



(EIA) AQUATIC SPECIALIST ASSESSMENT REPORT
Proposed Grimbeek park township establishment-JB Marks local
Municipality-in Potchefstroom



Report number	AfrgriembeekbiodAQR2025
Project Title	Grimbeek park township establishment.
Client	Vhuluvhi group

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Declaration by specialist

I Mugwabana Fhatuwani Hendrick declare that: this report is certified correct and represents the findings on the proposed site capability and suitability to support intended development. I declare that this report reflects a true reflection of what exists on site, and we have no conflict of interest in the project proposed. I act as the independent specialist in this application.

I will perform the work relating to the application objectively, even if this results in views and findings that are not favorable 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 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 realize that a false declaration is an offense in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signed: 

Date: 30/10/2025

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Executive Summary

The proposed township development falls within JB Marks Local Municipality, North west Province. This appointment includes providing aquatic biodiversity study undertaken by Africa Ecological services to compile a supporting the proposed township development. This aquatic biodiversity report has evaluated the extent to which the aquatic environment is likely to be impacted; and analyzed the current existing environmental impacts and recommended the preventative and control measures.

The focus of the study was to map; survey and assess aquatic systems and associated resources impacts within the existing site of the proposed development footprint and 200-meter radius boundaries of the development proposed. The study also required Wetland delineation and relevant buffers to be applied where applicable.

Township establishment can have significant impacts on aquatic vegetation in various ways. These include direct vegetation clearance or removal, introduction of alien plants, alteration of microhabitats, soil erosion and compaction. Although township establishment is necessary for the development that entails homes and work opportunities, it requires careful consideration of environmental impacts on aquatic vegetation and ecosystems.

A site visit was conducted on the 15th of April 2025, and this constituted a later summer 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 them to take an informed decision. Authorization for the proposed development will be dependent on the specialist's recommendations which are aligned to the findings. Should the development be undertaken

with the ignorance of the indicated measures and recommendations any post damage or negative impacts will remain the responsibility of the developer.

According to the surveys undertaken, the study site is in an area that is currently used for grazing; the other farm portions are being used for the ploughing of crops.

The sensitivity study which was done revealed that the site is covered by 50m buffer flood plain that forms part of the Mooi river Perennial River and falls within Rand highveld grassland.

The aquatic sensitivity of the site is very high. Hydropedology assessment was done and confirmed the site water flow to be subsurface water flow mostly influenced by rainfall recharge. The plan designs must avoid the indicated protected areas that are no-go areas together with the irreplaceable areas indicated on the sensitivity map and other google based maps that have clear background.

During the site survey, no aquatic faunal species of conservation concern were encountered on site. Their absence could be explained by the habitat fragmentation and daily presence of humans in the area and grazing. A vegetation survey revealed that the site has been exposed to continuous disturbance from uncontrolled veld fires, grazing and alien invasion. Rand Highveld Grassland is the one that occupies the geographic area with it being made up of mixed secondary vegetation and invasive alien plants that require eradication.

The Mooi River is currently classified as a class III water resource, meaning it is heavily impacted by human activity but nevertheless ecologically sustainable. The recommended ecological category for the Mooi River is C/D, indicating it is moderately to largely modified (DWA, 2016). The Mooi River is mainly impacted on by mining and agricultural activities that are being taking place in the catchment.

It is the opinion of the specialist that this application should be considered, provided that all recommendations and mitigations are strictly adhered to and any further additional measures that might arise also get the involvement or seek continuous advice from the specialist.

1 Introduction

Aquatic studies are referred to or defined as a study that focuses on fauna and flora that are living in or near water. It is further explained as the natural environment that is characterized by visible or surface water, flowing river, wetlands and stream. The term "wetland" is a generic term for all the different kinds of habitats where the land is wet for some period each year, but not necessarily permanently wet. Wetlands are found where the landform (topography) or geology slows down or obstructs the movement of water through the catchment, or where the groundwater surfaces causing the soil layers in the area to be temporarily, seasonally or permanently wet. This provides an environment where plants (hydrophytes) that are adapted to wet conditions tend to grow in abundance. The plants in turn affect the soil and hydrology by further slowing down the movement of water (e.g. reed beds) or by producing organic matter that may accumulate in the soil.

Wetlands are important because of the functions and values that they provide which benefit mankind. These benefits can be either direct or indirect benefits. Until very recently the benefits of wetlands to society were often not recognized, and many wetlands have been destroyed, or poorly managed. Wetland benefits refer to: "those functions, products, attributes, and services provided by the ecosystem that have value to humans in terms of worth, merit, quality or importance. These benefits may derive from outputs that can be consumed directly; indirect uses which arise from the functions or attributes occurring within the ecosystem; or possible future direct outputs or indirect uses" (Howe et al., 1991 in Kotze et al., 2005).

The functioning of aquatic resources is also affected by other factors, many of which result from the activities of people. These include "off-site" factors that take place in the surrounding catchment (e.g. a change in land cover from natural grassland to a gum tree plantation which would decrease the amount of water reaching the wetland) and "on-site" factors that take place at the wetland (e.g. fire, draining, damming, etc.).

A wetland delineation study was conducted on the study site to determine the presence and extent of wetland habitat for a proposed development accepting environment. The study area and its surroundings were surveyed, and it was found that no permanent wetlands are not present on the study area footprint where proposed development is intended. Vegetation indicators played a major role in determining the non-existence of wetland within the area.

Sensitivity assessment was done to investigate and determine the existence of wetlands in the study area. The intensive investigations that entailed both indicators for wetlands were used and for vegetation indicators the ones found were those that grown in non-wetland and wetland environments.

The sampling and analysis undertaken confirmed that there is no wetland within the floodplain which was inundated by water. Visual indicators confirmed that the affected area has large part covered by a flood plain was flowing water; water logged soil and maize that shows effects of water logging.



The aquatic ecology of the study area is affected by previously constituted agricultural practices and mining activities on the upper catchment.

1.1 Aim, scope, and objectives of the study.

The aims of the study were to:

- Verify the occurrence and typology of wetlands on the study site as delineated through desktop methods, and correct the delineation based on field-based assessment, thus enabling all wetlands on the study site to be mapped.
- Assess all wetland areas on the study site in the field.
- Based on the field assessment gain an understanding of the characteristics of the wetland, including hydrology, vegetation, soils, and geomorphology.
- Assess the possible impacts of the proposed developments on the wetlands, and suggest suitable mitigation measures, if relevant, to ameliorate or rehabilitate the damaged wetlands.
- Conduct Wet-Health for the determination of the Present Ecological State (PES) of the wetland.
- Conduct Wet-Eco Services for determination of ecosystem services. (Assessment of individual wetland ecosystem services.
- Assess the magnitude of impacts that could have occurred.
- Delineate wetland buffers as per the outcome of the field assessment.

1.2 Assumptions and Limitations

Detailed investigations were done through desktop surveys and field surveys for the affected area and the surrounding habitats to determine the wetland existence. The wetland survey was undertaken in the summer season (15th April 2025). This entails that the site was assessed during the summer season. All vegetation was green, vegetation gave a high confidence in the determination of a need for delineation or not as the wetland delineation is also based on primarily the analysis of soil-based indicators, terrain unit indicators, hydromorphic unit indicators, and water table and zonation. The predominantly grassy vegetation still displayed sufficient inflorescences to broadly identify the vegetative composition within the study area.

The primary aim of this aquatic study was the identification of human-driven impacts on the wetland, and determination of the buffer surrounding the wetland, in line with the stipulations of the Department of Water Affairs (DWAF) (DWAF, 2005), as well as the identification of potential impacts on the wetland associated with existing sand mining and other types of developments in the surrounding areas. Buffer zone guidelines for wetlands were used to assess the occurred impacts together with other various kinds of literature.

It was assumed that the area might be affected by a floodplain wetland hence this was not as their area was found to be having a-perennial stream associated with a 50m buffer flood plain. •

Analysis of the freshwater ecosystems was undertaken at a rapid level and did not involve detailed habitat and biota assessments

1.3 Definitions and the Legislative Framework and other agreements such as international agreements.

The proposed development must take into consideration the legislative requirements, policies, guidelines, and principles of the relevant regulatory documents such as the National Spatial Development Framework, the Local Municipality Integrated Development Plan (IDP), and National Biodiversity Plan; the provincial biodiversity sector plan and the National Environmental Management Act (NEMA).

