Environmental Impact Assessment for the proposed Elandsfontein Coal Mining Project

Mpumalanga Province, South Africa

Wetland Assessment

July 2020 (Updated November 2020)

CLIENT

Prepared by:

The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

Report Name	Environmental Impact Assessment for the proposed Elandsfontein Coal Mining Project: Wetland Assessment
Submitted to	EIMS ENVIRONMENTAL IMPACT MANAGEMENT SERVICES
Report 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.
Report Writer and Fieldwork	**Ivan Baker** Ivan Baker is Cand. Sci Nat registered (119315) in environmental science and geological science. Ivan is a wetland and ecosystem service specialist, a hydropedologist and pedologist that has completed numerous specialist studies ranging from basic assessments to EIAs. Ivan has carried out various international studies following FC standards. Ivan completed training in Tools for Wetland Assessments with a certificate of competence and completed his MSc in environmental science and hydropedology at the North-West University of Potchefstroom.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

EXECUTIVE SUMMARY

GNR 326	Appendix 6 (n): Specialist Opinion

In the event underground mining is authorised, it is recommended that a subsidence assessment prescribe measures to avoid subsidence of the mined-out areas below the wetlands and buffer zones. In the event open cast mining of Seam 2 is authorised, it is recommended that the extent of the open cast area be amended to adhere to the buffer zone. If this is not feasible, then a direct loss of wetlands will occur. Due to the expected loss and also degradation of wetlands as a result of the project with either option, it is also recommended that on-site rehabilitation of the area be implemented to allow for some level of wetland compensation, this should be informed by an offset strategy.

If all recommendations made are met, it is the specialist's opinion that no fatal flaws exist and that the proposed activities may proceed as have been planned.

The Elandsfontein Colliery comprises of two Mining Right Areas (MR63 and MR314). The applicant plans to combine these two Mining Right Areas (MRAs) into one single MRA with an associated consolidated Environmental Management Programme (EMPR). In addition, the applicant plans to expand current mining areas and include new open cast and underground mining areas.

The purpose of the specialist study is to provide relevant input into the authorisation process and to provide a report for the proposed activities associated with mining and ancillary activities proposed to take place on site.

Three wetland hydro-geomorphic (HGM) units were identified, of which two have been largely modified by current and historic mining activities impeding into the wetland's buffer zones and, in some cases, into the wetland itself. Severe limitations exist in regard to wetland identification, which has resulted in a section characterised by signs of wetness to be classified as an "artificial system" given the presence of transported Technosols as well as altered surface and sub-surface flow dynamics.

The delineated wetlands do provide a moderate to high level of service, especially in regard to indirect benefits (water quality and flow regulation). Significant wetland habitat degradation has taken place due to impaired water quality, which has resulted in a lack of unique species.

A buffer zone 106 m in size has been calculated for all the wetlands on-site due to the high level of threats associated with open cast mining. No buffer zones are required for the underground mining activities due to the fact that very little to no surface impacts are associated with underground mining activities as well as the fact that the open cast mining's calculated buffer zone will conserve the wetland for any mining activity.

It is firstly recommended that the proposed open cast mining areas (Seam 2) be amended to adhere to the delineated wetland's buffer zone and that a subsidence assessment prescribe measures to avoid subsidence of the underground mining areas (Seam 1) to be permitted to proceed. If either of these requirements are not deemed feasible for the selected alternative, it is recommended that a wetland offset strategy (which according to (DEA, 2013) is the last resort) be compiled for the project. The wetland offset must be focussed on the extent of the wetland and associated buffer zone that will be lost, as indicated in the sensitivity sections. The proposed wetland offset must incorporate onsite rehabilitation and must be implemented from the onset of the project until closure.

