Wetland Baseline and Risk Assessment for the proposed Matsopa Minerals Prospecting Right Application (Ref. 10631 PR)

Koppies, Fezile Dabi District Municipality

January 2022

CLIENT

CABANGA environmental

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Report Name	**Wetland Baseline and Risk Assessment for the proposed Matsopa Minerals Prospecting Right Application**
Submitted to	CABANGA environmental
Report Writer & Fieldwork	**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 principles of science.

Table of Contents

Figures

Tables

Declaration

I, Andrew Husted declare that:

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

Andrew Husted

Freshwater Ecologist

The Biodiversity Company

January 2022

1 Introduction

The Biodiversity Company was commissioned to conduct a wetland baseline and impact (risk) assessment, as part of the environmental authorisation process for the proposed Matsopa Minerals Prospecting Right Application (PRA) over the farms Geluk 237 and Goudlaagte 238 near the town of Koppies, Free State Province. The two farms Geluk 237 and Goudlaagte have been jointly referred to as the 'project area' from here on, with the 500 m regulation area extent beyond the 'project area'.

This assessment has been completed in accordance with the requirements of the published General Notice (GN) 509 by the Department of Water and Sanitation (DWS), and Appendix 6 of the EIA Regulations, 2014 (Government Notice (GN) R 982 of 2014, as amended).

GN509 was published in the Government Gazette (no. 40229) under Section 39 of the National Water Act (Act no. 36 of 1998) in August 2016, and provides for the authorisation of Section 21(c) & (i) water uses in terms of a General Authorisation (GA) as opposed to a full water use license. A water use (or potential) qualifies for a GA under GN 509 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM), and the risk class is determined to be LOW. This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation going forward.

One wetland site visit was conducted on 6th of January 2022, this would constitute a wet season survey. 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 with regards to the proposed activity.

1.1 Aims and Objectives

The aim of the assessment was to determine the current state of the associated water resources within the regulation area and to determine the associated risks involved with the proposed activities. This was achieved through the following:

- The delineation and assessment of wetlands within the project area;
- The evaluation of the extent of site-related impacts;
- An impact assessment for the proposed development; and
- The prescription of mitigation measures and recommendations for identified risks.

1.2 Terms of Reference

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- The delineation, classification and assessment of wetlands within 500 m of the project area;
- Conduct a risk assessment relevant to the proposed activity;
- Recommendations relevant to associated impacts; and
- Report compilation detailing the baseline findings.

1.3 Literature Review

The following reports were provided for consideration:

- Wetland Assessment as part of the Environmental Assessment and Authorisation Process for the Proposed Koppies Bentonite Mining Project within the Free State Province. Scientific Aquatic Services, 2015; and
- Wetland Rehabilitation and Management Plan with focus on the Watercourse Re-Establishment for the Proposed Koppies Bentonite Mining Project Near Koppies, Free State Province. Scientific Aquatic Services, 2016.

2 Receiving Environment

The project area is located approximately 10 km north of Koppies, immediately west of Koppies Bentonite Mine and north of the R82 regional road in the Free State Province. The surrounding land uses include farming, mining and watercourses (see Figure 2-1). The project area has been divided into two separate areas, the farm Geluk 237 with a total size of 166 Ha, and the farm Goudlaagte 238 with a total size of 167 Ha. A single, non-related farm lies between the two farms of interest, separating them by approximately 500 m. (see Figure 2-1). Approximately 330 drilling sites have been proposed throughout the prospecting right area (PRA).

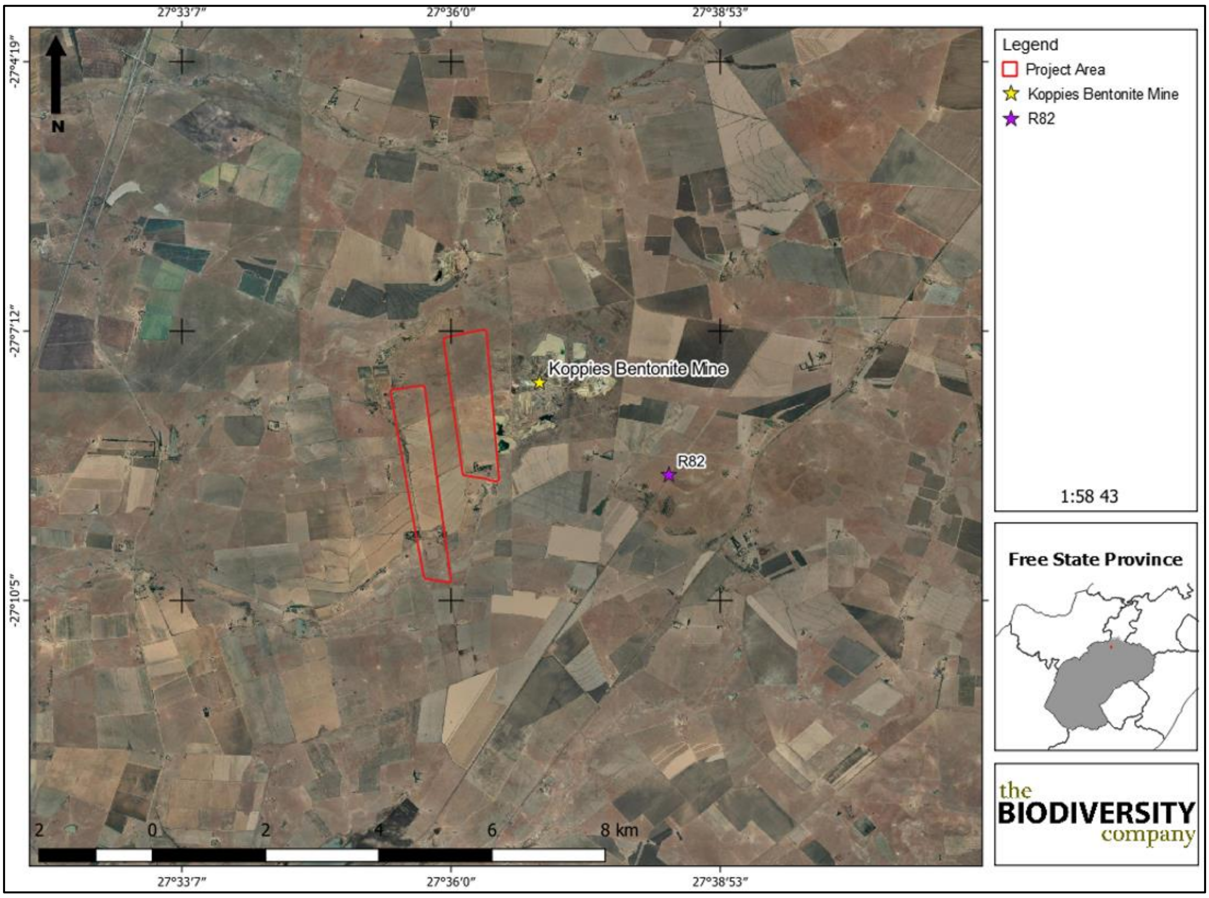

Figure 2-1 Locality map of the project area

2.1 Climate

The Gh 6 vegetation type is characterised by a summer rainfall with a Mean Annual Precipitation (MAP) of 560 mm which peaks in December and January. The Mean Annual Temperature has been calculated at approximately 15℃ with a relatively high frost occurrence (Mucina & Rutherford, 2006) (see Figure 2-2).

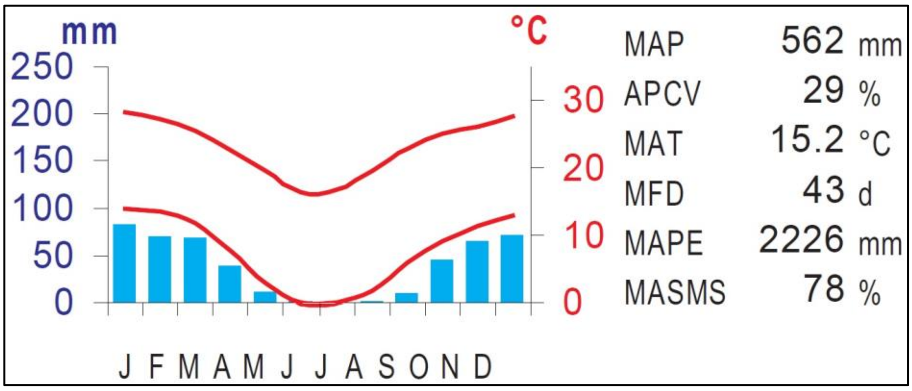

Figure 2-2 Climate for the Central Free State Grassland (Mucina & Rutherford, 2006)

2.2 Soils and Geology

The Adelaide Subgroup's Sandstone and Sedimentary mudstone are found in the extreme northern section of this vegetation type together with that of the Ecca Group. This geology gives rise to Melanic, Vertic and red soils typically from the Dc land type (Mucina and Rutherford, 2006).

According to the land type database (Land Type Survey Staff, 1972 - 2006) the proposed drilling sites are located within the Dc 7 land type. The land type database (Land Type Survey Staff, 1972 - 2006) further indicates that the Dc land type consists of prismacutanic and/or pedocutanic diagnostic horizons with the addition of one or more of the following; Vertic, melanic and red structured diagnostic horizons. The relevant terrain units and expected soils are illustrated and listed in Figure 2-3.

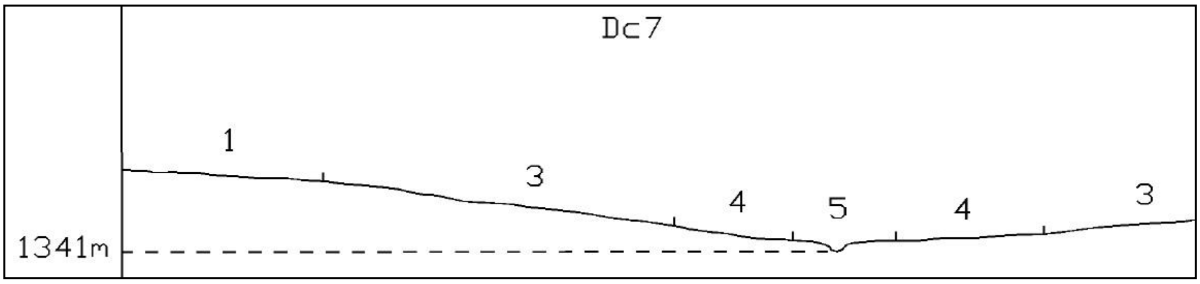

Figure 2-3 Illustration of land type Dc 7 terrain units (Land Type Survey Staff, 1972 - 2006

2.3 Terrain

The terrain of the PRA has been analysed to determine potential areas where wetlands are more likely to accumulate (due to convex topographical features, preferential pathways, or more gentle slopes).

