Alloteropsis semialata*	(R.Br.) Hitchc.	LC	Indigenous
Lobeliaceae	*Lobelia dregeana*	(C.Presl) A.DC.	LC	Indigenous
Ruscaceae	*Eriospermum porphyrovalve*	Baker	LC	Indigenous
Hyacinthaceae	*Albuca sp.*			

Poaceae	*Paspalum scrobiculatum*	L.	LC	Indigenous
Anacardiaceae	*Searsia dentata*	(Thunb.) F.A.Barkley	LC	Indigenous
Polygonaceae	*Oxygonum dregeanum*	Meisn.	NE	Indigenous; Endemic
Ranunculaceae	*Clematis villosa*	DC.	LC	Indigenous
Asparagaceae	*Asparagus suaveolens*	Burch.	LC	Indigenous
Iridaceae	*Tritonia nelsonii*	Baker	LC	Indigenous
Poaceae	*Poa sp.*			
Fabaceae	*Trifolium africanum*	Ser.	NE	Indigenous
Apocynaceae	*Carissa bispinosa*	(L.) Desf. ex Brenan	LC	Indigenous
Poaceae	*Phalaris minor*	Retz.	NE	Not indigenous; Naturalised
Asteraceae	*Senecio laevigatus*	Thunb.	LC	Indigenous; Endemic
Myrtaceae	*Eucalyptus camaldulensis*	Dehnh.		Not indigenous; Cultivated; Naturalised; Invasive
Fabaceae	*Sphenostylis angustifolia*	Sond.	LC	Indigenous
Orchidaceae	*Holothrix villosa*	Lindl.	LC	Indigenous; Endemic
Cyperaceae	*Cyperus denudatus*	L.f.	LC	Indigenous
Myrtaceae	*Eucalyptus grandis*	W.Hill ex Maiden		Not indigenous; Cultivated; Naturalised; Invasive
Asteraceae	*Afroaster peglerae*	(Bolus) J.C.Manning & Goldblatt	LC	Indigenous; Endemic
Fabaceae	*Tephrosia elongata*	E.Mey.		Indigenous
Cleomaceae	*Cleome maculata*	(Sond.) Szyszyl.	LC	Indigenous
Poaceae	*Microchloa caffra*	Nees	LC	Indigenous
Hyacinthaceae	*Drimia calcarata*	(Baker) Stedje	LC	Indigenous
Orobanchaceae	*Striga sp.*			
Asteraceae	*Helichrysum aureum*	(Houtt.) Merr.	NE	Indigenous
Asteraceae	*Sonchus dregeanus*	DC.	LC	Indigenous
Fabaceae	*Argyrolobium speciosum*	Eckl. & Zeyh.	LC	Indigenous
Fabaceae	*Neorautanenia ficifolia*	(Benth.) C.A.Sm.	LC	Indigenous
Asteraceae	*Senecio achilleifolius*	DC.	LC	Indigenous
Geraniaceae	*Monsonia attenuata*	Harv.	LC	Indigenous
Cyperaceae	*Schoenoplectus brachyceras*	(Hochst. ex A.Rich.) Lye	LC	Indigenous
Poaceae	*Digitaria sanguinalis*	(L.) Scop.	NE	Not indigenous; Naturalised
Campanulaceae	*Wahlenbergia lycopodioides*	Schltr. & Brehmer	LC	Indigenous
Malvaceae	*Abutilon sonneratianum*	(Cav.) Sweet	LC	Indigenous
Orchidaceae	*Satyrium trinerve*	Lindl.	LC	Indigenous
Boraginaceae	*Ehretia rigida*	(Thunb.) Druce	LC	Indigenous
Solanaceae	*Solanum tuberosum*	L.		Not indigenous; Naturalised
Fissidentaceae	*Fissidens fasciculatus*	Hornsch.		Indigenous; Endemic
Lamiaceae	*Syncolostemon subvelutinus*	(Gurke) D.F.Otieno	LC	Indigenous; Endemic
Rubiaceae	*Anthospermum rigidum*	Eckl. & Zeyh.	LC	Indigenous
Polygalaceae	*Polygala leendertziae*	Burtt Davy	LC	Indigenous
Hyacinthaceae	*Dipcadi viride*	(L.) Moench	LC	Indigenous
Droseraceae	*Drosera madagascariensis*	DC.	LC	Indigenous
Asteraceae	*Dicoma anomala*	Sond.	LC	Indigenous
Cyperaceae	*Kyllinga alata*	Nees	LC	Indigenous

Boraginaceae	*Trichodesma physaloides*	(Fenzl) A.DC.	LC	Indigenous
Malvaceae	*Hibiscus lunariifolius*	Willd.	LC	Indigenous
Apocynaceae	*Xysmalobium brownianum*	S.Moore	LC	Indigenous
Gentianaceae	*Chironia purpurascens*	(E.Mey.) Benth. & Hook.f.	LC	Indigenous
Thymelaeaceae	*Lasiosiphon caffer*	Meisn.	LC	Indigenous
Asteraceae	*Vernonia sp.*			
Aspleniaceae	*Asplenium adiantum-nigrum*	L.	LC	Indigenous
Hyacinthaceae	*Ledebouria burkei*	(Baker) J.C.Manning & Goldblatt	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia burkeana*	(Benth.) Hilliard	LC	Indigenous
Poaceae	*Cynodon hirsutus*	Stent	LC	Indigenous
Euphorbiaceae	*Acalypha caperonioides*	Baill.	DD	Indigenous
Poaceae	*Urochloa brachyura*	(Hack.) Stapf	LC	Indigenous
Amaranthaceae	*Einadia nutans*	(R.Br.) A.J.Scott		Not indigenous; Naturalised
Brassicaceae	*Lepidium transvaalense*	Marais	LC	Indigenous
Myrtaceae	*Eucalyptus regnans*	F.Muell.		Not indigenous; Naturalised
Asteraceae	*Senecio affinis*	DC.	LC	Indigenous
Scrophulariaceae	*Zaluzianskya sp.*			
Sapindaceae	*Acer buergerianum*	Miq.		Not indigenous; Naturalised; Invasive
Santalaceae	*Thesium transvaalense*	Schltr.	LC	Indigenous; Endemic
Plantaginaceae	*Plantago myosuros*	Lam.		Not indigenous; Naturalised
Ruscaceae	*Sansevieria aethiopica*	Thunb.	LC	Indigenous
Poaceae	*Eragrostis gummiflua*	Nees	LC	Indigenous
Bartramiaceae	*Philonotis hastata*	(Duby) Wijk & Margad.		Indigenous
Gisekiaceae	*Gisekia pharnaceoides*	L.		Indigenous
Poaceae	*Sacciolepis chevalieri*	Stapf	LC	Indigenous
Poaceae	*Poa annua*	L.	NE	Not indigenous; Naturalised
Poaceae	*Bromus sp.*			
Leucobryaceae	*Campylopus flaccidus*	Renauld & Cardot		Indigenous
Scrophulariaceae	*Jamesbrittenia sp.*			
Scrophulariaceae	*Gomphostigma virgatum*	(L.f.) Baill.	LC	Indigenous
Solanaceae	*Physalis viscosa*	L.		Not indigenous; Naturalised; Invasive
Poaceae	*Agrostis eriantha*	Hack.	LC	Indigenous
Juncaceae	*Juncus oxycarpus*	E.Mey. ex Kunth	LC	Indigenous
Poaceae	*Agrostis eriantha*	Hack.		Indigenous
Celastraceae	*Gymnosporia polyacantha*	Szyszyl.	LC	Indigenous; Endemic
Iridaceae	*Moraea pallida*	(Baker) Goldblatt	LC	Indigenous
Scrophulariaceae	*Zaluzianskya elongata*	Hilliard & B.L.Burtt	LC	Indigenous
Hyacinthaceae	*Drimia intricata*	(Baker) J.C.Manning & Goldblatt	LC	Indigenous
Geraniaceae	*Pelargonium luridum*	(Andrews) Sweet	LC	Indigenous
Ricciaceae	*Riccia okahandjana*	S.W.Arnell		Indigenous
Lamiaceae	*Salvia stenophylla*	Burch. ex Benth.		Indigenous

Poaceae	*Paspalum sp.*			
Fabaceae	*Trifolium medium*	L.	NE	Not indigenous; Naturalised
Orobanchaceae	*Harveya pumila*	Schltr.	LC	Indigenous
Orchidaceae	*Eulophia hians*	Spreng.	LC	Indigenous
Asphodelaceae	*Aloe verecunda*	Pole-Evans	LC	Indigenous; Endemic
Lamiaceae	*Pycnostachys urticifolia*	Hook.	LC	Indigenous
Marsileaceae	*Marsilea macrocarpa*	C.Presl	LC	Indigenous
Malvaceae	*Grewia occidentalis*	L.	LC	Indigenous
Asteraceae	*Tolpis capensis*	(L.) Sch.Bip.	LC	Indigenous
Cyperaceae	*Bulbostylis humilis*	(Kunth) C.B.Clarke	LC	Indigenous
Lamiaceae	*Stachys hyssopoides*	Burch. ex Benth.	LC	Indigenous
Fabaceae	*Robinia pseudoacacia*	L.	NE	Not indigenous; Naturalised; Invasive
Proteaceae	*Protea sp.*			
Poaceae	*Leersia hexandra*	Sw.	LC	Indigenous
Malvaceae	*Pavonia columella*	Cav.	LC	Indigenous
Thymelaeaceae	*Gnidia nodiflora*	Meisn.	LC	Indigenous; Endemic
Euphorbiaceae	*Acalypha sp.*			
Crassulaceae	*Kalanchoe rotundifolia*	(Haw.) Haw.	LC	Indigenous
Ericaceae	*Erica viscaria*	L.	LC	Indigenous; Endemic
Orchidaceae	*Bonatea porrecta*	(Bolus) Summerh.	LC	Indigenous
Poaceae	*Cymbopogon caesius*	(Hook. & Arn.) Stapf	LC	Indigenous
Apocynaceae	*Aspidoglossum glabrescens*	(Schltr.) Kupicha	LC	Indigenous; Endemic
Caryophyllaceae	*Silene burchellii*	Otth ex DC.	LC	Indigenous
Apocynaceae	*Aspidoglossum ovalifolium*	(Schltr.) Kupicha	LC	Indigenous
Combretaceae	*Combretum molle*	R.Br. ex G.Don	LC	Indigenous
Loganiaceae	*Strychnos pungens*	Soler.	LC	Indigenous
Poaceae	*Eragrostis sp.*			
Orchidaceae	*Eulophia ovalis*	Lindl.	LC	Indigenous
Asteraceae	*Senecio barbertonicus*	Klatt	LC	Indigenous
Proteaceae	*Leucospermum saxosum*	S.Moore	EN	Indigenous
Convolvulaceae	*Cuscuta campestris*	Yunck.		Not indigenous; Naturalised; Invasive
Bryaceae	*Bryum alpinum*	Huds. ex With.		Indigenous
Myrtaceae	*Eucalyptus sideroxylon*	A.Cunn. ex Woolls		Not indigenous; Cultivated; Naturalised; Invasive
Lamiaceae	*Ocimum obovatum*	E.Mey. ex Benth.	NE	Indigenous
Asteraceae	*Berkheya insignis*	(Harv.) Thell.	LC	Indigenous
Fabroniaceae	*Fabronia pilifera*	Hornsch.		Indigenous
Poaceae	*Setaria sphacelata*	(Schumach.) Stapf & C.E.Hubb. ex M.B.Moss	LC	Indigenous
Lamiaceae	*Salvia repens*	Burch. ex Benth.	LC	Indigenous
Crassulaceae	*Kalanchoe paniculata*	Harv.	LC	Indigenous
Polygonaceae	*Rumex lanceolatus*	Thunb.	LC	Indigenous
Urticaceae	*Pouzolzia mixta*	Solms	LC	Indigenous
Fabaceae	*Indigofera oxalidea*	Welw. ex Baker	LC	Indigenous
Lamiaceae	*Acrotome inflata*	Benth.	LC	Indigenous

Cyperaceae	*Cyperus obtusiflorus*	Vahl	LC	Indigenous
Poaceae	*Trachypogon sp.*			
Chenopodiaceae	*Chenopodiastrum murale*	(L.) S.Fuentes, Uotila & Borsch		Not indigenous; Naturalised; Invasive
Campanulaceae	*Wahlenbergia undulata*	(L.f.) A.DC.	LC	Indigenous
Molluginaceae	*Psammotropha myriantha*	Sond.	LC	Indigenous
Poaceae	*Monocymbium ceresiiforme*	(Nees) Stapf	LC	Indigenous
Asteraceae	*Symphyotrichum squamatum*	(Spreng.) G.L.Nesom		Not indigenous; Naturalised
Asphodelaceae	*Bulbine angustifolia*	Poelln.	LC	Indigenous
Lobeliaceae	*Lobelia laxa*	MacOwan	LC	Indigenous
Poaceae	*Paspalum dilatatum*	Poir.	NE	Not indigenous; Naturalised; Invasive
Malvaceae	*Hibiscus trionum*	L.		Not indigenous; Naturalised
Caryophyllaceae	*Cerastium arabidis*	E.Mey. ex Fenzl	LC	Indigenous
Solanaceae	*Solanum pseudocapsicum*	L.		Not indigenous; Naturalised; Invasive
Funariaceae	*Physcomitrium spathulatum*	Mull.Hal.		Indigenous
Araceae	*Lemna minor*	L.	LC	Indigenous
Fabaceae	*Argyrolobium tuberosum*	Eckl. & Zeyh.	LC	Indigenous
Fabaceae	*Otholobium polystictum*	(Benth. ex Harv.) C.H.Stirt.	LC	Indigenous
Poaceae	*Avena fatua*	L.	NE	Not indigenous; Naturalised; Invasive
Pteridaceae	*Cheilanthes hirta*	Sw.	LC	Indigenous
Peraceae	*Clutia pulchella*	L.	LC	Indigenous
Rubiaceae	*Anthospermum hispidulum*	E.Mey. ex Sond.	LC	Indigenous
Boraginaceae	*Cordia caffra*	Sond.	LC	Indigenous
Asteraceae	*Nidorella auriculata*	DC.	LC	Indigenous
Euphorbiaceae	*Euphorbia prostrata*	Aiton	NE	Not indigenous; Naturalised
Pittosporaceae	*Pittosporum viridiflorum*	Sims	LC	Indigenous
Scrophulariaceae	*Phygelius aequalis*	Harv. ex Hiern	LC	Indigenous
Poaceae	*Urochloa panicoides*	P.Beauv.	LC	Indigenous
Onagraceae	*Epilobium capense*	Buchinger ex Hochst.	LC	Indigenous
Poaceae	*Setaria sphacelata*	(Schumach.) Stapf & C.E.Hubb. ex M.B.Moss	LC	Indigenous
Rubiaceae	*Kohautia caespitosa*	Schnizl.	LC	Indigenous
Ricciaceae	*Riccia volkii*	S.W.Arnell		Indigenous
Asteraceae	*Felicia muricata*	(Thunb.) Nees	LC	Indigenous; Endemic
Santalaceae	*Osyris lanceolata*	Hochst. & Steud.	LC	Indigenous
Verbenaceae	*Chascanum hederaceum*	(Sond.) Moldenke	LC	Indigenous
Fabaceae	*Tipuana tipu*	(Benth.) Kuntze		Not indigenous; Naturalised; Invasive
Polygonaceae	*Rumex sagittatus*	Thunb.	LC	Indigenous
Santalaceae	*Thesium spartioides*	A.W.Hill	LC	Indigenous
Scrophulariaceae	*Chaenostoma leve*	(Hiern) Kornhall	LC	Indigenous
Pottiaceae	*Trichostomum brachydontium*	Bruch		Indigenous
Polygalaceae	*Polygala gracilenta*	Burtt Davy	LC	Indigenous

Anacardiaceae	*Searsia pyroides*	(Burch.) Moffett	LC	Indigenous
Malvaceae	*Dombeya rotundifolia*	(Hochst.) Planch.	LC	Indigenous
Asteraceae	*Hilliardiella elaeagnoides*	(DC.) Swelank. & J.C.Manning		Indigenous
Apocynaceae	*Raphionacme galpinii*	Schltr.	LC	Indigenous
Proteaceae	*Protea compacta*	R.Br.	NT	Indigenous; Endemic
Proteaceae	*Protea caffra*	Meisn.		Indigenous
Orchidaceae	*Habenaria filicornis*	Lindl.	LC	Indigenous
Verbenaceae	*Lantana camara*	L.		Not indigenous; Cultivated; Naturalised; Invasive
Gentianaceae	*Sebaea exigua*	(Oliv.) Schinz	LC	Indigenous
Poaceae	*Andropogon appendiculatus*	Nees	LC	Indigenous
Asteraceae	*Crepis hypochaeridea*	(DC.) Thell.		Not indigenous; Naturalised; Invasive
Santalaceae	*Viscum rotundifolium*	L.f.	LC	Indigenous
Sapotaceae	*Englerophytum magalismontanum*	(Sond.) T.D.Penn.	LC	Indigenous
Anacardiaceae	*Searsia magalismontana*	(Sond.) Moffett	LC	Indigenous
Fabaceae	*Rhynchosia pentheri*	Schltr. ex Zahlbr.	LC	Indigenous
Solanaceae	*Cestrum laevigatum*	Schltdl.		Not indigenous; Naturalised; Invasive
Cyperaceae	*Fuirena pubescens*	(Poir.) Kunth	LC	Indigenous
Orchidaceae	*Orthochilus welwitschii*	Rchb.f.	LC	Indigenous
Linaceae	*Linum thunbergii*	Eckl. & Zeyh.	LC	Indigenous
Asparagaceae	*Asparagus laricinus*	Burch.	LC	Indigenous
Hyacinthaceae	*Albuca virens*	(Ker Gawl.) J.C.Manning & Goldblatt	LC	Indigenous
Fabaceae	*Indigofera atrata*	N.E.Br.	LC	Indigenous
Linderniaceae	*Craterostigma wilmsii*	Engl. ex Diels	LC	Indigenous; Endemic
Hypoxidaceae	*Hypoxis hemerocallidea*	Fisch., C.A.Mey. & Ave-Lall.	LC	Indigenous
Poaceae	*Sporobolus discosporus*	Nees	LC	Indigenous
Hyacinthaceae	*Ledebouria ovatifolia*	(Baker) Jessop		Indigenous
Amaranthaceae	*Dysphania multifida*	(L.) Mosyakin & Clemants		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Achyranthes aspera*	L.		Not indigenous; Naturalised
Phytolaccaceae	*Phytolacca dioica*	L.		Not indigenous; Naturalised; Invasive
Euphorbiaceae	*Croton gratissimus*	Burch.	LC	Indigenous
Araliaceae	*Cussonia paniculata*	Eckl. & Zeyh.	LC	Indigenous
Poaceae	*Trisetopsis imberbis*	(Nees) Roser, A.Wolk & Veldkamp		Indigenous
Amaryllidaceae	*Nerine sp.*			
Limeaceae	*Limeum pauciflorum*	Moq.	LC	Indigenous; Endemic
Lamiaceae	*Salvia tiliifolia*	Vahl		Not indigenous; Naturalised; Invasive
Apocynaceae	*Asclepias meyeriana*	(Schltr.) Schltr.	LC	Indigenous
Cyperaceae	*Scleria dregeana*	Kunth	LC	Indigenous
Euphorbiaceae	*Euphorbia terracina*	L.		Not indigenous; Naturalised; Invasive
Salicaceae	*Populus deltoides*	Bartram ex Marshall		Not indigenous; Naturalised; Invasive
Phytolaccaceae	*Phytolacca octandra*	L.		Not indigenous; Naturalised; Invasive
Cyperaceae	*Cyperus semitrifidus*	Schrad.	LC	Indigenous