DECLARATION

I, Ivan Baker, declare that:

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

Ivan Baker

Wetland Specialist

The Biodiversity Company

July 2020

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Figures

1. Introduction & Background

The Biodiversity Company was commissioned to conduct a wetland assessment as part of the environmental authorisation process for the relevant mining activities. The project will also be undertaken to meet the requirements of the National Environmental Management Act 107 of 1998, specifically Appendix 6.

One dry-season wetland survey was conducted in August 2019 with one wet-season survey conducted in March 2020. The survey was conducted by ecologists over a total period of four days.

The purpose of the specialist study is to provide relevant input into the EIA process and to provide a report for the proposed activities associated with open cast and underground mining. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

1.1 Study Protocols

The wetland assessment has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 20 March 2020: “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation”

According to the National Web based Environmental Screening Tool the combined aquatic biodiversity for the area is classified as predominantly Low sensitivity, with an extent classified as Very High sensitivity (Figure 1-1). The wetland and riverine assessments should be jointly considered for the minimum report content requirements for a very high sensitivity rating.

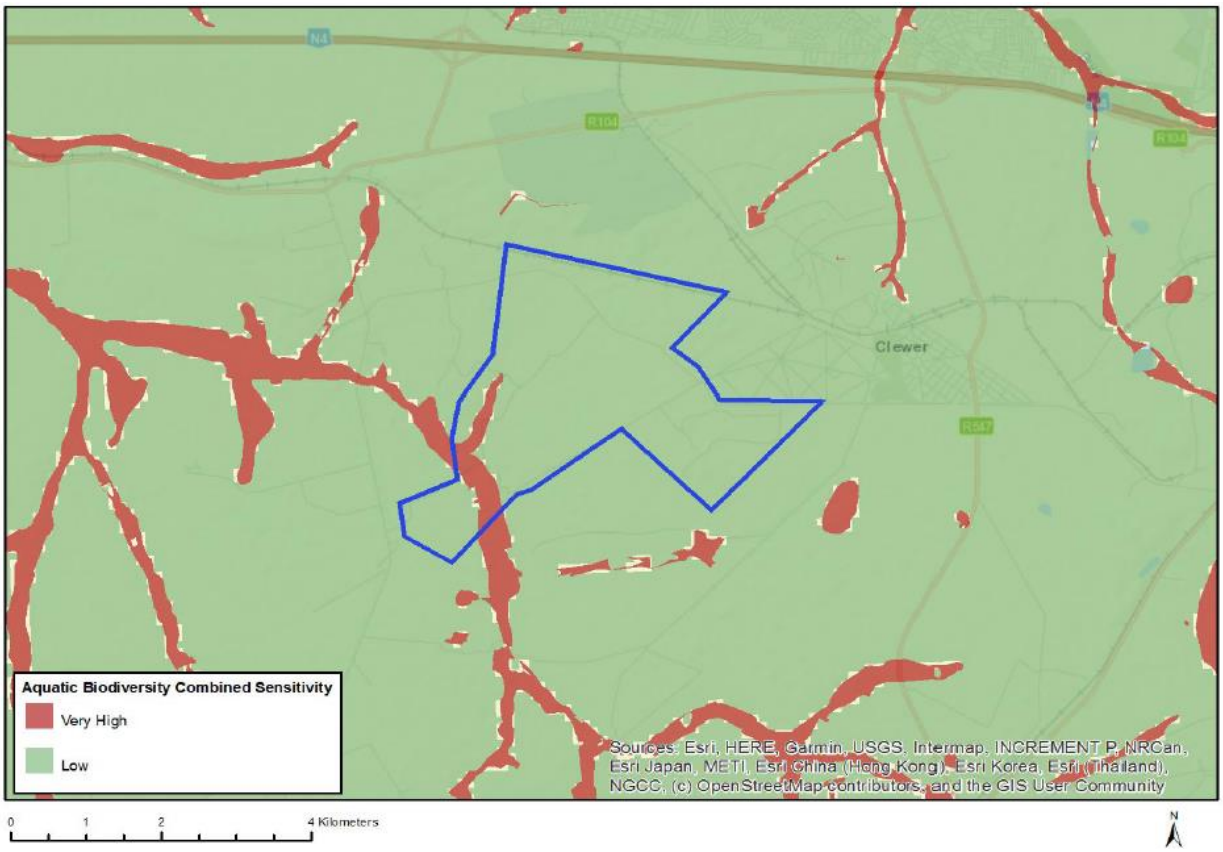

Figure 1-1 Map of relative aquatic biodiversity theme sensitivity

2. Document Structure

The table below provides the NEMA (2014) Requirements for Ecological Assessments, and also the relevant sections in the reports where these requirements are addressed:

GNR 326	Description	Section in the Report
Specialist Report		
Appendix 6 (a)	A specialist report prepared in terms of these Regulations must contain— details of— i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page iv.
Appendix 6 (b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix A
Appendix 6 (c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 4
Appendix 6 (cA)	An indication of the quality and age of base data used for the specialist report;	Section 8
Appendix 6 (cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8.7 and 10
Appendix 6 (d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1
Appendix 6 (e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 7
Appendix 6 (f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a, site plan identifying site alternatives;	Section 9
Appendix 6 (g)	An identification of any areas to be avoided, including buffers;	Section 8.9, 9 and 10
Appendix 6 (h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 8.9 and 9
Appendix 6 (i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 13