2.3.1 Slope

The slope percentage of the project area has been calculated and is illustrated in Figure 2-4. The majority of the regulated area is characterised by a slope percentage between 0 and 5%, with some smaller patches within the project area characterised by a slope percentage up to 18. This illustration indicates a non-uniform topography with gentle to steep slopes being present.

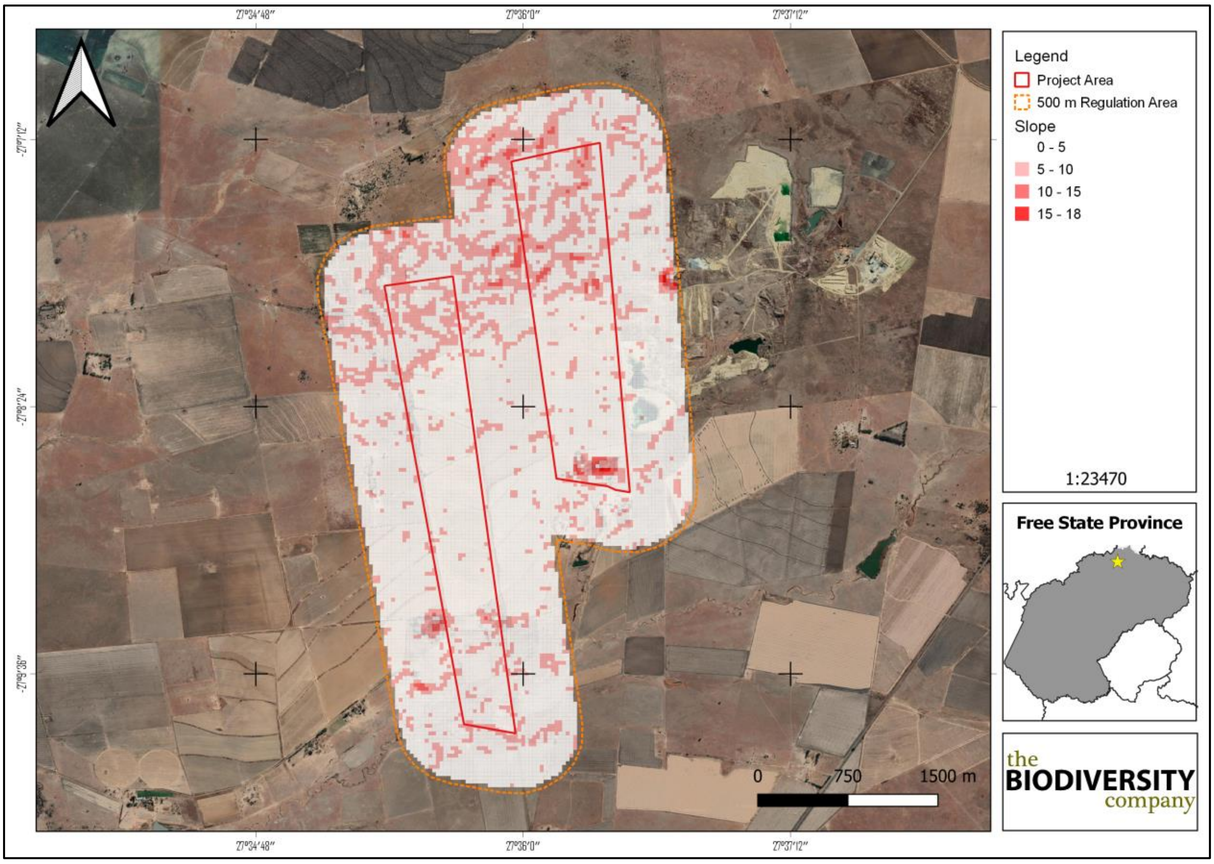

Figure 2-4 Slope percentage map for the regulated area

2.3.2 Digital Elevation Model

The Digital Elevation Model (DEM) of the project area (Figure 2-5) indicates an elevation of 1 420 to 1 490 Metres Above Sea Level (MASL). The lower laying areas (generally represented in dark blue) represent the areas that will have the highest potential to be characterised as wetlands.

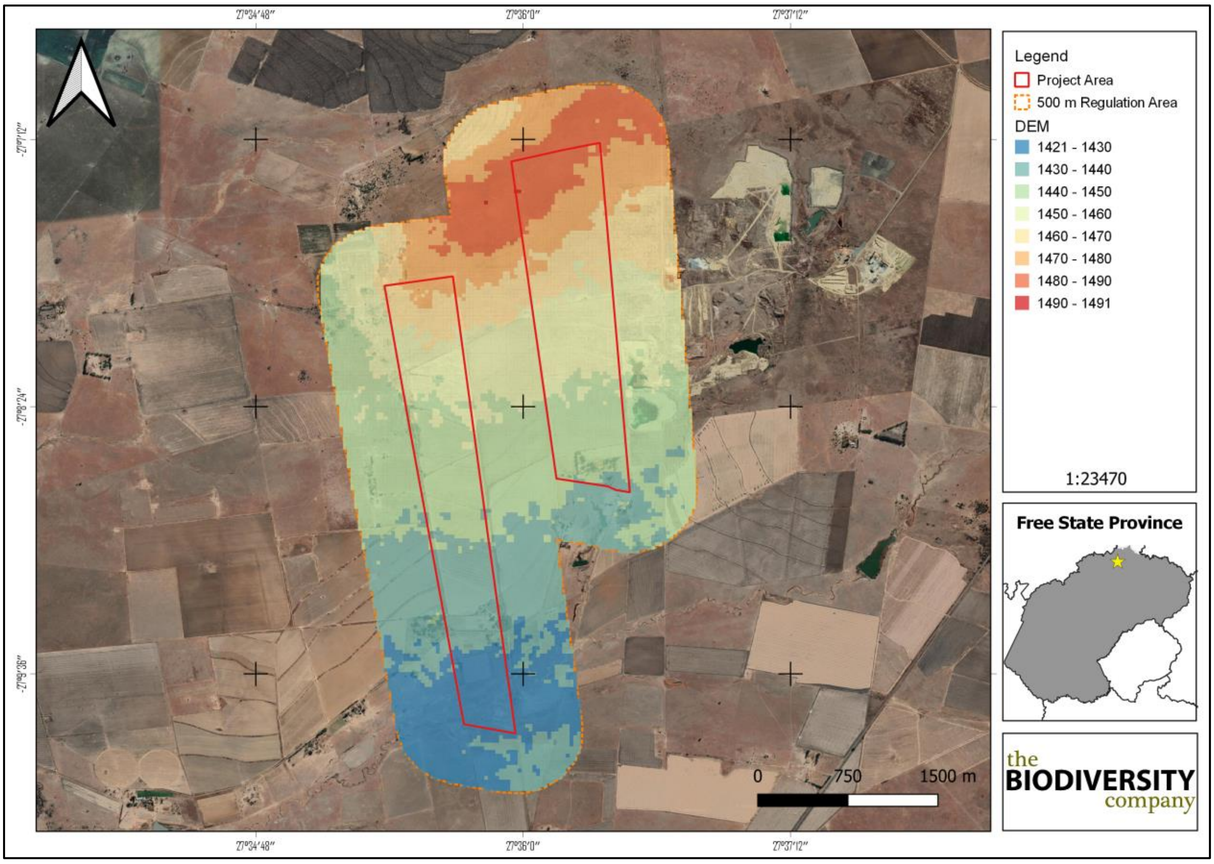

Figure 2-5 Digital Elevation Model of the regulated area (metres above sea level)

2.4 Topographical Inland Water and River Line Data

The topographical river line data layer from the "2727" quarter degree square was used during the desktop assessment to determine any additional areas that might indicate potential wetlands. This desktop dataset indicates the presence of a single perennial and numerous non-perennial river lines within the 500 m regulated area (see Figure 2-6).