Apocynaceae	*Asclepias adscendens*	(Schltr.) Schltr.	LC	Indigenous
Convolvulaceae	*Convolvulus thunbergii*	Roem. & Schult.	LC	Indigenous
Leskeaceae	*Pseudoleskeopsis claviramea*	(Mull.Hal.) Ther.		Indigenous
Ericaceae	*Erica jasminiflora*	Salisb.	CR	Indigenous; Endemic
Poaceae	*Urelytrum agropyroides*	(Hack.) Hack.	LC	Indigenous
Sapindaceae	*Acer negundo*	L.		Not indigenous; Naturalised; Invasive
Asteraceae	*Senecio coronatus*	(Thunb.) Harv.	LC	Indigenous
Asphodelaceae	*Trachyandra asperata*	Kunth	LC	Indigenous
Rubiaceae	*Anthospermum rigidum*	Eckl. & Zeyh.	LC	Indigenous
Fabaceae	*Spartium junceum*	L.	NE	Not indigenous; Cultivated; Naturalised; Invasive
Limeaceae	*Limeum viscosum*	(J.Gay) Fenzl	NE	Indigenous
Ebenaceae	*Diospyros lycioides*	Desf.	LC	Indigenous
Poaceae	*Eleusine coracana*	(L.) Gaertn.	LC	Indigenous
Rubiaceae	*Galium capense*	Thunb.	LC	Indigenous
Fabaceae	*Eriosema cordatum*	E.Mey.	LC	Indigenous
Fabaceae	*Acacia cultriformis*	A.Cunn. ex G.Don	NE	Not indigenous; Naturalised
Poaceae	*Panicum repens*	L.	LC	Indigenous
Onagraceae	*Oenothera stricta*	Ledeb. ex Link		Not indigenous; Naturalised; Invasive
Solanaceae	*Cestrum aurantiacum*	Lindl.		Not indigenous; Naturalised; Invasive
Pinaceae	*Pinus patula*	Schltdl. & Cham.		Not indigenous; Naturalised
Sapotaceae	*Sideroxylon sp.*			
Asteraceae	*Macledium zeyheri*	(Sond.) S.Ortiz	LC	Indigenous
Crassulaceae	*Crassula capitella*	Thunb.	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia aurantiaca*	(Burch.) Hilliard	LC	Indigenous
Asphodelaceae	*Kniphofia ensifolia*	Baker	LC	Indigenous
Fabaceae	*Zornia linearis*	E.Mey.	LC	Indigenous
Caryophyllaceae	*Silene burchellii*	Otth ex DC.		Indigenous
Poaceae	*Setaria lindenbergiana*	(Nees) Stapf	LC	Indigenous
Asparagaceae	*Asparagus cooperi*	Baker	LC	Indigenous
Apocynaceae	*Asclepias eminens*	(Harv.) Schltr.	LC	Indigenous
Sapotaceae	*Mimusops zeyheri*	Sond.	LC	Indigenous
Hyacinthaceae	*Ledebouria sp.*			
Asphodelaceae	*Aloe marlothii*	A.Berger	LC	Indigenous
Asteraceae	*Dimorphotheca spectabilis*	Schltr.	LC	Indigenous; Endemic
Rhamnaceae	*Helinus integrifolius*	(Lam.) Kuntze	LC	Indigenous
Asteraceae	*Berkheya pinnatifida*	(Thunb.) Thell.	LC	Indigenous; Endemic
Asteraceae	*Helichrysum cerastioides*	DC.	LC	Indigenous
Lepidoziaceae	*Telaranea sp.*			
Rosaceae	*Agrimonia procera*	Wallr.	LC	Not indigenous; Naturalised; Invasive
Peraceae	*Clutia hirsuta*	(Sond.) Mull.Arg.	LC	Indigenous
Plantaginaceae	*Veronica anagallis-aquatica*	L.	LC	Indigenous
Poaceae	*Heteropogon contortus*	(L.) Roem. & Schult.	LC	Indigenous

Fabaceae	*Vachellia karroo*	(Hayne) Banfi & Galasso	LC	Indigenous
Asteraceae	*Lactuca inermis*	Forssk.	LC	Indigenous
Fabaceae	*Crotalaria magaliesbergensis*	A.S.Flores & Sch.Rodr.	LC	Indigenous; Endemic
Poaceae	*Cynodon transvaalensis*	Burtt Davy	LC	Indigenous
Lamiaceae	*Rotheca hirsuta*	(Hochst.) R.Fern.	LC	Indigenous
Cleomaceae	*Cleome oxyphylla*	Burch.	LC	Indigenous
Santalaceae	*Thesium utile*	A.W.Hill	LC	Indigenous
Poaceae	*Cymbopogon nardus*	(L.) Rendle	LC	Indigenous
Ruscaceae	*Eriospermum sp.*			
Cyperaceae	*Scleria woodii*	C.B.Clarke	LC	Indigenous
Commelinaceae	*Commelina eckloniana*	Kunth	LC	Indigenous
Asteraceae	*Euryops oligoglossus*	DC.	LC	Indigenous
Apocynaceae	*Acokanthera oppositifolia*	(Lam.) Codd	LC	Indigenous
Salviniaceae	*Azolla filiculoides*	Lam.	NE	Not indigenous; Naturalised; Invasive
Fagaceae	*Quercus rugosa*	Nee		Not indigenous; Cultivated; Naturalised
Iridaceae	*Watsonia sp.*			
Asteraceae	*Helichrysum argyrosphaerum*	DC.	LC	Indigenous
Iridaceae	*Hesperantha coccinea*	(Backh. & Harv.) Goldblatt & J.C.Manning	LC	Indigenous
Apocynaceae	*Asclepias stellifera*	Schltr.	LC	Indigenous
Fabaceae	*Erythrina zeyheri*	Harv.	LC	Indigenous
Polypodiaceae	*Pleopeltis macrocarpa*	(Bory ex Willd.) Kaulf.	LC	Indigenous
Caryophyllaceae	*Dianthus mooiensis*	F.N.Williams	NE	Indigenous
Fabaceae	*Indigofera dimidiata*	Vogel ex Walp.	LC	Indigenous
Bryaceae	*Anomobryum julaceum*	(Schrad. ex G.Gaertn., B.Mey. & Schreb.) Schimp.		Indigenous
Amaranthaceae	*Amaranthus thunbergii*	Moq.	LC	Indigenous
Campanulaceae	*Wahlenbergia virgata*	Engl.	LC	Indigenous
Orobanchaceae	*Cycnium tubulosum*	(L.f.) Engl.	LC	Indigenous
Polygalaceae	*Polygala rehmannii*	Chodat	LC	Indigenous
Exormothecaceae	*Exormotheca holstii*	Steph.		Indigenous
Marchantiaceae	*Marchantia debilis*	K.I.Goebel		Indigenous
Asteraceae	*Bidens pilosa*	L.		Not indigenous; Naturalised
Poaceae	*Setaria pumila*	(Poir.) Roem. & Schult.	LC	Indigenous
Fabaceae	*Tephrosia marginella*	H.M.L.Forbes	LC	Indigenous; Endemic
Caryophyllaceae	*Herniaria erckertii*	F.Herm.	LC	Indigenous
Caryophyllaceae	*Corrigiola litoralis*	L.	NE	Indigenous
Lobeliaceae	*Cyphia stenopetala*	Diels	LC	Indigenous
Cyperaceae	*Cyperus marginatus*	Thunb.	LC	Indigenous
Poaceae	*Eragrostis chloromelas*	Steud.	LC	Indigenous
Cyperaceae	*Cyperus capensis*	(Steud.) Endl.	LC	Indigenous; Endemic
Scrophulariaceae	*Manulea bellidifolia*	Benth.	LC	Indigenous; Endemic

Poaceae	*Phalaris canariensis*	L.	NE	Not indigenous; Naturalised
Convolvulaceae	*Convolvulus dregeanus*	Choisy	LC	Indigenous; Endemic
Malvaceae	*Hibiscus mutabilis*	L.		Not indigenous; Naturalised
Lamiaceae	*Teucrium trifidum*	Retz.	LC	Indigenous
Thymelaeaceae	*Lasiosiphon kraussianus*	(Meisn.) Meisn.		Indigenous
Asparagaceae	*Asparagus flavicaulis*	(Oberm.) Fellingham & N.L.Mey.	LC	Indigenous
Amaryllidaceae	*Nerine angustifolia*	(Baker) W.Watson	LC	Indigenous
Cucurbitaceae	*Peponium mackenii*	(Naudin) Engl.	LC	Indigenous; Endemic
Cyperaceae	*Cyperus sphaerospermus*	Schrad.	LC	Indigenous
Rubiaceae	*Pygmaeothamnus zeyheri*	(Sond.) Robyns	LC	Indigenous
Scrophulariaceae	*Buddleja salviifolia*	(L.) Lam.	LC	Indigenous
Nyctaginaceae	*Mirabilis jalapa*	L.		Not indigenous; Naturalised; Invasive
Asteraceae	*Felicia filifolia*	(Vent.) Burtt Davy	LC	Indigenous
Asteraceae	*Erigeron karvinskianus*	DC.		Not indigenous; Naturalised; Invasive
Juncaceae	*Juncus effusus*	L.	LC	Indigenous
Asteraceae	*Dicoma sp.*			
Pteridaceae	*Cheilanthes quadripinnata*	(Forssk.) Kuhn	LC	Indigenous
Asteraceae	*Artemisia afra*	Jacq. ex Willd.	LC	Indigenous
Bryaceae	*Bryum sp.*			
Alliaceae	*Tulbaghia leucantha*	Baker	LC	Indigenous
Poaceae	*Eragrostis tef*	(Zuccagni) Trotter	NE	Not indigenous; Naturalised
Cyperaceae	*Bulbostylis oritrephes*	(Ridl.) C.B.Clarke	LC	Indigenous
Anemiaceae	*Anemia dregeana*	Kunze	LC	Indigenous
Poaceae	*Cymbopogon prolixus*	(Stapf) E.Phillips	LC	Indigenous
Bartramiaceae	*Philonotis sp.*			
Lamiaceae	*Pycnostachys reticulata*	(E.Mey.) Benth.	LC	Indigenous
Cucurbitaceae	*Cucumis hirsutus*	Sond.	LC	Indigenous
Oleaceae	*Ligustrum sinense*	Lour.		Not indigenous; Cultivated; Naturalised; Invasive
Oxalidaceae	*Oxalis corniculata*	L.		Not indigenous; Naturalised; Invasive
Asteraceae	*Senecio sp.*			
Orchidaceae	*Eulophia hereroensis*	Schltr.	LC	Indigenous
Asteraceae	*Euryops transvaalensis*	Klatt	LC	Indigenous
Asteraceae	*Erigeron bonariensis*	L.		Not indigenous; Naturalised; Invasive
Hyacinthaceae	*Ledebouria cooperi*	(Hook.f.) Jessop	LC	Indigenous
Poaceae	*Sporobolus stapfianus*	Gand.	LC	Indigenous
Poaceae	*Elionurus muticus*	(Spreng.) Kunth	LC	Indigenous
Apocynaceae	*Schizoglossum nitidum*	Schltr.	LC	Indigenous
Poaceae	*Melinis nerviglumis*	(Franch.) Zizka	LC	Indigenous
Commelinaceae	*Commelina benghalensis*	L.	LC	Indigenous
Lamiaceae	*Salvia reflexa*	Hornem.		Not indigenous; Naturalised; Invasive
Crassulaceae	*Crassula swaziensis*	Schonland	LC	Indigenous

Fabaceae	*Rhynchosia sordida*	(E.Mey.) Schinz	LC	Indigenous
Lamiaceae	*Plectranthus neochilus*	Schltr.	LC	Indigenous
Malvaceae	*Pavonia burchellii*	(DC.) R.A.Dyer	LC	Indigenous
Fabaceae	*Eriosema nutans*	Schinz	LC	Indigenous
Hypoxidaceae	*Hypoxis iridifolia*	Baker	LC	Indigenous
Poaceae	*Bromus catharticus*	Vahl	NE	Not indigenous; Naturalised; Invasive
Scrophulariaceae	*Hebenstretia sp.*			
Eriocaulaceae	*Eriocaulon sonderianum*	Korn.	LC	Indigenous
Stilbaceae	*Nuxia congesta*	R.Br. ex Fresen.	LC	Indigenous
Vitaceae	*Rhoicissus tridentata*	(L.f.) Wild & R.B.Drumm.	NE	Indigenous
Asteraceae	*Berkheya zeyheri*	Oliv. & Hiern	LC	Indigenous
Iridaceae	*Aristea torulosa*	Klatt	LC	Indigenous
Crassulaceae	*Crassula lanceolata*	(Eckl. & Zeyh.) Endl. ex Walp.	LC	Indigenous
Apocynaceae	*Asclepias brevipes*	(Schltr.) Schltr.	LC	Indigenous; Endemic
Asteraceae	*Senecio lydenburgensis*	Hutch. & Burtt Davy	LC	Indigenous
Typhaceae	*Typha capensis*	(Rohrb.) N.E.Br.	LC	Indigenous
Fabaceae	*Vigna vexillata*	(L.) A.Rich.	LC	Indigenous
Rutaceae	*Zanthoxylum capense*	(Thunb.) Harv.	LC	Indigenous
Fabaceae	*Dolichos angustifolius*	Eckl. & Zeyh.	LC	Indigenous
Poaceae	*Eragrostis micrantha*	Hack.	LC	Indigenous
Asteraceae	*Brachylaena rotundata*	S.Moore	LC	Indigenous
Boraginaceae	*Anchusa azurea*	Mill.		Not indigenous; Naturalised
Fabaceae	*Indigofera melanadenia*	Benth. ex Harv.	LC	Indigenous
Malvaceae	*Dombeya tiliacea*	(Endl.) Planch.	LC	Indigenous; Endemic
Poaceae	*Eragrostis plana*	Nees	LC	Indigenous
Caryophyllaceae	*Cerastium capense*	Sond.	LC	Indigenous
Lamiaceae	*Syncolostemon pretoriae*	(Gurke) D.F.Otieno	LC	Indigenous
Iridaceae	*Babiana bainesii*	Baker	LC	Indigenous
Rubiaceae	*Pavetta gardeniifolia*	A.Rich.	LC	Indigenous
Malvaceae	*Hibiscus microcarpus*	Garcke	LC	Indigenous
Asteraceae	*Gerbera ambigua*	(Cass.) Sch.Bip.	LC	Indigenous
Papaveraceae	*Papaver aculeatum*	Thunb.	LC	Indigenous
Bruchiaceae	*Trematodon longicollis*	Michx.		Indigenous
Euphorbiaceae	*Euphorbia striata*	Thunb.	LC	Indigenous
Cyperaceae	*Cyperus fastigiatus*	Rottb.	LC	Indigenous
Asteraceae	*Helichrysum kraussii*	Sch.Bip.	LC	Indigenous
Poaceae	*Eragrostis patentipilosa*	Hack.	LC	Indigenous
Moraceae	*Morus alba*	L.		Not indigenous; Naturalised; Invasive
Apocynaceae	*Gomphocarpus fruticosus*	(L.) W.T.Aiton	LC	Indigenous
Anacardiaceae	*Lannea edulis*	(Sond.) Engl.	LC	Indigenous
Orobanchaceae	*Striga bilabiata*	(Thunb.) Kuntze	LC	Indigenous
Poaceae	*Aristida congesta*	Roem. & Schult.	LC	Indigenous
Asteraceae	*Senecio pentactinus*	Klatt	LC	Indigenous
Apocynaceae	*Asclepias gibba*	(E.Mey.) Schltr.	LC	Indigenous

Asteraceae	*Helichrysum uninervium*	Burtt Davy	LC	Indigenous; Endemic
Malvaceae	*Hermannia depressa*	N.E.Br.	LC	Indigenous
Asteraceae	*Chrysanthellum sp.*			
Talinaceae	*Talinum caffrum*	(Thunb.) Eckl. & Zeyh.	LC	Indigenous
Apocynaceae	*Sisyranthus randii*	S.Moore	LC	Indigenous
Poaceae	*Eleusine indica*	(L.) Gaertn.	LC	Indigenous
Amaryllidaceae	*Nerine rehmannii*	(Baker) L.Bolus	LC	Indigenous
Cyperaceae	*Ficinia stolonifera*	Boeckeler	LC	Indigenous
Asteraceae	*Tragopogon dubius*	Scop.		Not indigenous; Naturalised
Cyperaceae	*Cyperus usitatus*	Burch.	LC	Indigenous
Dioscoreaceae	*Dioscorea retusa*	Mast.	LC	Indigenous
Convolvulaceae	*Convolvulus sagittatus*	Thunb.	LC	Indigenous
Apiaceae	*Heteromorpha arborescens*	(Spreng.) Cham. & Schltdl.	LC	Indigenous
Ruscaceae	*Eriospermum cooperi*	Baker	LC	Indigenous
Poaceae	*Polypogon monspeliensis*	(L.) Desf.	NE	Not indigenous; Naturalised
Euphorbiaceae	*Euphorbia inaequilatera*	Sond.	LC	Indigenous
Boraginaceae	*Cynoglossum lanceolatum*	Forssk.	LC	Indigenous
Oliniaceae	*Olinia emarginata*	Burtt Davy	LC	Indigenous
Brachytheciaceae	*Brachythecium ruderale*	(Brid.) W.R.Buck		Indigenous
Ricciaceae	*Riccia stricta*	(Lindenb.) Perold		Indigenous
Asteraceae	*Pseudognaphalium luteoalbum*	(L.) Hilliard & B.L.Burtt	LC	Not indigenous; Cryptogenic
Cyperaceae	*Schoenoplectus tabernaemontani*	(C.C.Gmel.) Palla		Not indigenous; Naturalised
Commelinaceae	*Commelina africana*	L.	LC	Indigenous
Cyperaceae	*Pycreus pumilus*	(L.) Nees	LC	Indigenous
Poaceae	*Chloris virgata*	Sw.	LC	Indigenous
Orchidaceae	*Satyrium cristatum*	Sond.	LC	Indigenous
Solanaceae	*Physalis angulata*	L.		Not indigenous; Naturalised; Invasive
Frullaniaceae	*Frullania ericoides*	(Nees) Mont.		Indigenous
Lamiaceae	*Leonotis martinicensis*	(Jacq.) J.C.Manning & Goldblatt	LC	Indigenous
Asteraceae	*Gnaphalium filagopsis*	Hilliard & B.L.Burtt	LC	Indigenous
Poaceae	*Dactyloctenium giganteum*	Fisher & Schweick.	LC	Indigenous
Acanthaceae	*Barleria obtusa*	Nees	LC	Indigenous
Amaranthaceae	*Salsola kali*	L.		Not indigenous; Naturalised; Invasive
Boraginaceae	*Echium plantagineum*	L.		Not indigenous; Naturalised; Invasive
Hyacinthaceae	*Drimia depressa*	(Baker) Jessop	LC	Indigenous
Apocynaceae	*Brachystelma chloranthum*	(Schltr.) Peckover	LC	Indigenous
Poaceae	*Hyparrhenia dregeana*	(Nees) Stapf ex Stent	LC	Indigenous
Portulacaceae	*Portulaca quadrifida*	L.	LC	Indigenous
Apocynaceae	*Asclepias fallax*	(Schltr.) Schltr.	LC	Indigenous; Endemic
Poaceae	*Digitaria eriantha*	Steud.	LC	Indigenous
Poaceae	*Eragrostis cilianensis*	(All.) Vignolo ex Janch.	LC	Indigenous