The National Environmental Management Act (NEMA) outlines several principles that give guidance to developers, private landowners, members of the public, and authorities, of which principle number three of the act stipulates that development must be socially, environmentally, and economically sustainable. Section number 4(a) of the Act states that consideration should be given to all relevant factors which include ecosystem disturbance and loss of biological diversity must be avoided and prevented, and or where they cannot be completely avoided must be minimized, and mitigation measures applied; and that pollution and environmental degradation be avoided, and or where such cannot be completely avoided remedial action to the environment be instituted.

African Union climate change and resilient development strategy and action plan (2022-2032).

This strategy states the following

Principle 2: Conserving and restoring natural capital.

On 15 July 2021 the African Union launched our continental Green Recovery Action Plan, which focuses in five priority areas of which the following two are relevant to sustaining the natural resources through sustainable development:

Nature-based solutions and focus on biodiversity through work on sustainable land management, forestry, oceans, and ecotourism. Resilient agriculture, by focusing on inclusive economic development and green jobs. Green and resilient cities, including a focus on water (flooding and water resources) and enhancing information, communication and technology.

If natural ecosystems continue to be degraded and habitat loss is left unchecked, human-wildlife conflict is inevitable and the experiences so far suggest that the odds are stacked against wildlife and ecosystems.

Land-based ecosystems and the carbon sinks they comprise are concomitantly Africa's biggest risk

and opportunity in the face of projected impacts of climate change. Terrestrial biodiversity conservation is dependent on the protection and restoration of key ecosystems such as forests, wetlands, grasslands, highlands and coastal systems, which all serve as carbon sinks. Human-induced modification of the structure and function of many ecosystems through land use change and degradation (e.g., agricultural conversion, forest/grassland clearing and burning, urban expansion, mine and road expansion etc.). Africa's extensive tropical forests, mangroves and rangelands are critical land-based ecosystems in combating global climate change and provide valuable

ecosystem services to its people.

2 Description of the Site

2.1 Visual characteristics, topography and Geographic area.

The site is situated within the area of jurisdiction of JB MARKS Local Municipality, north west province. It is located within the following coordinates: Latitude: 26°44'5.8S 27°9'57.22E E. The site located in an area characterized by and surrounded by existing residential areas. Is located along the Mooi Rivier river catchment.

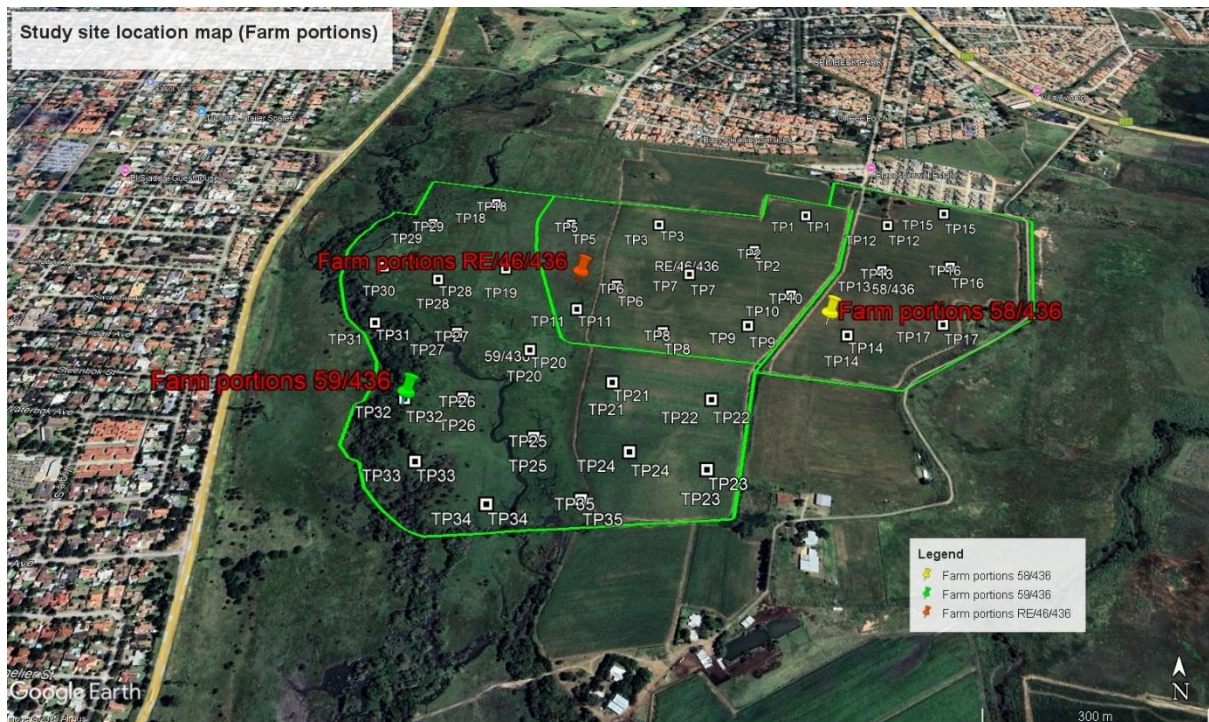


Figure 1: Map of the study area (The site of study is demarcated by the yellow line on the map).

The site of study area is characterized by gentle undulating and flat areas. Main tributary channel to Mooi river is loop spruit which has shallow to deep channels that has alluvial edges and deposits.

Loop spruit joins Mooi river on the south eastern side of the study site.

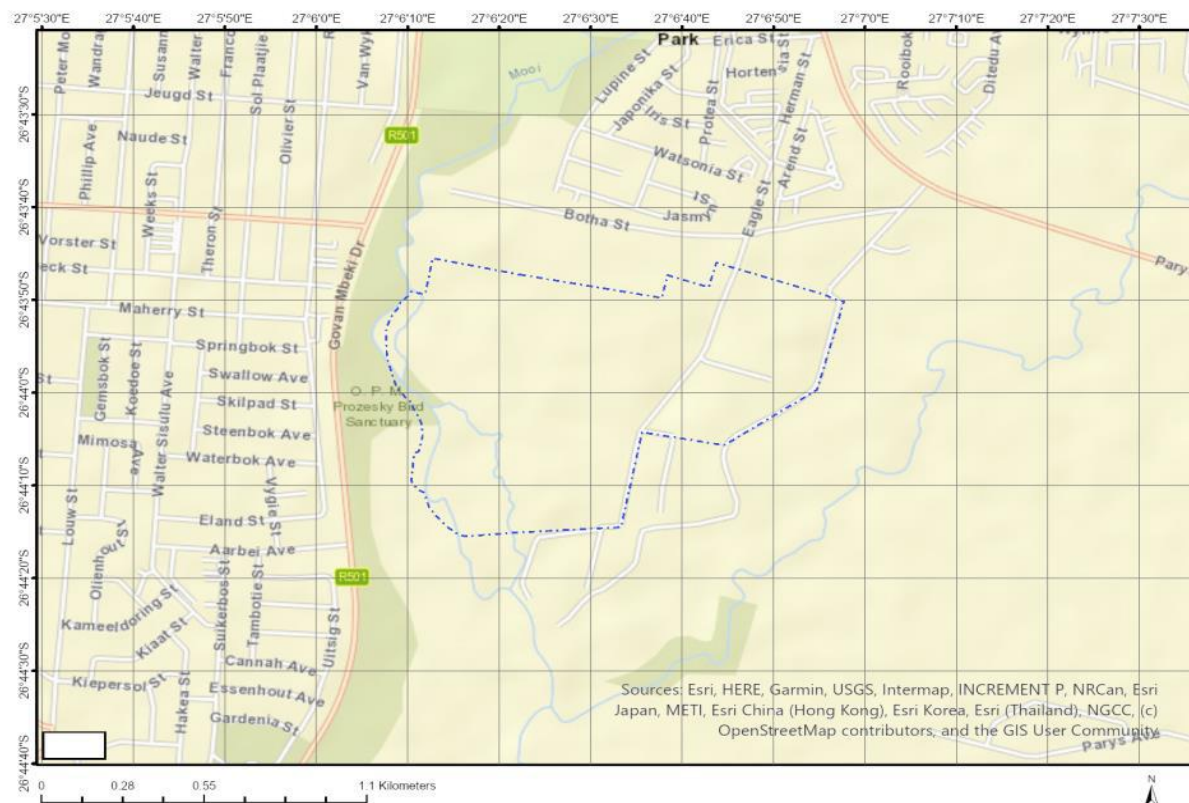


Figure 2: The map above shows orientation to the location of the study site (Sourced from screening report).