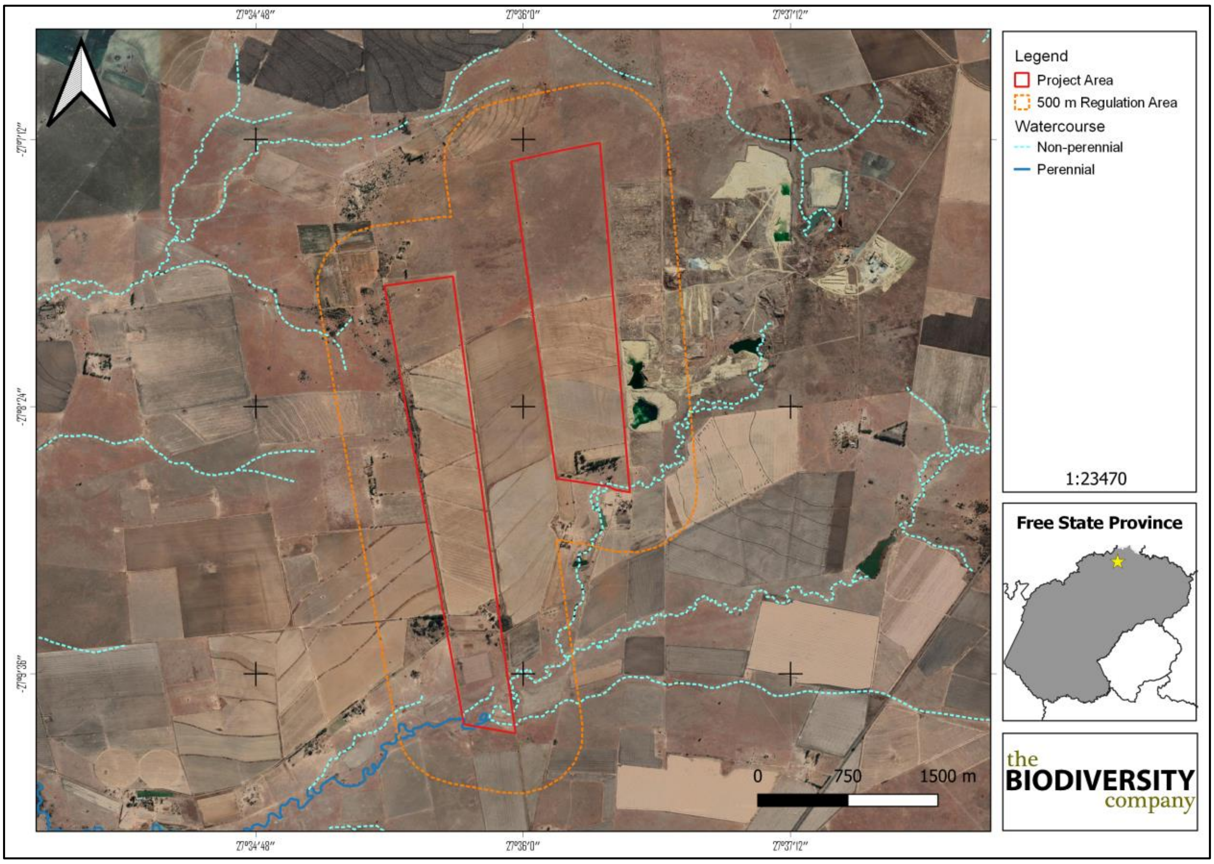

Figure 2-6 Illustration of topographical data applicable to signs of wetness

2.5 South African Inventory of Inland Aquatic Ecosystems

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 (NWM 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). According to NWM 5 a single depression wetland is located within the PRA (see Figure 2-7).

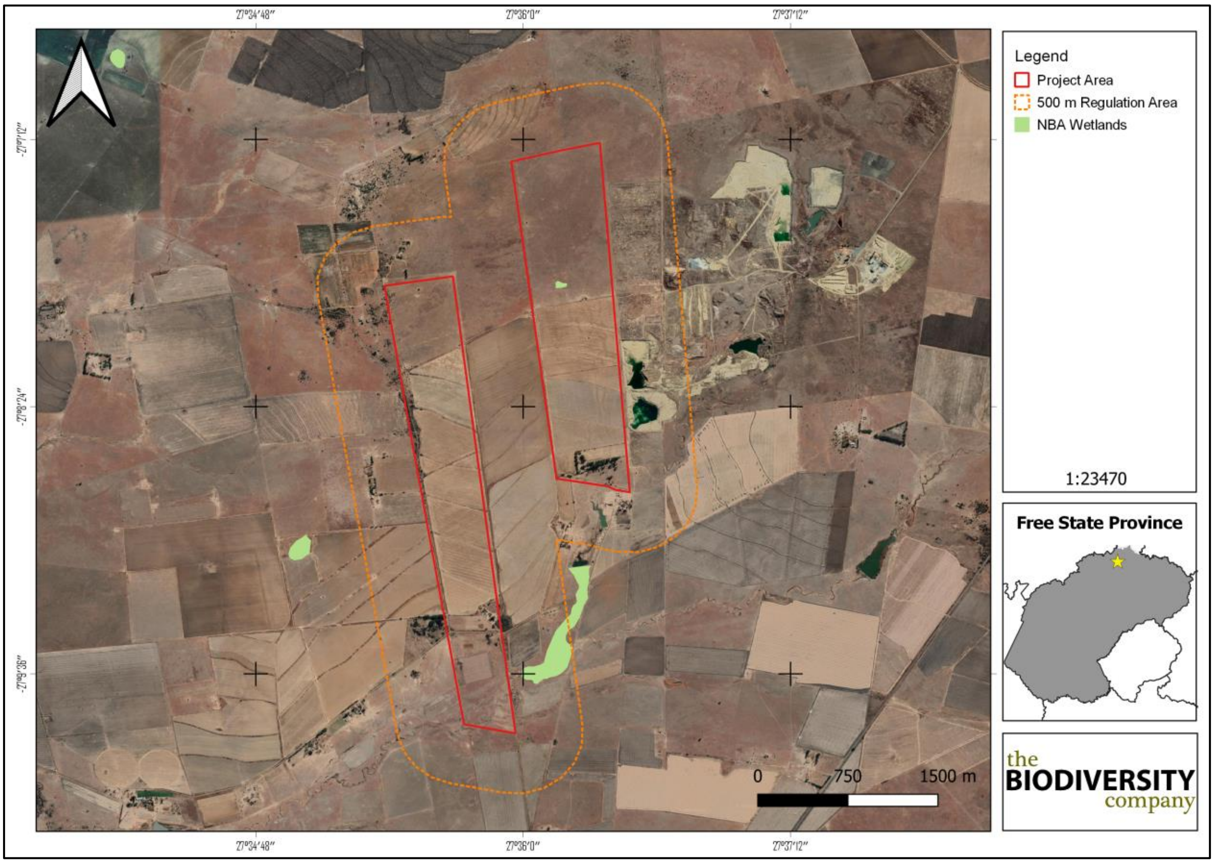

Figure 2-7 NWM 5 wetlands in relation to the 500 m regulated area

2.6 NFEPA Wetlands

The Freshwater Ecosystem Priority Areas (FEPA) database was consulted. Two wetland types have been identified within the 500 m regulated area (see Figure 2-8), with only a single depression located within the PRA.

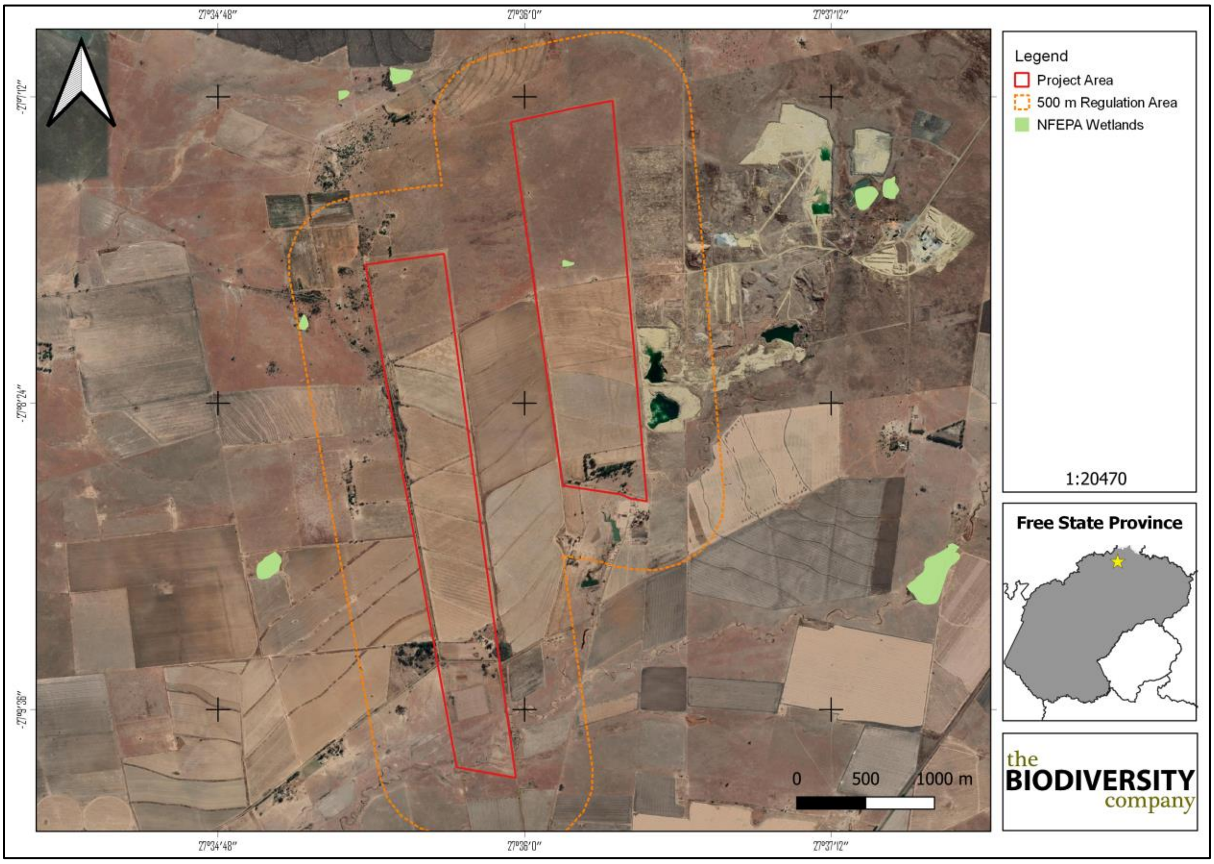

Figure 2-8 NFEPA wetlands in relation to the 500 m regulated area

3 Key Legislative Requirements

3.1 National Water Act (NWA, 1998)

The DWS is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998) (NWA) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource;
- The rehabilitation of the water resource;

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

3.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated EIA Regulations, 2014 (as amended), states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

4 Methodology

4.1 Identification and Mapping

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 4-1. 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 because 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.

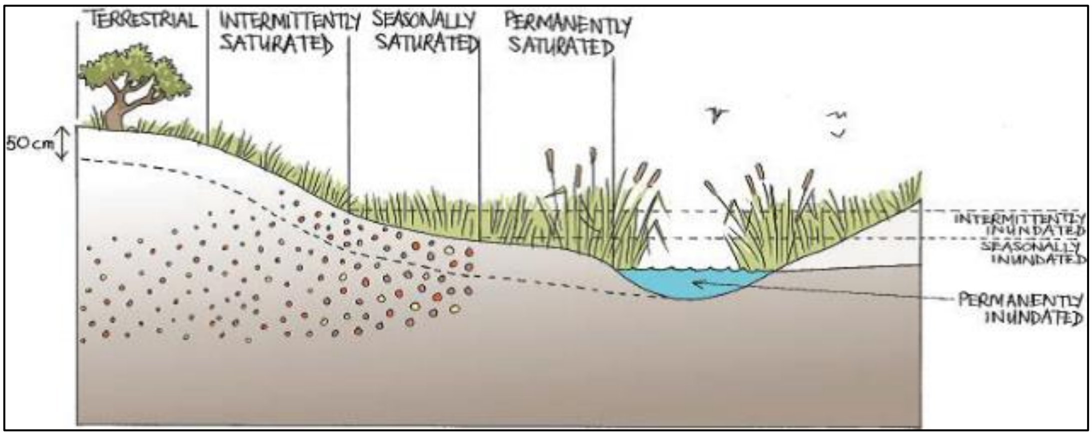

Figure 4-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al. 2013)

4.2 Delineation

The wetland indicators described above are used to determine the boundaries of the wetlands within the project area. These delineations are illustrated by means of maps accompanied by descriptions.

