Wetland Baseline and Risk Assessment for the proposed Doornrug Cemetery Project

Emalahleni, Gauteng

February 2022

CLIENT

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Report Name	**Wetland Baseline and Risk Assessment for the proposed Doornrug Cemetery**
Submitted to	AmberEarth
Report Writer & Fieldwork	**Rian Pienaar** Rian Pienaar is an aquatic ecologist (Cand. Sci. Nat. 135544) with experience in wetland identification and delineations. Rian completed his M.Sc. in environmental science at the North-West University Potchefstroom Campus. Rian have been part of wetland studies for road and culvert upgrades, power station and dam construction.
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 principles of science.

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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

Freshwater Ecologist

The Biodiversity Company

February 2022

1 Introduction

The Biodiversity Company was commissioned to conduct a wetland baseline and impact (risk) assessment, as part of the environmental authorisation (EA) process for the proposed Doornrug Cemetery project.

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). This notice was published in the Government Gazette (no. 40229) under Section 39 of the National Water Act (Act no. 36 of 1998) in August 2016, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 509 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). 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). This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation.

One wetland site visit was conducted on 27th 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 in the area of study and 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 project; and
- Recommendations relevant to associated impacts.

2 Receiving Area

The Biodiversity Company (TBC) was appointed to conduct a wetland baseline and impact assessment comprising baseline information and also a high-level impact identification and assessment for the Environmental Authorisation (EA) for the proposed Doornrug Cemetery development.

The project area is located approximately 16 km west of Emalahleni and approximately 12 km east of the Mpumalanga-Gauteng border, Mpumalanga (see Figure 2-3). The dominant land uses surrounding the project area includes watercourses, cultivation, urban sprawls and mining.

2.1 Vegetation Types

The project area falls within the Rand Highveld Grassland (GM11) vegetation type according to Mucina & Rutherford (2006).

The distribution of the Rand Highveld Grassland ranges between the North-West, Gauteng, Free State and Mpumalanga provinces. This vegetation type can be found between rocky ridges specifically between Witbank and Pretoria. The Rand Highveld Grassland extends into these ridges in the Stoffberg area as well as west of Krugersdorp stretching all the way to Potchefstroom. The preferred altitude for this vegetation type is between 1300 m and 1635 m above sea level.

Grass species commonly found in these regions include the genera *Themeda. Eragrostis, Elionurus* and *Heteropogon*. The diversity of herbs is high in these regions with rocky ridges and hills being colonized by sparse woodlands accompanied by a rich suite of shrubs with the genus *Rhus* making up the bulk thereof. The sparse woodlands in this vegetation type includes species like *Protea caffra* subsp., *Caffra, Acacia caffra, P. Welwitschii* etc..

2.2 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Bb 16 land type. The Bb land type consists of plinthic catena. Upland duplex and margalitic soils are rare and dystrophic and/or mesotrophic red soils are not wide spread. Figure 2-1 illustrates the respective terrain units relevant to the Bb 16 land type.

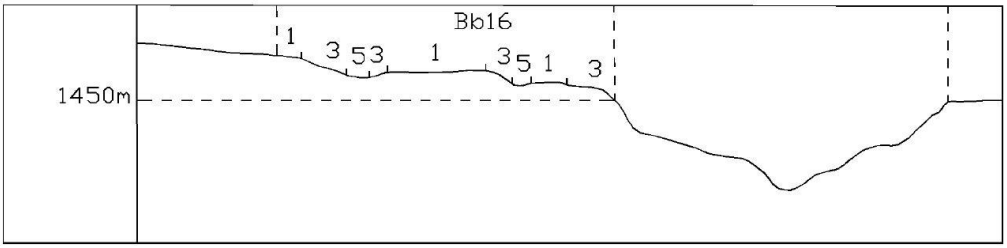

Figure 2-1 Illustration of land type Bb 16 terrain units (Land Type Survey Staff, 1972 - 2006)

The geology of this vegetation type is characterised by the Pretoria group and the Witwatersrand Subgroup's quartzite ridges as well as the Rooiberg Group's Selons River Formation which is from the Transvaal Supergroup. The parent geology from this vegetation type supports shallow soils like Glenrosa and Mispah which typically forms on slopes and ridges where topsoil is likely to wash off.

2.3 Climate

The climate for the Rand Highveld Grassland is characterised by a summer rainfall with a mean annual precipitation of 654 mm which is slightly lower in the western parts of this vegetation type (see Figure 2-2). These areas are known to have warm-temperate conditions

with dry winters. The likelihood of frost however is greater in the western parts with the incidence of frost ranging from 30 to 40 days compared to the east which has a frost incidence of 10 to 35 days (Mucina & Rutherford, 2006). This vegetation type is also classified as endangered even though very little conservation has been done for this vegetation type.

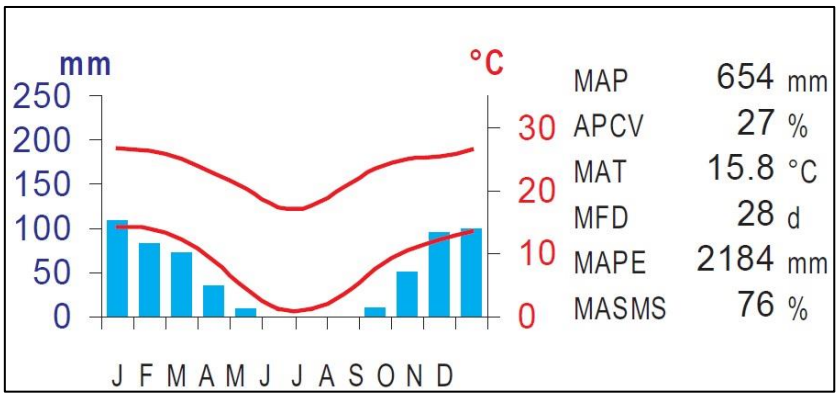

Figure 2-2 Climate for the Rand Highveld Grassland (Mucina & Rutherford, 2006).