2.2 Catchment Assessment.

WATER MANAGEMENT AREA: Middle Vaal (Major Rivers are mooi,vet and vaal)				
QUATENARY CATCHMENT: Tertiary drainage regions C24, C25, C41 to C43, C60 and C70				
WETLAND TYPES IN THE STUDY SITE(HGM): No wetland				
WATER SOURCE TO THE WETLAND: Rainfall recharge and subsurface flow				
DELINEATED BUFFER DESCRIPTION (METRES)			50m flood plain	
WETLAND VEGETATION SPECIES COMPOSITION				
SAMPLING ZONE	FUCULTATIVE SPECIES		OBLIGATES SPECIES	
A01(20CM)	Sporobolus africanus		Typha capensis	
1B 01(40CM)	Sporobolus africanus		Typha capensis	
B02 (60CM)	Sporobolus africanus		Typha capensis	
C01(60CM)	Sporobolus africanus		Typha capensis	
SOIL ASSESSMENT USING AUGER				
ZONE	MOTTLES(Y/N)	COLOR	TYPE	COORDINATES
A01(20CM)	N	Black	Clay loam	-26.733 495/27.106 768
1B 01(40CM)	N	Black	Clay loam	-26.732 999/27.106 723
B02 (60CM)	N	Grey	Clay	-26. 732 263/27. 115 224
C01(60CM)	N	Black	Clay	-26.733 865/27.106 766

Table 1: Catchment, aquatic Wetland assessment for wetland typology and delineation.

2.2.1 Climate, hydrology, geology and geohydrology.

In Potchefstroom, the summers are long, warm, and mostly clear and the winters are short, cold, dry, and clear. Over the course of the year, the temperature typically varies from 36°C.

During the months of April, May, June, July and August you are most likely to experience good weather with pleasant average temperatures that fall between 20°C and 26°C. The area's topography is characterized by flat gentle land. The main geology of the area is characterized by Diabase rock group. Diabase is an intrusive igneous rock with the same mineral composition as basalt. It cools under basaltic volcanoes, like those at mid-ocean ridges. Diabase cools moderately quickly when magma moves up into fractures and weak zones below a volcano. The main soil group falls within the Rhodic Lixisols. Lixisols (notably in argic horizons) are the result of 'rubefaction' by dehydration of ferrihydrite to hematite in long dry seasons. These soils cover a total area of about 435 million hectares, of which more than half in Sub-Saharan and East Africa.

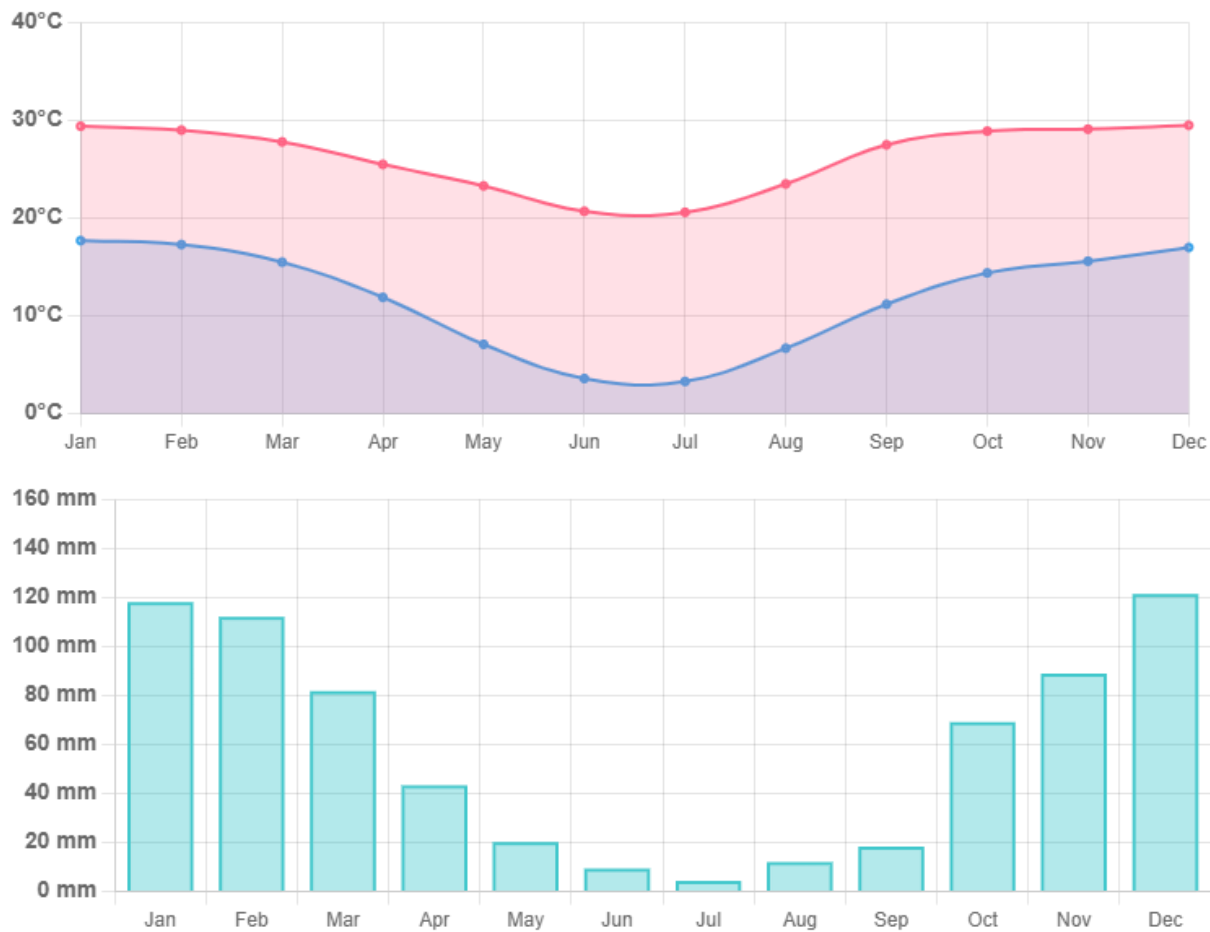


Figure 3: Climatic data of the study area (Climate data.org).

The runoff and the resulting flow within the watercourse on the property is thus higher during summer (December/February to April).

Water Source Area: these quaternary catchments are defined as water source areas, which are crucial for understanding and managing water resources within a region.

Sub-catchments: the Mooi River catchment is further subdivided into three major sub-catchments, which are important for managing water quality and resource allocation.

Dams: the presence of dams like Klerkskraal, Boskop, Klipdrift, and Potchefstroom within the catchment highlights its role in water storage and supply.

Environmental Issues: The Mooi River catchment faces challenges related to mining activities, pollution, and the need for integrated catchment management.

The Mooi River catchment in the North West Province of South Africa is situated within the broader quaternary catchment system, which is a hierarchical unit for water management. Specifically, the Mooi River catchment is defined by its three major sub-catchments: the Wonderfontein Spruit, the Mooi River proper, and the Loop Spruit. The catchment is also home to four major dams: Klerkskraal, Boskop, Klipdrift, and Potchefstroom.

The main geology of the area is characterized by Diabase rock group. Diabase is an intrusive igneous rock with the same mineral composition as basalt. It cools under basaltic volcanoes, like those at mid-ocean ridges. Diabase cools moderately quickly when magma moves up into fractures and weak zones

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2.3 Aquatic Vegetation and Indicator Species.

Detailed aquatic and wetland vegetation assessment was undertaken using vegetation as the main indicator to determine wetland existence; confirm zones and determine the functionality. The results concluded on the area is mainly covered by a flood plain which is linked to Mooi river catchment.

Facultative plants are plants that are equally likely to be found in wetlands and non-wetlands. They are categorized as FAC and are further divided into subcategories FAC+ and FAC-. A plus sign indicates that the plant is more likely to be found in wetlands, while a minus sign indicates that it is less likely to be found in wetlands.

The Mooi River and its tributaries are recharged through several dolomitic eyes by the precipitation that ends up as ground water recharge (Winde & van der Walt, 2004) (Figure 2.4). The Bovenste Oog as well as surface water from the Wonderfontein spruit (WFS) feeds the Mooi River. The Boskop-Turffontein compartment and Gerhard Minnebron eye supplements the Mooi River through underground dolomitic compartments (Annandale and Nealer, 2011).