4.3 Ecological Classification and Description

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. 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 includes structural features at the lower levels of classification (Ollis *et al.,* 2013).

4.4 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands as well as humans. Eco Services serve as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines described in WET-EcoServices (Kotze *et al*. 2008). 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 4-1).

Table 4-1 Classes for determining the likely extent to which a benefit is being supplied

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

4.5 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 4-2.

Table 4-2 The Present Ecological Status categories (Macfarlane, et al., 2008)

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 recognisable.	**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**

4.6 Importance and Sensitivity

The importance and sensitivity of water resources is determined in order to establish resources that provide higher than average ecosystem services, biodiversity support functions are particularly sensitive to impacts. The mean of the determinants is used to assign the Importance and Sensitivity (IS) category as listed in Table 4-3 (Rountree and Kotze, 2013).

Table 4-3 Description of 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**

4.7 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.

4.8 Risk Assessment

The Department of Water and Sanitation (DWS) risk matrix assesses impacts in terms of consequence and likelihood. The significance of the impact is calculated according to Table 4-4.

Table 4-4 Significance ratings matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s)impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

4.9 Knowledge Gaps

The following aspects were considered as limitations:

- Areas characterised by external wetland indicators have been the focus for this study. Areas lacking these characteristics have not been focussed on;
- Fieldwork was only achieved within the proposed PRA, with desktop assessments being concluded for the remaining extent within the 500 m regulation area;
- Despite wetland indicators being identified within selected cultivated areas, the accuracy of delineating the extent of these wetland areas is comprised due to the agricultural practices. Wet areas within the cultivated areas could not be delineated with any appreciable level of confidence, and the locality of these wet areas has only be demarcated (Figure 4-2). The soil form identified for these area is the Westleigh form, generally characteristic of a seasonal wetland zone (DWAF, 2005);
- It has been assumed that the extent of the project area provided to the specialist is accurate; and
- The GPS used for water resource delineations is accurate to within five metres. Therefore, the wetland delineation plotted digitally may be offset by a maximum of five metres to either side.

Figure 4-2 Soil forms identified for the project area

5 Results and Discussion

Aerial imagery of the site, dating back to 1955 was consulted in order to facilitate the identification and delineation of wetlands, and to also note the land use changes in the area. Historical imagery from 1955 (Figure 5-1) and 1987 (Figure 5-2) were considered. The meandering of the Klein-Rietspruit system towards the south of the project area is evident in both images.

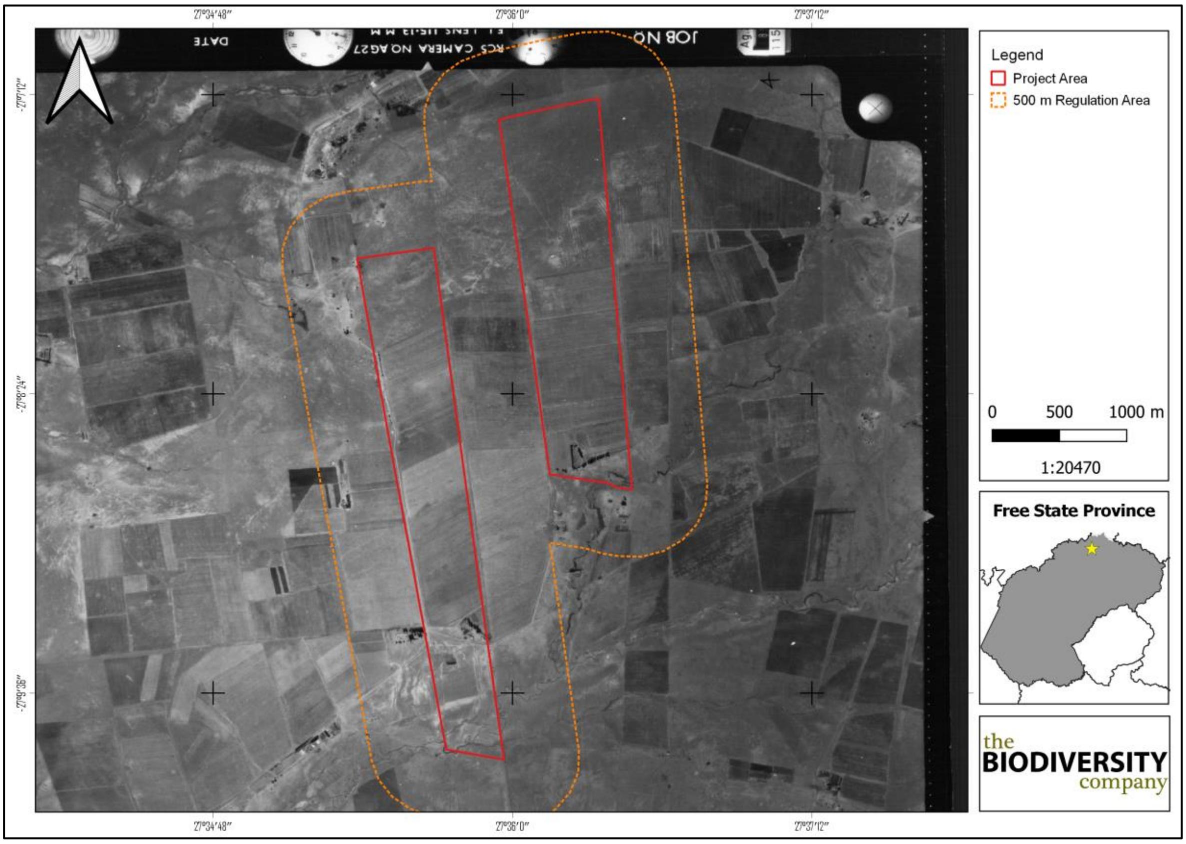

Figure 5-1 The historical imagery of the project area from 1955

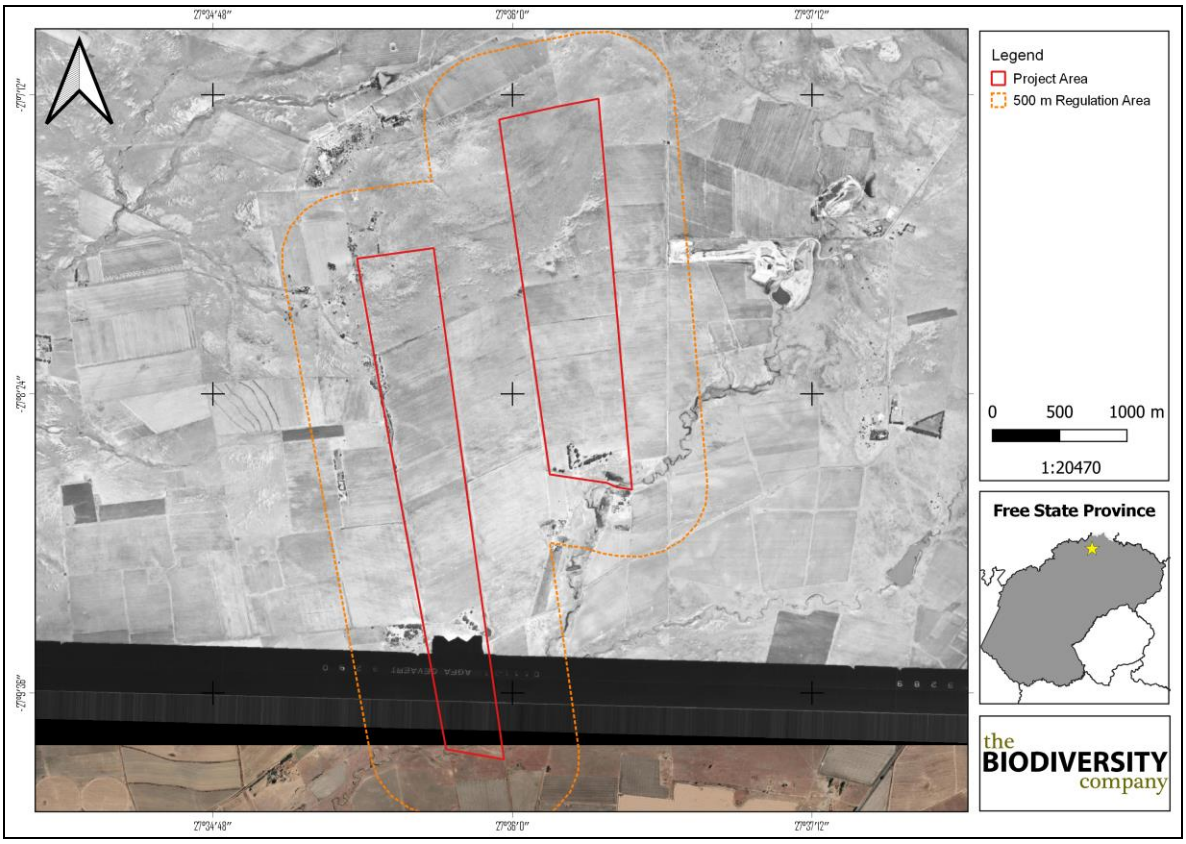

Figure 5-2 historical imagery of the project area from 1987

5.1 Delineation and Description

The wetland areas were delineated in accordance with the DWAF (2005) guidelines (see Figure 5-4). Two (2) primary wetland types were identified for the project area, namely the expansive Klein-Rietspruit floodplain system and numerous depressions (or pans). Photographs of these wetland types and the associated characteristics are presented in Figure 5-3. Figure 5-4 presents the extent of the delineated areas in relation to the PRA. For the purposes of this assessment, the depressions have been jointly considered for the functional assessment. The wetland classification as per SANBI guidelines (Ollis *et al.,* 2013) is presented in Table 5-1.