Poaceae	*Melinis sp.*			
Apiaceae	*Pimpinella transvaalensis*	H.Wolff	LC	Indigenous
Ditrichaceae	*Ceratodon purpureus*	(Hedw.) Brid.		Indigenous
Crassulaceae	*Crassula lanceolata*	(Eckl. & Zeyh.) Endl. ex Walp.	LC	Indigenous
Iridaceae	*Gladiolus papilio*	Hook.f.	LC	Indigenous
Podocarpaceae	*Podocarpus henkelii*	Stapf ex Dallim. & A.B.Jacks.	LC	Indigenous; Endemic
Lycopodiaceae	*Palhinhaea cernua*	(L.) Vasc. & Franco		Indigenous
Solanaceae	*Datura stramonium*	L.		Not indigenous; Naturalised; Invasive
Asteraceae	*Senecio venosus*	Harv.	LC	Indigenous
Apiaceae	*Berula repanda*	(Hiern) Spalik & S.R.Downie	LC	Indigenous
Asteraceae	*Conyza podocephala*	DC.		Indigenous
Poaceae	*Setaria sp.*			
Cyperaceae	*Isolepis costata*	Hochst. ex A.Rich.	LC	Indigenous
Onagraceae	*Epilobium hirsutum*	L.	LC	Indigenous
Amaranthaceae	*Cyathula uncinulata*	(Schrad.) Schinz	LC	Indigenous
Hyacinthaceae	*Eucomis autumnalis*	(Mill.) Chitt.	NE	Indigenous
Ricciaceae	*Riccia sp.*			
Amaranthaceae	*Chenopodium album*	L.		Not indigenous; Naturalised; Invasive
Verbenaceae	*Lippia javanica*	(Burm.f.) Spreng.	LC	Indigenous
Santalaceae	*Thesium rasum*	(A.W.Hill) N.E.Br.	LC	Indigenous
Poaceae	*Eragrostis mexicana*	(Hornem.) Link	NE	Not indigenous; Naturalised
Apocynaceae	*Ancylobothrys capensis*	(Oliv.) Pichon	LC	Indigenous
Malvaceae	*Hermannia geniculata*	Eckl. & Zeyh.	LC	Indigenous
Lythraceae	*Nesaea sagittifolia*	(Sond.) Koehne	LC	Indigenous
Malvaceae	*Hermannia sp.*			
Malpighiaceae	*Sphedamnocarpus pruriens*	(A.Juss.) Szyszyl.	LC	Indigenous
Polygonaceae	*Fallopia convolvulus*	(L.) Holub		Not indigenous; Naturalised
Asteraceae	*Helichrysum chionosphaerum*	DC.	LC	Indigenous
Scrophulariaceae	*Manulea parviflora*	Benth.	LC	Indigenous; Endemic
Rhamnaceae	*Ziziphus mucronata*	Willd.	LC	Indigenous
Limeaceae	*Limeum argute-carinatum*	Wawra ex Wawra & Peyr.	LC	Indigenous
Poaceae	*Briza maxima*	L.	NE	Not indigenous; Naturalised; Invasive
Salicaceae	*Scolopia zeyheri*	(Nees) Harv.	LC	Indigenous
Selaginellaceae	*Selaginella dregei*	(C.Presl) Hieron.	LC	Indigenous
Poaceae	*Sporobolus sp.*			
Cyperaceae	*Lipocarpha rehmannii*	(Ridl.) Goetgh.	LC	Indigenous
Fabaceae	*Vachellia robusta*	(Burch.) Kyal. & Boatwr.	LC	Indigenous
Convolvulaceae	*Ipomoea crassipes*	Hook.	LC	Indigenous
Asteraceae	*Montanoa hibiscifolia*	Benth.		Not indigenous; Naturalised; Invasive
Dryopteridaceae	*Dryopteris athamantica*	(Kunze) Kuntze	LC	Indigenous
Iridaceae	*Moraea stricta*	Baker	LC	Indigenous

Asteraceae	*Schistostephium crataegifolium*	(DC.) Fenzl ex Harv.	LC	Indigenous
Orobanchaceae	*Graderia scabra*	(L.f.) Benth.	LC	Indigenous
Apiaceae	*Afrosciadium magalismontanum*	(Sond.) P.J.D.Winter	LC	Indigenous
Juncaceae	*Juncus rigidus*	Desf.	LC	Indigenous
Hyacinthaceae	*Dipcadi papillatum*	Oberm.	LC	Indigenous
Amaranthaceae	*Gomphrena celosioides*	Mart.		Not indigenous; Naturalised
Hypoxidaceae	*Hypoxis interjecta*	Nel	LC	Indigenous; Endemic
Asteraceae	*Helichrysum lepidissimum*	S.Moore	LC	Indigenous
Scrophulariaceae	*Nemesia rupicola*	Hilliard	LC	Indigenous
Poaceae	*Ehrharta erecta*	Lam.	LC	Indigenous
Lamiaceae	*Ocimum angustifolium*	Benth.	LC	Indigenous
Bryaceae	*Bryum pycnophyllum*	(Dixon) Mohamed		Indigenous
Amaryllidaceae	*Nerine bowdenii*	W.Watson	LC	Indigenous; Endemic
Asteraceae	*Felicia fruticosa*	(L.) G.Nicholson	LC	Indigenous; Endemic
Brassicaceae	*Capsella bursa-pastoris*	(L.) Medik.		Not indigenous; Naturalised
Blechnaceae	*Blechnum australe*	L.	LC	Indigenous
Lythraceae	*Nesaea schinzii*	Koehne	LC	Indigenous
Zygophyllaceae	*Tribulus terrestris*	L.	LC	Indigenous
Asteraceae	*Nolletia rarifolia*	(Turcz.) Steetz	LC	Indigenous; Endemic
Amaranthaceae	*Cyathula cylindrica*	Moq.	LC	Indigenous
Apiaceae	*Alepidea peduncularis*	Steud. ex A.Rich.	DD	Indigenous
Acanthaceae	*Blepharis stainbankiae*	C.B.Clarke	LC	Indigenous; Endemic
Asteraceae	*Taraxacum officinale*	Weber		Not indigenous; Naturalised
Euphorbiaceae	*Euphorbia clavarioides*	Boiss.	LC	Indigenous
Poaceae	*Eleusine multiflora*	A.Rich.	NE	Not indigenous; Naturalised
Solanaceae	*Solanum sisymbriifolium*	Lam.		Not indigenous; Naturalised; Invasive
Achariaceae	*Kiggelaria africana*	L.	LC	Indigenous
Celastraceae	*Mystroxylon aethiopicum*	(Thunb.) Loes.	LC	Indigenous; Endemic
Asteraceae	*Senecio inornatus*	DC.	LC	Indigenous
Asteraceae	*Conyza pinnata*	(L.f.) Kuntze		Indigenous
Fabaceae	*Indigofera rostrata*	Bolus	LC	Indigenous
Poaceae	*Agrostis lachnantha*	Nees	LC	Indigenous
Rubiaceae	*Canthium inerme*	(L.f.) Kuntze	LC	Indigenous
Caryophyllaceae	*Pollichia campestris*	Aiton	LC	Indigenous
Scrophulariaceae	*Selago capitellata*	Schltr.	LC	Indigenous; Endemic
Poaceae	*Trachypogon spicatus*	(L.f.) Kuntze	LC	Indigenous
Fabaceae	*Indigastrum burkeanum*	(Benth. ex Harv.) Schrire	LC	Indigenous
Solanaceae	*Solanum humile*	Lam.		Indigenous
Lamiaceae	*Plectranthus ramosior*	(Benth.) Van Jaarsv.	LC	Indigenous; Endemic
Scrophulariaceae	*Limosella maior*	Diels	LC	Indigenous
Moraceae	*Ficus ingens*	(Miq.) Miq.		Indigenous

Malvaceae	*Hermannia lancifolia*	Szyszyl.	LC	Indigenous; Endemic
Poaceae	*Setaria nigrirostris*	(Nees) T.Durand & Schinz	LC	Indigenous
Solanaceae	*Solanum campylacanthum*	Hochst. ex A.Rich.		Indigenous
Fabaceae	*Lessertia perennans*	(Jacq.) DC.	NE	Indigenous
Cyperaceae	*Bulbostylis burchellii*	(Ficalho & Hiern) C.B.Clarke	LC	Indigenous
Verbenaceae	*Lippia scaberrima*	Sond.	LC	Indigenous
Asparagaceae	*Asparagus asparagoides*	(L.) W.Wight	LC	Indigenous
Apocynaceae	*Aspidoglossum biflorum*	E.Mey.	LC	Indigenous
Malvaceae	*Sida rhombifolia*	L.	LC	Indigenous
Hyacinthaceae	*Drimia uniflora*	J.C.Manning & Goldblatt	LC	Indigenous
Orchidaceae	*Eulophia hians*	Spreng.	LC	Indigenous
Asteraceae	*Garuleum woodii*	Schinz	LC	Indigenous
Vitaceae	*Rhoicissus tridentata*	(L.f.) Wild & R.B.Drumm.	NE	Indigenous; Endemic
Lamiaceae	*Leonotis schinzii*	Gurke	LC	Indigenous
Asteraceae	*Senecio isatideus*	DC.	LC	Indigenous
Convolvulaceae	*Ipomoea oblongata*	E.Mey. ex Choisy	LC	Indigenous
Asphodelaceae	*Trachyandra sp.*			
Myrsinaceae	*Lysimachia ovalis*	(Ruiz & Pav.) U.Manns & Anderb.		Not indigenous; Naturalised
Asteraceae	*Lactuca serriola*	L.		Not indigenous; Naturalised
Cyperaceae	*Cyperus margaritaceus*	Vahl	LC	Indigenous
Asteraceae	*Berkheya seminivea*	Harv. & Sond.	LC	Indigenous; Endemic
Rubiaceae	*Cordylostigma virgatum*	(Willd.) Groeninckx & Dessein		Indigenous
Rosaceae	*Pyracantha crenulata*	(D.Don) M.Roem.		Not indigenous; Cultivated; Naturalised; Invasive
Pteridaceae	*Cheilanthes viridis*	(Forssk.) Sw.	LC	Indigenous
Bryaceae	*Bryum apiculatum*	Schwagr.		Indigenous
Proteaceae	*Leucadendron sp.*			
Gentianaceae	*Chironia palustris*	Burch.	LC	Indigenous
Campanulaceae	*Wahlenbergia sp.*			
Cyperaceae	*Cyperus rupestris*	Kunth	LC	Indigenous
Funariaceae	*Funaria limbata*	(Mull.Hal.) Broth.		Indigenous
Cyperaceae	*Eleocharis atropurpurea*	(Retz.) J.Presl & C.Presl	LC	Indigenous
Scrophulariaceae	*Selago densiflora*	Rolfe	LC	Indigenous
Rubiaceae	*Afrocanthium mundianum*	(Cham. & Schltdl.) Lantz	LC	Indigenous
Rubiaceae	*Vangueria parvifolia*	Sond.	LC	Indigenous
Cucurbitaceae	Coccinia adoensis	(A.Rich.) Cogn.	LC	Indigenous

Appendix C Avifauna species expected in the project area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Accipiter badius	Shikra	Unlisted	LC
Accipiter melanoleucus	Sparrowhawk, Black	Unlisted	LC
Accipiter minullus	Sparrowhawk, Little	Unlisted	LC
Accipiter ovampensis	Sparrowhawk, Ovambo	Unlisted	LC
Acridotheres tristis	Myna, Common	Unlisted	LC
Acrocephalus arundinaceus	Reed-warbler, Great	Unlisted	LC
Acrocephalus baeticatus	Reed-warbler, African	Unlisted	Unlisted
Acrocephalus gracilirostris	Swamp-warbler, Lesser	Unlisted	LC
Acrocephalus palustris	Warbler, Marsh	Unlisted	LC
Acrocephalus schoenobaenus	Warbler, Sedge	Unlisted	LC
Actitis hypoleucos	Sandpiper, Common	Unlisted	LC
Actophilornis africanus	Jacana, African	Unlisted	LC
Afrotis afraoides	Korhaan, Northern Black	Unlisted	LC
Agapornis roseicollis	Lovebird, Rosy-faced	Unlisted	LC
Alcedo semitorquata	Kingfisher, Half-collared	NT	LC
Alopochen aegyptiaca	Goose, Egyptian	LC	LC
Amadina erythrocephala	Finch, Red-headed	Unlisted	LC
Amadina fasciata	Finch, Cut-throat	Unlisted	Unlisted
Amandava subflava	Waxbill, Orange-breasted	Unlisted	Unlisted
Amblyospiza albifrons	Weaver, Thick-billed	Unlisted	LC
Anaplectes rubriceps	Weaver, Red-headed	Unlisted	LC
Anas capensis	Teal, Cape	Unlisted	LC
Anas erythrorhyncha	Teal, Red-billed	Unlisted	LC
Anas platyrhynchos	Duck, Mallard	Unlisted	LC
Anas sparsa	Duck, African Black	Unlisted	LC
Anas undulata	Duck, Yellow-billed	Unlisted	LC
Anhinga rufa	Darter, African	Unlisted	LC
Anser anser	Goose, Domestic	Unlisted	LC
Anthropoides paradiseus	Crane, Blue	NT	VU
Anthus cinnamomeus	Pipit, African	Unlisted	LC
Anthus leucophrys	Pipit, Plain-backed	Unlisted	LC
Anthus nicholsoni	Nicholson's pipit	Unlisted	Unlisted
Anthus vaalensis	Pipit, Buffy	Unlisted	LC
Apalis thoracica	Apalis, Bar-throated	Unlisted	LC
Apus affinis	Swift, Little	Unlisted	LC
Apus apus	Swift, Common	Unlisted	LC

Apus barbatus	Swift, African Black	Unlisted	LC
Apus caffer	Swift, White-rumped	Unlisted	LC
Apus horus	Swift, Horus	Unlisted	LC
Aquila spilogaster	Hawk-eagle, African	Unlisted	LC
Aquila verreauxii	Eagle, Verreaux's	VU	LC
Ardea alba	Egret, Great	Unlisted	LC
Ardea cinerea	Heron, Grey	Unlisted	LC
Ardea goliath	Heron, Goliath	Unlisted	LC
Ardea intermedia	Egret, Yellow-billed (Intermediate)	Unlisted	LC
Ardea melanocephala	Heron, Black-headed	Unlisted	LC
Ardea purpurea	Heron, Purple	Unlisted	LC
Ardeola ralloides	Heron, Squacco	Unlisted	LC
Asio capensis	Owl, Marsh	Unlisted	LC
Aviceda cuculoides	Hawk, African Cuckoo	Unlisted	LC
Batis molitor	Batis, Chinspot	Unlisted	LC
Bostrychia hagedash	Ibis, Hadeda	Unlisted	LC
Bradypterus baboecala	Rush-warbler, Little	Unlisted	LC
Brunhilda erythronotos	Waxbill, Black-faced	Unlisted	LC
Bubo africanus	Eagle-owl, Spotted	Unlisted	LC
Bubulcus ibis	Egret, Cattle	Unlisted	LC
Burhinus capensis	Thick-knee, Spotted	Unlisted	LC
Burhinus vermiculatus	Thick-knee, Water	Unlisted	LC
Buteo buteo	Buzzard, Common (Steppe)	Unlisted	LC
Buteo rufofuscus	Buzzard, Jackal	Unlisted	LC
Butorides striata	Heron, Green-backed	Unlisted	LC
Calidris ferruginea	Sandpiper, Curlew	LC	NT
Calidris minuta	Stint, Little	LC	LC
Calidris pugnax	Ruff	Unlisted	LC
Camaroptera brevicaudata	Camaroptera, Grey-backed	Unlisted	Unlisted
Campephaga flava	Cuckoo-shrike, Black	Unlisted	LC
Campethera abingoni	Woodpecker, Golden-tailed	Unlisted	LC
Caprimulgus europaeus	Nightjar, European	Unlisted	LC
Caprimulgus pectoralis	Nightjar, Fiery-necked	Unlisted	LC
Caprimulgus tristigma	Nightjar, Freckled	Unlisted	LC
Cecropis abyssinica	Swallow, Lesser Striped	Unlisted	LC
Cecropis cucullata	Swallow, Greater Striped	Unlisted	LC
Cecropis semirufa	Swallow, Red-breasted	Unlisted	LC
Centropus burchellii	Coucal, Burchell's	Unlisted	Unlisted
Cercotrichas leucophrys	Scrub-robin, White-browed	Unlisted	LC

Cercotrichas paena	Scrub-robin, Kalahari	Unlisted	LC
Ceryle rudis	Kingfisher, Pied	Unlisted	LC
Chalcomitra amethystina	Sunbird, Amethyst	Unlisted	LC
Charadrius tricollaris	Plover, Three-banded	Unlisted	LC
Chersomanes albofasciata	Lark, Spike-heeled	Unlisted	LC
Chlidonias hybrida	Tern, Whiskered	Unlisted	LC
Chlidonias leucopterus	Tern, White-winged	Unlisted	LC
Chlorophoneus sulfureopectus	Bush-Shrike, Orange-breasted	Unlisted	LC
Chroicocephalus cirrocephalus	Gull, Grey-headed	Unlisted	LC
Chrysococcyx caprius	Cuckoo, Diderick	Unlisted	LC
Chrysococcyx klaas	Cuckoo, Klaas's	Unlisted	LC
Ciconia abdimii	Stork, Abdim's	NT	LC
Ciconia ciconia	Stork, White	Unlisted	LC
Cinnyricinclus leucogaster	Starling, Violet-backed	Unlisted	LC
Cinnyris talatala	Sunbird, White-bellied	Unlisted	LC
Circaetus cinereus	Snake-eagle, Brown	Unlisted	LC
Circaetus pectoralis	Snake-eagle, Black-chested	Unlisted	LC
Circus ranivorus	Marsh-harrier, African	EN	LC
Cisticola aberrans	Cisticola, Lazy	Unlisted	LC
Cisticola aridulus	Cisticola, Desert	Unlisted	LC
Cisticola ayresii	Cisticola, Wing-snapping	Unlisted	LC
Cisticola chiniana	Cisticola, Rattling	Unlisted	LC
Cisticola fulvicapilla	Neddicky, Neddicky	Unlisted	LC
Cisticola juncidis	Cisticola, Zitting	Unlisted	LC
Cisticola textrix	Cisticola, Cloud	Unlisted	LC
Cisticola tinniens	Cisticola, Levaillant's	Unlisted	LC
Clamator glandarius	Cuckoo, Great Spotted	Unlisted	LC
Clamator jacobinus	Cuckoo, Jacobin	Unlisted	LC
Clamator levaillantii	Cuckoo, Levaillant's	Unlisted	LC
Colius colius	Mousebird, White-backed	Unlisted	LC
Colius striatus	Mousebird, Speckled	Unlisted	LC
Columba arquatrix	Olive-pigeon, African	Unlisted	LC
Columba guinea	Pigeon, Speckled	Unlisted	LC
Columba livia	Dove, Rock	Unlisted	LC
Coracias caudatus	Roller, Lilac-breasted	Unlisted	LC
Coracias garrulus	Roller, European	NT	LC
Corvus albus	Crow, Pied	Unlisted	LC
Corvus capensis	Crow, Cape	Unlisted	LC
Corythornis cristatus	Kingfisher, Malachite	Unlisted	Unlisted