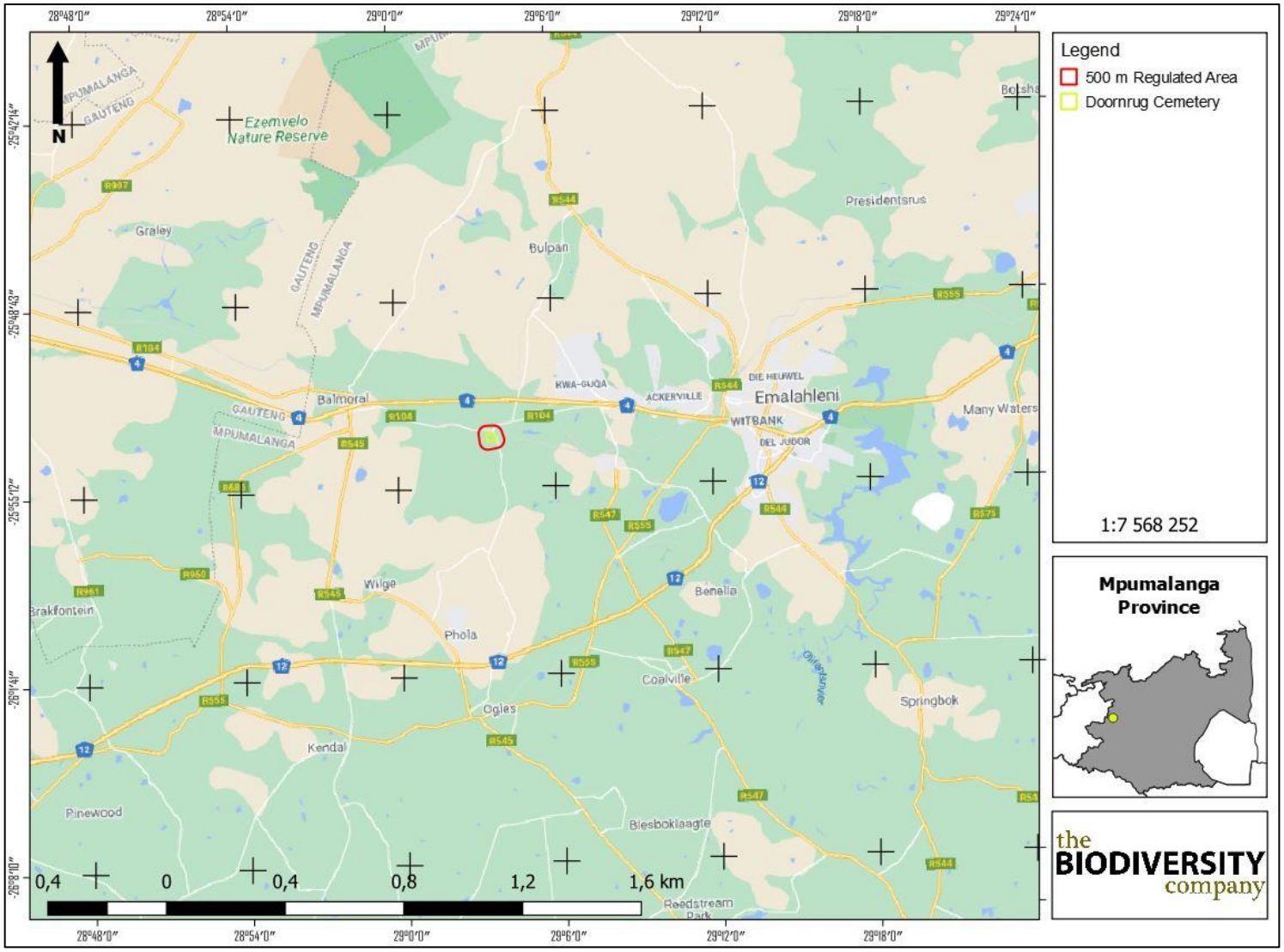

Figure 2-3 Locality map of the project area

2.4 Topographical Inland Water and River Line Data

One perennial stream has been identified within the proposed project area by means of the “2529” quarter degree square topographical river line data set. A single inland water area has also been identified within the 500 m regulated area (see Figure 2-4).

2.5 Mpumalanga Highveld Grassland Wetlands

The Mpumalanga Highveld Grassland Wetland Layer indicates additional wetlands within the 500 m regulated area, namely a channelled valley bottom, a floodplain wetland as well as a seep wetland (see Figure 2-5).

2.6 NFEPA Wetlands

Two types of NFEPA wetlands were identified within the MRA, namely channelled valley bottom wetlands as well as seeps (see Figure 2-6). The channelled valley bottom wetlands are classified as natural and the seeps are classified as artificial.

2.7 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 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE, 2018).

Two wetland types were identified by means of this data set, including a channelled valley bottom wetland and a hillslope seep (see Figure 2-4). The conditions of these wetlands are classified as “D/E/F” (heavily/critically modified).

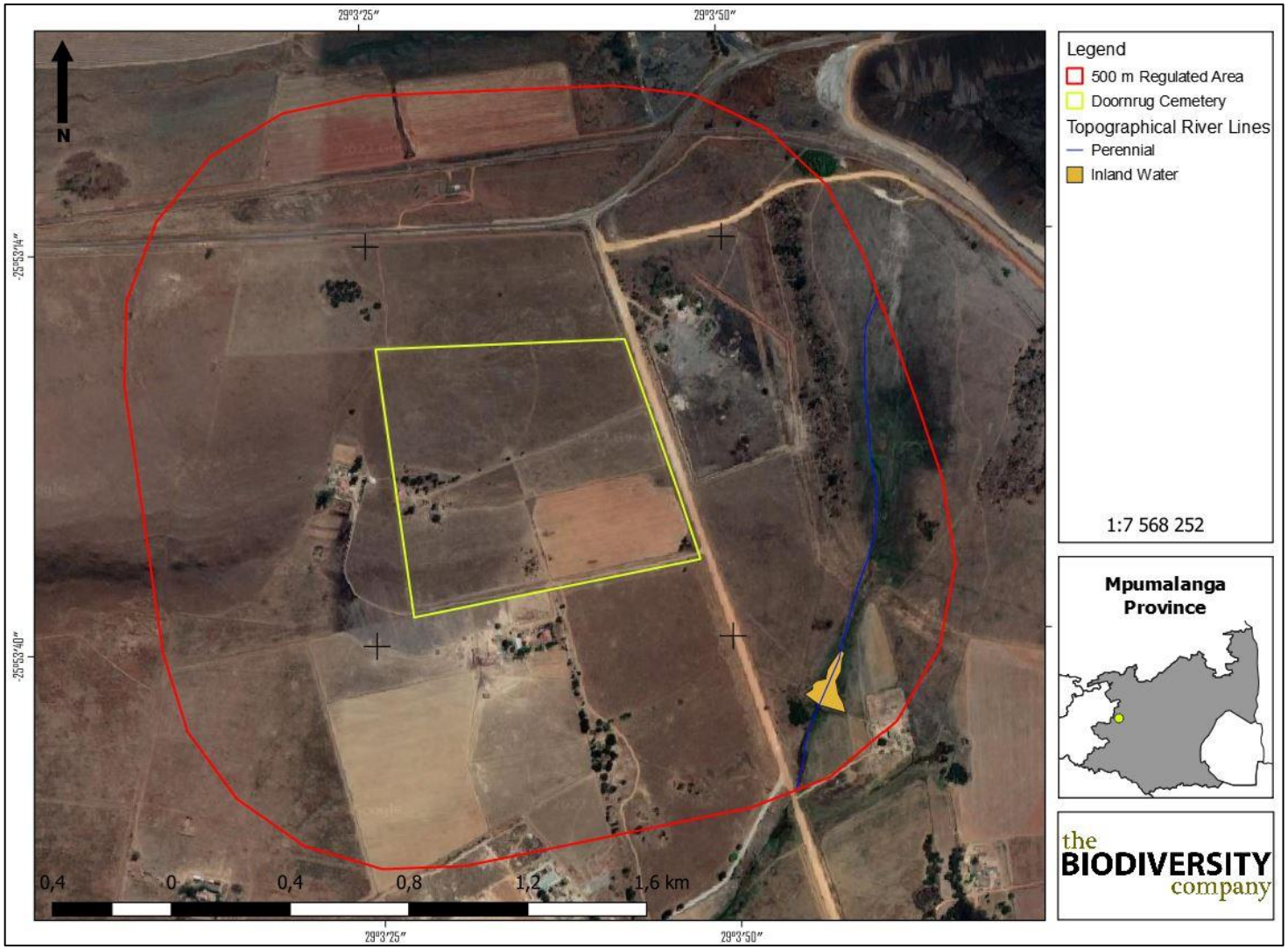

Figure 2-4 Illustration of topographical river lines and the inland water area located within the 500 m regulated area