Table 5-1 Wetland classification as per SANBI guideline (Ollis et al. 2013)

Wetland System	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	Highveld	Dry Highveld Grassland Group 4	Valley Floor	Unchanneled Valley Bottom	N/A	N/A
HGM 2	Inland	Highveld	Dry Highveld Grassland Group 4	Bench	Depression	Endoheric	Without channelled outflow

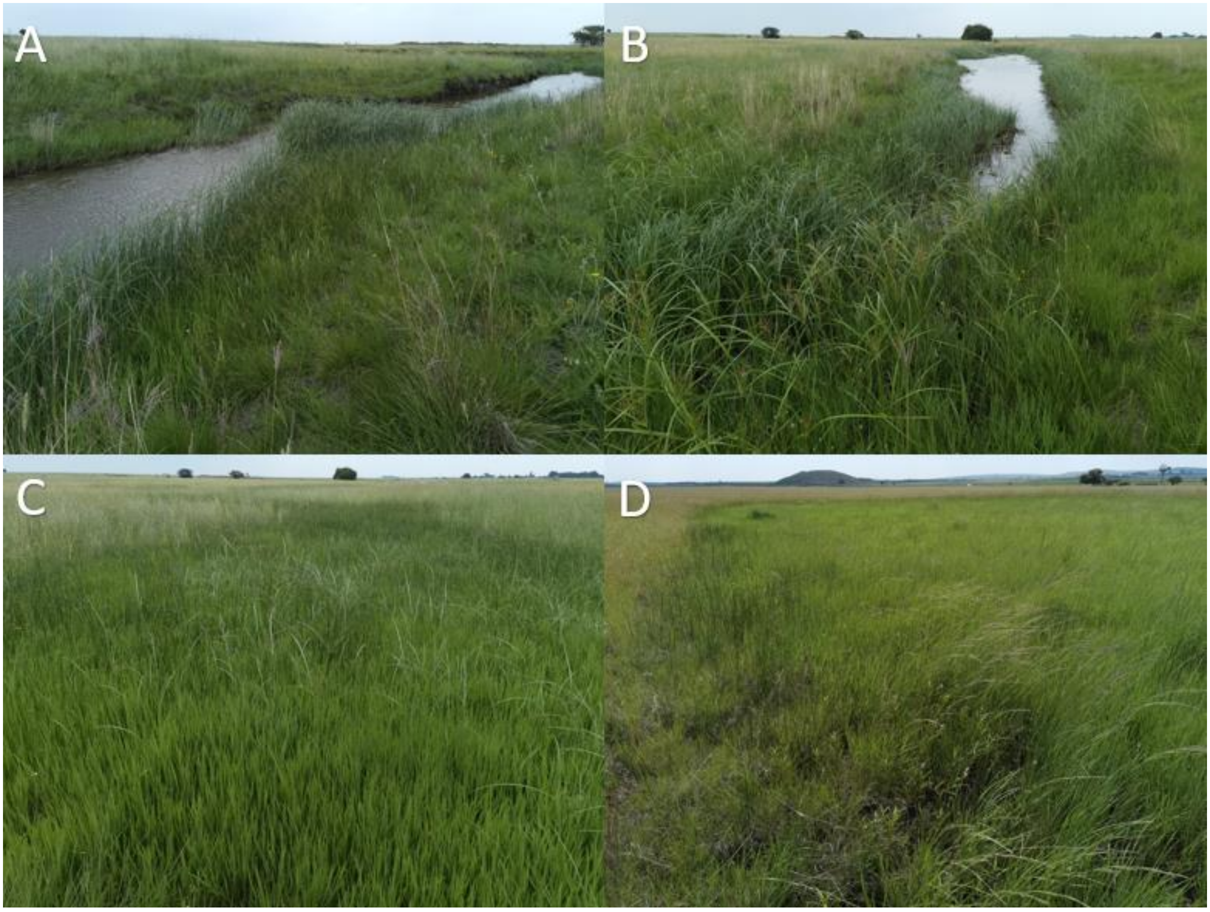

Figure 5-3 Wetland characteristics identified for the area. A) The channel within the floodplain, B) A cut-off meander, C) Saturated channel, D) A depression.

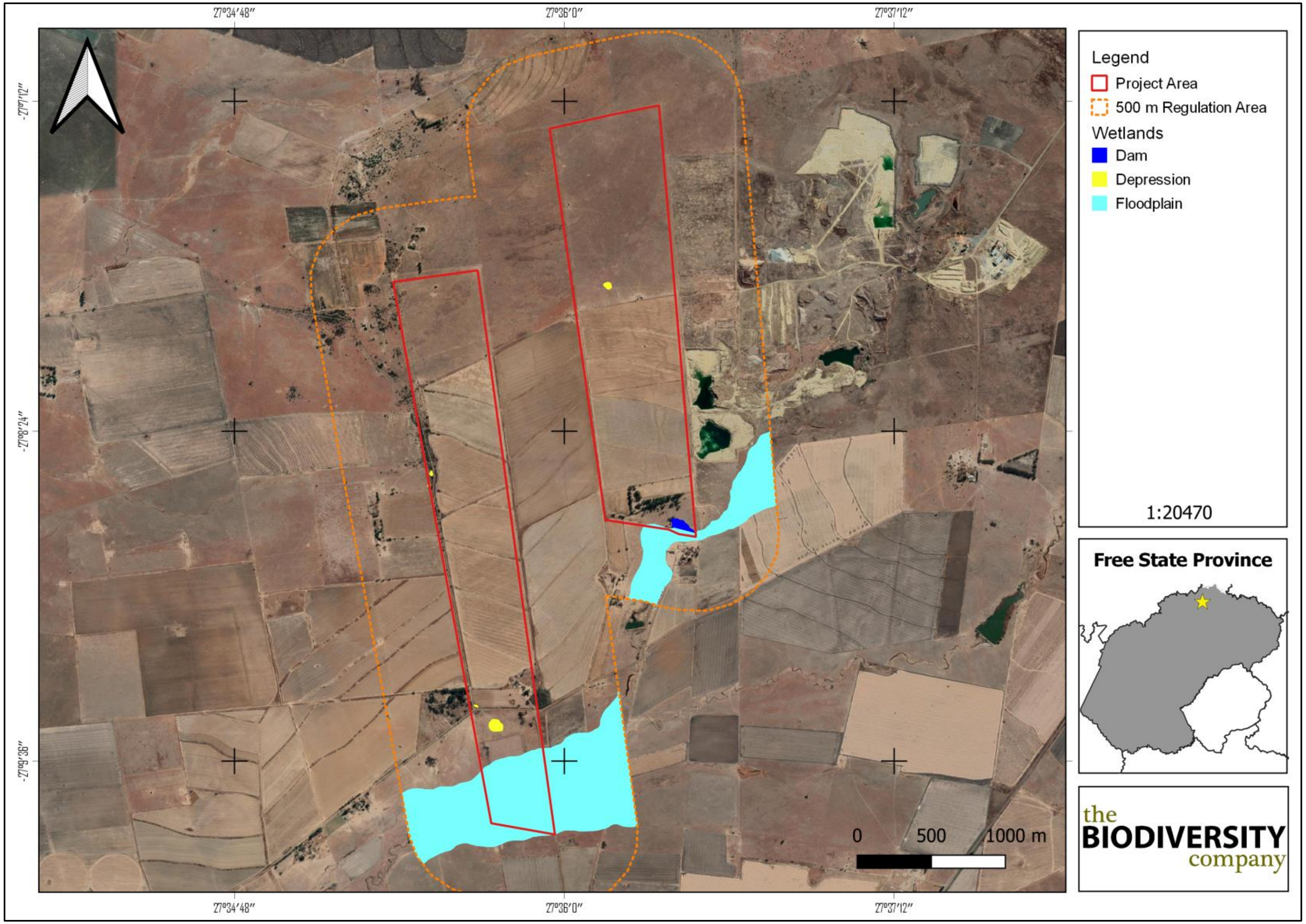

Figure 5-4 Delineation of wetlands within project area

5.2 Wetland Unit Setting

Figure 5-5 presents a diagram of the HGM units, showing the dominant movement of water into, through and out of the various wetland HGM types (Ollis *et al*., 2013). A total of five (5) depressions and a floodplain system were identified, representing two HGM types. A general description of the wetland HGM types is provided below.

The floodplain flow path remains in a relatively intact state. The system is large, well developed and relatively intact which displays typical floodplain features. These include a highly sinuous stream channel, large floodplain depressions and an abundance of well vegetated backwaters and meander cut-offs. These systems are distinctly "U" shaped, well vegetated and are perennially inundated with a large proportion of the flow paths occupied by permanent and seasonal zone vegetation. The system is largely natural but is, in places, heavily encroached by alien and invasive plant species. According to Ollis *et al*. (2013) floodplains are typically located on plains or wide valley floors. They are typically characterised by the presence of meander cut-offs, depressions and backwaters. They are, by definition, depositional environments formed by the accumulation of alluvial deposits carried downstream by rivers. Another characteristic of floodplains is that they are typically inundated on average, several times per year, during high flows. The floodplain features occur mainly in the more natural grassland areas.

The depression systems are located on the "bench" landscape unit. Depressions are inward draining basins with an enclosing topography which allows for water to accumulate within the system. Depressions, in some cases, are also fed by lateral sub-surface flows in cases where the dominant geology allows for these types of flows.