The main vegetation is characterized by woody invasive species; grass, reeds that were localised on farm boundaries where there are ridges and channelled drains. Weeping willow trees are the most dominate water adapted tree species.

2.4 Aquatic features, Fauna Biodiversity, ecological health, importance and sensitivity.

2.4.1 Aquatic Macroinvertebrates.

The following aquatic identification of the aquatic macroinvertebrates were recorded as presented in a table below. Their population might have been affected by negatively by pollution as Mooi river is known to facing lot of pollution form the industrial activities.

Order	Family	Taxon	Common name
Hemiptera	Corixidae	<i>Hesperocorixa castenea</i>	Water boatmen
Hemiptera	Naucoridae	<i>Ilyocoris cimicoides</i>	Creeping water bugs
Hemiptera	Notonectidae	<i>Notonecta maculata</i>	Backswimmers
Hemiptera	Nepidae	<i>Nepa cinerea</i>	Water scorpion
Diptera	Chironomidae	<i>Chironomous spp</i>	Midges
Mollusca	Lymnaeidae	<i>Lymnaea columella</i>	Reticulate pond snail
Diptera	Tabanidae	<i>Tabanus sulcifrons</i>	Horse flies

Table 2: List of aquatic macroinvertebrates species commonly found in wetlands.

2.4.2 Bird species diversity in the study area.

South Africa is a dry country; its rivers are often stretches of sand rather than of flowing water. Its estuaries, pans, and vleis are of the constant long droughts and human encroachment. Despite these, our wetlands have a considerable bird life of the widest variety and in high numbers. Within the

wetland habitat, there are countless niches for individual species to exploit without intruding on others.

Waterbirds use many kinds of wetlands, including swamps, lagoons, mudflats, estuaries, bays and open beaches, freshwater and saltwater lakes, rivers, floodplain wetlands, and dams.

They fall into 3 main categories:

Common threats to wetlands include clearing and draining wetlands for agricultural and urban development; alterations to flooding patterns due to river regulation and climate change disturbance of feeding and roosting habitats by recreational users such as people fishing or walking, especially with dogs, or by feral animals such as foxes.

Bird life in the study area is normal for common birds but very low for aquatic or wetland types of birds because there is no permanent wetland that can provide favorable sites.

2.4.3 Description of aquatic features.

The main aquatic features that are present include flood plain; Mooi river and Loop spruit river. There are no wetlands. The Mooi River is located in the JB Marks Local Municipality in the Highveld eco-region within the North West Province in South Africa. A perennial river, it falls under the upper Vaal River WMA, catchment C23 and drains into the Vaal River (Fosso-Kankeu et al., 2015). The geographic coordinates covering the catchment are 26°52'28"S and 26°57'6"E with elevation between 1 305m (4281 ft.) and 1 550m (5090 ft.)

2.4.4 River, characterisation and resource quality objectives (RQOs) for in-stream and riparian zone habitat.

The results showed that there is an abundance of anthropogenic activities which change catchment conditions and the in-channel and bank conditions are modified. The in-stream and riparian zone integrity scores were between 40-59% and 60-79% placing it to category D or C/D. The results for overall fish PES were 52, placing it in category D, therefore, largely modified. The results of the habitat integrity and PES are within the recommended limit of Resource Quality Objectives (RQOs). The results of the PCA and unconstrained ordination indicated temporal variation at Sites 2 and 3 as well as sites 4, 5 and 6 which were grouped together. Site 1 varied spatially and grouped separately due to increased changes in landscape. The PES across all sampling sites is moderately to largely modified, therefore there is a great need to continuously monitor the catchment and alert community and stakeholders on possible activities that may trigger a critical modified environment.

Resource quality objectives for in-stream and riparian habitat were established by the Department of Water and Sanitation to manage the habitat in the ecosystem for catchment C23F (Government Gazette No: 39943, 2016). According to Dickens et al. (2014), the Mooi River in-stream and riparian limit is >D and >42 respectively as shown in Table 4.7. The in-stream results show a limited to largely modified habitat (B/D), while the riparian zone habitat integrity results range between moderately to largely modified (C/D). According to the results, the Mooi River is still within RQOs limit. In 2012, the Mooi River was assessed amongst other catchments, and it was found to be critically modified (E) (Dickens et al., 2014).

Most issues were around the anthropogenic factors such as bank and channel modifications, decreased vegetation and increased exotic species. Other factors were water abstractions, agriculture and water quality deterioration. This shows that the Mooi River requires continuous monitoring as the

The results by Dickens et al. (2014) are different from the current results which show an improved status from critically modified (E) in 2014 to limited to largely modified (B/D & C/D) in the current study. The differences in the findings are attributed to interventions such as the implementation of RQOs which limit the impact of land-uses and promote ecological conservation. There has also been a lot of ongoing research from DWS and NWU over the years which serves as environmental alert to all stakeholders involved. Although current findings are not similar to Dickens et al. (2014), there is similarity to the findings of Louw et al.

Evaluation of Index of Habitat Integrity (IHI) provides a measure of the degree to which a river has been modified from its natural state. This assessment was undertaken for the Mooi River at the site

The EIS assessment considers several biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale. The median of the resultant score was calculated to derive the EIS category. The Mooi River is considered to be of moderate to high ecological importance and sensitivity. The river provides a refuge and habitat within the landscape. The CBA of the area is under VU Rand highveld grass land (Wetlands_Mesic Highveld Grassland Bioregion Floodplain).



Aquatic sensitivity is very high with a flood plain that is a very important ecological feature on the wester side of the site. This has demarcated with a 50m buffer. Maintenance of the buffer must be enforced by all stakeholders in the catchment. The area falls within ecological support area 2.

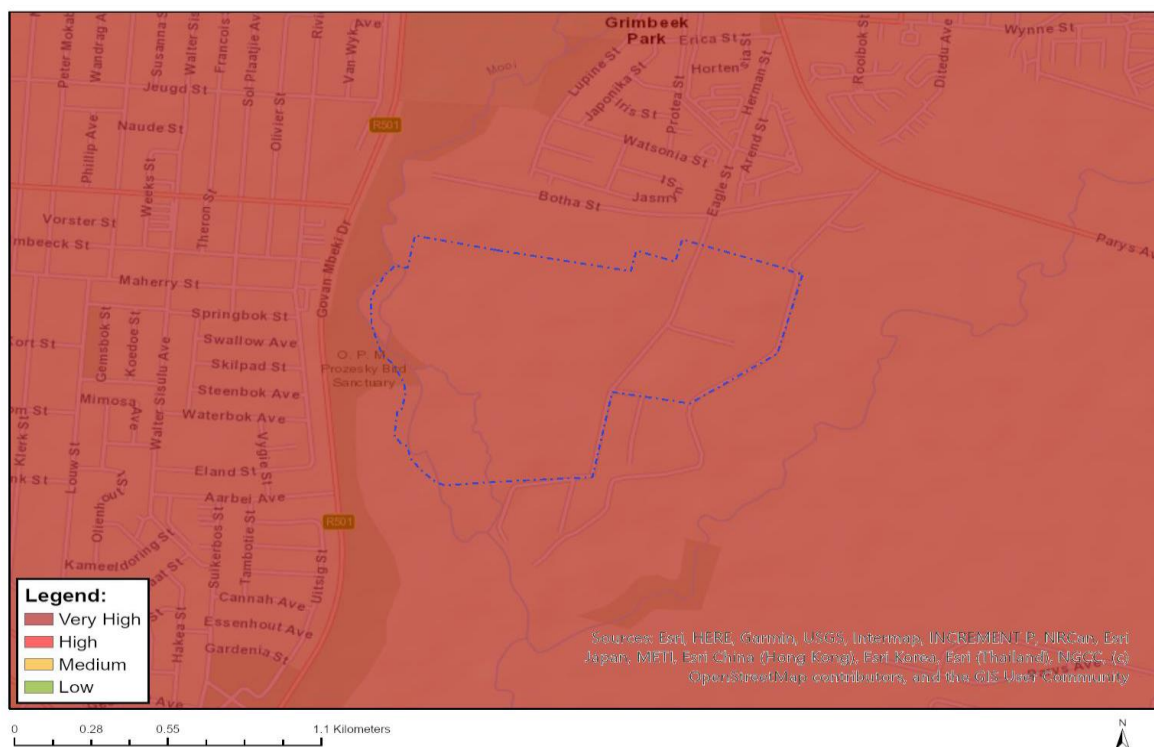


Figure 5: Aquatic sensitivity theme.