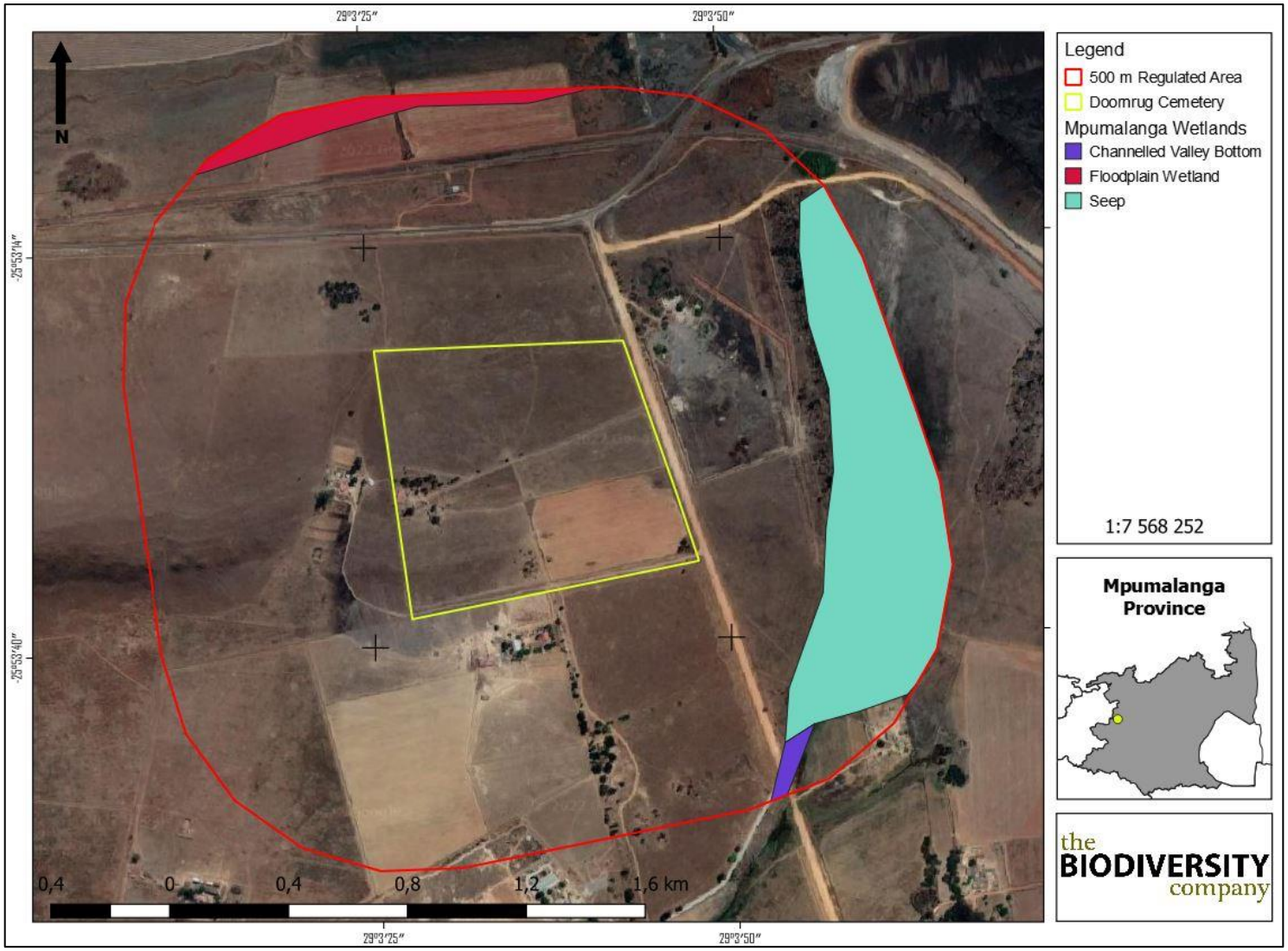

Figure 2-5 Wetlands located inside the 500 m regulated area according to the Mpumalanga wetland dataset

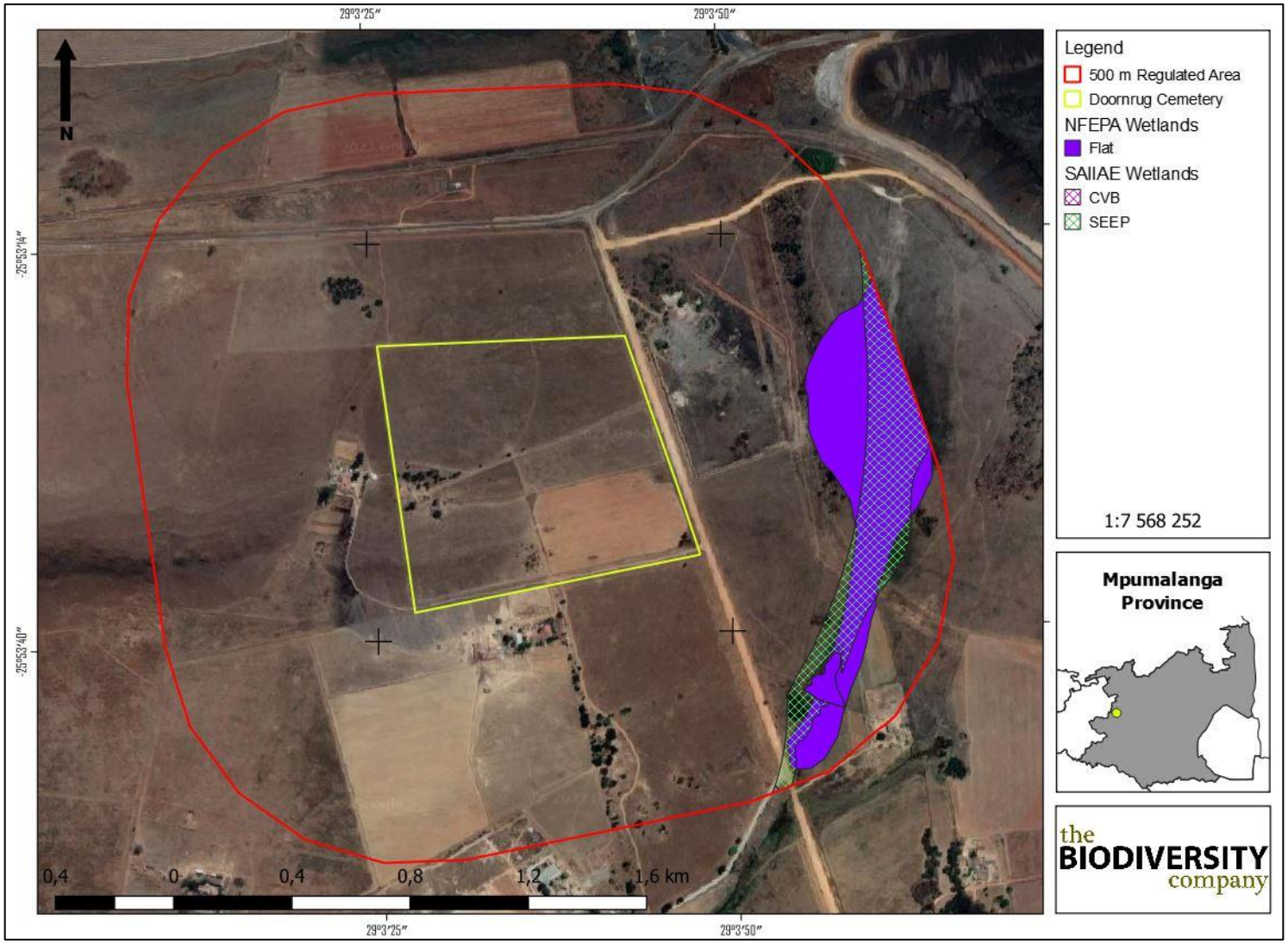

Figure 2-6 NFEPA and SAIIAE wetlands within the project area and its surroundings

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 Regulations as amended in April 2017, 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 Wetland 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.

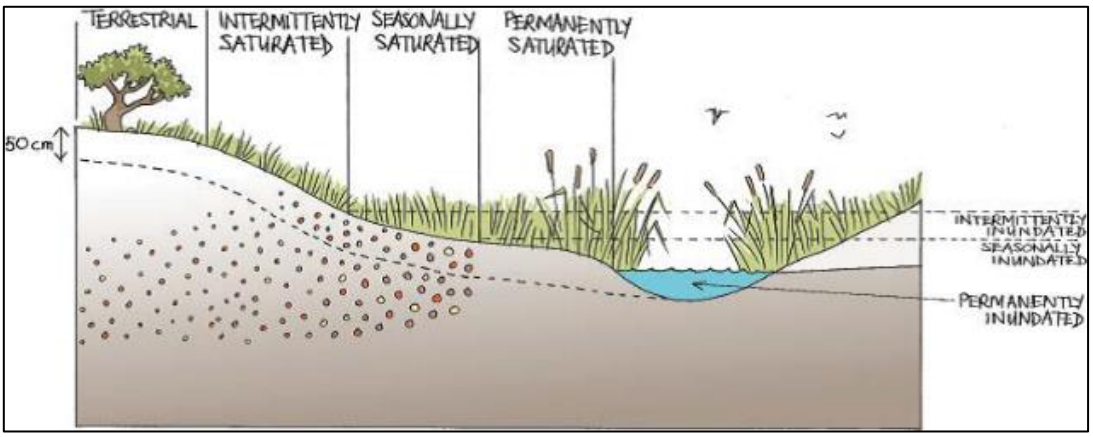

Figure 4-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al. 2013)

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 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 as 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

4.4 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 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**

4.5 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 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 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**

4.6 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).