Appendix 6 (j)	A description of the findings and potential implications of such findings on the impact of the proposed activity [including identified alternatives on the environment] or activities;	Section 10, 12.2 and 12.3
Appendix 6 (k)	Any mitigation measures for inclusion in the EMPr;	Section 11
Appendix 6 (l)	Any conditions for inclusion in the environmental authorisation;	Section 12.2 and 12.3
Appendix 6 (m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	11
Appendix 6 (n)	A reasoned opinion— i. [as to] whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 12.2 and 12.3
Appendix 6 (o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	None
Appendix 6 (p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
Appendix 6 (q)	Any other information requested by the competent authority.	None

3. Specialist Details

3.1 Report Writer and Fieldwork

Ivan Baker

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

3.2 Report 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.

4. 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;
- Implementation of WET-Health for determination of Present Ecological State (PES) of wetland areas;
- Implementation of WET-EcoServices for determination of ecosystem services for the wetland areas;
- Determine the Environmental Importance and Sensitivity (EIS) of wetland systems;
- Conduct risk assessments relevant to the proposed activity;
- Recommendations relevant to associated impacts; and
- Report compilation detailing the baseline findings.

5. Project Description

5.1 Project area

The Elandsfontein Colliery is located in the Witbank Coal Field on the farm Elandsfontein 309 JS. The property is approximately 16 km west of the town of Witbank in the Mpumalanga Province, South Africa. The centre point of the site is 25°53'05.01"S and 29°05'36.57"E. The

Elandsfontein Colliery comprises 2 distinct mining rights (MR314 and MR63). The applicant plans to consolidate the two mining right areas into a single mining right with associated consolidated EMPR. In addition, the applicant wishes to expand their existing mining operations to include additional mineral resource areas (i.e.: new open cast & underground areas within the consolidated mining right boundary) (GSW, 2019). The dominant land uses surrounding the project area includes watercourses, cultivation, urban sprawls and mining. A locality map of the project area is shown in Figure 5-1**Error! Reference source not found.**.

5.2 Background

Elandsfontein Colliery is an existing mine with opencast and underground sections. Elandsfontein Colliery holds two mining rights, namely MP 314 MR (~593 ha) and MP 63 MR (~237 ha). It produces coal for the local and the export market, at a rate of ~500 000 tons/annum. Coal has been produced historically from the No. 1 Seam (underground bord and pillar operation) and an opencast operation on the No. 4 Seam and on the No. 2 Seam.