Cossypha caffra	Robin-chat, Cape	Unlisted	LC
Cossypha humeralis	Robin-chat, White-throated	Unlisted	LC
Coturnix delegorguei	Quail, Harlequin	Unlisted	LC
Creatophora cinerea	Starling, Wattled	Unlisted	LC
Crecopsis egregia	Crake, African	Unlisted	LC
Crinifer concolor	Go-away-bird, Grey	Unlisted	LC
Crithagra atrogularis	Canary, Black-throated	Unlisted	LC
Crithagra flaviventris	Canary, Yellow	Unlisted	LC
Crithagra gularis	Seedeater, Streaky-headed	Unlisted	LC
Crithagra mozambica	Canary, Yellow-fronted	Unlisted	LC
Cuculus canorus	Cuckoo, Common	Unlisted	LC
Cuculus clamosus	Cuckoo, Black	Unlisted	LC
Cuculus gularis	Cuckoo, African	Unlisted	LC
Cuculus solitarius	Cuckoo, Red-chested	Unlisted	LC
Curruca communis	Whitethroat, Common	Unlisted	LC
Curruca subcoerulea	Tit-babbler, Chestnut-vented	Unlisted	Unlisted
Cypsiurus parvus	Palm-swift, African	Unlisted	LC
Delichon urbicum	House-martin, Common	Unlisted	LC
Dendrocygna bicolor	Duck, Fulvous	Unlisted	LC
Dendrocygna viduata	Duck, White-faced Whistling	Unlisted	LC
Dendroperdix sephaena	Francolin, Crested	Unlisted	LC
Dendropicos fuscescens	Woodpecker, Cardinal	Unlisted	LC
Dicrurus adsimilis	Drongo, Fork-tailed	Unlisted	LC
Dryoscopus cubla	Puffback, Black-backed	Unlisted	LC
Egretta ardesiaca	Heron, Black	Unlisted	LC
Egretta garzetta	Egret, Little	Unlisted	LC
Elanus caeruleus	Kite, Black-shouldered	Unlisted	LC
Emberiza tahapisi	Bunting, Cinnamon-breasted	Unlisted	LC
Eremomela icteropygialis	Eremomela, Yellow-bellied	Unlisted	LC
Estrilda astrild	Waxbill, Common	Unlisted	LC
Euplectes afer	Bishop, Yellow-crowned	Unlisted	LC
Euplectes albonotatus	Widowbird, White-winged	Unlisted	LC
Euplectes ardens	Widowbird, Red-collared	Unlisted	LC
Euplectes axillaris	Widowbird, Fan-tailed	Unlisted	LC
Euplectes capensis	Bishop, Yellow	Unlisted	LC
Euplectes orix	Bishop, Southern Red	Unlisted	LC
Euplectes progne	Widowbird, Long-tailed	Unlisted	LC
Falco amurensis	Falcon, Amur	Unlisted	LC
Falco biarmicus	Falcon, Lanner	VU	LC

Falco naumanni	Kestrel, Lesser	Unlisted	LC
Falco peregrinus	Falcon, Peregrine	Unlisted	LC
Falco rupicoloides	Kestrel, Greater	Unlisted	LC
Falco rupicolus	Kestrel, Rock	Unlisted	LC
Falco subbuteo	Hobby, Eurasian	Unlisted	LC
Falco vespertinus	Falcon, Red-footed	NT	NT
Fulica cristata	Coot, Red-knobbed	Unlisted	LC
Gallinago nigripennis	Snipe, African	Unlisted	LC
Gallinula chloropus	Moorhen, Common	Unlisted	LC
Glareola nordmanni	Pratincole, Black-winged	NT	NT
Glaucidium perlatum	Owlet, Pearl-spotted	Unlisted	LC
Granatina granatina	Waxbill, Violet-eared	Unlisted	LC
Gyps coprotheres	Vulture, Cape	EN	EN
Halcyon albiventris	Kingfisher, Brown-hooded	Unlisted	LC
Halcyon senegalensis	Kingfisher, Woodland	Unlisted	LC
Haliaeetus vocifer	Fish-eagle, African	Unlisted	LC
Hieraaetus pennatus	Eagle, Booted	Unlisted	LC
Himantopus himantopus	Stilt, Black-winged	Unlisted	LC
Hippolais icterina	Warbler, Icterine	Unlisted	LC
Hirundo albigularis	Swallow, White-throated	Unlisted	LC
Hirundo dimidiata	Swallow, Pearl-breasted	Unlisted	LC
Hirundo rustica	Swallow, Barn	Unlisted	LC
Iduna natalensis	Warbler, Dark-capped Yellow	Unlisted	LC
Indicator indicator	Honeyguide, Greater	Unlisted	LC
Indicator minor	Honeyguide, Lesser	Unlisted	LC
Ixobrychus minutus	Bittern, Little	Unlisted	LC
Ixobrychus sturmii	Bittern, Dwarf	Unlisted	LC
Jynx ruficollis	Wryneck, Red-throated	Unlisted	LC
Kaupifalco monogrammicus	Buzzard, Lizard	Unlisted	LC
Lagonosticta rhodopareia	Firefinch, Jameson's	Unlisted	LC
Lagonosticta rubricata	Firefinch, African	Unlisted	LC
Lagonosticta senegala	Firefinch, Red-billed	Unlisted	LC
Lamprotornis bicolor	Starling, Pied	Unlisted	LC
Lamprotornis nitens	Starling, Cape Glossy	Unlisted	LC
Laniarius atrococcineus	Shrike, Crimson-breasted	Unlisted	LC
Laniarius ferrugineus	Boubou, Southern	Unlisted	LC
Lanius collaris	Fiscal, Common (Southern)	Unlisted	LC
Lanius collurio	Shrike, Red-backed	Unlisted	LC
Lanius minor	Shrike, Lesser Grey	Unlisted	LC

Leptoptilos crumeniferus	Stork, Marabou	NT	LC
Locustella fluviatilis	Warbler, River	Unlisted	LC
Lophaetus occipitalis	Eagle, Long-crested	Unlisted	LC
Lophoceros nasutus	Hornbill, African Grey	Unlisted	LC
Lybius torquatus	Barbet, Black-collared	Unlisted	LC
Macronyx capensis	Longclaw, Cape	Unlisted	LC
Malaconotus blanchoti	Bush-shrike, Grey-headed	Unlisted	LC
Megaceryle maxima	Kingfisher, Giant	Unlisted	Unlisted
Melaenornis mariquensis	Flycatcher, Marico	Unlisted	LC
Melaenornis pammelaina	Flycatcher, Southern Black	Unlisted	LC
Melaenornis silens	Flycatcher, Fiscal	Unlisted	LC
Melaniparus cinerascens	Tit, Ashy	Unlisted	LC
Merops apiaster	Bee-eater, European	Unlisted	LC
Merops bullockoides	Bee-eater, White-fronted	Unlisted	LC
Merops persicus	Bee-eater, Blue-cheeked	Unlisted	LC
Microcarbo africanus	Cormorant, Reed	Unlisted	LC
Micronisus gabar	Goshawk, Gabar	Unlisted	LC
Milvus aegyptius	Kite, Yellow-billed	Unlisted	Unlisted
Milvus migrans	Kite, Black	Unlisted	LC
Mirafra africana	Lark, Rufous-naped	Unlisted	LC
Mirafra fasciolata	Lark, Eastern Clapper	Unlisted	LC
Monticola brevipes	Rock-thrush, Short-toed	Unlisted	LC
Motacilla aguimp	Wagtail, African Pied	Unlisted	LC
Motacilla capensis	Wagtail, Cape	Unlisted	LC
Motacilla clara	Wagtail, Mountain	Unlisted	LC
Motacilla flava	Wagtail, Western Yellow	Unlisted	LC
Muscicapa striata	Flycatcher, Spotted	Unlisted	LC
Mycteria ibis	Stork, Yellow-billed	EN	LC
Myrmecocichla formicivora	Chat, Anteating	Unlisted	LC
Myrmecocichla monticola	Wheatear, Mountain	Unlisted	LC
Nectarinia famosa	Sunbird, Malachite	Unlisted	LC
Netta erythrophthalma	Pochard, Southern	Unlisted	LC
Nilaus afer	Brubru	Unlisted	LC
Numida meleagris	Guineafowl, Helmeted	Unlisted	LC
Nycticorax nycticorax	Night-Heron, Black-crowned	Unlisted	LC
Oena capensis	Dove, Namaqua	Unlisted	LC
Oenanthe familiaris	Chat, Familiar	Unlisted	LC
Oenanthe pileata	Wheatear, Capped	Unlisted	LC
Onychognathus morio	Starling, Red-winged	Unlisted	LC

Oriolus larvatus	Oriole, Black-headed	Unlisted	LC
Oriolus oriolus	Oriole, Eurasian Golden	Unlisted	LC
Ortygospiza atricollis	Quailfinch, African	Unlisted	LC
Otus senegalensis	Scops-owl, African	Unlisted	LC
Oxyura maccoa	Duck, Maccoa	NT	NT
Passer diffusus	Sparrow, Southern Grey-headed	Unlisted	LC
Passer domesticus	Sparrow, House	Unlisted	LC
Passer melanurus	Sparrow, Cape	Unlisted	LC
Pavo cristatus	Peacock, Common	Unlisted	LC
Pernis apivorus	Honey-buzzard, European	Unlisted	LC
Petrochelidon spilodera	Cliff-swallow, South African	Unlisted	LC
Phalacrocorax lucidus	Cormorant, White-breasted	Unlisted	LC
Phoenicopterus roseus	Flamingo, Greater	NT	LC
Phoeniculus purpureus	Wood-hoopoe, Green	Unlisted	LC
Phylloscopus trochilus	Warbler, Willow	Unlisted	LC
Platalea alba	Spoonbill, African	Unlisted	LC
Plectropterus gambensis	Goose, Spur-winged	Unlisted	LC
Plegadis falcinellus	Ibis, Glossy	Unlisted	LC
Plocepasser mahali	Sparrow-weaver, White-browed	Unlisted	LC
Ploceus capensis	Weaver, Cape	Unlisted	LC
Ploceus cucullatus	Weaver, Village	Unlisted	LC
Ploceus intermedius	Masked-weaver, Lesser	Unlisted	LC
Ploceus velatus	Masked-weaver, Southern	Unlisted	LC
Podiceps cristatus	Grebe, Great Crested	Unlisted	LC
Podiceps nigricollis	Grebe, Black-necked	Unlisted	LC
Pogoniulus chrysoconus	Tinkerbird, Yellow-fronted	Unlisted	LC
Polyboroides typus	Harrier-Hawk, African	Unlisted	LC
Porphyrio madagascariensis	Swamphen, African Purple	Unlisted	Unlisted
Porzana porzana	Crake, Spotted	Unlisted	LC
Prinia flavicans	Prinia, Black-chested	Unlisted	LC
Prinia subflava	Prinia, Tawny-flanked	Unlisted	LC
Prionops plumatus	Helmet-shrike, White-crested	Unlisted	LC
Prodotiscus regulus	Honeybird, Brown-backed	Unlisted	LC
Psittacula krameri	Parakeet, Rose-ringed	Unlisted	LC
Pternistis natalensis	Spurfowl, Natal	Unlisted	LC
Pternistis swainsonii	Spurfowl, Swainson's	Unlisted	LC
Ptyonoprogne fuligula	Martin, Rock	LC	LC
Pycnonotus nigricans	Bulbul, African Red-eyed	Unlisted	LC
Pycnonotus tricolor	Bulbul, Dark-capped	Unlisted	Unlisted

Pytilia melba	Pytilia, Green-winged	Unlisted	LC
Quelea quelea	Quelea, Red-billed	Unlisted	LC
Recurvirostra avosetta	Avocet, Pied	Unlisted	LC
Rhinopomastus cyanomelas	Scimitarbill, Common	Unlisted	LC
Riparia cincta	Martin, Banded	Unlisted	LC
Riparia paludicola	Martin, Brown-throated	Unlisted	LC
Riparia riparia	Martin, Sand	Unlisted	LC
Rostratula benghalensis	Painted-snipe, Greater	NT	LC
Sarkidiornis melanotos	Duck, Comb	Unlisted	LC
Sarothrura rufa	Flufftail, Red-chested	Unlisted	LC
Saxicola torquatus	Stonechat, African	Unlisted	LC
Scleroptila gutturalis	Francolin, Orange River	Unlisted	LC
Scopus umbretta	Hamerkop, Hamerkop	Unlisted	LC
Spatula hottentota	Teal, Hottentot	Unlisted	LC
Spatula smithii	Shoveler, Cape	LC	LC
Spermestes cucullata	Mannikin, Bronze	Unlisted	LC
Sphenoeacus afer	Grassbird, Cape	Unlisted	LC
Spilopelia senegalensis	Dove, Laughing	Unlisted	LC
Sporopipes squamifrons	Finch, Scaly-feathered	Unlisted	LC
Stenostira scita	Flycatcher, Fairy	Unlisted	LC
Streptopelia capicola	Turtle-dove, Cape	Unlisted	LC
Streptopelia semitorquata	Dove, Red-eyed	Unlisted	LC
Sturnus vulgaris	Starling, Common	Unlisted	LC
Sylvia borin	Warbler, Garden	Unlisted	LC
Sylvietta rufescens	Crombec, Long-billed	Unlisted	LC
Tachybaptus ruficollis	Grebe, Little	Unlisted	LC
Tachymarptis melba	Swift, Alpine	Unlisted	LC
Tadorna cana	Shelduck, South African	Unlisted	LC
Tchagra australis	Tchagra, Brown-crowned	Unlisted	LC
Tchagra senegalus	Tchagra, Black-crowned	Unlisted	LC
Telophorus zeylonus	Bokmakierie, Bokmakierie	Unlisted	LC
Terpsiphone viridis	Paradise-flycatcher, African	Unlisted	LC
Thamnolaea cinnamomeiventris	Cliff-chat, Mocking	Unlisted	LC
Threskiornis aethiopicus	Ibis, African Sacred	Unlisted	LC
Tockus rufirostris	Hornbill, Southern Red-billed	Unlisted	Unlisted
Trachyphonus vaillantii	Barbet, Crested	Unlisted	LC
Treron calvus	Green-pigeon, African	Unlisted	LC
Tricholaema leucomelas	Barbet, Acacia Pied	Unlisted	LC
Tringa glareola	Sandpiper, Wood	Unlisted	LC

Tringa nebularia	Greenshank, Common	Unlisted	LC
Tringa ochropus	Sandpiper, Green	Unlisted	LC
Tringa stagnatilis	Sandpiper, Marsh	Unlisted	LC
Turdoides jardineii	Babbler, Arrow-marked	Unlisted	LC
Turdus libonyana	Thrush, Kurrichane	Unlisted	Unlisted
Turdus litsitsirupa	Thrush, Groundscraper	Unlisted	Unlisted
Turdus smithi	Thrush, Karoo	Unlisted	LC
Turnix sylvaticus	Buttonquail, Kurrichane	Unlisted	LC
Turtur chalcospilos	Wood-dove, Emerald-spotted	Unlisted	LC
Tyto alba	Owl, Barn	Unlisted	LC
Tyto capensis	Grass-owl, African	VU	LC
Upupa africana	Hoopoe, African	Unlisted	LC
Uraeginthus angolensis	Waxbill, Blue	Unlisted	LC
Urocolius indicus	Mousebird, Red-faced	Unlisted	LC
Vanellus armatus	Lapwing, Blacksmith	Unlisted	LC
Vanellus coronatus	Lapwing, Crowned	Unlisted	LC
Vanellus senegallus	Lapwing, African Wattled	Unlisted	LC
Vidua macroura	Whydah, Pin-tailed	Unlisted	LC
Vidua paradisaea	Paradise-whydah, Long-tailed	Unlisted	LC
Vidua purpurascens	Indigobird, Purple	Unlisted	LC
Zapornia flavirostra	Crake, Black	Unlisted	LC
Zosterops virens	White-eye, Cape	Unlisted	LC

Appendix D Mammals expected in the project area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Aethomys ineptus	Tete Veld Rat	LC	LC
Aethomys namaquensis	Namaqua rock rat	LC	LC
Aonyx capensis	Cape Clawless Otter	NT	NT
Atelerix frontalis	South Africa Hedgehog	NT	LC
Atilax paludinosus	Water Mongoose	LC	LC
Canis mesomelas	Black-backed Jackal	LC	LC
Caracal caracal	Caracal	LC	LC
Crocidura cyanea	Reddish-grey Musk Shrew	LC	LC
Crocidura maquassiensis	Makwassie musk shrew	VU	LC
Crocidura silacea	Lesser Grey-brown Musk Shrew	LC	LC
Cryptomys hottentotus	Common Mole-rat	LC	LC
Cynictis penicillata	Yellow Mongoose	LC	LC
Dasymys incomtus	African Marsh rat	NT	LC
Desmodillus auricularis	Short-tailed Gerbil	LC	LC
Eidolon helvum	African Straw-colored Fruit Bat	LC	NT
Elephantulus brachyrhynchus	Short-snouted Sengi	LC	LC
Elephantulus myurus	Eastern Rock Sengi	LC	LC
Epomophorus wahlbergi	Wahlberg's epauletted fruit bat	LC	LC
Eptesicus hottentotus	Long-tailed Serotine Bat	LC	LC
Felis nigripes	Black-footed Cat	VU	VU
Felis silvestris	African Wildcat	LC	LC
Genetta genetta	Small-spotted Genet	LC	LC
Gerbilliscus brantsii	Highveld Gerbil	LC	LC
Gerbilliscus leucogaster	Bushveld Gerbil	LC	LC
Herpestes sanguineus	Slender Mongoose	LC	LC
Hydrictis maculicollis	Spotted-necked Otter	VU	NT
Hystrix africaeaustralis	Cape Porcupine	LC	LC
Ichneumia albicauda	White-tailed Mongoose	LC	LC
Ictonyx striatus	Striped Polecat	LC	LC
Kerivoula lanosa	Lesser Woolly Bat	LC	LC
Leptailurus serval	Serval	NT	LC
Lepus saxatilis	Scrub Hare	LC	LC
Lepus victoriae	African Savanna Hare	LC	LC
Mastomys coucha	Multimammate Mouse	LC	LC
Mellivora capensis	Honey Badger	LC	LC
Mungos mungo	Banded Mongoose	LC	LC
Myotis tricolor	Temminck's Hairy Bat	LC	LC
Myotis welwitschii	Welwitsch's Hairy Bat	LC	LC
Mystromys albicaudatus	White-tailed Rat	VU	EN
Neoromicia capensis	Cape Serotine Bat	LC	LC
Neoromicia nana	Banana Bat	LC	LC