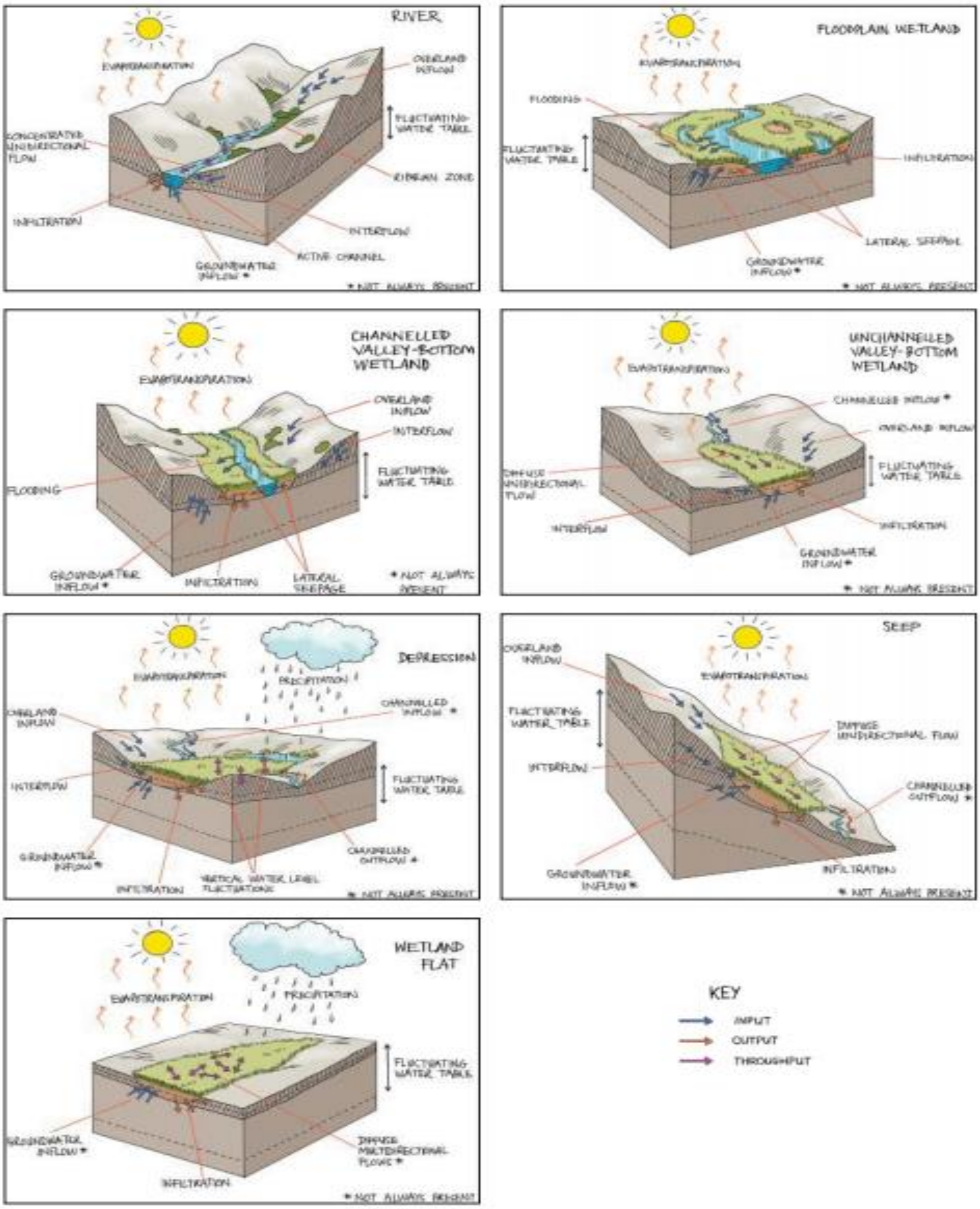

Figure 5-5 Amalgamated diagram of wetland types, highlighting the dominant water inputs, throughputs, and outputs, SANBI guidelines (Ollis et al. 2013)

5.3 Wetland Indicators

5.3.1 Hydromorphic Soils

According to (DWAF, 2005), soils are the most important characteristic of wetlands to accurately identify and delineate wetland areas. Two dominant wetland soil forms were identified for the project, namely the Rensburg and the Westleigh soil forms (see Figure 5-6).

The Westleigh soil form was identified within the cultivated areas, whereas the Rensburg form was associated with the region of the floodplain area.

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 “2000” soil family due to the calcareous nature of the soil.

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).

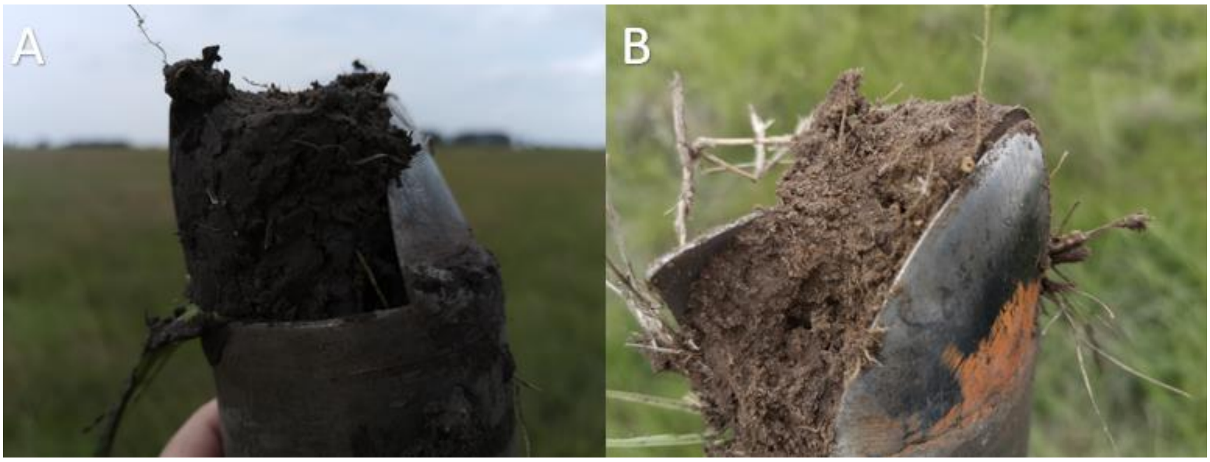

Figure 5-6 Soil characteristics, A) Vertic topsoil, B) Signs of wetness (mottling)

5.3.2 Hydrophytes

Vegetation plays a considerable role in identifying, classifying and accurately delineating wetlands (DWAF, 2005). During the site visit hydrophyte species which include *Typha capensis, Cyperus congestus, Kyllinga erecta, Schoenoplectus corymbosus, Schoenoplectus muricinux, Juncus oxycarpus, Agrostis lachnantha, Eragrostis curvula* and *Berkheya radula* were noted.

Figure 5-7 Hydrophytes identified within the delineated wetland. A) Cyperus fastigiatus B)Kyllinga melanosperma.

5.4 General Functional Description

Floodplains generally are formed during high flow events which subsequently cause water to overspill its banks. Due to the topographic setting of floodplains, flood attenuation for these systems is very high, especially during seasons where the soil within the wetland is not yet saturated and before the oxbows are filled. Seeing that floodplains usually are characterised by clayey soils which retain water for long periods and are susceptible to vast amounts of evapotranspiration, very little streamflow regulation is expected for floodplains. In hindsight, floodplains with course soil types are ideal in regulating streamflow. Floodplains are excellent in assimilating phosphates due to the decrease in velocity during the overspill of banks. During this process, lateral deposition of sediment is prone to happen. Phosphorus tends to bond strongly to mineral particles which ensures that the phosphorus is retained on the floodplain after the deposition of these particles. Denitrification does occur to a lesser extent due to little exposure of large amounts of water seeing that these water masses are dependent on floods. Additionally, sub-surface flows are rare for floodplains which decrease the possibility of denitrification even more so (Kotze *et al.,* 2009).

The generally impermeable nature of depressions and their inward draining features are the main reasons why the streamflow regulation ability of these systems is mediocre. Regardless of the nature of depressions in regard to trapping all sediments entering the system, sediment trapping is another Eco Service that is not deemed as one of the essential services provided by depressions, even though some systems might contribute to a lesser extent. The reason for this phenomenon is due to winds picking up sediments within pans during dry seasons which ultimately leads to the removal of these sediments and the deposition thereof elsewhere. The assimilation of nitrates, toxicants and sulphates are some of the higher rated EcoServices for depressions. This enabled by the local precipitation and dissolving of minerals and other contaminants during dry and wet seasons respectively, (Kotze et al., 2009).

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

5.5 Ecological Functional Assessment

The ecosystem services provided by the wetlands identified were assessed and rated using the WET-EcoServices method (Kotze *et al*. 2008) (Table 5-2). The overall level of benefit provided by the two HGM types was determined to be intermediate.

Overall, the wetlands generally provide important indirect regulating and supporting services relating to flood attenuation, streamflow regulation, sediment trapping and nutrient and toxicant removal. As the wetlands are not situated in a rural community setting (prevailing land use being agriculture) the wetlands are not considered important from a cultural perspective nor in terms the direct provision of water and harvestable resources on a subsistence level.

The wetlands are also generally considered relatively important from a biodiversity maintenance perspective, supporting a unique and diverse floral assemblage while providing important foraging, shelter and movement corridors for a wide diversity of wetland associated fauna.

Of the HGM units, the floodplain provides the highest levels of ecosystem services with an overall score of Moderately High due to the relatively large size, high channel sinuosity and largely intact vegetation cover. Specifically, the system plays an important role in attenuating floods received from the large (often ploughed catchments). The system also plays an important role in assimilating toxicants received from agricultural practices and mining operations, supporting unique, charismatic and conservation important biodiversity as well as their aesthetic, recreational (e.g. bird watching and fishing) and educational values.

The depressions are considered important for biodiversity maintenance for the area. The integrity of densely vegetated areas is both important to the conservation of fauna and flora species.

Table 5-2 Summary of the ecosystem services scores

<table>
<tr><th colspan="5">Wetland Unit</th><th>HGM 1</th><th>HGM 2</th></tr>
<tr><td rowspan="11">Ecosystem Services Supplied by Wetlands</td><td rowspan="8">Indirect Benefits</td><td rowspan="8">Regulating and supporting benefits</td><td colspan="2">Flood attenuation</td><td>2.2</td><td>1.8</td></tr>
<tr><td colspan="2">Streamflow regulation</td><td>2.0</td><td>1.7</td></tr>
<tr><td rowspan="5">Water Quality enhancement benefits</td><td>Sediment trapping</td><td>2.2</td><td>2.6</td></tr>
<tr><td>Phosphate assimilation</td><td>2.0</td><td>2.4</td></tr>
<tr><td>Nitrate assimilation</td><td>1.8</td><td>2.1</td></tr>
<tr><td>Toxicant assimilation</td><td>2.1</td><td>2.0</td></tr>
<tr><td>Erosion control</td><td>2.4</td><td>2.3</td></tr>
<tr><td colspan="2">Carbon storage</td><td>1.7</td><td>1.7</td></tr>
<tr><td rowspan="3">Direct Benefits</td><td colspan="3">Biodiversity maintenance</td><td>2.5</td><td>2.6</td></tr>
<tr><td rowspan="2">Provisioning</td><td colspan="2">Provisioning of water for human use</td><td>2.0</td><td>0.8</td></tr>
<tr><td colspan="2">Provisioning of harvestable resources</td><td>1.0</td><td>1.0</td></tr>
</table>

			Provisioning of cultivated foods	1.2	1.0
		Cultural benefits	Cultural heritage	0.3	0.3
			Tourism and recreation	1.6	1.0
			Education and research	1.0	1.5
			Overall	**26**	**24.8**
			Average	**1.7**	**1.7**

5.6 Wetland Health

The present ecological state (PES) of the wetlands identified within the 500 m regulated area is provided in Table 5-3. The ecological integrity of the two wetland types is determined to be moderately modified (or class C). Some notable impacts include;

- Adjacent mining activities/operations;
- Dirt roads;
- Clearance of vegetation;
- Erosion;
- Servitudes;
- Grazing; and
- Alien invasive species.