4.7 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 assessment. Areas lacking these characteristics have not been focussed on;
- Multiple small drainage features are present within the 500 m regulated area, these drainage features do not constitute a wetland and thus are not delineated within this report;
- 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 meters. Therefore, the wetland delineation plotted digitally may be offset by a maximum of five meters to either side.

5 Results and Discussion

5.1 Wetland Delineation and Description

The wetland areas were delineated in accordance with the DWAF (2005) guidelines (see Figure 5-2). Two HGM units both unchannelled valley bottom has been identified within the 500 m regulated area (see Figure 5-1 and Figure 5-2). In addition, multiple drainage features were identified within the 500 m regulated area. These drainage feature although not classified as wetland areas still require conservation while the proposed activity takes place. These drainage systems have been excluded from the functional assessment. Some recommendations have been made to conserve the integrity of the drainage features.

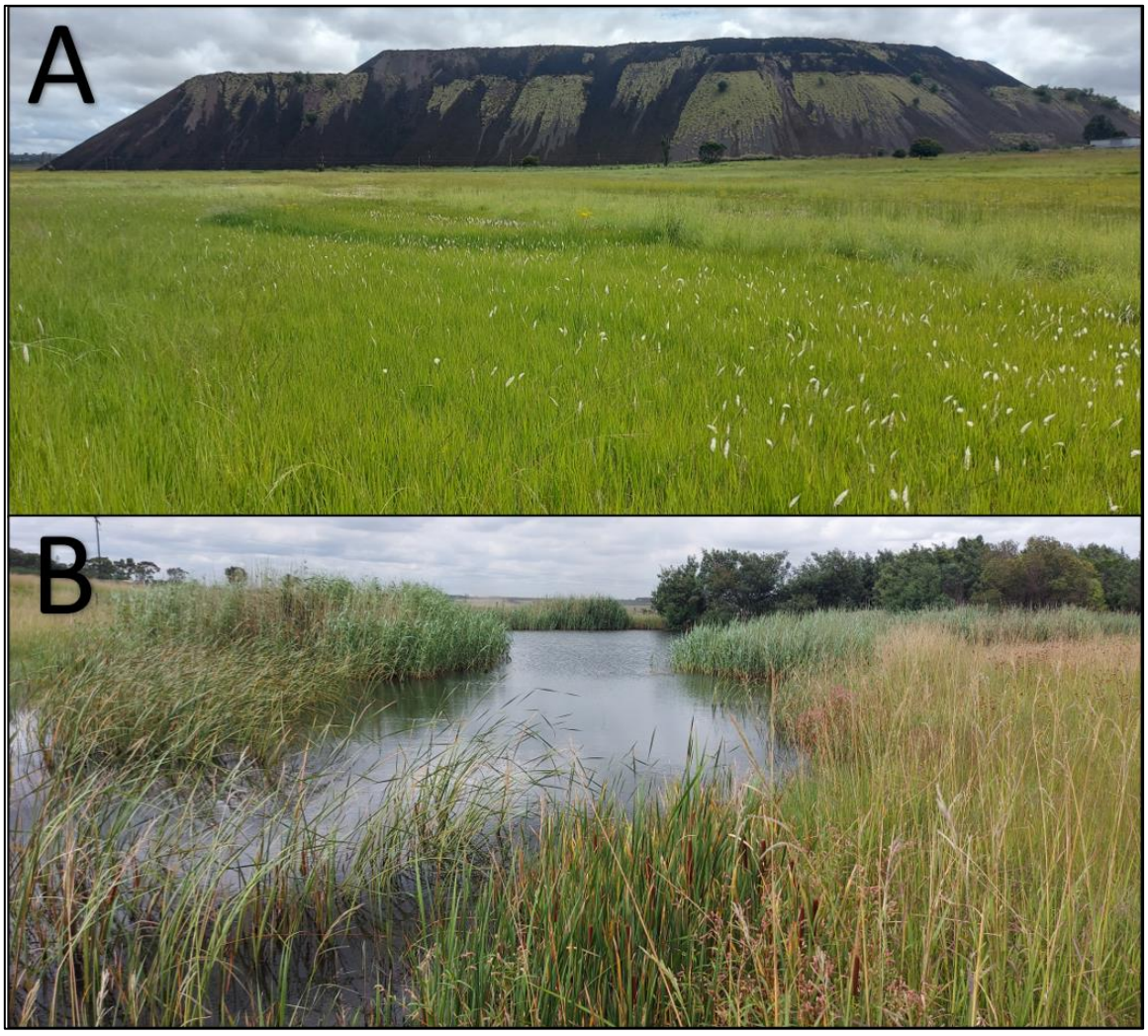

Figure 5-1 Examples of the different HGM units delineated within the project area. A) Unchanneled valley bottom at HGM 1, B) Dam located within the Unchannelled valley bottom at HGM 1.