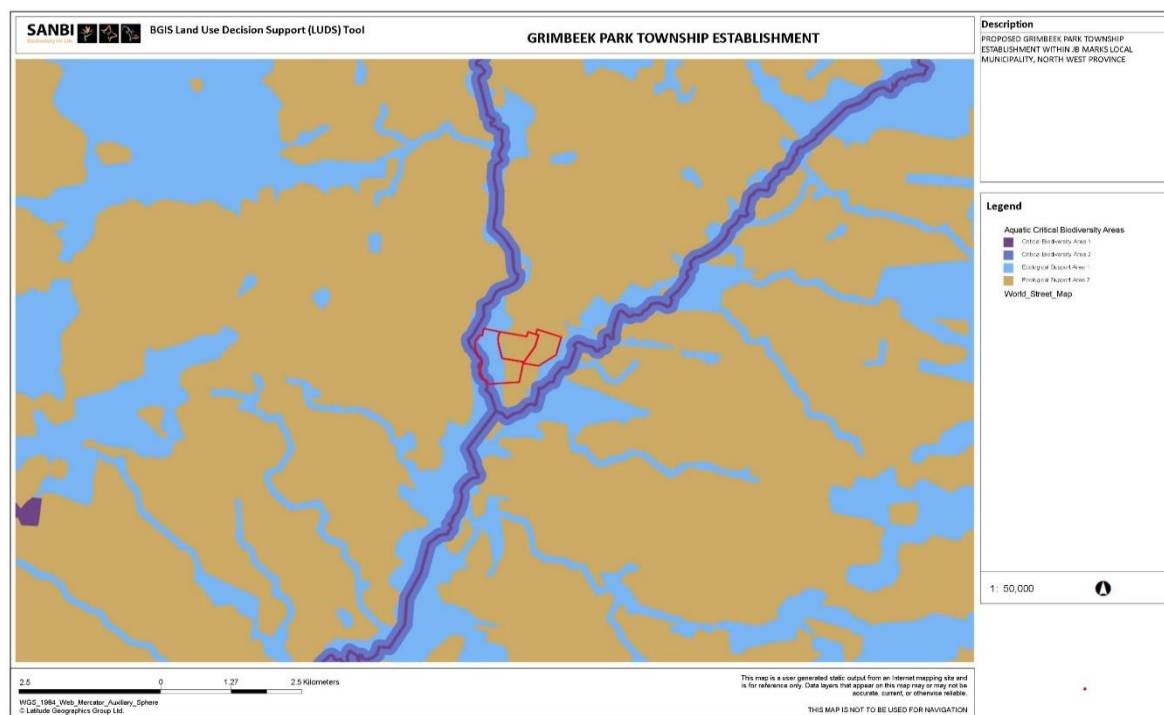


Figure 6: Aquatic biodiversity CBA.

2.5 Waterbirds review common on aquatic habitats including wetlands:

waterfowls such as ducks, geese, swans, grebes; pelicans.; cormorants; ibises and spoonbills; egrets and herons; crakes, rails, and waterhens; terns and gulls. shorebirds, which are also known as waders.

2.5.1 The three main categories:

Colonial nesting waterbirds: require substantial floods to support large breeding events in floodplain wetlands. They include egrets, ibises, pelicans, cormorants, and herons.

Non-colonial waterbirds: including resident shorebird species, generally don't congregate to breed but are still dependent on wetlands for nesting and feeding habitat in which to raise their young. They include waterfowl, grebes, crakes, rails, and waterhens.

Migratory waterbirds: such as migratory shorebirds, use a range of wetlands to rest, feed, and breed during their annual long journeys between wetlands in Australia and their breeding sites in the northern hemisphere.

Other native bird species also depend on wetlands for all or part of the life cycle. These include reed warblers, grassbirds, and birds of prey such as the swamp harrier.

2.5.2 Birds that live in wetlands:

Floodplain wetlands make up most of the wetland area and provide important habitat for waterbirds. Many species depend on them for breeding. Some sites regularly support more than 20,000 waterbirds. This figure rises to more than 100,000 during large floods.

At those times, the internationally significant Marshes, Wetlands; and Lakes support some of the largest breeding colonies of straw-necked ibis, intermediate egrets, and rufous night herons. Some waterbird species are thought to breed almost entirely within the wetlands. They include glossy ibis, freckled duck, and blue-billed duck.

2.5.3 Birds that stop over in wetlands:

It must be noted that wetlands importance to birds does cover other species from other areas both locally and regionally and internationally as they do move on different seasons across habitats influenced by season changes. Some birds move from one wetland to another. Many coastal and inland wetlands support a variety of migratory waterbird and shorebird species. These birds travel each year between their breeding grounds in the northern hemisphere and non-breeding habitats in Australia. The wetlands in Botany Bay support up to 34 migratory species, including the endangered.

Common name	Species name	Abundance
Village Weaver	<i>Ploceus cucullatus</i>	++++
Cattle egrets	<i>Bubulcus ibis</i>	++++
Dark-capped Bulbul	<i>Pycnonotus tricolor</i>	++++
African Masked Weaver	<i>Ploceus velatus</i>	++++
Laughing dove	<i>Streptopelia senegalensis</i>	++++
Southern Masked Weaver	<i>Ploceus velatus</i>	+
Ring-necked Dove	<i>Streptopelia capicola</i>	+

Table 3: List of birds recorded on site during field survey.

2.6 Anurans or amphibians identified from the wetland sites.

Suitable environmental conditions, especially at breeding sites are critically important to frogs, and most species tend to be in specific habitats such as wetlands and rivers (Du Preez and Carruthers, 2017). No frogs were physically identified or sighted in the study area or even their callings were never heard. The list of frogs likely to be occurring in the local wetlands is shown in Table 4 below.

2.6.1 List of frogs commonly found on wetland sites.

Suitable environmental conditions, especially at breeding sites are critically important to frogs, and most species tend to be in specific habitats such as wetlands and rivers (Du Preez and Carruthers, 2017). No frogs were physically identified or sighted in the study area's wetlands or even their callings were never heard. The list of frogs likely to be occurring in the local wetlands is shown in Table 4 below.

It is important to note that these frogs are plentiful in ponds where water is dammed. They are aquatic and highly adaptable and will lay their eggs whenever conditions allow. During wet rainy seasons, they will travel to other ponds or vernal pools of water to search for food. During drought times these frogs burrow themselves in the mud, becoming dormant for up to a year. This is indeed one of the mechanisms these frogs use to survive the unpredictable and harsh environment.

Family	Species name	Common name
Hemisotidae	<i>Hemius Gunther</i>	Shovel-nosed frog
Racophoridae	<i>Chiromantis xerampelina</i>	Foam nest frogs
Pipidae	<i>Xenopus laevis</i>	African clawed frog
Pyxicephalidae	<i>Amietia Dubois</i>	Common river frog
Pyxicephalidae	<i>Amietia poyntoni</i>	River frog

Table 4: List of frogs commonly found on wetland sites.

3 Methodology for assessment

3.1 Field Assessment and observations

The methodologies used to do the assessment were desktop methodology before the site visit, focusing on the boundaries of the possible wetland area. GPS was used to identify important points (e.g., wetland boundaries). These GPS points were converted into a GIS shapefile to allow these points to be mapped and to facilitate the correction of wetland boundaries and the identification of very sensitive wetlands portions within the study area. Google earth was used to view site of study and made it easy to locate the wetlands; mark them and considered for ground truthing using the KML map linked to the field area measure verification APP.

During the field visit, characterization and integrity assessments of the freshwater features were undertaken. The SANBI Biodiversity GIS, and Freshwater Biodiversity Information System websites were also consulted to identify any constraints in terms of aquatic biodiversity conservation importance. This information/data was used to inform the water resource protection-related recommendations.