All of the wetlands are subject to similar catchment impacts but vary in terms of the intensity and proximity of these impacts. Catchment impacts centre on the conversion of large areas of grassland to agriculture and mining, in places also include encroachment by alien and invasive species (AIS) and the presence of impeding features such as roads. Crop production has led to the creation of vast exposed soil surfaces during intercrop periods which increase the runoff potential of the catchment. This in turn increases the potential for erosion in the steeper valley-heads while heightening sediment deposition towards the toes of lower energy wetlands. The mining operations have altered the topography of the affected catchments, which in turn has altered the hydrology of the area.

Crop cultivation not only affects the catchment but has encroached upon the wetlands themselves. Some of the less conspicuous wetlands such as the temporarily saturated seeps have been completely transformed by cultivation. Tillage practices (including ridge and furrow as well as terraced croplands) have increased drainage in these wetlands and consequently decreased the distribution and retention time of water, effectively draining these wetlands. Beneficially to wetlands these croplands are not actively irrigated but rely on rainwater yet the crops produced still act to increase evapotranspirative losses above the natural grassland state.

Within wetlands, impacts vary markedly between the various HGM units. The main impacts altering the hydrological regime within the valley bottom wetlands are roads which have, in places served to promote downstream erosion through concentrated sediment deprived overflows. The main hydrological impacts faced by the depressions centre are crop cultivation and roads, which have altered and reduced the associated catchment areas.

Table 5-3 Summary of the scores for the wetland PES

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 1	C: Moderately Modified	3.5	B: Largely Natural	1.6	B: Largely Natural	1.7
Overall PES Score	2.4		Overall PES Class		C: Moderately Modified	
Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 2	C: Moderately Modified	3.0	B: Largely Natural	1.5	B: Largely Natural	1.5
Overall PES Score	2.1		Overall PES Class		C: Moderately Modified	

5.7 The Importance & Sensitivity Assessment

The Importance and Sensitivity ratings for each of the wetland HGM types is provided in Table 5-4. Several factors were considered when establishing the IS of the various wetlands. Regional to national scale considerations included NFEPA river or wetland status, protected areas as well as Ramsar wetlands. Local considerations included habitat integrity and diversity, likelihood of supporting conservation important species and potential for hosting significant congregations of local or migratory species.

At a regional scale the NFEPA Wetveg database recognises floodplains within the Dry Highveld Grassland Group 4 as Vulnerable and Not Protected (Nel *et al*., 2011), whereas depressions are recognised as Least Threatened and Not Protected. The following was also considered for the IS description:

- The area is not located in a Strategic Water Source Area;
- The Central Free State Grassland vegetation type is Vulnerable;
- The areas do not overlap with Critical Biodiversity Areas; and
- The project area does overlap Ecological Support Areas.

Table 5-4 Ecological importance and sensitivity for the wetland types

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	Dry Highveld Grassland Group 4	Vulnerable	Not Protected	B/C	Critically Endangered	No	**High**
HGM 2		Least Threatened	Not Protected	B/C	Least Concern	No	**Moderate**

5.8 Buffer Analysis

The "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane *et al.,* 2014) was considered to determine the appropriate buffer zone for the proposed activity. A post-mitigation buffer zone of 30 m is recommended for the identified wetlands (see Figure 5-8).

According to Rountree *et al*. (2012) floodplains are of the systems that are the most sensitive to flooding, and unchanneled valley bottom systems are the most affected by low flow changes. Based on the layout of the drill sites provided, numerous sites are within the recommended 30 m buffer zone and should be relocated. According to the buffer zones guidelines (Macfarlane and Bredin, 2017) 25 m is the minimum recommended buffer zone width for "mining (worst case)". Desbonnet *et al*. (1994) prescribed a maximum buffer width of 30 m for wetland species for low intensity impacts from adjacent land uses. Based on this, a (fixed) 30 m buffer has been allocated to all wetland areas. All prospecting activities beyond the 30 m buffer are expected to pose a low risk to the wetlands.

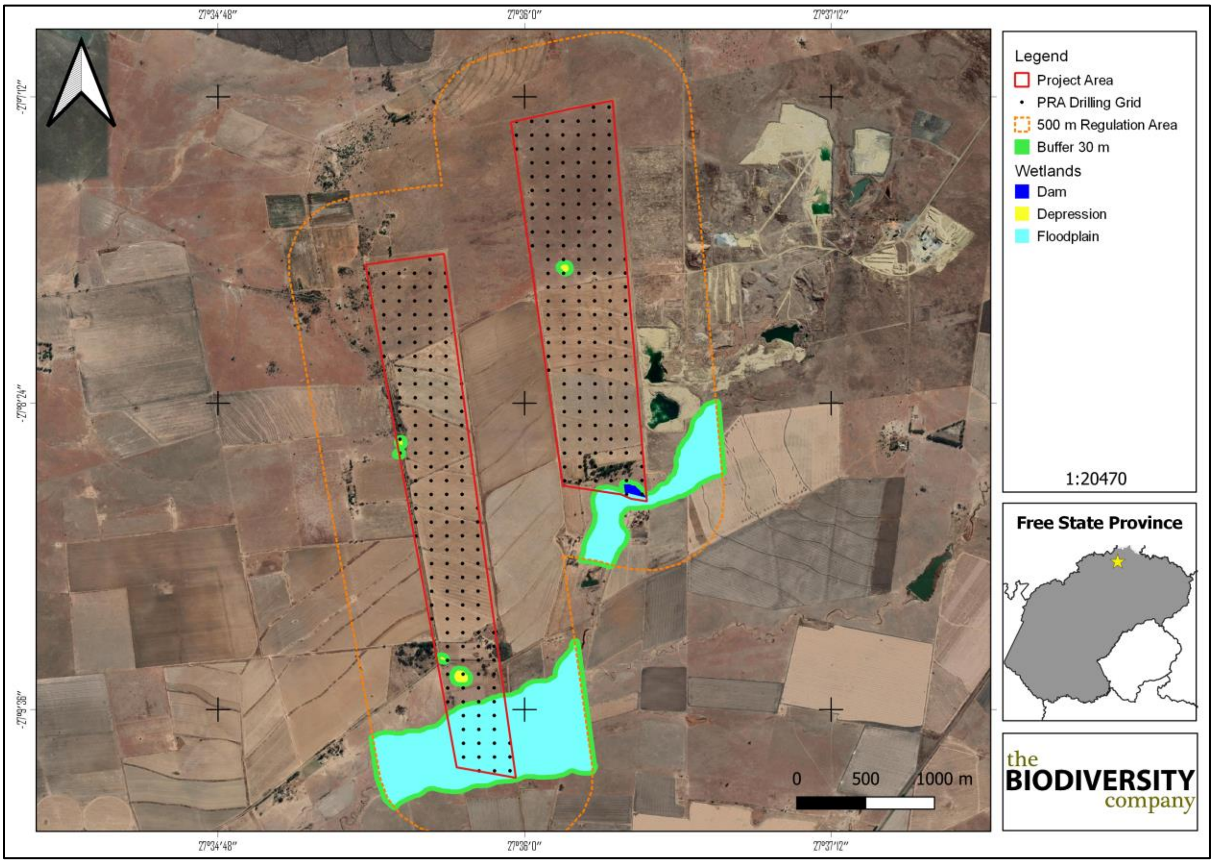

Figure 5-8 Recommended buffer zone of the delineated wetlands

6 Risk Assessment

The impact assessment considered both direct and indirect impacts on the wetland system. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 6-1).

The potential risks posed to wetlands as a result of the proposed project are detailed in Table 6-2. These ratings are based on the DWS Section 21 (c) and (i) Risk Assessment matrix. As per the risk matrix guidelines all activities associated with construction, operation and decommissioning have been accounted for. Ratings are given for pre- and post-mitigation scenarios. A number of drill sites are located within the delineated wetlands. It is apparent from the risk assessment that some aspects considered for the drilling programme pose a Medium Risk (pre-mitigation) due to the localities of some sites being within the wetlands. Due to the Low Risk post-mitigation, a General Authorisation is permissible for the drilling programme. All recommendations and mitigation measures are to be implemented for the project.

It is estimated that the total working area for each drill site is approximately <100m^2. The depths for the holes can be drilled in 1-3 days. Prospect drilling includes clearing an area, anchoring the drill rig and ultimately extracting core and laying core out to be logged. It is worth noting that no sump is required as a jumper rig will be used which does not require water. Photographs of the proposed drilling rig are presented in Figure 6-2.

The findings from Table 6-2 indicate that most aspects are scored "Moderate" pre-mitigation significance ratings. These aspects are all expected to be decreased to a "Low" post-mitigation significance rating with the application of mitigation measures, in specific, the adherence to the recommended buffer zone.