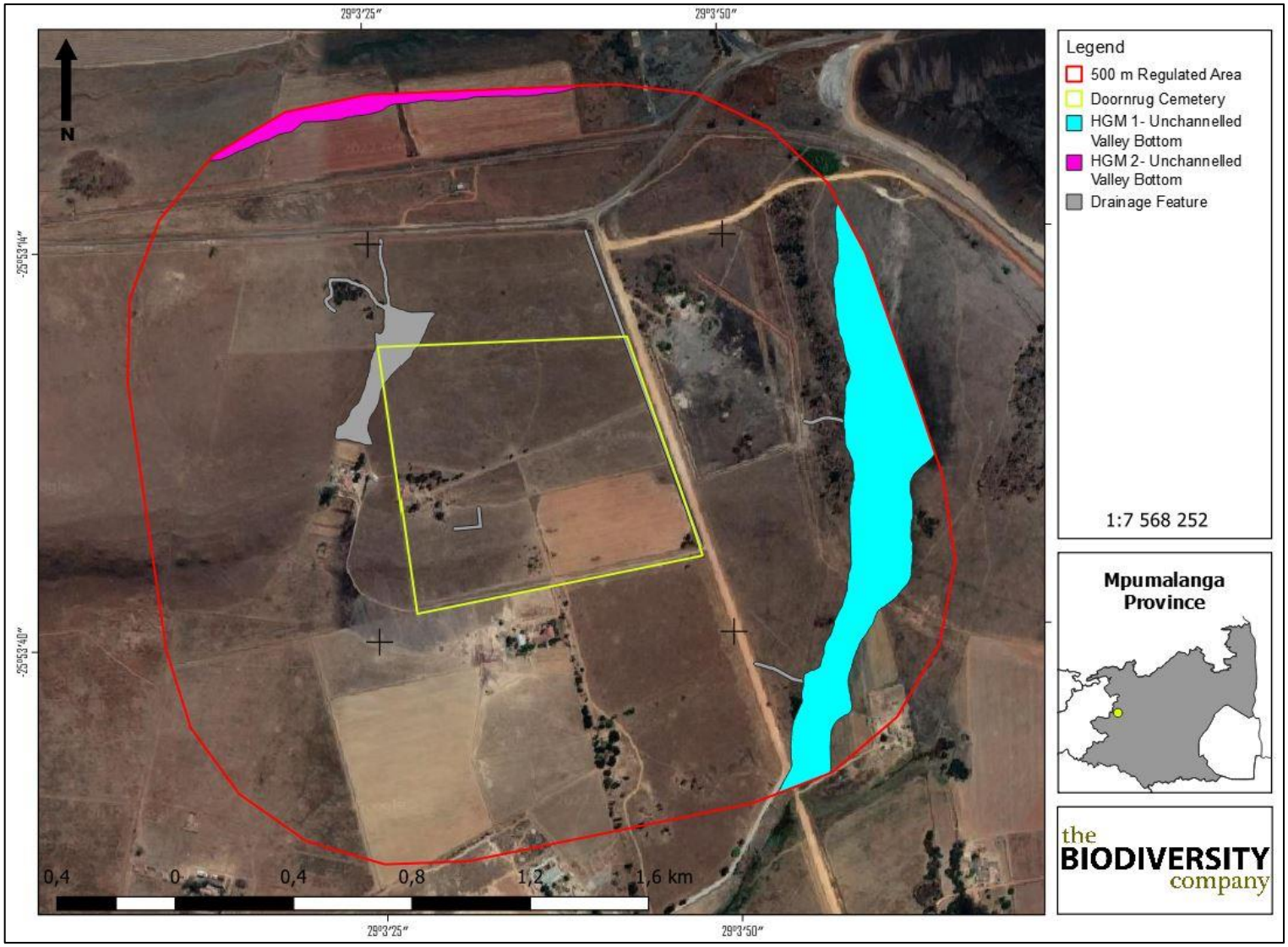

Figure 5-2 Delineation of wetlands within project area

5.2 Wetland Unit Identification

The wetland classification as per SANBI guidelines (Ollis *et al.,* 2013) is presented in Table 5-1. One wetland type was identified within the project area, namely an unchannelled valley bottom (HGM 1 and 2).

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 and 2	Inland	Highveld	Mesic Highveld Grassland Group 4	Valley Floor	Unchanneled Valley Bottom	N/A	N/A

5.3 Wetland Unit Setting

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

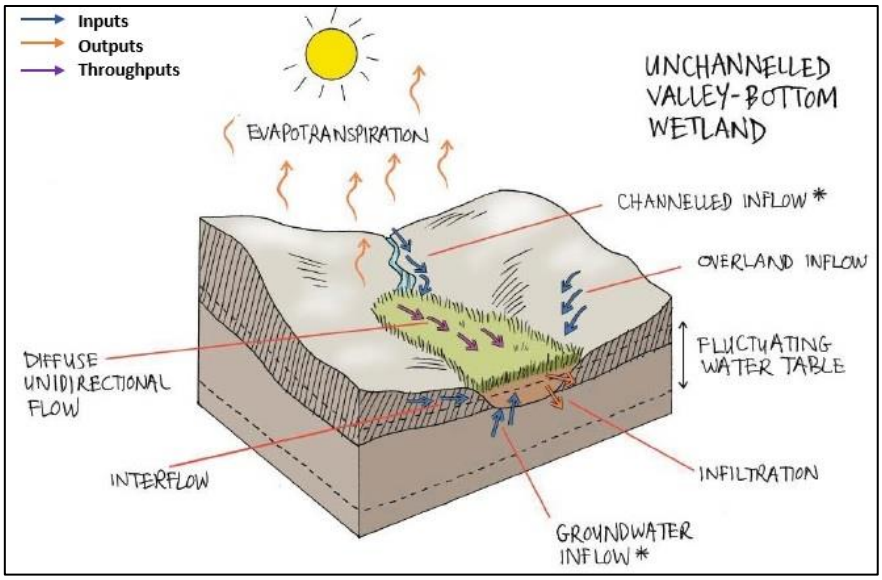

Figure 5-3 Amalgamated diagram of a typical unchanneled valley bottom, highlighting the dominant water inputs, throughputs, and outputs, SANBI guidelines (Ollis et al. 2013)

5.4 Wetland Indicators

5.4.1 Hydromorphic Soils

According to (DWAF, 2005), soils are the most important characteristic of wetlands to accurately identify and delineate wetland areas. Two dominant soil forms were identified within the delineated wetland, namely the Katspruit and the Rensburg soil forms (see Figure 5-4).

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

The Rensburg soil form consists of a vertic topsoil on top of an 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.

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).

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 repsectively. 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) is 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).

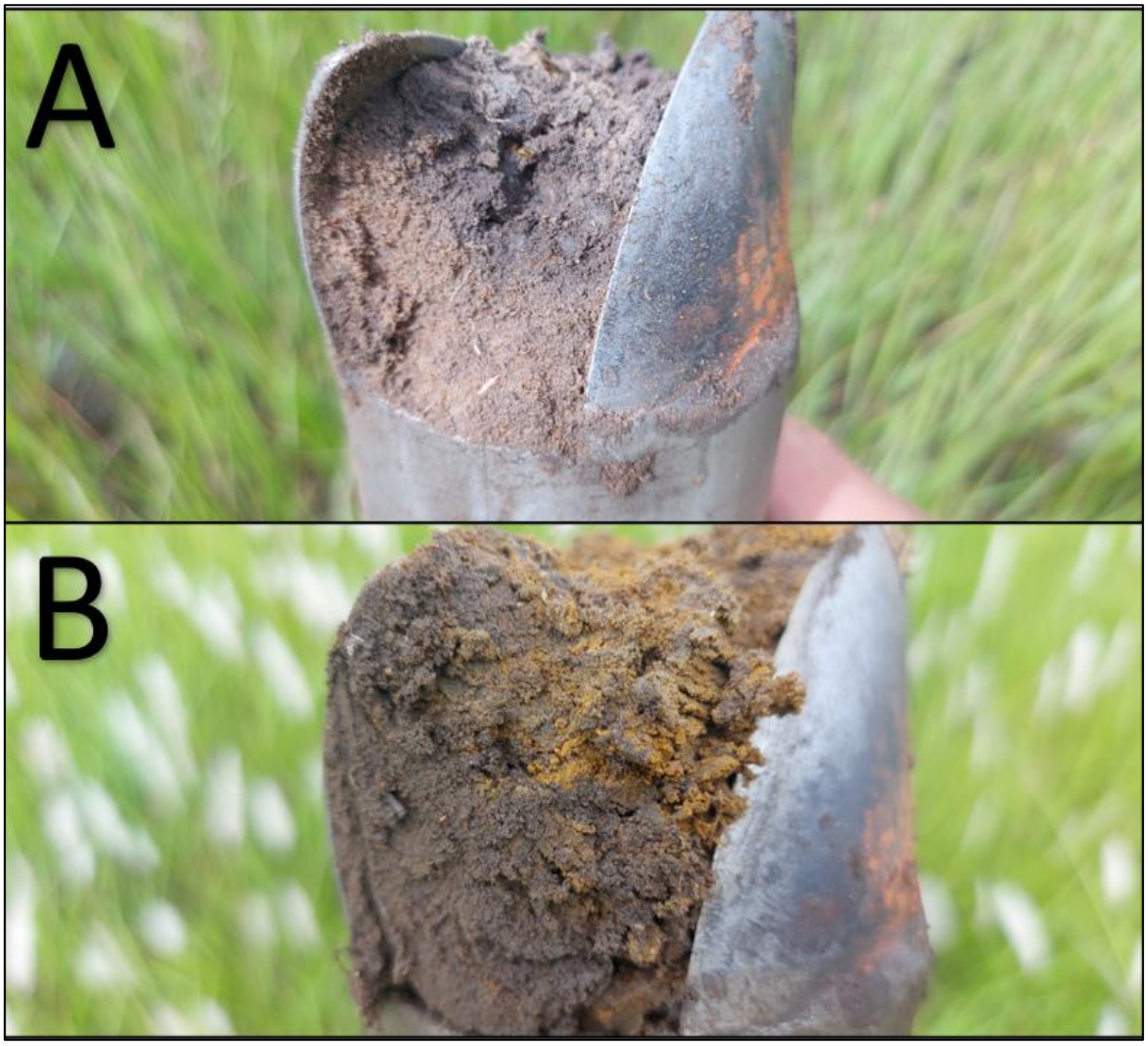

Figure 5-4 Relevant soil forms. A) Transition from orthic topsoil to gley subsoil. B) Orthic topsoil with signs of wetness.