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. The following techniques and methodology were utilized to undertake this study:

- Analysis of the freshwater ecosystems was undertaken at a rapid level and did not involve detailed habitat and biota assessments.
- The guideline document, “A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas” document, as published by DWAF (2005), was followed for the delineation of the wetland areas. According to the delineation procedure, the wetlands were delineated by considering the following wetland indicators: terrain unit indicator; Soil form indicator; Soil wetness indicator; and vegetation indicator.
 - Wetland boundaries reflect the ecological boundary where the interaction between water and plants influences the soils, but more importantly the plant communities. The depth to the water table where this begins to influence plant communities is approximately 50 centimeters. This boundary, based on plant species composition, can vary depending on antecedent rainfall conditions, and can introduce a degree of variability in the wetland boundary between years and/or sampling period. For this reason, several visits and past aerial imagery were utilised for the delineations.
 - The wetlands were subsequently classified according to their hydro-geomorphic determinants based on a classification system devised by Kotze *et al* (2004) and SANBI (2009). Notes were made on the levels of degradation in the wetlands based on field experience and a general understanding of the types of systems present.
 - A Present Ecological State (PES) assessment was conducted for the identified and delineated within the study area. For this study, the tool WET-Health as defined in the WET Health Series developed for the Water Research Commission was used to assess the present ecological state of each wetland unit.
 - The functional wetland assessment technique, WET-Eco-Services, developed by Kotze *et al* (2009) was used to indicate the ecological benefits and services provided by delineated wetland habitat. This technique consists of assessing a combination of desktop and infield criteria to identify the importance and level of functioning of the wetland within the landscape.
 - The ecological importance and sensitivity assessment was conducted according to the guidelines developed by DWAF (1999).

- Recommendations are made with respect to the adoption of buffer zones within the development site, based on the wetland's functioning and site characteristics.

The level of aquatic assessment undertaken was considered to be adequate for this study.

3.2 Wetland Delineation

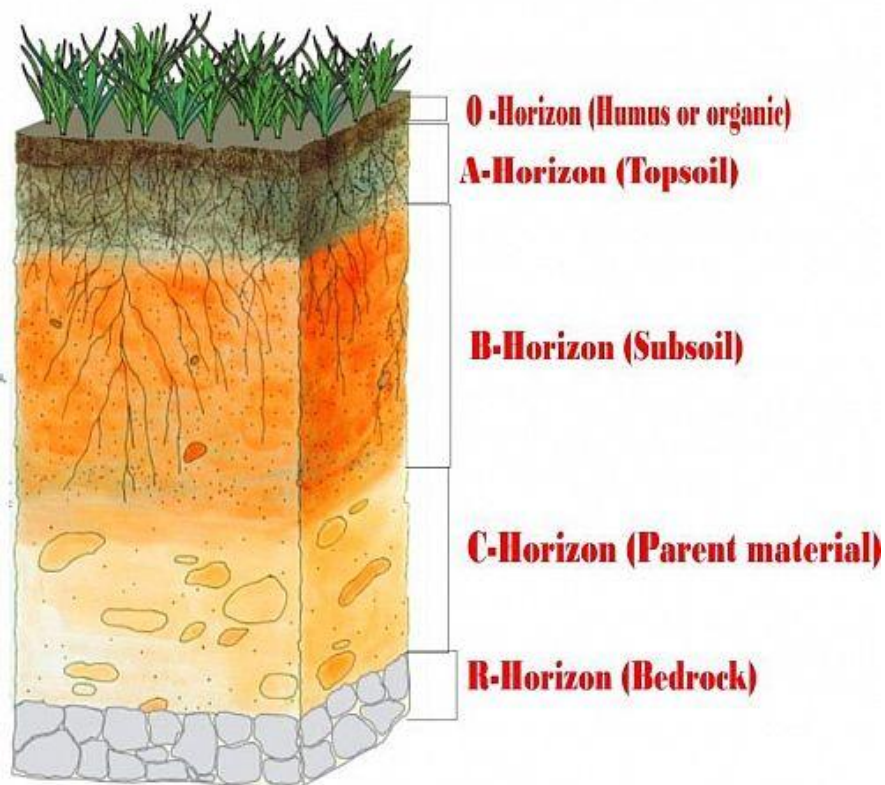
Determining the zone of the wetlands requires the delineator to consider specific indicators. The indicators must always be present in the wetlands, and under normal circumstances, the vegetation indicator is deemed to be the primary indicator. The soil indicator tends to be the most important indicator, and the other two indicators (The Terrain Unit and Soil Form Indicators) are used for confirmatory purposes (DWAF, 2005).

The National Water Act (Act 36 of 1998) defined wetland as a “land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and the land in which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

Wetland-based delineation and sampling of wetlands was based upon the DWAF guidelines “A practical field procedure for the identification and delineation of wetlands and riparian areas” (DWAF, 2005), which stipulates that consideration be given to four specific wetland indicators to determine the boundary of the wetland. These indicators are terrain unit indicator, soil form indicator, soil wetness indicator, and vegetation indicator.

This according to the DWAF (2005) guidelines for the delineation and identification of wetlands, soil wetness indicators are the most common indicator of wetland occurrence, because soil wetness indicators remain in wetland soils, even if the wetland site is degraded or drying out. Soil auger: tape measure and spade were used to profile the soil wetness. Existing road cuttings and quarry soil profiles assisted in determining soil layers.

Wetland delineation is important because it accurately identifies the boundaries of wetland areas, allowing for proper protection and management of these valuable ecosystems by enabling informed decisions regarding development projects, conservation efforts, and regulatory compliance, ensuring that wetlands are not inadvertently damaged or destroyed while also maximizing their ecological benefits like flood control, water filtration, and biodiversity support.



Schematic diagram indicating soil profiles as used during field assessment.

3.3 Wetland Functional Assessment

Wetland functionality is defined by Macfarlane et al. (2007), as a measure of the deviation of wetland structure and function from its natural reference condition. The natural reference condition is also based on a theoretical undisturbed state which is derived from an understanding of undisturbed regional vegetation and hydrological conditions knowledge (Macfarlane et al., 2007).

Kotze et al. (2007) emphasized that the wetland systems are critical for groundwater recharges, although flows through them are supplemented by surface water contributions from rain. Kotze et al. (2007) further reported that wetlands serve as unit for ecological services and a functional wetland system could contribute to the following: surface flow attenuation, contribution of water to the stream during dry seasons, provide water quality enhancement benefits, and as such the systems have a high potential to remove nitrogen and nitrates as well as carbon sequestration.

3.4 Determination of the Present Ecological Status (PES) of wetlands

WET-Health is a tool designed to assess the health or integrity of a wetland. Wetland health on the other hand is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. This technique is used to assess hydrological, geomorphological, and vegetation health in the form of ecological status categories and descriptions as shown in the Table below.

Category	Description	Range
A	Unmodified, natural	0-0.9
B	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.	1-1.9
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.5-5.9
E	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable	6-7.9
F	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10

Table 5: The Present Ecological Status (PES) categories and descriptions for WET- Health (Adapted from Macfarlane et al., 2007).

3.5 Determination of the Ecological Importance and Sensitivity (EIS) of Wetlands.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (MacFarlane et al., 2007). Water resources can be classified for an appropriate management class based on EIS. The EIS allows the classification of ecological importance in ecosystems and biodiversity for the estimation of species diversity and abundance. The EIS uses the rating scale for the estimation of scores (Table 6). Furthermore, these wetlands provide specialized habitat and dispersal corridors and basic human needs such as subsistence farming and water use.

Ecological Importance and Sensitivity Categories	Rating
Very High These are wetlands that are considered ecologically important and sensitive on a natural or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat alterations. They moderate the water quality and quantity of major rivers.	>3 and ≤4
High These wetlands are ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat alterations. Plays a role in moderating the quantity and quality of water of major rivers.	>2 and ≤3
Moderate These wetlands are considered ecologically important and sensitive at a local or provincial scale. Biodiversity in these wetlands is not usually sensitive to flow and habitat alterations. However, they play a small role in moderating the quantity and quality of water in major rivers.	>1 and ≤2
Low/Marginal Wetlands that are not ecologically important and sensitive at any site. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat alterations. However, they play a role in moderating the quantity and quality of water in major rivers.	>0 and ≤1

Table 6: Ecological Importance and Sensitivity rating scale used for the estimation of scores.

3.6 Determination of Buffer Requirements

The pre-mitigation buffer requirements for the construction and operational phases are 32 m for wetlands sites respectively. These buffer requirements are relevant to all the delineated wetlands sites and should be ideal after the successful application of recommended mitigation measures. It must be noted that the determination of a buffer zone is also dependent on the nature of the wetland system with its associated risks. Therefore, for this study delineated buffer zones were not done because the area does not have wetlands hence it was only done for a perennial stream and flood plain.