Neoromicia zuluensis	Aloe Bat	LC	LC
Nycteris thebaica	Egyptian Slit-faced Bat	LC	LC
Orycteropus afer	Aardvark	LC	LC
Otomys angoniensis	Angoni Vlei Rat	LC	LC
Otomys irroratus	Vlei Rat (Fynbos type)	LC	LC
Ourebia ourebi	Oribi	EN	LC
Panthera pardus	Leopard	VU	VU
Papio ursinus	Chacma Baboon	LC	LC
Parahyaena brunnea	Brown Hyaena	NT	NT
Pedetes capensis	Springhare	LC	LC
Phacochoerus africanus	Common Warthog	LC	LC
Poecilogale albinucha	African Striped Weasel	NT	LC
Procavia capensis	Rock Hyrax	LC	LC
Pronolagus randensis	Jameson's Red Rock Rabbit	LC	LC
Proteles cristata	Aardwolf	LC	LC
Raphicerus campestris	Steenbok	LC	LC
Rattus rattus	House Rat	Exotic (Not listed)	LC
Rhabdomys pumilio	Xeric Four-striped Mouse	LC	LC
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	LC	LC
Rhinolophus darlingi	Darling's Horseshoe Bat	LC	LC
Rhinolophus simulator	Bushveld Horseshoe Bat	LC	LC
Saccostomus campestris	Pouched Mouse	LC	LC
Sauromys petrophilus	Flat-headed Free-tail Bat	LC	LC
Scotophilus dinganii	Yellow House Bat	LC	LC
Steatomys krebsii	Krebs's Fat Mouse	LC	LC
Steatomys pratensis	Fat Mouse	LC	LC
Suncus varilla	Lesser Dwarf Shrew	LC	LC
Suricata suricatta	Suricate	LC	LC
Sylvicapra grimmia	Common Duiker	LC	LC
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	LC
Taphozous mauritianus	Mauritian Tomb Bat	LC	LC
Thallomys paedulcus	Tree Rat	LC	LC
Vulpes chama	Cape Fox	LC	LC

Appendix E Reptiles species expected in the project area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Acontias gracilicauda	Thin-tailed Legless Skink	LC	LC
Afroedura nivaria	Drankensberg Flat Gecko	LC	LC
Afrotyphlops bibronii	Bibron's Blind Snake	LC	LC
Agama aculeata distanti	Eastern Ground Agama	LC	LC
Agama atra	Southern Rock Agama	LC	LC
Aparallactus capensis	Black-headed Centipede-eater	LC	LC
Atractaspis bibronii	Bibron's Stiletto Snake	LC	Unlisted
Bitis arietans arietans	Puff Adder	LC	Unlisted
Boaedon capensis	Brown House Snake	LC	LC
Causus rhombeatus	Rhombic Night Adder	LC	LC
Chamaeleo dilepis	Common Flap-neck Chameleon	LC	LC
Chamaesaura aenea	Coppery Grass Lizard	NT	NT
Cordylus vittifer	Common Girdled Lizard	LC	LC
Crocodylus niloticus	Nile Crocodile	VU	LC
Crotaphopeltis hotamboeia	Red-lipped Snake	LC	Unlisted
Dasypeltis scabra	Rhombic Egg-eater	LC	LC
Dispholidus typus	Boomslang	LC	Unlisted
Duberria lutrix	Common Slug-eater	LC	LC
Elapsoidea sundevallii	Sundevall's Garter Snake	LC	Unlisted
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	LC	Unlisted
Hemachatus haemachatus	Rinkhals	LC	LC
Hemidactylus mabouia	Common Tropical House Gecko	LC	Unlisted
Homoroselaps dorsalis	Striped Harlequin Snake	NT	LC
Homoroselaps lacteus	Spotted Harlequin Snake	LC	LC
Kinixys lobatsiana	Lobatse hinged-back Tortoise	LC	VU
Lamprophis aurora	Aurora House Snake	LC	LC
Leptotyphlops distanti	Distant's Tread Snake	LC	LC
Leptotyphlops scutifrons	Peters' Thread Snake	LC	Unlisted
Lycodonomorphus inornatus	Olive House Snake	LC	LC
Lycodonomorphus laevissimus	Dusky-bellied Water Snake	LC	LC
Lycodonomorphus rufulus	Brown Water Snake	LC	Unlisted
Lycophidion capense capense	Cape Wolf Snake	LC	Unlisted
Lygodactylus capensis	Cape dwarf gecko	LC	LC
Lygodactylus ocellatus	Spotted Dwarf Gecko	LC	LC
Naja annulifera	Snouted Cobra	LC	Unlisted
Naja mossambica	Mozambique Spitting Cobra	LC	Unlisted

Naja nivea	Cape Cobra	LC	Unlisted
Nucras holubi	Holub's Sandveld Lizard	LC	Unlisted
Nucras intertexta	Spotted Sandveld Lizard	LC	Unlisted
Nucras lalandii	Delalande's Sandveld Lizard	LC	LC
Pachydactylus affinis	Transvaal Gecko	LC	LC
Pachydactylus capensis	Cape Gecko	LC	Unlisted
Panaspis wahlbergii	Wahlberg's Snake-eyed Skink	LC	Unlisted
Pedioplanis lineoocellata lineoocellata	Spotted Sand Lizard	LC	Unlisted
Pelomedusa galeata	South African Marsh Terrapin	Not evaluated	Unlisted
Philothamnus semivariegatus	Spotted Bush Snake	LC	Unlisted
Prosymna ambigua	Angolan Shovel-snout	Unlisted	LC
Prosymna sundevallii	Sundevall's Shovel-snout	LC	LC
Psammophis brevirostris	Short-snouted Grass Snake	LC	Unlisted
Psammophis crucifer	Cross-marked Grass Snake	LC	LC
Psammophis subtaeniatus	Stripe-bellied Sand Snake	LC	LC
Psammophis trinasalis	Fork-marked Sand Snake	LC	Unlisted
Psammophylax rhombeatus	Spotted Grass Snake	LC	Unlisted
Psammophylax tritaeniatus	Striped Grass Snake	LC	LC
Pseudaspis cana	Mole Snake	LC	Unlisted
Python natalensis	Southern African Python	LC	Unlisted
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	LC	Unlisted
Smaug vandami	Van Dam's Dragon Lizard	LC	LC
Stigmochelys pardalis	Leopard Tortoise	LC	LC
Telescopus semiannulatus semiannulatus	Eastern Tiger Snake	LC	Unlisted
Trachylepis capensis	Cape Skink	LC	Unlisted
Trachylepis damarana	Damara skink	Unlisted	LC
Trachylepis punctatissima	Speckled Rock Skink	LC	LC
Trachylepis varia	Variable Skink	LC	LC
Varanus albigularis albigularis	Southern Rock Monitor	LC	Unlisted
Varanus niloticus	Water Monitor	LC	Unlisted

Appendix F Amphibians expected in the project area

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Amietia delalandii	Delalande's River Frog	LC	Unlisted
Amietia fuscigula	Common River Frog	LC	LC
Amietia poyntoni	Poynton's River Frog	LC	LC
Breviceps adspersus	Bushveld Rain Frog	LC	LC
Cacosternum boettgeri	Common Caco	LC	LC
Chiromantis xerampelina	Southern Foam Nest Frog	LC	LC
Kassina senegalensis	Bubbling Kassina	LC	LC
Phrynobatrachus natalensis	Snoring Puddle Frog	LC	LC
Ptychadena anchietae	Plain Grass Frog	LC	LC
Pyxicephalus adspersus	Giant Bullfrog	LC	LC
Schismaderma carens	African Red Toad	LC	LC
Sclerophrys capensis	Raucous Toad	LC	LC
Sclerophrys garmani	Olive Toad	LC	LC
Sclerophrys gutturalis	Guttural Toad	LC	LC
Sclerophrys poweri	Power's Toad	LC	LC
Semnodactylus wealii	Rattling Frog	LC	LC
Strongylopus fasciatus	Striped Stream Frog	LC	LC
Tomopterna cryptotis	Tremelo Sand Frog	LC	LC
Tomopterna natalensis	Natal Sand Frog	LC	LC
Tomopterna tandyi	Tandy's Sand Frog	LC	LC
Xenopus laevis	Common Platanna	LC	LC

BRAAMFONTEIN SPRUIT PIPELINE CROSSING FLOOD STUDY: PROPOSED JAN SMUTS AVENUE TO BORDEAUX RIVERSIDE PARK SEWER PIPELINE

Project No. EIM-007

Version 2

October, 2021

HYDROLOGIC CONSULTING

CONSULTING HYDROLOGISTS

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BRAAMFONTEIN SPRUIT PIPELINE CROSSING FLOOD STUDY: PROPOSED JAN SMUTS AVENUE TO BORDEAUX RIVERSIDE PARK SEWER PIPELINE

Prepared For

EIMS (PTY) LTD

Prepared By

Hydrologic Consulting (Pty) Ltd

Project No. EIM-007

Version 2

October, 2021

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BRAAMFONTEIN SPRUIT PIPELINE CROSSING FLOOD STUDY: PROPOSED JAN SMUTS AVENUE TO BORDEAUX RIVERSIDE PARK SEWER PIPELINE

1 INTRODUCTION

1.1 BACKGROUND

Hydrologic Consulting has been appointed by Environmental Impact Management Services (EIMS) to undertake a flood study for a section of the Braamfontein Spruit, located in Randburg, Johannesburg.

As per the project description of the Johannesburg Social Housing Company (JOSHCO) Selkirk Social Housing Development in Randburg, Gauteng [1] "*As part of the development approval process, Johannesburg Water (JW) requires that JOSHCO upgrades portions of the existing sewer infrastructure to comply with their masterplan requirements. The proposal is to install new sewer infrastructure adjacent to the existing system with the existing system to be kept operational. The sewer infrastructure will be installed from Jan Smut Avenue to Bordeaux Riverside Park, tracking through Valley Road and Garden Road. Before the proposed sewer infrastructure connects to an existing sewer infrastructure manhole which is located on the other side of Bordeaux Riverside Park, the pipeline will cross the Braamfontein Spruit stream, alongside the existing pipe*"

To inform the above, the primary purpose of this study was to delineate the 1:100 year recurrence interval (RI) flood-line for the baseline (current) scenario, with supplementary depth and velocity results provided.

1.2 SCOPE OF WORK

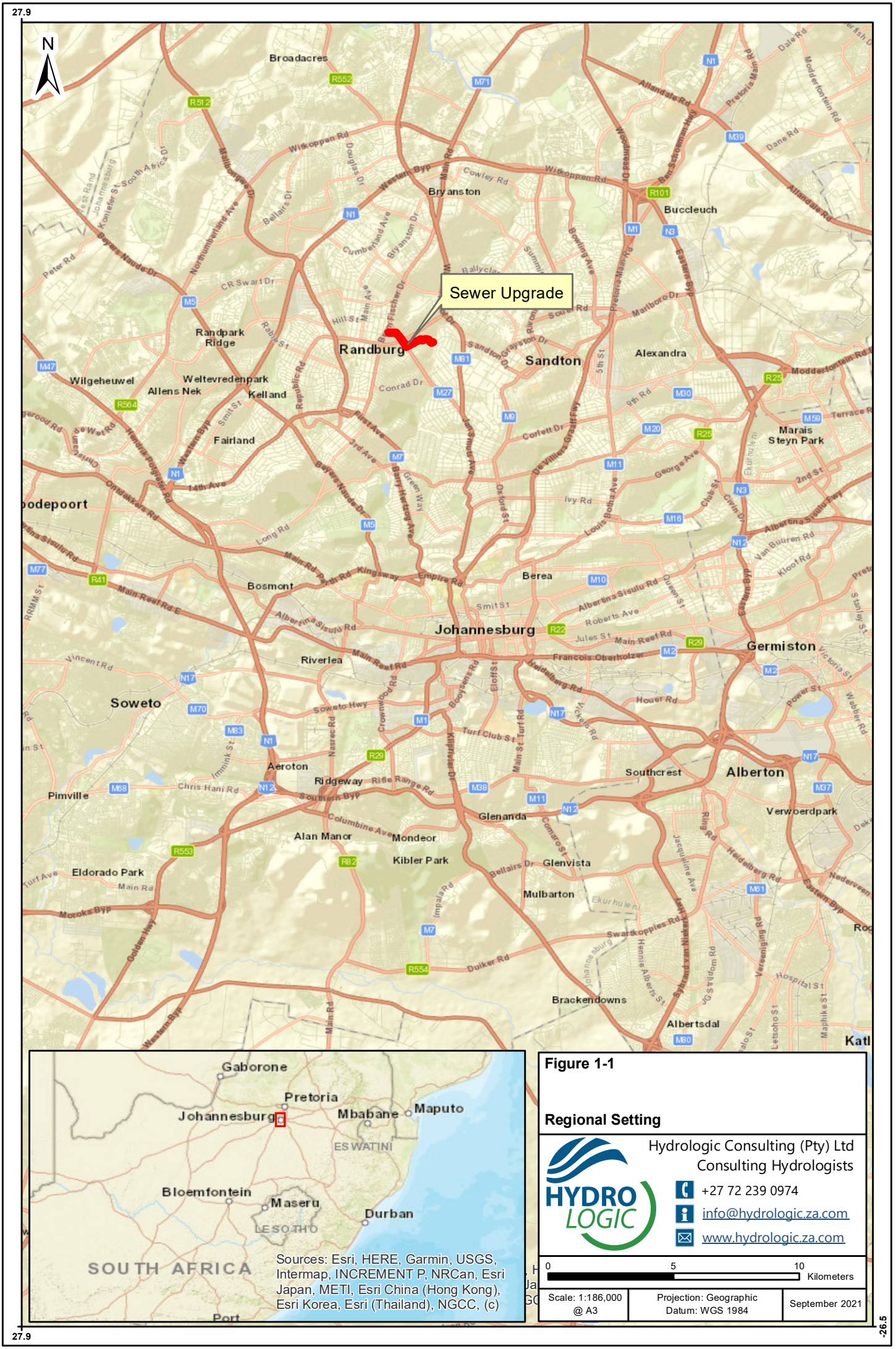
The scope of work for the flood study involved the following:

- *Baseline Information* – this included the interrogation of site-specific design rainfall (depth-duration-frequency) and land-cover, as well as a regional and local hydrological assessment.
- *Flood Modelling* – this involved the estimation of the 1:100 year recurrence interval (RI) flood hydrograph and the subsequent use of a 2D hydraulic model of the river to simulate the flood response of the river and derive flood-lines.

1.3 REGIONAL SETTING AND LAYOUT

The sewer line upgrade of interest (hereafter also referred to as the site) is located in Randburg, Johannesburg at approximately 28° 1' 17" E and 26° 6' 0" S. Figure 1-1 illustrates the regional setting of the study while Figure 1-2 presents the local layout of the proposed sewer line upgrade.

[1] Project Description_Final.docx


27.9
N
Sewer Upgrade
Broadacres
Bryanston
Buccleuch
Randpark Ridge
Randburg
Sandton
Alexandra
Wilgeheuwel
Weltevredenpark
Allens Nek
Kelland
Fairland
Marais Steyn Park
Bosmont
Berea
Johannesburg
Germiston
Riverlea
Soweto
Aeroton
Ridgeway
Southcrest
Alberton
Pimville
Verwoerdpark
Glenanda
Alan Manor
Mondeor
Kibler Park
Glenvista
Eldorado Park
Mulbarton
Brackendowns
Albertsdal
Gaborone
Pretoria
Johannesburg
Mbabane
Maputo
ESWATINI
Bloemfontein
Maseru
Durban
LESOTHO
SOUTH AFRICA
Port
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c)
Figure 1-1
Regional Setting
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0
5
10
Kilometers
Scale: 1:186,000 @ A3
Projection: Geographic
Datum: WGS 1984
September 2021
-26.5

-99000

-98000

-2888000

N

BRAAMFONTEINSPRUIT

Legend

- Sewer Upgrade
- Footpath (50K Topo)
- Main Road (50K Topo)
- Secondary Road (50K Topo)
- Street (50K Topo)
- Non-Perennial River (50K Topo)
- Additional River Noted

Figure 1-2

Layout

Hydrologic Consulting (Pty) Ltd
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0 200 Meters

Scale: 1:13,300 @ A3	Projection: Transverse Mercator Datum: Hartebeeshoek, LO29	September 2021

2 BASELINE INFORMATION

Baseline information in this section includes discussions on design rainfall, topography, hydrology, soils and land-cover.

2.1 DESIGN RAINFALL

For the purpose of modelling flooding, design rainfall is one of the most important variables to consider as it is the driver behind runoff volumes and peak flows.

Design rainfall estimates for various recurrence intervals and durations were sourced from the Design Rainfall Estimation Software for South Africa (DRESSA), developed by the University of Natal in 2002 as part of WRC project K5/1060 (WRC, 2002). This method uses a regional l-moment algorithm in conjunction with a scale invariance approach to provide site-specific estimates of design rainfall (depth, duration and frequency), based on surrounding station records. WRC (2002) provides more detail on this method of design rainfall estimation. Table 2-2 presents the DRESSA design rainfall estimates.

TABLE 2-1: DRESSA 24-HOUR RAINFALL DEPTH

Recurrence Interval (Years)	Rainfall Depth (24 hour) (mm)
2	62.9
5	86.9
10	105
20	124.3
50	152.4
100	176
200	202

* Values are representative of the centre of the catchment upstream of the sewer river crossing.

It is important to note, that no allowances for climate change was included in this study. A risk analysis using the expected life of a structure or process will indicate the relevance of considering climate change (i.e. as the expected life increases the influence of climate change increases). Climate change is expected to exacerbate any flooding due to an increase in rainfall intensities.

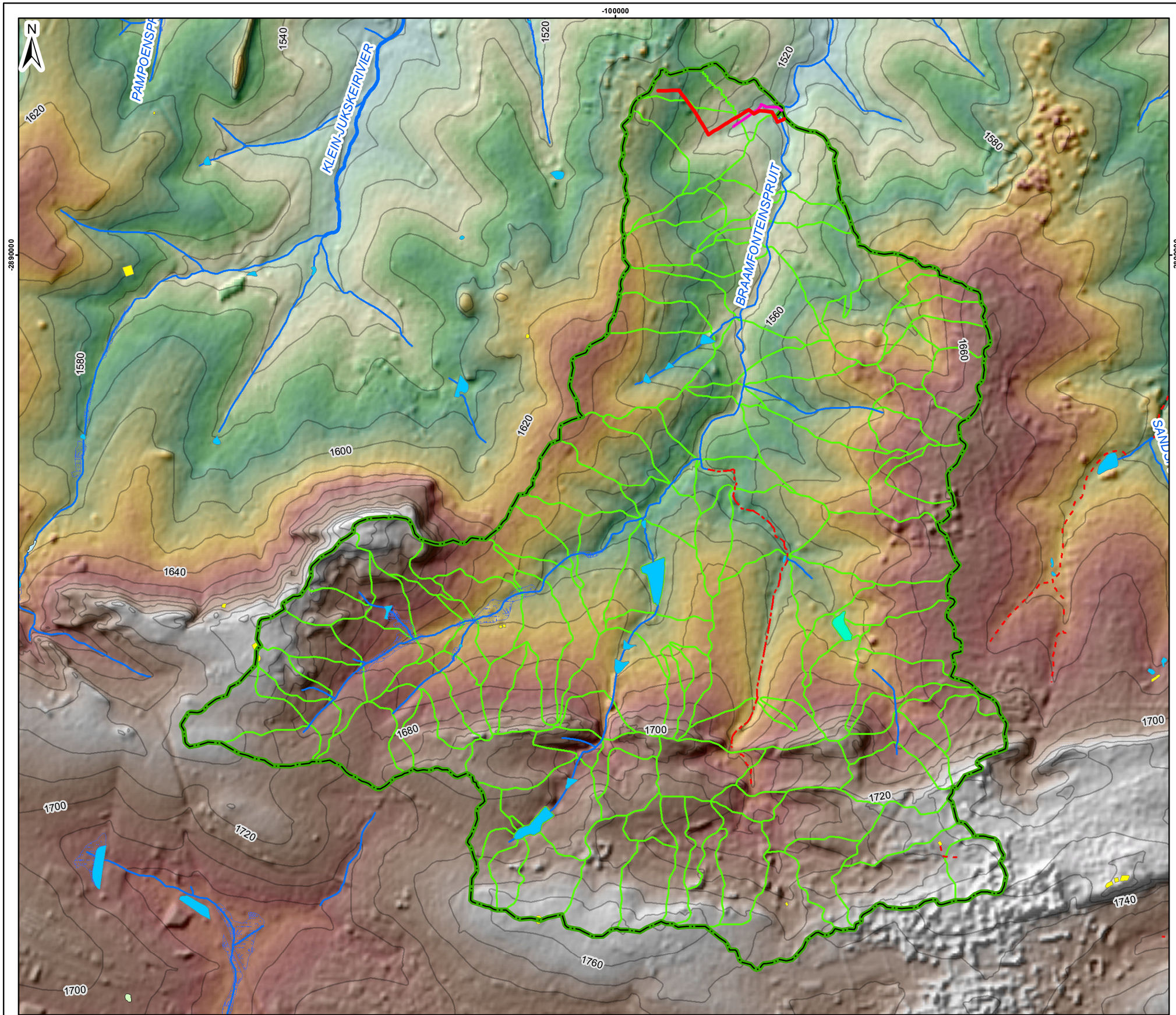
2.2 TERRAIN

Three terrain datasets were used to assess the terrain of the site and surrounds, namely:

1. 0.5m Digital Elevation Model (DTM) of the site, generated from a 0.25m contour dataset[2] provided by JRA (the Johannesburg Roads Authority).
2. 30m AW3D30 (ALOS Global Digital Surface Model - DSM) for the areas beyond the 0.5m DTM;
3. National Geo-spatial Information (NGI) 1:50,000 topographical map 20m contours.