5.4.2 Hydrophytes

Vegetation plays a considerable role in identifying, classifying and accurately delineating wetlands (DWAF, 2005). During the site visit, four dominant hydrophyte species (*Juncus effusus, Imperata cylindrica, Phragmites australis* and *Typha capensis* was identified within the delineated wetlands (see Figure 5-5).

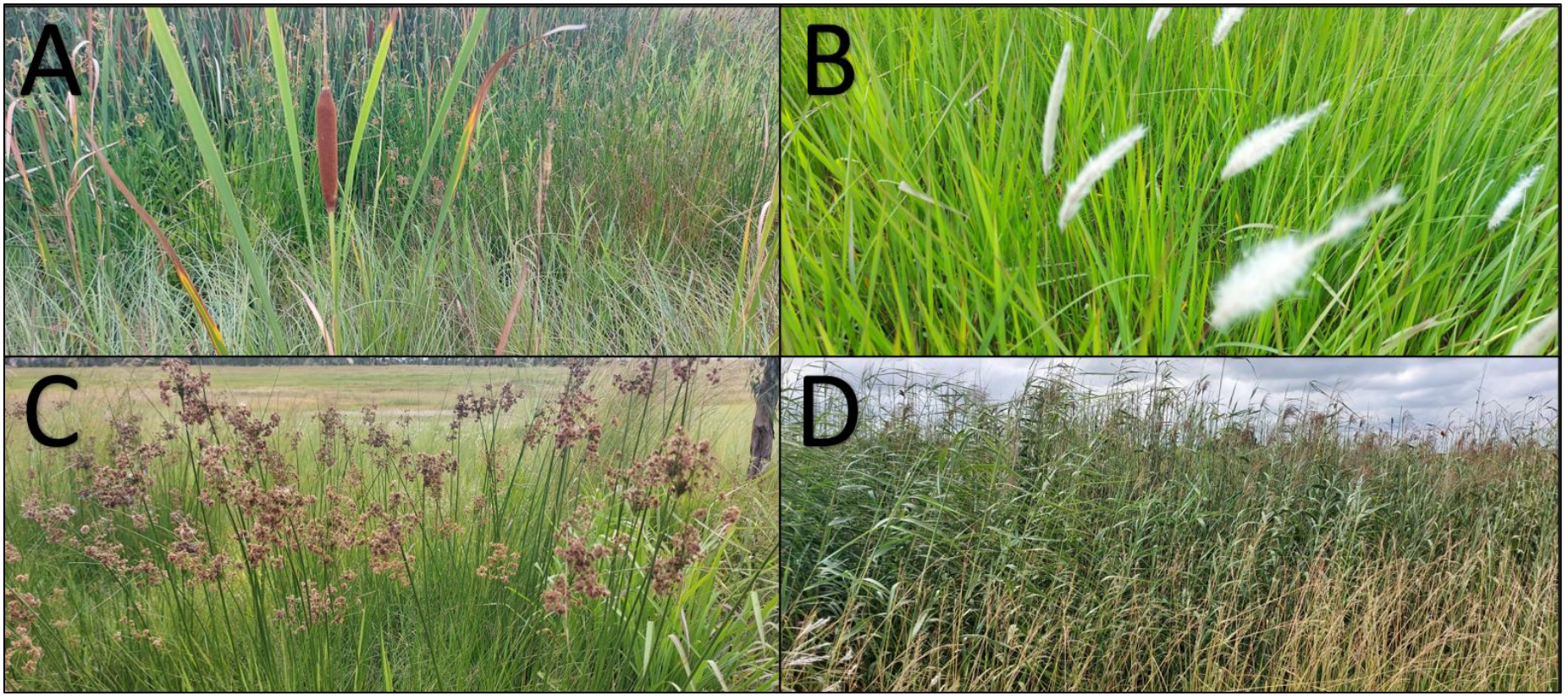

Figure 5-5 Hydrophytes identified within the delineated wetland. A) Typha capensis. B) Imperata cylindrica. C) Juncus effusus. and D) Phragmites australis.

5.5 General Functional Description

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

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.

5.6 Ecological Functional Assessment

The ecosystem services provided by the wetlands identified within the project area were assessed and rated using the WET-EcoServices method (Kotze *et al*. 2008) (Table 5-2). Overall, HGM 1 and 2 scored “Intermediate” for ecosystem servicess.

Both HGM units were classified as being unchannelled valley bottoms, which is known for their ability to attenuate floods, streamflow regulation and erosion control during wet seasons. HGM 1 scored a higher ecosystem services score for the assimilation of both phosphates and toxicants due to its location downstream of the mine. HGM 2 scored “Moderately High” ecosystem services scores for nitrate assimilation due to agricultural activities taking place inside the wetland’s catchment. Both the HGM units have high volumes of hydrophyte vegetation that plays an important role in the above-mentioned ecosystem services and help the HGM units to score “Moderately High” scores.

Both HGM units scored “Intermediate” to “Moderately Low” scores for the direct benefits such as provisioning for water, food and resources for human use. This is due to the fact that the wetlands are located in rural areas where there is little to no people to use the wetlands. The hydrophyte vegetation present within the wetlands consist mostly of sedges which is not regularly use by humans as resources. There is also little to no cultivation taking place within the wetlands to provide food. Looking at cultural benefits little to no information is available on the use of the HGM units for cultural activities and no evidence of any cultural activities were identified during the site visit. There was also no evidence of any tourism of recreational activities present within the HGM units. Although the HGM units are good examples of unchannelled valley bottoms there were no evidence of any educational activities taking place within the wetlands. During the site visit there was no evidence of any of the cultural benefits but it is not possible to rule out historical or short activities that might happen when specialist is not at site and thus the scores cannot be zero for these activities.

Table 5-2 Summary of the ecosystem services scores

Wetland Unit				HGM 1	HGM 2
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation	2.2	2.3
			Streamflow regulation	2.3	2.2
			Water Quality enhancement benefits: Sediment trapping	1.7	1.5
			Water Quality enhancement benefits: Phosphate assimilation	2.2	1.9
			Water Quality enhancement benefits: Nitrate assimilation	2.3	2.1
			Water Quality enhancement benefits: Toxicant assimilation	2.1	1.9
			Water Quality enhancement benefits: Erosion control	2.6	2.9
			Carbon storage	1.7	2.0
	Direct Benefits	Biodiversity maintenance		1.7	1.7
		Provisioning benefits	Provisioning of water for human use	1.6	1.4
			Provisioning of harvestable resources	1.8	1.8
			Provisioning of cultivated foods	1.2	1.2
		Cultural benefits	Cultural heritage	1.5	1.5
			Tourism and recreation	1.4	0.9
			Education and research	1.8	1.5
Overall				28.0	26.7
Average				1.9	1.8

5.7 Ecological Integrity

The PES of the wetlands identified within the project area is provided in Table 5-3. Overall, both HGM 1 and HGM 2 were rated as being in a “Largely Modified” (class D), which indicates a large degree of modification. The main modification to the wetlands are to the hydrology of the wetlands due to modifications in the wetlands catchments as well as some modifications inside the wetlands themselves. Modifications to the catchments of both the HGM units consists of mining activities as well as agricultural fields surrounding the wetlands. The wetlands is also subjected to roads crossing through the wetlands altering waterflow within the wetlands. The modification to the wetlands catchments causes an increase in waterflow during raining season which leads to a modification in wetlands function. The increase in subwater flows due to the modification to the wetlands catchments has formed some channels within the HGM units are may lead to erosion and the loss of sediment within the wetlands.