3.7 Results and Discussions

3.7.1 Functions and values of the Wetlands in the study site.

Generally, Wetlands perform many ecological functions. Knowledge and understanding of complexities. Hence this was not assessed because there is no wetland. The existing flood plain is providing grazing for livestock.

Wetland ecologists have already documented the following general environmental benefits wetlands provide but this is not happening in the study area because there is no permanent wetland.

- Water purification.
- Flood protection.
- Shoreline stabilization.

The study area only has a non-perennial river and temporary wet zones.

3.8 Status of the study area's wetlands.

The study area does not have a permanent wetland. This has been confirmed by a sensitivity study in which the map is attached. There is a temporary wet zone in an unchanneled flood plain.

3.9 Wetland Delineation Results using various Techniques (soils, vegetation, and soil wetness indicators)

The site does not have wetland that requires delineation but the boundaries for a flood plain had to be established using the same indicators. The delineation was undertaken using vegetation indicators, soil and topography. Soil wetness did play a role because the soil type and texture found that there is a well-drained soil. The delineation for a 50M buffer was done for the flood plain.

3.9.1 Wetland Soils (Wetness and Soil Form Indicators)

The soil is well drained dominated by loamy clay and clay loamy.

3.9.2 Hydric Soil Indicators of Saturation:

No hydric soil due to non-present of permanent wetland. Soil sampling found that there were no indicators for wetland.



3.10 Description of Wetland Type, Hydrology, and catchment characteristics.

The main wetland type in the study area was not analyzed as there is no wetland. Detailed sensitivity analysis confirmed the area to have no wetland. Refer to the attached sensitivity map. Sensitivity Features within confirmed that the site is covered by Ecological support area 2 and a flood plain.

3.11 Present Ecological Status of wetlands in the study area.

The study area is on the Rand Highveld Grassland which is dominated by grass that is non -wetland grass. The habitat is within Ecological support area 2.

3.12 The Ecological Health Assessment

Wetland ecological health is the condition of a wetland, and how it's able to perform its functions and provide services to the environment and people. It's a measure of the wetland's physical, chemical, and biological characteristic. Therefore, this was not done due to the site not having a permanent wetland. The Mooi river is known to be polluted by various factors such as industrial; agriculture; mining and domestic wastes that are being dumped into the riverine areas.

3.13 The EIS Assessment of the Remaining Wetland Areas

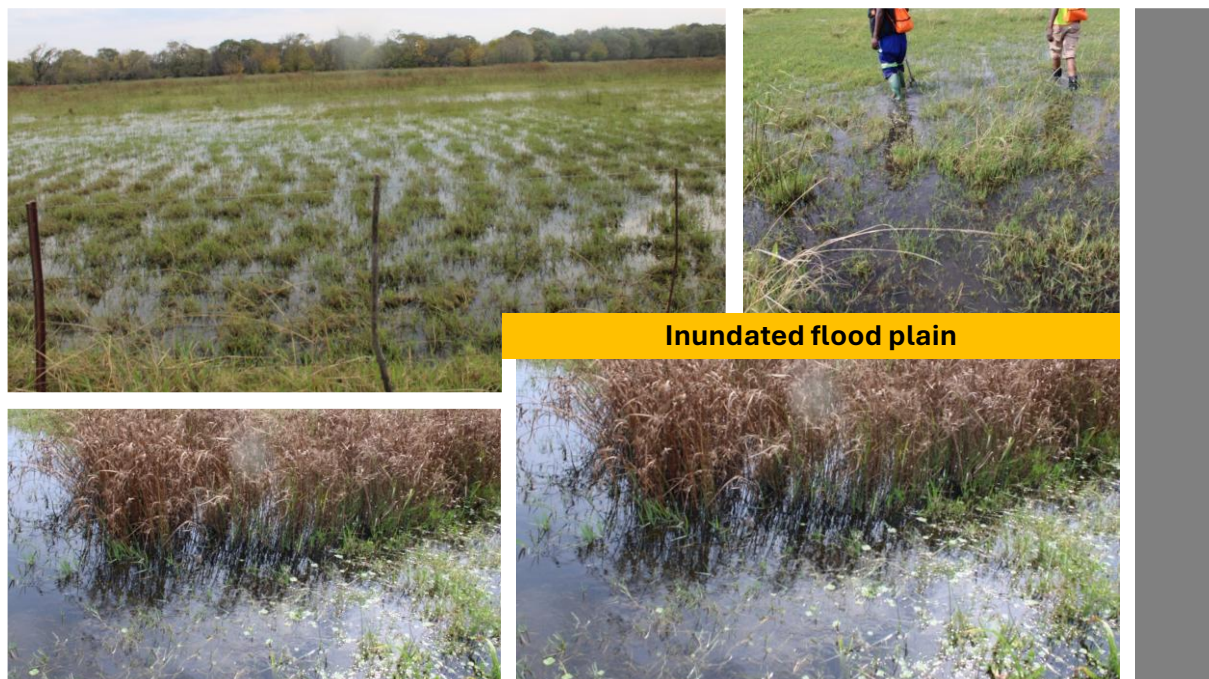
The study area does not have a wetland as confirmed with the sensitivity assessment results.

3.14 Buffer Requirements

Analysis recommends that the development complies with the flood-line zoned area (100 year).



FIGURE 7: Demarcated zones within the study area.



4 Impact assessment and significant

4.1 Impact and mitigation measures

Consideration of the mitigation measures was applied on note of the broader catchment area considering that impacts will not be fixed as they can expand outside the footprint.

PROBABILITY	DURATION
1- very improbable	1- very short duration (0-1years)
2- improbable	2- short duration (2-5 years)
3- probable	3- medium term (5-15 years)
4- highly probable	4- long term (>15 years)
5- definite	5- permanent/unknown
EXTENT	MAGNITUDE
1- limited to the site	2- minor
2- limited to the local area	4- low
3- limited to the region	6- moderate
4- national	8- high
5- international	10 - very high

Table 7: the significance scoring technique used for scoring each potential impact.

The impact was estimated to be moderate and permanent if mitigations were not implemented.

SIGNIFICANCE POINTS	SIGNIFICANCE RATING
0 - 30 points	Low environmental significance
31- 59 points	Moderate environmental significance
60-100 points	High environmental significance
Details on scores obtained based on findings are presented in detail in the sections below	

Table 8: shows the impact significance ratings used.

4.2 Nature of the impacts on wetlands associated with the existing land use activities.

4.2.1 Impact Assessment

The impact assessment was generally done in consideration of the non-perennial stream.

Waste dumping is the main problem in the study area.

4.3 Impacts assessed in the wetlands.

Impact	Aspect
Construction phase/Excavation	Will be high
Impeding on flow paths entering Siltation	Expected to be low.
Sedimentation Eutrophication	No impact.
Water quality impairment	
Operational phase	Dumping of waste will continue taking place if not managed.

Table 9: Impacts assessed in the study area.

4.4 Associated Mitigation Measures

Mitigations to prevent destruction of the non-perennial stream must be applied.

4.5 Impact Rating Matrix before and after mitigation measures for wetlands sites.

It was worth it to present this matrix even though there was no permanent wetland on the study site taking into consideration the existence of wetlands in the same catchment area. Impacts can still happen on the wetlands outside and still have direct impacts.

Criteria	Description	Score
Extent	The loss of wetlands is likely to have a local impact, the catchments found within the proposed township establishment could feed directly to the wetland system	20
Duration	The loss of wetland is likely to be permanent, as the portions in the wetland could be destroyed permanently	40
Intensity	Given the largely modified or degraded nature of the Wetlands.	60
Probability of occurrence	The proposed layout could destroy wetland habitat	35

Table 10: The Impact Assessment Matrix of Wetland loss before mitigation. measures.

Criteria	Description	Score
Extent	The loss of wetlands is likely to have a site impact, as the catchments will be rehabilitated	25
Duration	The loss of wetland integrity is likely to be short-term, as the wetlands will have an offset of negative impacts by rehabilitation	40
Intensity	Given the degraded or altered nature of the wetland areas, it is likely that the intensity will be moderate.	55
Probability of occurrence	The proposed development offset will possibly reduce the loss of wetlands site	20

Table 11: The Impact Assessment Matrix of Wetland loss after mitigation measures.