Figure 2-1 illustrates the terrain over the greater catchment upstream of the sewer line crossing on the Braamfontein Spruit.

[2] AM108.dxf and AN108.dxf



Legend

- Sewer Upgrade
- 5m Contour (50K Topo)
- Drainage Canal (50K Topo)
- Furrow (50K Topo)
- Non-Perennial River (50K Topo)
- Perennial River (50K Topo)
- Additional River Noted
- Dam (50K Topo)
- Lake
- Non-perennial Pan (50K Topo)
- Open Reservoir (50K Topo)
- Perennial Pan (50K Topo)
- Vlei (50K Topo)
- Contributing Catchment (AW3D30 Derived)
- Subcatchment (AW3D30 Derived)

Figure 2-1

Terrain and Hydrology

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0 1 2 Kilometers

Scale: 1:45,300 @ A3	Projection: Transverse Mercator Datum: Hartebeeshoek, LO29	September 2021

The 0.5m DTM was generated from a 0.25m contour survey of the area about the site (contours provided by JRA[3]). A 0.5m cell size was selected on the basis of the contour interval and the horizontal spacing of the contours, with 0.5m an approximate balance between maximising detail in the DTM while limiting the over-interpolation of the data. Using the parent contour data (0.25m contours) in this way, is not the optimum method for developing a flood model, since it relies on the use of already interpolated data (i.e. contour data) for subsequent interpolation (to a DTM). Best practice would be to use the original point data (i.e. the lidar point cloud expected to have been used to produce the JRA contours). The result is a DTM that is interpolated from contour data, with the parent contour data being the determinant as to the accuracy of the DTM (i.e. a 0.25m contour dataset produces a DTM with an approximate vertical accuracy of 0.25m). In addition, features present in the terrain that are below the contour interval are not present, with smoothing of the surface occurring.

To estimate the design hydrographs, it was necessary to delineate the catchment containing the site. A global terrain dataset[4] in the form of a Digital Surface Model (DSM) with a cell size that approximates 30m, was used for this purpose.

Lastly, the NGI's 20m contour dataset was utilised to illustrate the general terrain over the catchment of interest.

2.3 HYDROLOGY

Figure 2-1 illustrates the hydrological setting of the site. The Braamfontein Spruit is the only defined 1:50,000 topographical map watercourse that intersects the proposed sewer-line upgrade, however, upon review of aerial imagery and the 0.5m DTM, it was noted that an additional river is present which intersects the sewer line. This additional river is a tributary to the primary The Braamfontein Spruit, which in turn is a major tributary to the Jukskei River and intersects the sewer line along Garden Road (in association with a culverted bridge over this river).

The primary points of assessment for this study were the two river crossings (associated with the sewer line upgrade) where delineated flood-lines would be of value. To this end, the contributing catchment containing both river crossings is illustrated in Figure 2-1, with the various subcatchments making up this catchment are also illustrated (these subcatchments were derived based upon an approximate contributing area of 50ha. The collective subcatchments (or contributing catchment) totals 63.4km^2.

No storm water masterplan for the contributing catchment draining to the site was available at the time of writing and a high-level estimate of the largest elements of the storm water network was approximated using the AW3D30 data. These elements comprised the 113 subcatchments which were delineated according to the ~50ha subcatchment area. The storm water network was assumed to follow the primary flow paths identified by the AW3D30 data, with a combined storm water network and overland flow path set out according to this.

Various water bodies are noted within the contributing catchment. When considering the 1:50,000 topographical map data, they include numerous dams and a lake. The largest of these dams and lakes were included in the PCSWMM model discussed in Appendix A (those dams/lakes above 4ha, with three waterbodies qualifying).

[3] AM108.dxf and AN108.dxf
[4] ALOS Global Digital Surface Model "ALOS World 3D - 30m (AW3D30)"

2.4 LAND-COVER, SOILS AND MANNING'S ROUGHNESS VALUES

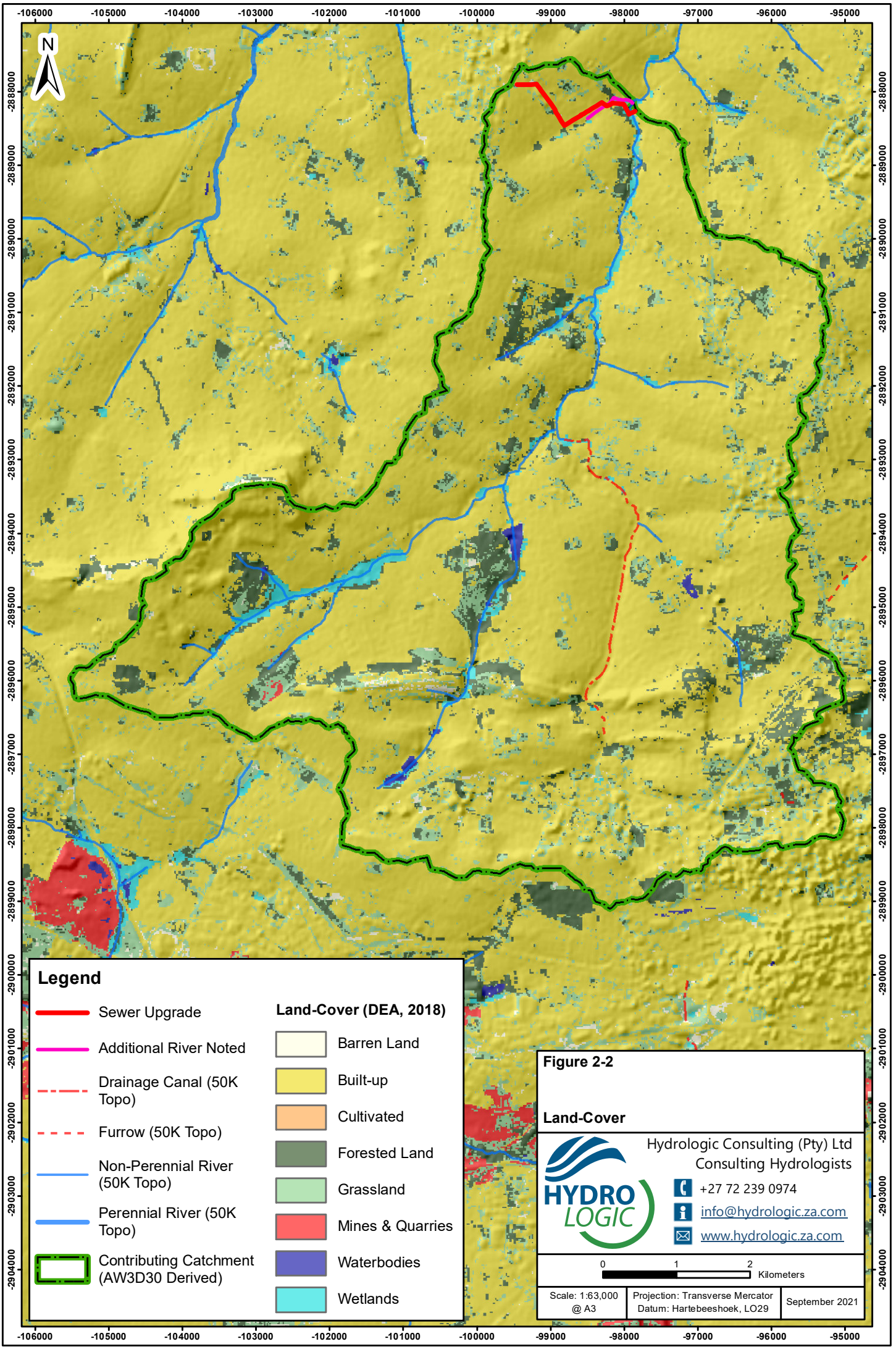
According to the Department of Environmental Affairs (DEA) 2018 dataset, land-cover of the site is classified as 'built-up' with some minor area of 'Barren Land', 'Forested Land', 'Grasslands' and 'Wetlands' Figure 2-2 presents the DEA (2018) land-cover for the site.

In considering the Soil Conservation Service for South Africa (SCS-SA) dataset, the soils within the catchment draining to the site are classified as being within hydrological soil group B (moderately low runoff potential) and group C (moderately high runoff potential).

Both the land-cover and soils datasets formed the basis (along with rainfall) for the estimation of design hydrographs. Land-cover was further distinguished (for the flood modelling) by considering the DEA's 2018 land-cover dataset's most detailed classification, with 30 land-cover classifications defined with the contributing catchment. One of the more uncertain aspects of the land-cover classification was the estimation of the percentage of impervious areas associated with the four sub-classifications of 'residential formal'. This was informed by a high-level assessment of the JRA provided aerial imagery[5]. Some inaccuracy in the estimation of impervious areas and other hydrological parameters (using the DEA 2018 dataset as the basis) is nevertheless expected.

Since it is related to land-cover, this section also refers to the Manning's N roughness values utilised for the flood modelling of the site. The JRA aerial imagery also informed this aspect of the work, with Manning's N value's defined for the river channel and floodplain (according to the land types identified in this dataset). Roughness values varied from 0.02 (road) to 0.08 (trees and urban area).

[5] AM108.ecw and AN108.ecw


-106000
-105000
-104000
-103000
-102000
-101000
-100000
-99000
-98000
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-2896000
-2897000
-2898000
-2899000
-2900000
-2901000
-2902000
-2903000
-2904000
N
Legend
Sewer Upgrade
Additional River Noted
Drainage Canal (50K Topo)
Furrow (50K Topo)
Non-Perennial River (50K Topo)
Perennial River (50K Topo)
Contributing Catchment (AW3D30 Derived)
Land-Cover (DEA, 2018)
Barren Land
Built-up
Cultivated
Forested Land
Grassland
Mines & Quarries
Waterbodies
Wetlands
Figure 2-2
Land-Cover
Hydrologic Consulting (Pty) Ltd
Consulting Hydrologists
HYDRO LOGIC
+27 72 239 0974
info@hydrologic.za.com
www.hydrologic.za.com
0
1
2
Kilometers
Scale: 1:63,000 @ A3
Projection: Transverse Mercator
Datum: Hartebeeshoek, LO29
September 2021

3 FLOODING

The detail for the flood modelling for the site is presented in Appendix A.

3.1 MODEL APPROACH

The hydraulic (flood) modelling of the site utilised the 0.5m DTM. A 2D model approach was consequently possible, using HEC-RAS 6.0. A computational model mesh was defined for the area over which hydraulic modelling could occur. This model mesh utilised a base cells size of 5m x 5m (gridded structure). Breaklines (representing sudden changes in terrain) weren't necessary (possibly due to the smoothing present in the DTM due to the use of contours). Instead, breaklines were used for a single bridge (river crossing) associated with the additional river noted as per section 2.3. The dimensions of the culvert passing beneath this bridge were extracted from a PDF of the sewer layout[6]. Some minor adjustment was needed to the culverts to fit in with the 0.5m DTM.

The design hydrograph (1:100 year RI) estimated using PCSWMM (outlined in Appendix A) were placed in the model at the upstream points of the two modelled river reaches (i.e. one on the Braamfontein Spruit and the other on the additional river).

3.2 FLOOD MODELLING RESULTS

The results of the flood modelling are presented in Figure 3-1 to Figure 3-3 illustrating the flood-lines, maximum flood depth and maximum flood velocity for the 1:100 year RI event. Figure 3-1 presents the boundary inundated by the 1:100 year RI flood (also referred to as the 1:100 year flood-line).

The mapped results are fairly self-explanatory with deeper flooding noted towards the centre of the river channel. The undeveloped floodplain contains most of the flooding on the Braamfontein Spruit, however, the additional river does see flooding in various properties, possibly due to poorer representation of the river channel in this area (due to a higher tree coverage that may have limited the collection of terrain data by aerial methods (such as a Lidar survey).

The flooding associated with the rivers crossed by the sewer line upgrade is expected since rivers are being intersected. Maximum depths of flooding exceed 2m on the Braamfontein Spruit (at the sewer crossing) and 1m at the additional river (for flooding passing over Garden Road). Maximum flood velocities at the additional river crossing exceed 3m/s. On the Braamfontein Spruit, maximum velocities exceed 5m/s. A transect for both river crossings is presented in Figure 3-4 and 3-5 and illustrates the specific depths, velocities and water surface elevation (WSE) of flooding (at its maximum value). The position of the two transects are illustrated in Figure 3-1.

[6] 0691807C-C-03-001-03-Johannesburg Water Sewer Layout_JOSHCO & ATTCO-Sheet 4 of 4.pdf

-98000

-2888000

N

B1

B2

A1

A2

BRAAMFONTEINSPRUIT

-98000

-2888000

Legend

- Sewer Upgrade
- Footpath (50K Topo)
- Secondary Road (50K Topo)
- Street (50K Topo)
- Additional River Noted
- Non-Perennial River (50K Topo)
- Inundation Boundary (100-Year RI)
- Transect

Figure 3-1

1:100 Year RI Inundation Boundary (Flood-Lines)

Hydrologic Consulting (Pty) Ltd
Consulting Hydrologists
+27 72 239 0974
info@hydrologic.za.com
www.hydrologic.za.com

0 100 Meters

Scale: 1:3,000 @ A3	Projection: Transverse Mercator Datum: Hartebeeshoek, LO29	September 2021

-98000

-2888000

-2888000

-98000

Legend

Sewer Upgrade

Maximum Depth (m)

- < 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- > 2.5

Figure 3-2

1:100 RI Maximum Flood Depth

Hydrologic Consulting (Pty) Ltd
Consulting Hydrologists
+27 72 239 0974
info@hydrologic.za.com
www.hydrologic.za.com

0 100 Meters

Scale: 1:3,000 @ A3	Projection: Transverse Mercator Datum: Hartebeeshoek, LO29	September 2021

-98000

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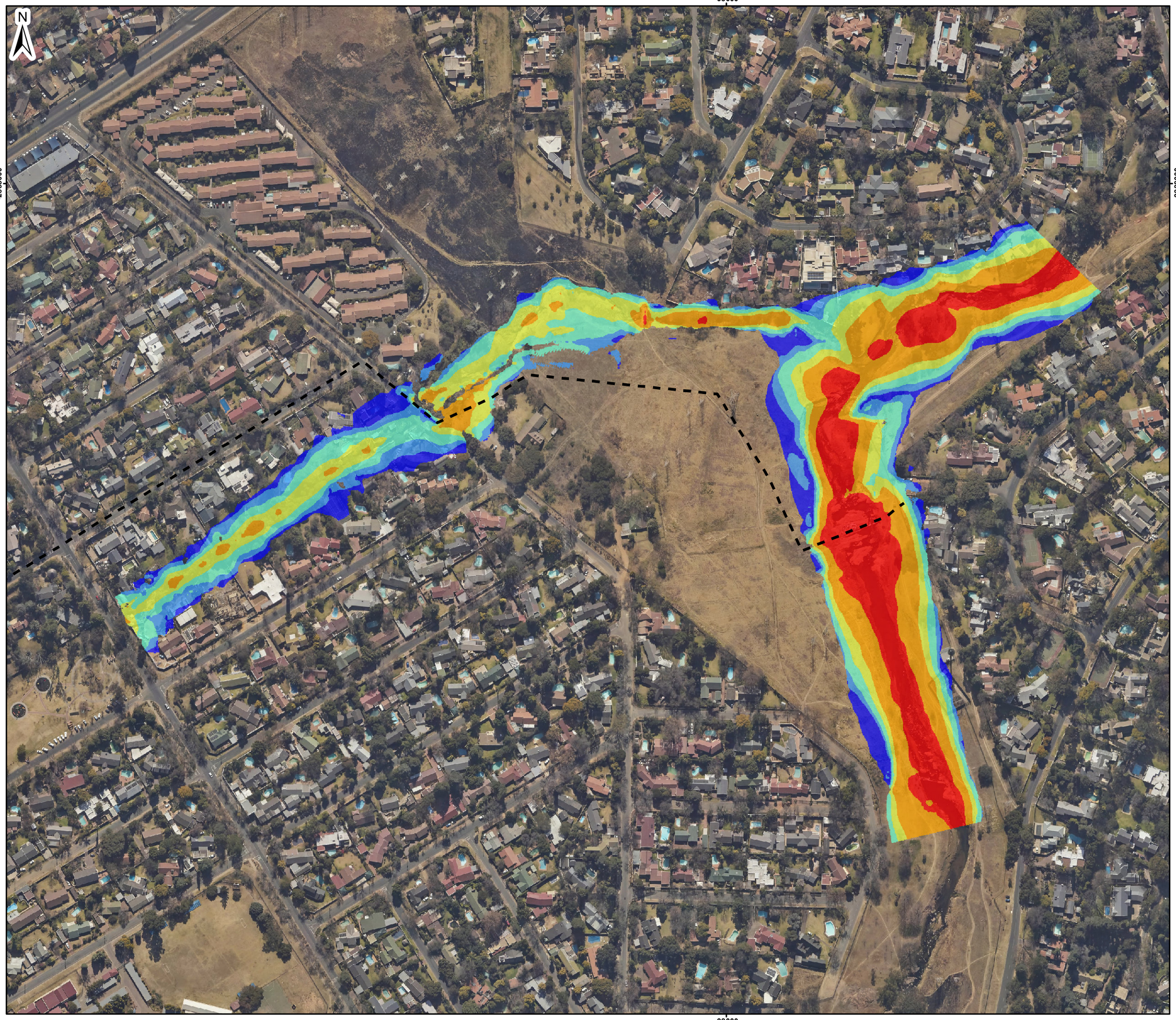

-98000

-2888000

Legend

Sewer Upgrade

Maximum Velocity (cumecs)

- < 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 5.0
- > 5.0

Figure 3-3

1:100 RI Maximum Flood Velocity

Hydrologic Consulting (Pty) Ltd
Consulting Hydrologists
+27 72 239 0974
info@hydrologic.za.com
www.hydrologic.za.com

0 100 Meters

Scale: 1:3,000 @ A3	Projection: Transverse Mercator Datum: Hartebeeshoek, LO29	September 2021