The wetlands have also undergone modification to their vegetation cover due to the constructon of roads within the wetland as well as grazing of domesticated animals. There is also multiple alien invasive plant species present within the wetland which will out compete the natural hydrophytes if left unattended. Alien invasive plants takes up a lot of space as well as large volumes of water making the habitat less sutable for hydrophytes that plays an important role in wetlands function. Hydrophytes are important to help prevent ersosion and sedimenttation and the help provide clean water for the downstream areas.

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

Wetland	Area (ha)	Hydrology		Geomorphology		Vegetation	
		Rating	Score	Rating	Score	Rating	Score
HGM 1	11,3	D: Largely Modified	5.1	C: Moderately Modified	3.2	C: Moderately Modified	3.0
Overall PES Score		4.0		Overall PES Class		D: Largely Modified	
Wetland	Area (ha)	Hydrology		Geomorphology		Vegetation	
		Rating	Score	Rating	Score	Rating	Score
HGM 1	11,3	D: Largely Modified	5.7	C: Moderately Modified	3.5	D: Largely Modified	5.2
Overall PES Score		4.9		Overall PES Class		D: Largely Modified	

5.8 Importance & Sensitivity Assessment

The results of the IS assessment are shown in Table 5-4. 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 dataset. The IS for all the HGM units have been calculated to be “Moderate”, which combines the relatively high protection status of the wet veg type and the low protection status of the wetland itself.

Table 5-4 The IS results for the delineated HGM unit

HGM Type	Wet Veg			NBA Wetlands			SWSA (Y/N)	Calculated IS
	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018	Ecosystem Protection Level		
HGM 1 and 2	Mesic Highveld Grassland Group 4	Critical Endangered	Not Protected	D/E/F Seriously Modified	Critical	Poorly Protected	N	Moderate

5.9 Buffer Analysis

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 32 m is recommended for the identified wetland, which can be decreased to 15 m with the implementation of all prescribed mitigation measures (see Figure 5-6).

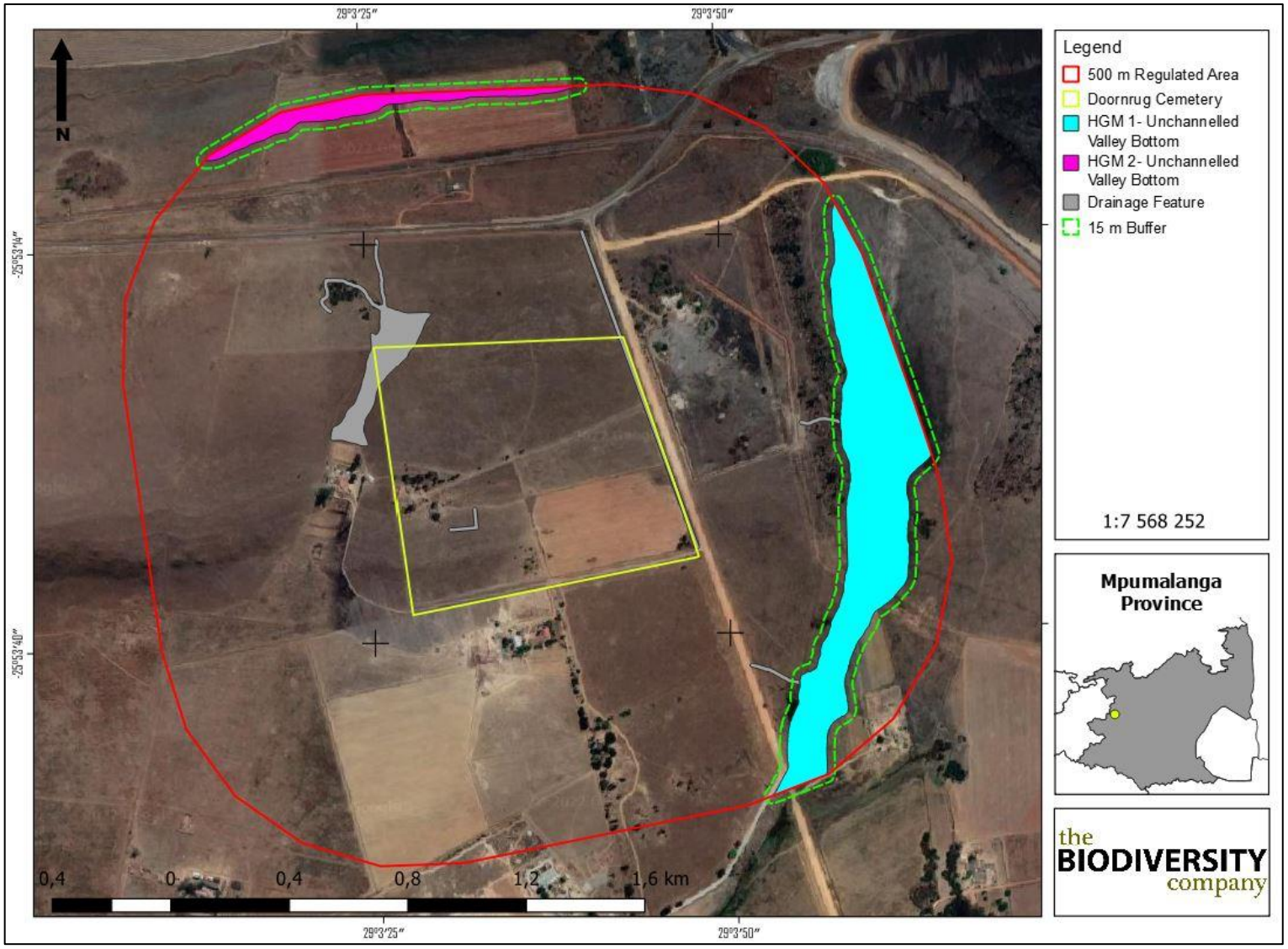

Figure 5-6 Recommended buffer zone of the delineated wetlands

6 Risk Assessment

The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 6-1). 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. The buffer section illustrates the extent of the recommended buffer zones for the identified wetlands. It is evident from these illustrations that the proposed activity is located well outside of any natural wetland systems (in excess of 300 m) (see Figure 6-2). Considering the distance between the proposed cemetery development as well as the fact that the area between the proposed activity and the relevant HGM units is characterised by Glenrosa soil forms with deep, freely drained orthic topsoil with a lithic subsoil (which completely eliminates overland flow), no indirect risks are foreseen.

In regard to the drainage features located within close proximity to the proposed development, it is important to keep in mind that drainage features can transport some impacts from the development towards the HGM unit downslope. The above mentioned fact makes it important to have a stormwater management plan in place to ensure that no overland flow volumes originating from the developement area is concentrated within these drainage features. Considering these statements, it's clear that the first step in the mitigation hierarchy, namely avoidance will be met and that no risks are expected.