5 Recommendations

RECOMMENDATIONS
Recommendation 1
Riparian zone monitoring and assessment programs: Consistent, thorough, and timely riparian monitoring and assessment programs are a critical tool for municipality and community to better manage and protect their water resources to safe guard their benefits. These programs, if considered, can enhance the following attributes, namely: Establishment of a baseline in riparian extent, condition, and function; Detect change and Characterize trends within and around the riparian over time. Riparian monitoring and assessment data can be used to help make decisions in: The National Water Act, 36 of 1998 regulatory programs. Riparian restoration and watershed planning. The development of meaningful water quality standards for aquatic resources.
Recommendation 2
No construction or sand mining may take place within the flood plain, or 100 m zone of regulation ecosystem buffer zone and such an area demarcated as a no-go area.
Recommendation 3
No dumping of waste may take place on wetlands and water courses (National water act 36 of 1996 prevents pollution of water resources by any land user or individual. Waste dumped in wetlands gets dissolved giving more chances of chemicals and metals to cause ground water pollution. This results in the risk of people staying in wetlands and gathering natural resources from the wetlands to get exposed to sicknesses such as cholera.
Recommendation 4
Environmental education to raise awareness on the value and protection of riparian must be done for local communities and schools for them to understand the importance of wetlands.
Recommendation 5
Protection of the riparian zones must be done through evaluation of their benefits and ecosystem services at micro level.
Recommendation 6
As stated in chapter 3 part four of the National Water Act invasive alien plants must be controlled using chemical and mechanical methods. Near permanent wetlands only manual removal.
Recommendation 7
The stormwater management plan for the site should ensure that any impacts of stormwater from the site are mitigated as far as possible within the site (measures such as the use of permeable surfaces, re-use of runoff from built areas such as roofs as well as the use of measures such as swales) to minimise the stormwater impacts on the associated aquatic habitats;
Recommendation 8

Integrated stakeholder engagement must urgently take place as it will assist in coming up with joint measures that will assist in the sustainable use and protection of the wetlands.

Recommendation 9

It is recommended that no sand mining trenches and holes digging up to avoid sedimentation.

Recommendation 10

Natural environment must be conserved around the riparian and flood plain.

6 Conclusions

It is the opinion that of the ecologist to conclude that there is no wetland in the study area. The risk of flooding must be prevented by building proper houses that have raised foundations. All areas marked as the no go areas must be conserved. All aquatic features mapped must be protected using the buffer zone.

The following potential impacts to the Bokkemenskloof River and wetland areas that are associated with the proposed development activities could be expected: Short- and longer-term disturbance and loss of aquatic habitat; modified stormwater surface water runoff from the developed site; and potential for localized impairment of water quality during the construction and operational phases of the development.

From a freshwater perspective, the No-Go Alternative would have less potential impact on the aquatic ecosystems within the site. However, if the recommended mitigation measures are implemented, there would be a low significance impact on the aquatic ecosystems and there is no reason why the proposed development could not be approved.

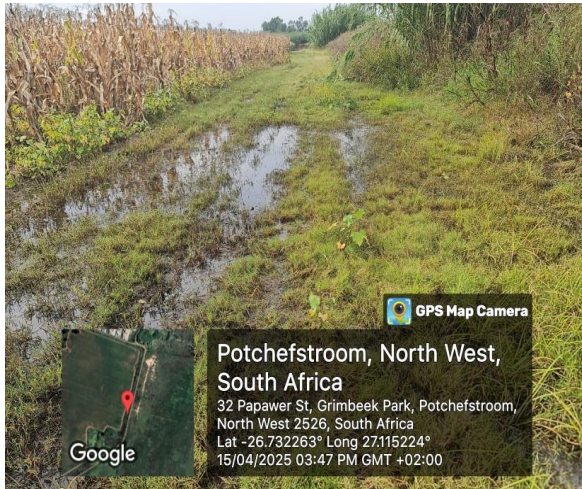
7 Photos and maps

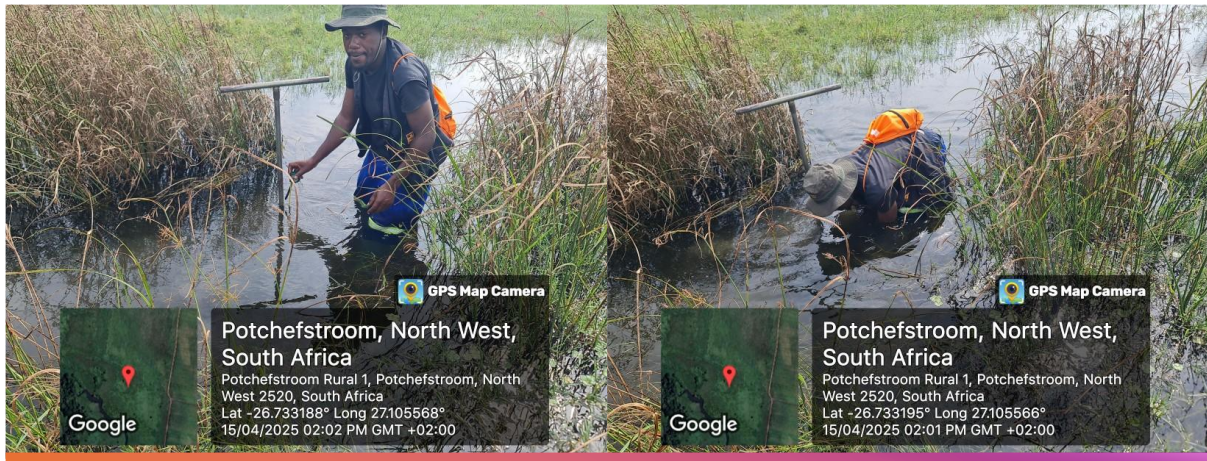


Soil sampling on flooded zone with non-wetland grasses (*Cynodon dactylon*/Bermuda grass)

Soil type is a rich agricultural dark loamy clay soil

Water logged farm road on farm portion 58/436 north eastern corner boundary



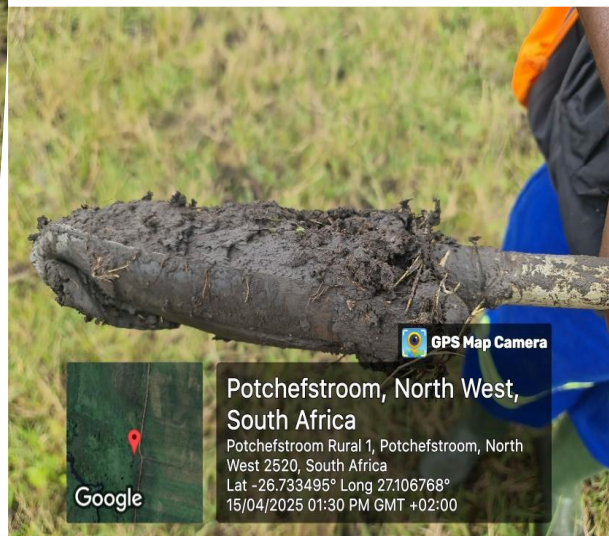
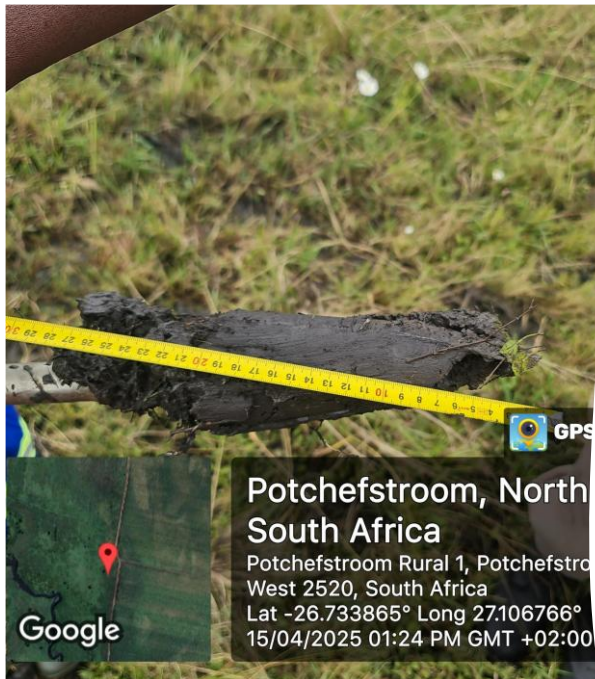


Coordinates points for sampled zones along the flood plain

This is where water flowing channel exist on the flood plain



Soil sampling during wetland investigations



Flood plain on the eastern side of the river not suitable for development



This zone must be excluded and buffered by 200m from the river

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