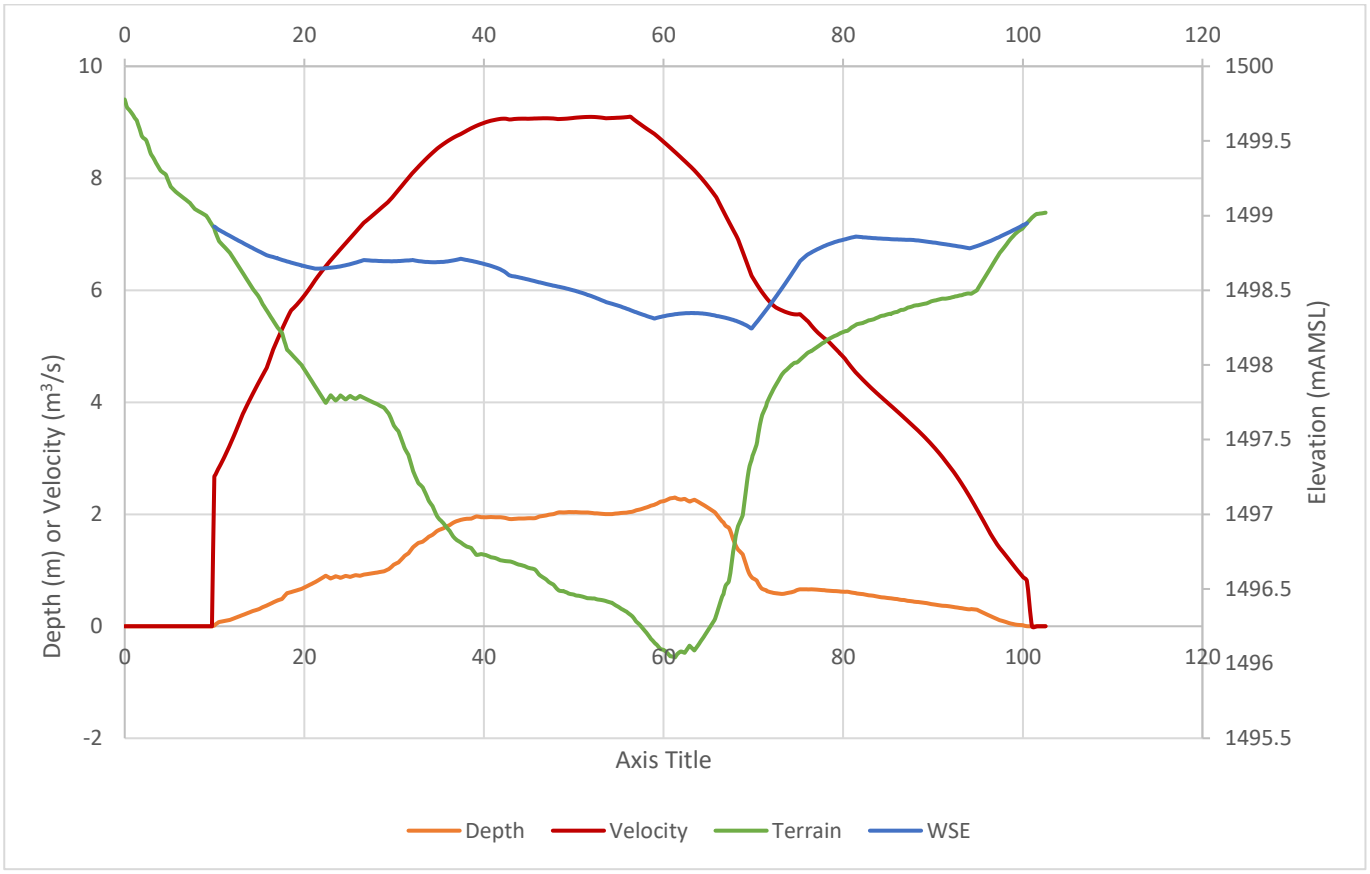

FIGURE 3-4: TRANSECT A1 TO A2 – MAXIMUM RESULT

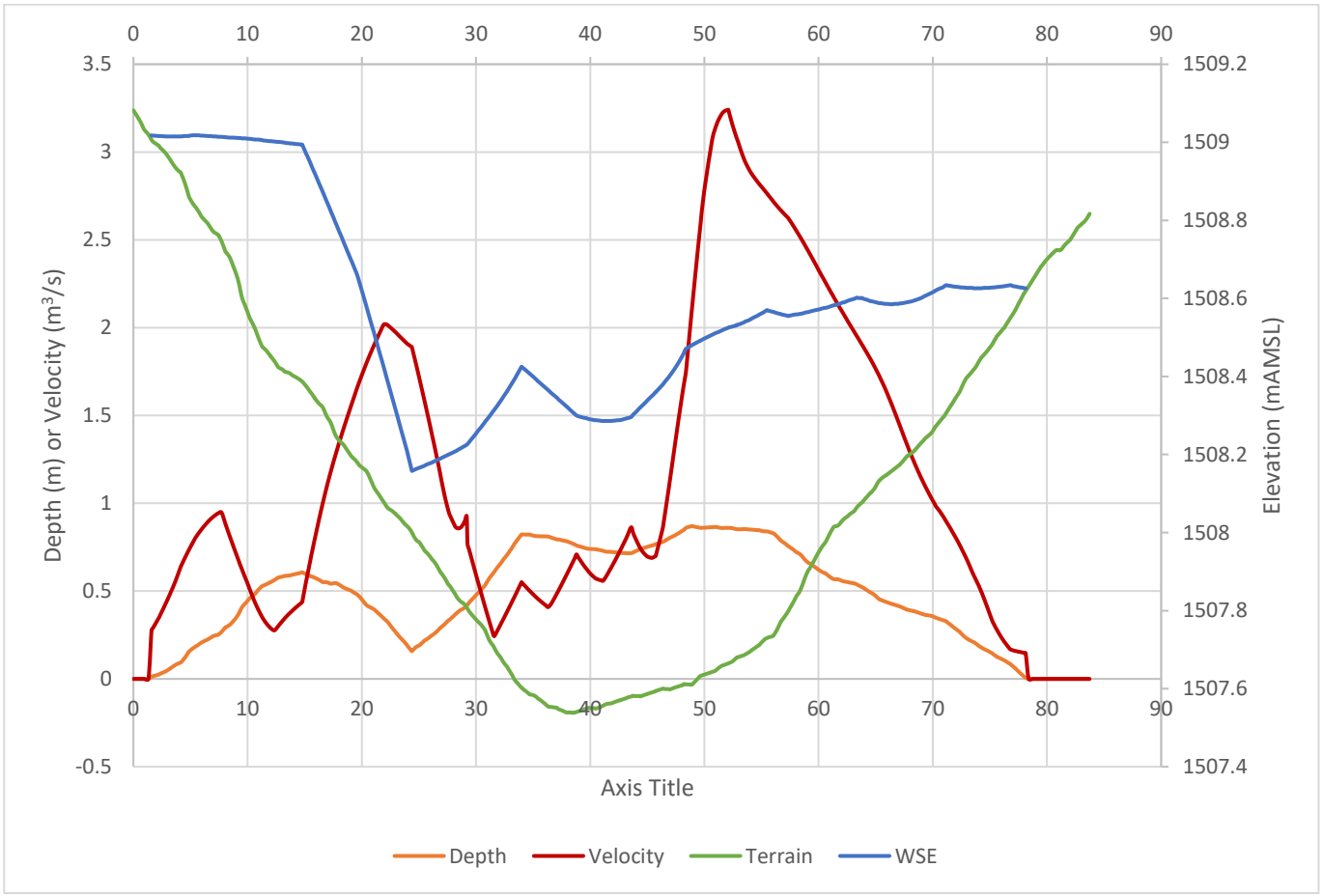

FIGURE 3-5: TRANSECT B1 TO B2 – MAXIMUM RESULT

4 CONCLUSIONS AND RECOMMENDATIONS

Hydrologic Consulting was appointed by EIMS, to undertake a flood study of a section of the Braamfontein Spruit associated with the proposed sewer crossing upgrade. During the study, an additional river was noted with the scope of flood modelling extended to incorporate this river.

Baseline information including rainfall, soils, land-cover, terrain and hydrological setting have been considered for the site.

A PCSWMM model was developed to simulate the 1:100 year design hydrograph necessary as input into the hydraulic (flood) model. This included a high-level conceptualisation of the storm water network, given the absence of a storm water masterplan and the associated level of intended PCSWMM model development.

A 2D HEC-RAS model was subsequently developed using the 0.5m DTM generated from JRA 0.25m contours.

The results of the modelling are presented in Figures 3-1 to 3-5. Since the modelling of flooding is (as undertaken), an approximation of reality, various assumptions and limitations are relevant (when considering the model results). These have been highlighted at various places in this report and are also outlined in Section A.3 of Appendix A.

Mark Bollaert (MSc, PrSciNat, CSci, CEnv, C.WEM)

Project Author

DISCLAIMER

5 REFERENCES

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Schulze, R.E. and Lynch, S.E., 2006. "*South African Atlas of Climatology and Agrohydrology",* WRC Report 1489/1/06, Water Research Commission, Pretoria

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WRC (Water Research Commission), 2002, "*Design Rainfall Estimation in South Africa*". WRC Report No. K5/1060

APPENDIX A: FLOOD MODELLING

A.1 HYDROLOGICAL MODEL

A hydrological model was required to first be developed for the site and its associated subcatchments are illustrated in Figure 2-1.

A.1.1 HYDROLOGICAL MODEL CHOICE

PCSWMM is a model package that makes use of the USEPA Storm Water Management Model (SWMM), which is a computer program that computes dynamic rainfall-runoff from developed urban and undeveloped or rural areas (Rossman, 2008).

The SWMM model suited application to this study since it could account for:

- Time-varying rainfall;
- Rainfall interception in depression storage;
- Infiltration of rainfall into unsaturated soil layers;
- Routing of overland flow;
- Dynamic wave flow routing of flood waters; and
- Capture and retention of rainfall/runoff.

The hydrological modelling as it pertains to the development of storm water management plans and flooding assessments using SWMM has been undertaken for many thousands of studies throughout the world (Rossman, 2008), including South Africa and was well suited to deriving the upstream inflows and effective rainfall as input into the hydraulic component of this study.

A.1.2 HYDROLOGICAL MODEL DOMAIN

The 30m AW3D30 DEM formed the basis of the hydrological model domain, informing the partitioning of subcatchments, the accumulation of flow and some parameterisation of the model (e.g. subcatchment slope). Subcatchments of interest were derived through geoprocessing of the available elevation data. Sequential computations of flow direction, flow accumulation and stream definition based upon a contributing area of 50ha were then used to delineate subcatchments. This resulted in the subcatchments identified in Figure 2-1.

A.1.3 SUBCATCHMENT PARAMETERISATION

Land cover parameters were estimated according to the SCS-SA soil for the area of interest, DEA land-cover, the 30m AW3D30 DEM and JRA aerial imagery, for each of the 113 subcatchments. These were used to populate model attributes relating to depression storage, surface roughness, infiltration loss, slope and impervious areas.

A.1.4 STORM WATER NETWORK CONCEPTUALISATION

The absence of a storm water masterplan and the associated level of intended model development meant that the accumulation of storm water from the highly urbanised catchment associated with the site could not be accurately modelled. A high-level approximation of the influence of this storm water network was instead sought. This included the use of shorter flow paths (for subcatchments) to simulate the quicker routing of runoff by the storm water network,

and a pseudo pipe network of the major storm water network to simulate the routing of storm water. Significant error is expected within this pseudo network given the many assumptions required in its development.

A.1.5 DESIGN RAINFALL

In assessing flooding, it was necessary to define the associated rainfall that would cause this flooding. A hypothetical storm consequently needed to be developed which utilised the depth-duration-frequency (DDF) data provided by DRESSA (see Section 2.2). This hypothetical storm is the design rainfall that will produce the highest degree of flooding at each location independent of catchment response time (which is the index of the rate at which stormflow moves through a catchment). To calculate the hypothetical storm, the DRESSA 1: 1:100 year RI rainfall depths for various durations (e.g. 5 minutes, 30 minutes and 2 hours) were transformed into a synthetic rainfall distribution or design hyetograph.

When considering the catchment upstream of the assessment, its area approximates 63.4km^2 and it was consequently necessary to include an areal reduction factor that considers the difference between the design rainfall estimate for a point versus that over a large catchment (since larger catchments are less likely to experience high-intensity storms over the full catchment area). This reduction factor was estimated as 94% of point rainfall.

A.1.6 DESIGN HYDROGRAPHS

The 1:100 year RI design hydrographs were estimated at two points (for introduction into the hydraulic model), with the resulting hydrograph for the primary Braamfontein Spruit presented in Figure A-1.

A comparison of the modelled PCSWMM peak flow for the Braamfontein Spruit (at the sewer crossing) was made using the Regional Maximum Flood (RMF) and Standard Design Flood (SDF) methods. These flood estimation methods provide peak flow estimates that are generated using a regional approach and can sometimes be used as a high-level validation of modelled stormflows. The variation in the regional (RMF and SDF) estimates, ultimately, do not influence the PCSWMM estimates since these are regional methods that are will not reflect the highly urbanised nature of the catchment draining to the site.

It is, however, also the specific hydrological characteristics of the subcatchments upstream of the site, which lead to likely the largest uncertainty with regards to the flood modelling undertaken. The parameterisation of these subcatchments has utilised site-specific datasets, however, some inaccuracy is expected with the potential for the peak flows to vary by ± 10% (possibly more). Lack of calibration due to an absence of observed flows meant that the PCSWMM model results couldn't be verified. Furthermore, the hydrological (PCSWMM) model was developed as a highly simplistic model of the urbanised catchment of interest. Accurate simulation of the design hydrographs would require a far more complex storm water masterplan model to be developed.

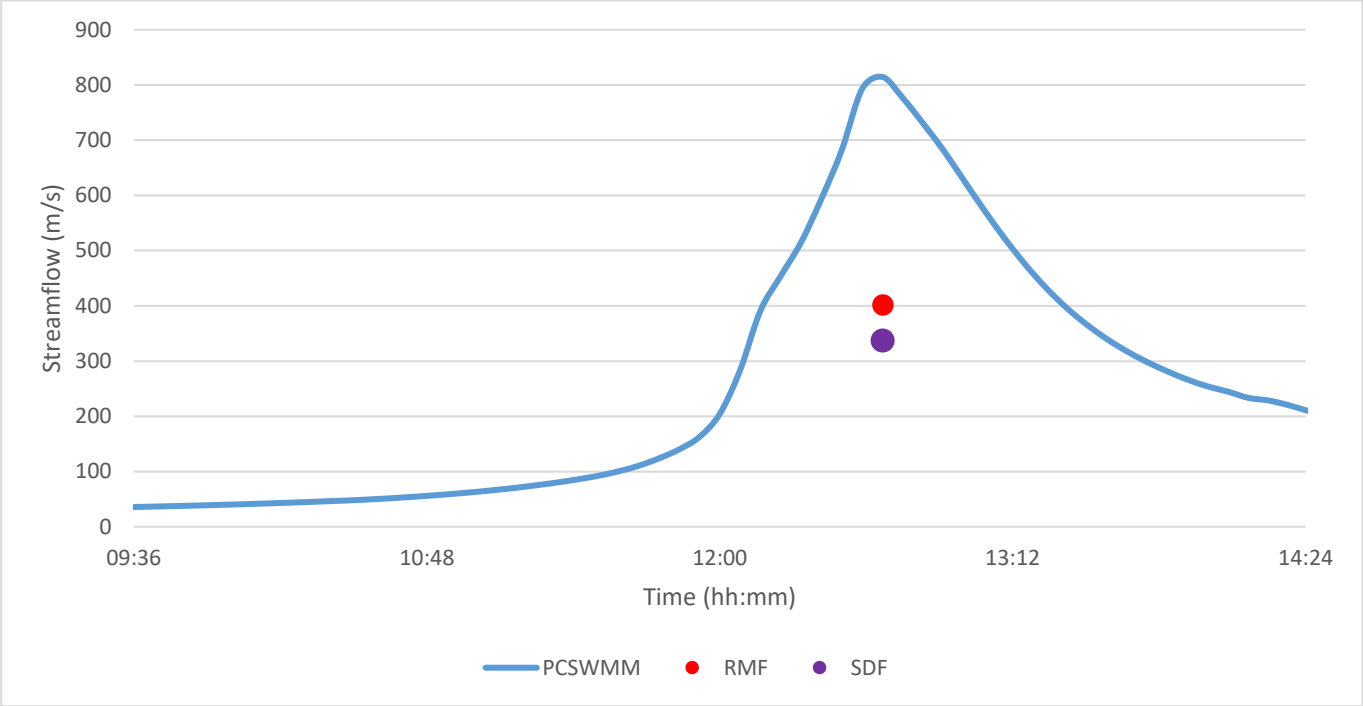


FIGURE A-1: 1:100 YEAR RI HYDROGRAPHS AND RMF/SDF COMPARISON

The figures above illustrate the greater peak flows simulated by PCSWMM, compared to the RMF and SDF methods. In this way, the PCSWMM estimates are more conservative.

A.2 HYDRAULIC (FLOOD) MODELLING

The hydraulic model developed for assessing the flooding of the site needed to utilise available terrain data in as efficient a manner as possible. It was accordingly decided that a 2D hydraulic modelling approach would be utilised to make effective use of the continuous elevation data available.

A.2.1 HYDRAULIC MODEL CHOICE

HEC-RAS 6.0.0 was selected to model the hydraulic flooding on the site. HEC-RAS is designed to perform one-dimensional and two-dimensional hydraulic calculations for a full network of natural and constructed channels. The software is used worldwide and the 1D component of the model has been thoroughly tested through numerous case studies. The 2D component to the HEC-RAS model is a recent addition having been released in 2015 although robust benchmarking (USACE, 2016) and verification and validation tests (USACE, 2018) have been performed to prove the 2D component of the model works as intended.

A.2.2 TERRAIN DATA

The 0.5m DTM (developed from 0.25m JRA contours) formed the foundation of the hydraulic (flood) model. Using the contour data in this way (as the parent data), is not the optimum method of developing a flood model, as outlined in Section 2.3.

A.2.3 COMPUTATIONAL MODEL MESH

In developing a 2D HEC-RAS model, it was necessary to first delineate the model boundary. The model boundary was then used to define the model grid, with a 5m model mesh spacing selected to maximise spatial detail while

limiting unnecessary model complexity. The computational model mesh is the primary element making up the HEC-RAS 2D model. This mesh contains the data pertaining to the terrain of the underlying elevation data, the presence of linear features (such as berms) and surface roughness.

One of HEC-RAS 5's major advances to hydraulic modelling has been the addition of a subgrid. The subgrid extracts the detail available in the underlying terrain (e.g. the 0.5x0.5m DEM) into a hydraulic properties table for each cell and cell face in the model mesh. This includes variables such as the elevation/volume relationship per cell and the cross-section, elevation/area, and wetted perimeter for each cell face. This results in HEC-RAS models being able to use a larger cell size while still representing much of the underlying terrain, thereby producing an improved model result.

Aside from added hydraulic detail, the visual benefit from HEC-RAS using a subgrid, is that a more representative result of the expected flooding is possible since HEC-RAS will show only partial flooding for a mesh cell (where applicable).