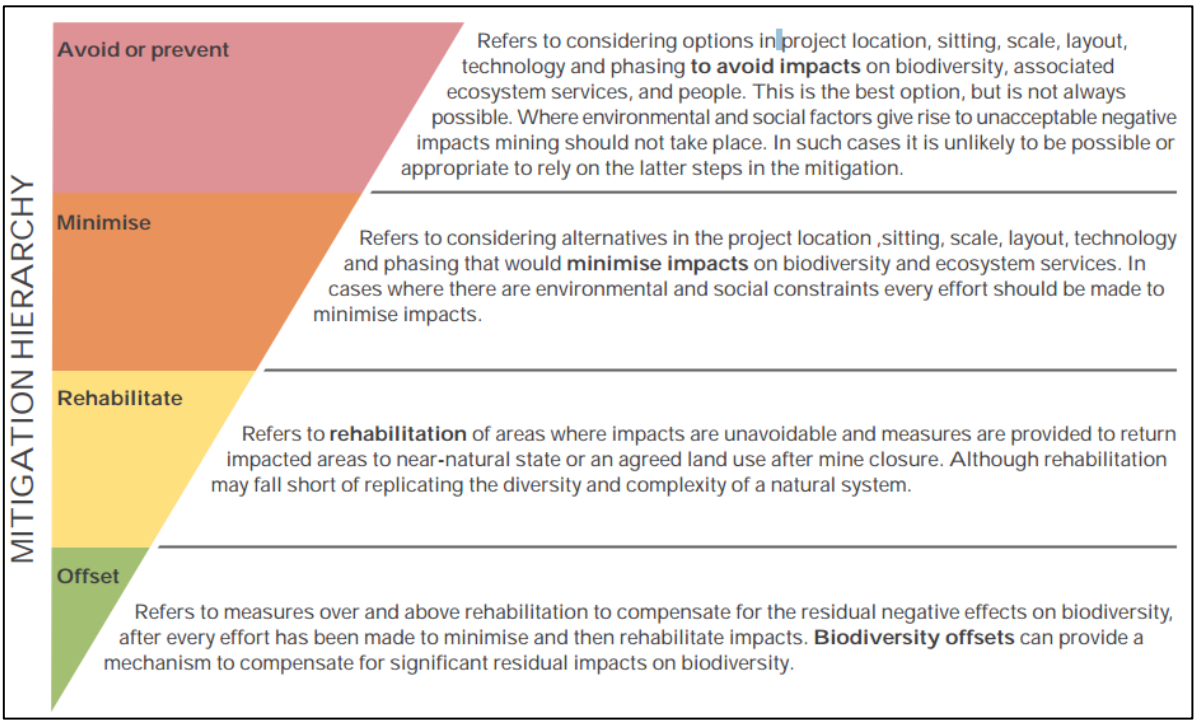

Figure 6-1 The mitigation hierarchy as described by the DEA (2013)

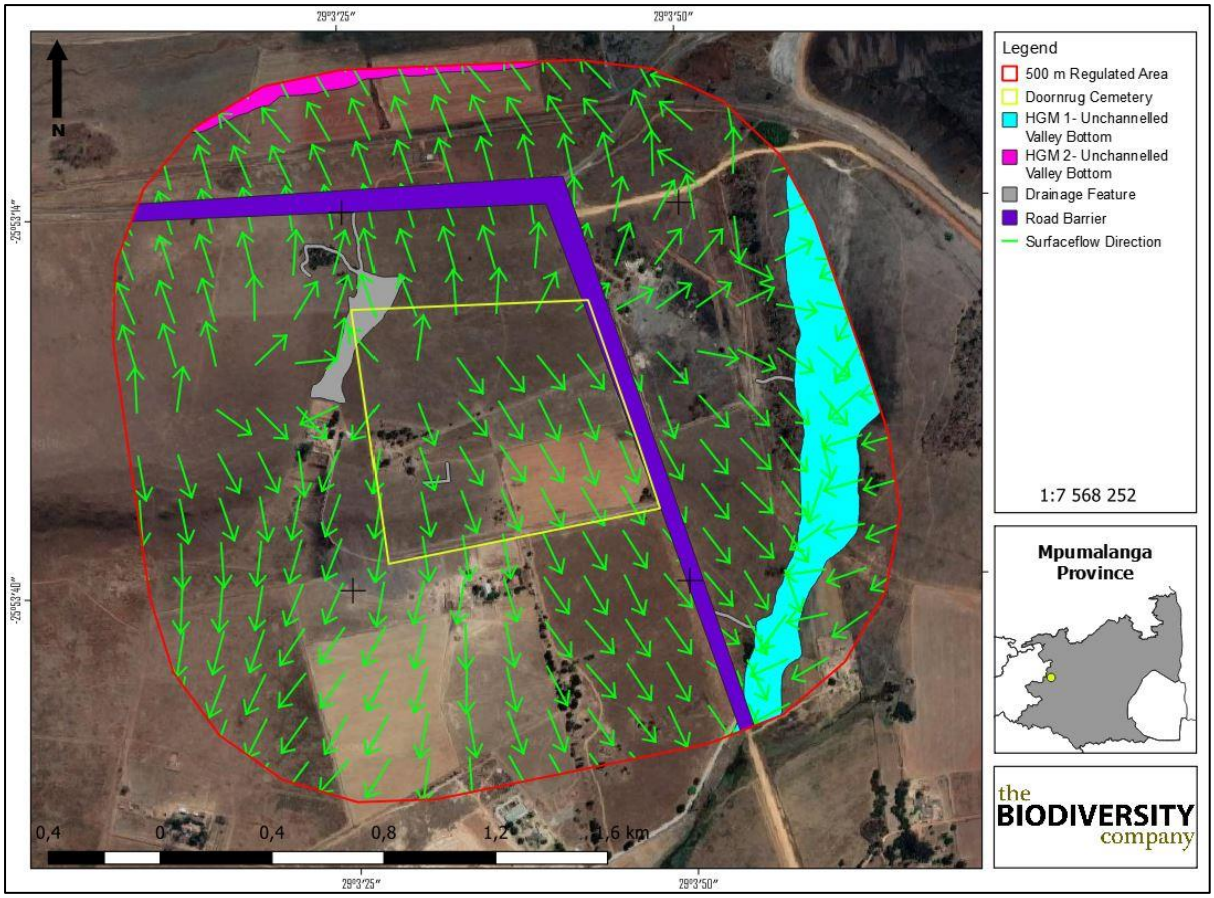

Figure 6-2 Surface flows within the project area with road barriers preventing surface flow into wetlands

6.1 Mitigation Measures

The following mitigation measures are prescribed to ensure the conservation of wetlands by limiting any indirect impacts;

6.1.1 General

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

- 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 demarcated 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;
- All waste generated on site during construction must be adequately managed. Separation and recycling of different waste materials should be supported;

6.2 Recommendations

The following recommendations have been made to ensure the conservation of the delineated wetlands during the construction and operational phase;

- It is recommended that a stormwater management plan be implemented for the cemetery. This is to prioritise the appropriate management of surface water;
- A condition for the Environmental Authorisation should be the bi-annual monitoring of surface water in both the HGM units during the operational phase of the cemetery. In

the event contamination of the system by the functioning of the cemetery is recorded, reactive measures must be taken and the issuing authority consulted in this regard; and

- A 15 m buffer area must be adhered to for the identified watercourse within the 500 m regulated area.

7 Conclusion

7.1 Baseline Ecology

Two HGM units were identified within the 500 m regulated area, of which both have been classified as unchanneled valley bottom wetlands. The average ecosystem service scores for the HGM units were rated as “Intermediate”. The integrity of the systems was determined to be “Largely Modified” (class D). The ecological importance and sensitivity of the delineated wetlands was classified as “Moderate”. A 15 m post-mitigation buffer zone has been calculated and recommended for the proposed housing development.

7.2 Impact Statement

No wetland systems are located within the project area, thus all direct risks to wetlands are avoided. Considering the distance between the proposed activity as well as the fact that the area between the proposed cemetery and the relevant HGM units are characterised by the Glenrosa soil forms with deep, freely drained orthic topsoil with a lithic subsoil (which completely eliminates overland flow), no indirect risks are foreseen.

Since no risks are expected towards natural wetland systems, it is recommended that the proposed activities may proceed without the application for a water use license or general authorisation.

Due to the presence of drainage lines/features in relation to the project area, the following Listing Notice is applicable:

Regulatory authorisation required	Zone of applicability
Listed activities in termsof the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended. Department of Environmental Affairs and Development Planning (DEA&DP)	Activity 12 of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) states that: *The development of:* *(xii) Infrastructure or structures with a physical footprint of 100 square meters or more;* *Where such development occurs—* *a) Within a watercourse;* *b) In front of a development setback; or* *c) If no development setback has been adopted, within 32 meters of awatercourse, measured from the edge of a watercourse.*

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