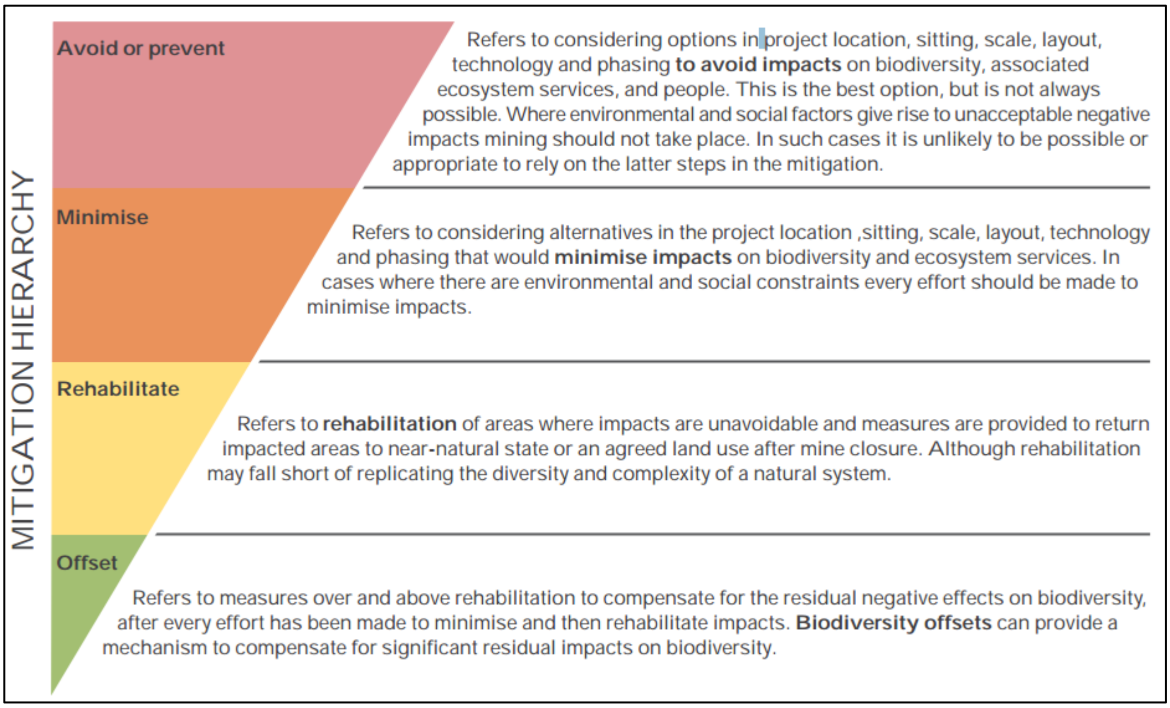

Figure 6-1 The mitigation hierarchy as described by the DEA (2013)

Figure 6-2 Photographs of the jumper rig planned to be used for the programme

Table 6-1 Typical Impacts expected for the various drilling programme aspects

Activity	Aspect	Risks
	Andrew Husted (Pr Sci Nat 400213/11)	
Phase	**Drilling Programme** **Vertical Holes / Drilling**	**Expected Impacts**
Construction / operation phase	Clearing of vegetation	Impeding hydro-dynamics;
	Stripping and stockpiling of topsoil	Siltation of water resources;
	Establish working area	Erosion of water resources;
	Drilling of hole	Loss of indigenous vegetation;
	Vehicle access	Altering hydromorphic soils;
	Leaks and spillages from machinery, equipment & vehicles	Drainage pattern change;
	Solid waste disposal	Direct loss of wetland areas;
	Human sanitation& ablutions	Decrease in functionality;
	Re-fuelling of machinery and vehicles	Additional water quality impairment.
	Laying of core samples	
	Backfill of material	
Decommission phase	Removal of structures, machinery, and equipment	Impeding hydro-dynamics; Siltation of water resources;
	Backfilling of hole	Additional water quality impairment.

Table 6-2 DWS Risk Impact Matrix for the proposed drilling programme (Andrew Husted Pr Sci Nat 400213/11)

Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes
Construction	Clearing of vegetation	Impeding the flow of water. Siltation of watercourse. Water quality impairment.	3	2	3	3	2.75	1	1	4.75	1	3	5	3	12	57	Moderate	Section 6.2	Low
	Stripping and stockpiling of topsoil		3	3	3	2	2.75	1	1	4.75	1	3	5	3	12	57	Moderate	Section 6.2	Low
	Establish working area		2	2	2	2	2	2	1	5	1	3	5	3	12	60	Moderate	Section 6.2	Low
	Digging of sump (lining), if applicable		3	4	2	3	3	1	1	5	1	3	5	3	12	60	Moderate	Section 6.2	Low
	Vehicle access		1	2	1	3	1.75	2	1	4.75	2	2	5	3	12	57	Moderate	Section 6.2	Low
	Leaks and spillages from machinery, equipment & vehicles		1	3	1	2	1.75	2	1	4.75	2	2	1	3	8	38	Low	Section 6.2	Low
	Solid waste disposal		1	2	1	3	1.75	2	1	4.75	2	2	1	3	8	38	Low	Section 6.2	Low
	Human sanitation& ablutions		1	2	1	3	1.75	2	1	4.75	2	2	1	2	7	33.25	Low	Section 6.2	Low
	Re-fuelling of machinery and vehicles		1	2	1	1	1.25	1	1	3.25	2	2	1	2	7	22.75	Low	Section 6.2	Low
	Laying of core samples		1	1	2	2	1.5	1	1	3.5	2	2	1	3	8	28	Low	Section 6.2	Low
	Backfill of material		1	1	1	2	1.25	1	1	3.25	1	2	5	3	11	35.75	Low	Section 6.2	Low
Deco	Removal of structures, machinery, and equipment	Impeding the flow of water.	1	1	1	2	1.25	1	2	4.25	2	3	1	2	8	34	Low	Section 6.2	Low

	Backfilling of hole	Siltation of watercourse. Water quality impairment.	1	1	1	1	1	1	2	4	1	1	1	2	5	20	Low	Section 6.2	Low

6.1 Recommendations

The following recommendations are provided:

- It is recommended that all drill sites be located outside (or beyond) the 30 m buffer zone;
- Drill sites must be decommissioned and rehabilitated on completion of drilling each hole, and not left to be rehabilitated on completion of the drilling programme; and
- Existing access routes should be prioritised for the programme, with all newly required features adhering to the buffer zone.

6.2 Mitigation Measures

The following mitigation measures are typically prescribed:

- Adhere to the 30 m buffer zones;
- Restrict all drilling related activities to within the designated footprint area;
- Use wetland spatial data, load it onto a GPS and use it to mark out the prescribed 30 m buffer on the boundary of a wetland;
- Retain as much vegetation cover as possible for all selected routes and working areas;
- Removed vegetation should be preserved and replaced for rehabilitation of the drill sites. Rehabilitation should be completed for the closure of each hole, and not at the end of the drilling programme;
- Promptly remove all alien and invasive plant species that may emerge during drilling (i.e. weedy annuals and other alien forbs) must be removed;
- The use of herbicides is not recommended in or near wetlands (opt for mechanical removal);
- Appropriately stockpile topsoil cleared from the project area. This can be used for rehabilitation of the drill site;
- Clearly demarcate drill site footprint area, and limit all activities to within this area;
- Minimise unnecessary clearing of vegetation;
- Landscape and re-vegetate all denuded areas as soon as possible;
- Re-instate topsoil and lightly till disturbance footprint;
- Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) or construction materials on site (e.g. concrete) in such a way as to prevent leaks;
- Provide appropriate sanitation facilities and service them regularly;
- Site establishment must be undertaken in an orderly manner and all amenities must be installed before the onset of drilling;

- All contractors and labour must undergo environmental awareness training, and be encouraged to maintain a "clean" working area, and report any (potential) risks to the environment as a result of the drilling programme;
- All structures must be temporary and should preferably be pre-fabricated or constructed of re-usable/recyclable materials;
- A method statement is required from the Contractor(s) that includes the layout of the drilling site, amenities and wastewater / water management during drilling;
- Ablution facilities with chemical toilets must be provided for all labour. The labour must be encouraged to make use of the ablution and under no circumstances shall indiscriminate excretion and urinating be permitted other than in supplied facilities;
- The locations of domestic waste areas, contractors camp and placement of ablution facilities must be demarcated on an approved site plan. The temporary storage of domestic waste shall be in covered bins, but these must be emptied on a weekly basis;
- The Contractor should supply sealable and properly marked domestic waste collection bins and all solid waste collected must be disposed of at a licensed disposal facility;
- The Contractor must be in possession of an emergency spill kit that must be complete and available at all times on site;
- Any possible contamination of topsoil by hydrocarbons, concrete or concrete water must be avoided. Any contaminated soil must be treated *in situ* or be placed in containers and removed from the site for disposal in a licensed facility;
- Drip trays or any form of oil absorbent material must be placed underneath vehicles/machinery and equipment when not in use;
- No storage of vehicles or equipment will be allowed outside of the designated drilling site or contractor's camp area. Make use of existing tracks and routes as much as possible before new routes are constructed;
- No servicing of equipment on site unless absolutely necessary. Leaking equipment must be repaired immediately or be removed from site to facilitate repair;
- All vehicles and equipment must be well maintained to ensure that there are no oil or fuel leakages; and
- All disturbed and compacted footprint areas must be rehabilitated and landscaped after drilling is complete. These areas must either be rehabilitated to the original land use or an agreed upon land use.

7 Conclusion

Two HGM units were identified within the 500 m regulated area, namely a floodplain system and numerous depressions (or pans). The average ecosystem service scores for the two HGM types were rated as “Intermediate”. Ecosystem services contributing to these scores include flood attenuation, streamflow regulation, sediment trapping, phosphate assimilation, nitrate assimilation, toxicant assimilation, erosion control and biodiversity maintenance. The overall present ecological state for the HGM types was determined to be “Moderately Modified” (class C). The ecological importance and sensitivity of the floodplain and depressions was determined to be “High” and “Moderate” respectively. A 30 m post-mitigation buffer zone has been calculated and recommended for the proposed prospecting activities.

The potential risks posed to wetlands were based on the DWS Section 21 (c) and (i) Risk Assessment matrix. A number of drill sites are located within the delineated wetlands. It is apparent from the risk assessment that some aspects considered for the drilling programme pose a Medium Risk (pre-mitigation) due to the localities of some sites being within the wetlands. The Low Risk (post-mitigation) expected for all the drilling aspects is attributed to the adherence to the 30 m buffer zone. Further to this, mitigation measures have been prescribed which will further contribute to a reduced risk level. Due to the Low Risk post-mitigation, a General Authorisation is permissible for the drilling programme. All recommendations and mitigation measures are to be implemented for the project.

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