A.2.4 BOUNDARY CONDITIONS AND BREAKLINES

The design hydrographs (1:100 year) estimated using PCSWMM were placed in the model at the upstream reach of the Braamfontein Spruit and additional river being modelled. This is common practice, whereby the design hydrographs for a point at the end of a modelled river reach are applied to a point upstream and results in some conservatism (where more flooding is conservative).

Breaklines were used in the hydraulic model to define the centre line of the bridge associated with the additional river.

A.2.5 ROUGHNESS VALUES

A Manning's 'n' value shapefile was developed for the site based upon available aerial imagery as discussed in Section 2.4

A.2.7 MODEL RUN

Full momentum wave equations were used in the running of the model, with a variable time step used.

A.3 ASSUMPTIONS AND LIMITATIONS

Various assumptions were required in the development of the hydrological and hydraulic model with resultant limitations in the accuracy of the modelled flooding. They have been discussed at various points in this report, and are partly summarised here, including some additional considerations:

- The PCSWMM model developed for the simulation of design hydrographs is assumed accurate despite being developed at a high level, excluding the influence of the actual storm water network within the highly urbanised catchment.
- The 0.5m DTM was generated from JRA 0.25m contours. Using parent contour data in this way, is not the optimum method for developing a flood model, since it relies on the use of interpolated data (i.e. contour data) for subsequent interpolation (to a DTM). Best practice would be to use the original point data. The result (of using the contour data to derive the DTM) is that the parent contour data becomes the determinant

as to the accuracy of the DTM (i.e. a 0.25m contour dataset produces a DTM with an approximate vertical accuracy of 0.25m). In addition, features present in the terrain that are below the contour interval are not present, with smoothing of the surface occurring. Lastly, the lows (e.g. along the river channel) and highs are only reflected in the contour data in as far as the vertical interval allows.

- The model mesh was developed utilised a 5m mesh size. While the model mesh benefits from HEC-RAS's underlying sub-grid, it is assumed that the mesh size is suitable to the necessary level of detail of this study.
- The selected Manning's 'n' value was representative of the areas they covered, including being representative regardless of the depth of flooding.
- The culvert entry and exit losses of 0.5 and 1.0 are representative of the culvert of interest.
- Boundary condition normal depths were sufficiently accurate (with regards to the point at which hydrographs were introduced into the hydraulic model).

REF: 554HIA

03 August 2021

Att: **Mr Andrew Salomon**
Archaeological Heritage Impact Assessor
South African Heritage Resources Agency
PO Box 4637
Cape Town
8000

By email: asalomon@sahra.org.za

Dear Mr Salomon,

REQUEST FOR EXEMPTION FROM A HERITAGE IMPACT STUDY: DEVELOPMENT OF A SEWER PIPELINE, BORDEAUX, CITY OF JOHANNESBURG, GAUTENG PROVINCE

Introduction

This letter constitutes a notification of intention to install a new sewer pipeline, Bordeaux, Gauteng Province.

PGS Heritage has been contacted to evaluate the possible heritage impacts by the proposed sewer pipeline and determine if a heritage impact assessment will be required.

Project description

CSM Consulting Services Pty (Ltd) is appointed to provide professional services for Johannesburg Social Housing Company (JOSHCO) Selkirk Social Housing Development in Randburg, Gauteng. The proposed site for the Selkirk Social Housing Development is located on erf 34-50 and on part of farm portion 323 Klipfontein No. 203-IQ with coordinates 26°5'48.03"S (latitude) and 28°0'18.86"E (Longitude).

As part of the development approval process, Johannesburg Water (JW) requires that JOSHCO upgrades portions of the existing sewer infrastructure to comply with their masterplan requirements.

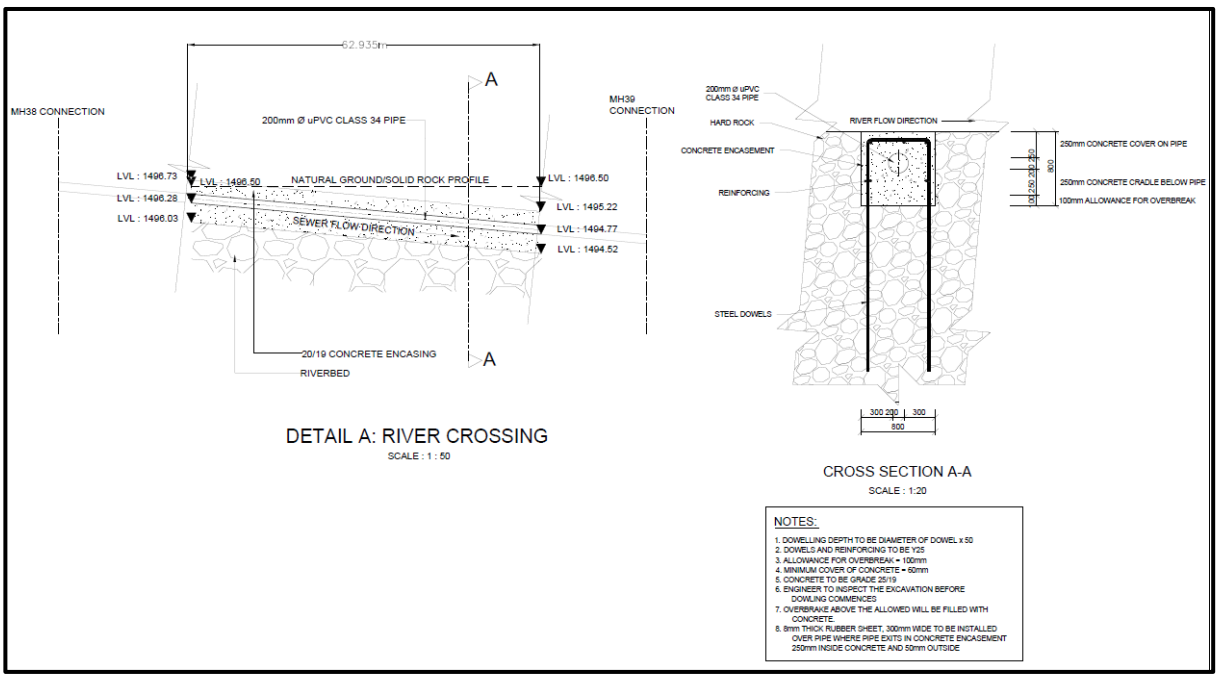
The proposal is to install new sewer infrastructure adjacent to the existing system with the existing system to be kept operational. The sewer infrastructure will be installed from Jan

Smut Avenue to Bordeaux Riverside Park, tracking through Valley Road and Garden Road. Before the proposed sewer infrastructure connects to an existing sewer infrastructure manhole which is locate on the other side of Bordeaux Riverside Park, the pipeline will cross the Braamfontein Spruit stream, alongside the existing pipe.

The proposed pipeline will be made of uPVC Class 34 with an internal diameter of between 200-360mm. Construction of the pipeline will be conducted as follows:

- Road: Traditional open trench excavation
- Watercourse: break through sections of existing rock and installed concrete encased pipe as per the detail provided below. Details also include in drawings issued.

Image below shows the construction of the sewer pipeline through the river crossing.



It is anticipated that the width of the trench for the pipeline will be between 800mm to 960mm wide depending on the pipeline size chosen (Width = 300mm side allowance + pipe diameter + 300mm side allowance). Within the protected Bordeaux Riverside Park area, the trench depth will be approximately 3.0 meters from the surface at its deepest point and 2.0 meters at its shallowest point, flatulating based on the terrain encountered. The portion of the pipeline crossing the river will be installed at an approximate depth of 2.0 meters.

Description of the receiving environment

The pipeline alignment starts on the property of the proposed Selkirk development to the north of Selkirk Avenue and then crosses on to the western shoulder of the double

carriageway of Jan Smuts Drive in the Bordeaux residential area. It then tracks down Jan Smuts Drive and crosses in to the Bordeaux residential area on Valley Road in an easterly direction before turning down Garden Road and then east into the Bordeaux Riverside Park. It follows a long a tributary of the Braamfonteinspruit before crossing the main water course over a rocky outcrop where the existing sewer line crosses. The pipeline then connects to an existing connection on Glen Road in Glenadrienne (*Figure 2 to Figure 15*).

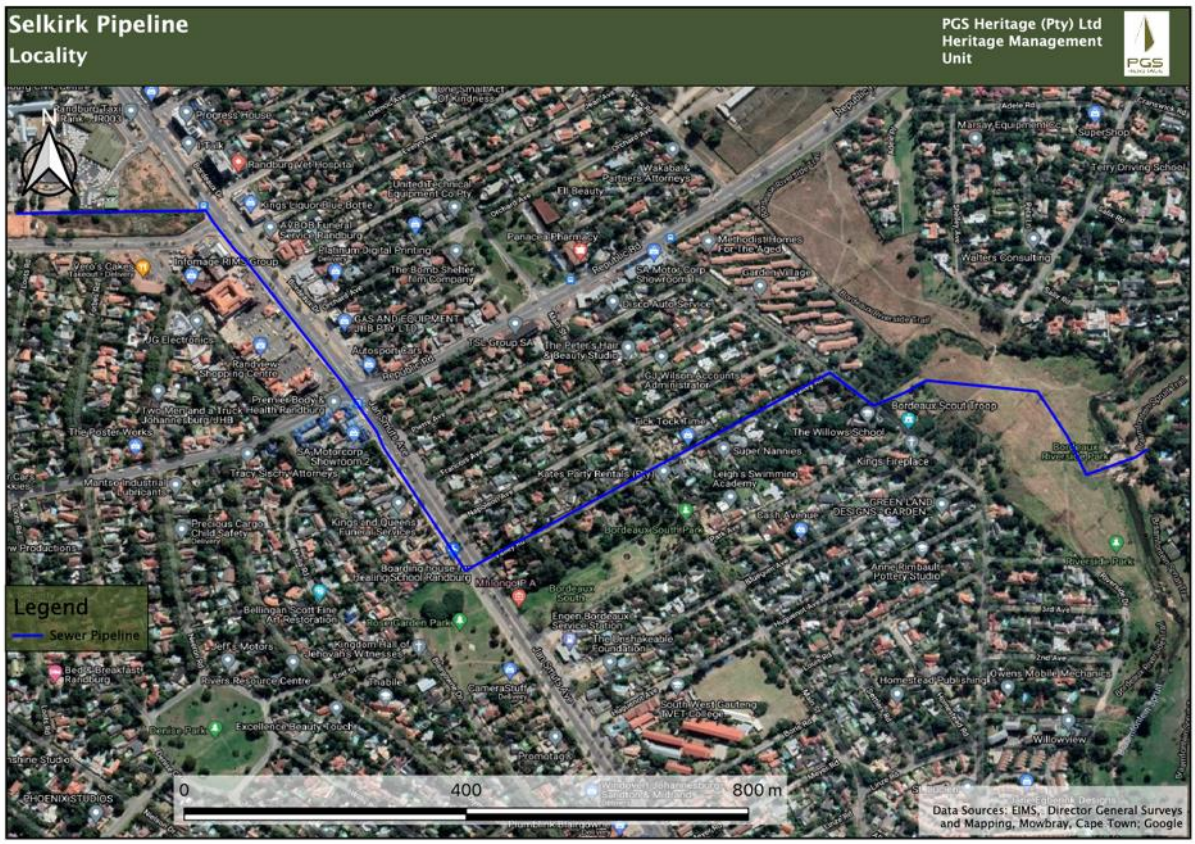


Figure 1 – Alignment in the Randburg and Bordeaux area

Figure 2 – Start of the pipeline as it runs east towards Jan Smuts Avenue

Figure 3 – Crossing over Selkrik Avenue on the shoulder of Jan Smuts Drive (left to right)

Figure 4 – Pipeline running south down Jan Smuts Drive (alignment in red)

Figure 5 – Crossing Republic Road (south towards Valley road)

Figure 6 – Pipeline crossing over Jan Smuts Drive toward Valley Rd towards the east (alignment in red)

Figure 7 – View of alignment down Valley Road toward the east

Figure 8 – The alignment between Garden Road and Main street on Valley Rd

Figure 9 – Alignment down garden road (corner of valley and Garden). Existing sewer manhole in the right corner of the picture.

Figure 10 – Alignment from Garden road towards the Bordeaux Riverside park fence

Figure 11 – Alignment from the western side of the park

Figure 12 – Alignment through the park southwards

Figure 13 – Alignment through the towards the water crossing

Figure 14 – Alignment through the park and over the Braamfonteinspruit

Figure 15 – Final section from the western border of the park to the connection close to Glen Road in Glenadrianne

Heritage potential

The alignment runs through a highly transformed urban and residential area before entering the Bordeaux Riverside Park. The only untransformed section is through the park and ground visibility was good due to recent vegetation fires. No historic, Iron Age or Stone Age heritage sites were noted during the site visit undertaken on 6th November 2018 as well as 25 June 2021.

An analysis of the 1939 and 1954 topographical maps also indicate that the area and its alignment was transformed over a period of 20 years from agriculture in to residential. No historic structures are indicated on the maps that are in the vicinity of the proposed alignment.

Figure 16 – Track Logs and heritage sites from the survey undertaken on 16 July 2021

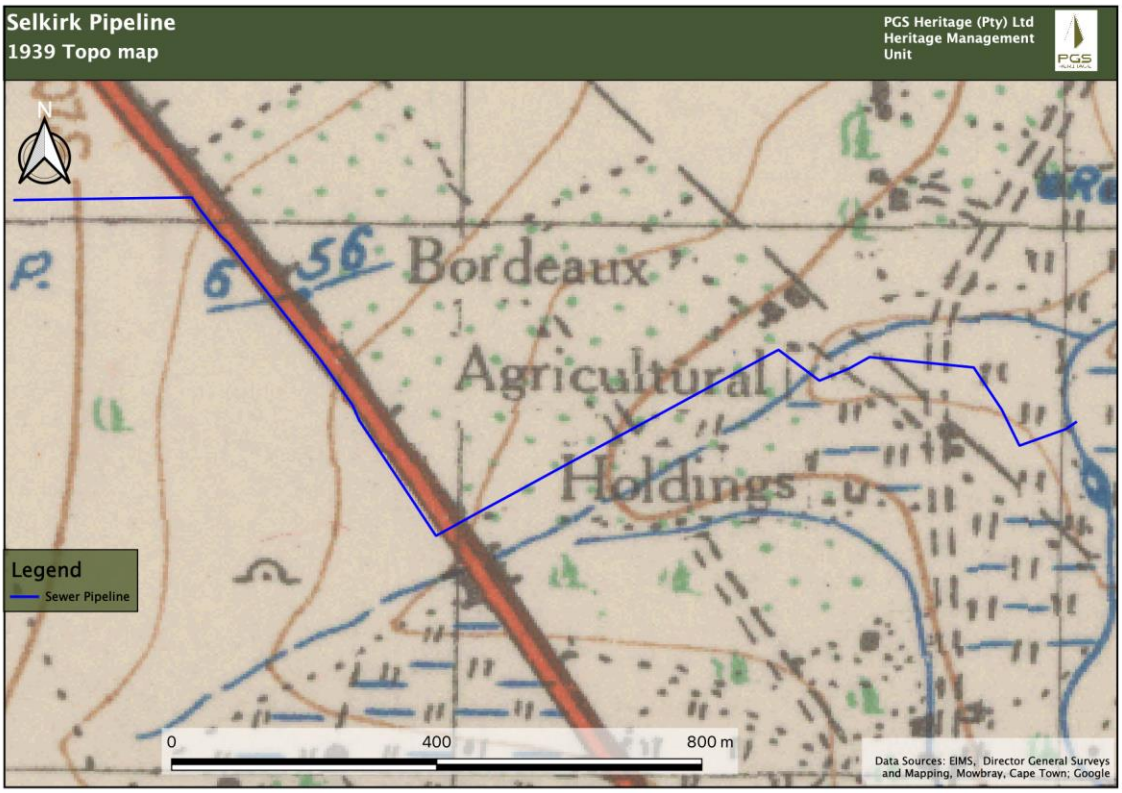


Figure 17 – 1st Edition 1939 Topographic Map (2628AA)

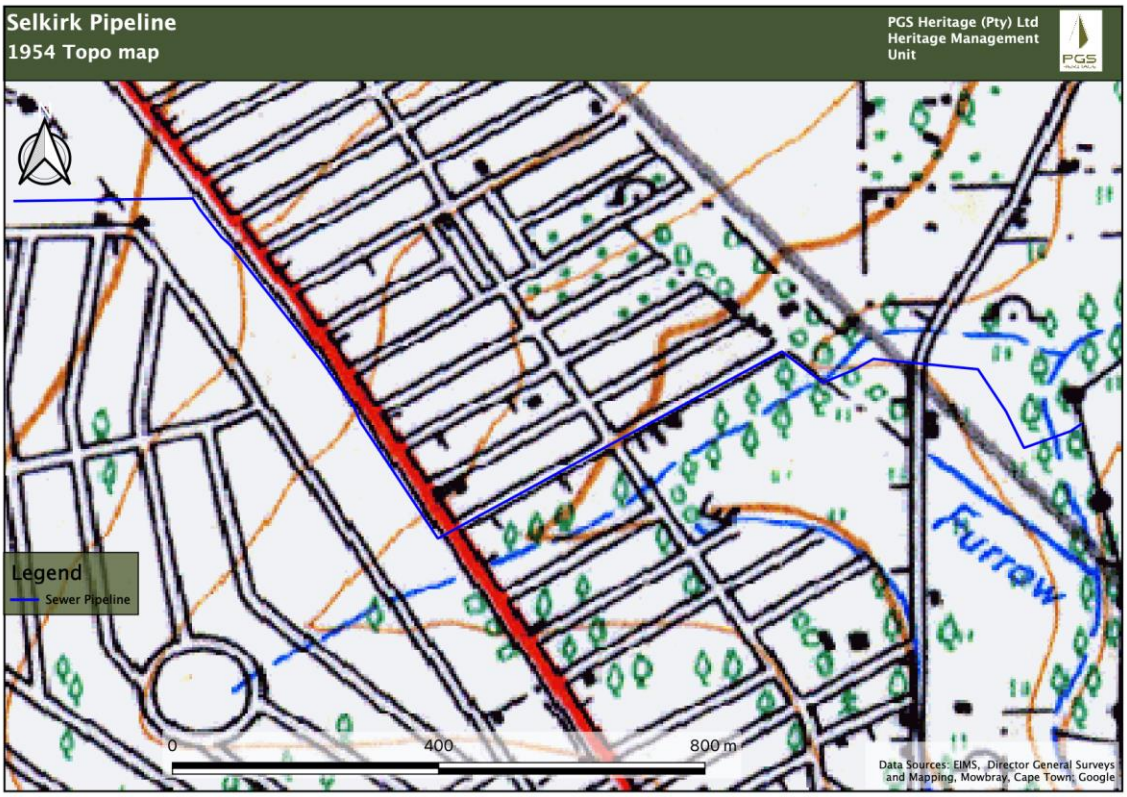


Figure 18 – 2nd Edition 1954 Topographic Map (2628AA)

Conclusions and Recommendations

With regard to the proposed process, the following recommendations are made:

1. No further heritage impact assessment of the study area is required.
2. **Analysis of the alignment shows no fatal flaws from a heritage perspective.**
3. In the unlikely event of any unmarked human burials, burial pits, potsherds or stone tools being uncovered during earthworks for the proposed development, these must be reported immediately to the South African Heritage Resources Agency (Mr Andrew Salomon (021 362 2535).

Should you have any queries, please contact Wouter Fourie (email: wouter@pgsheritage.com; Tel: (012) 332 5305).

Yours Sincerely

Wouter Fourie

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