The roll over strip mining method is utilised to extract coal from the shallower No.2 coal seam. The existing opencast operations have an approximate extent of 257 ha (some of this area has already been mined and other areas are currently being mined in accordance with the previous approved mine plan) while the applicant wishes to authorise an additional 69.47 ha of opencast mining. Deeper coal will be extracted by underground bord and pillar mining using decline shafts to access the No. 1 coal seam. The historical underground footprint covers an approximate area of 182 ha, while Elandsfontein Colliery wishes to authorise an additional 485 ha of underground mining and 249 ha of opencast mining. Associated infrastructure consists of a discard dump, coal RoM stockpiles, overburden stockpiles, pollution control dams (PCD) and slurry dam.

Elandsfontein Colliery is planning to add additional opencast and underground mining areas within the existing mining right areas to extend the life-of-mine (LoM). As such a MPRDA S102 amendment process is being undertaken by the mine, supported by the integrated EIA/WML and WULA applications. The EIA process will result in a consolidation of the numerous authorisation processes that have been undertaken to date to produce a single overarching EMPr for holistic management of the Colliery going forward. Elandsfontein Colliery will be applying for the relevant approvals to cover their extended LoM which will include future opencast and underground mining operations and associated infrastructure. Various amendments to the existing EA/EMP as well as IWUL will also be applied for to align the specific conditions with the current status of the mine as well as to provide more clarity on certain conditions.

The following rights, authorisations and approvals are currently in place and have been considered in the compilation of the report:

- Mining Right 63 MR renewal, granted to Elandsfontein Colliery (Pty) Ltd, in terms of Section 24 (3) of the MPRDA on 6 August 2019 which covers the following portions of the farm Elandsfontein 309 JS: Portion of the RE of Portion 6, Portion of the RE of Portion 8 and RE of Portion 1.
- Mining Right 314 MR renewal, granted to Elandsfontein Colliery (Pty) Ltd, in terms of Section 24 (3) of the MPRDA on 6 August 2019 which covering the following portions of the farm Elandsfontein 309 JS: RE of Portion 7, Portion of the RE of Portion 8, Portion 44 and Portion 14;

- An amended EMPr dated August 2017;
- Approved IWUL, File No. 16/2/7/B100/C11 granted on 20 October 2015 for various S21 (g), (c) and (i) which covers Portions 1, 7, 8 and 14 of Elandsfontein 309 JS (amended 23 July 2019).

The existing approved surface infrastructure at Elandsfontein Colliery consists of the following:

- Opencast pit;
- Underground mining areas;
- Stockpiles;
- Offices;
- Beneficiation Plant area (crushing and screening);
- Contractors yard;
- Weighbridge;
- Access and haul roads;
- Security point and fencing;
- Pumps and sumps;
- Clean water trenches;
- Dirty water trenches;
- 3 PCD's; and
- Storm water control trenches.

5.3 Description of Activities to Be Undertaken

This section describes the current authorization process activities as provided. The proposed project includes inter alia the following application processes with associated activities:

- New Integrated Environmental Authorisation (Scoping and Environmental Impact Report (S&EIR)) for:
    - New opencast and underground mining areas;
    - New PCDs and stormwater management infrastructure;
    - New residue deposits and/or residue stockpiles (requiring Waste Management Licence); and
    - Various activities including the primary processing of a mineral resource related to the extended LoM.
- Renewal of Integrated Water Use Licence (IWUL) and application for new water uses for:
    - Residue stockpiles/deposits;

- Dewatering of pits and underground areas;
- New PCD's and stormwater management infrastructure; and
- GN704 exemptions.

- MPRDA Section 102 Amendment:
  - Revised Mine Works Programme;
  - Revised Social and Labour Plan;
  - Revised Regulation 2.2 Plan; and
  - Revised consolidated EMPr.

The proposed mining can be seen in Figure 5-2 whereas the proposed surface infrastructure, stockpiles and the related activities can be seen in Figure 5-3.

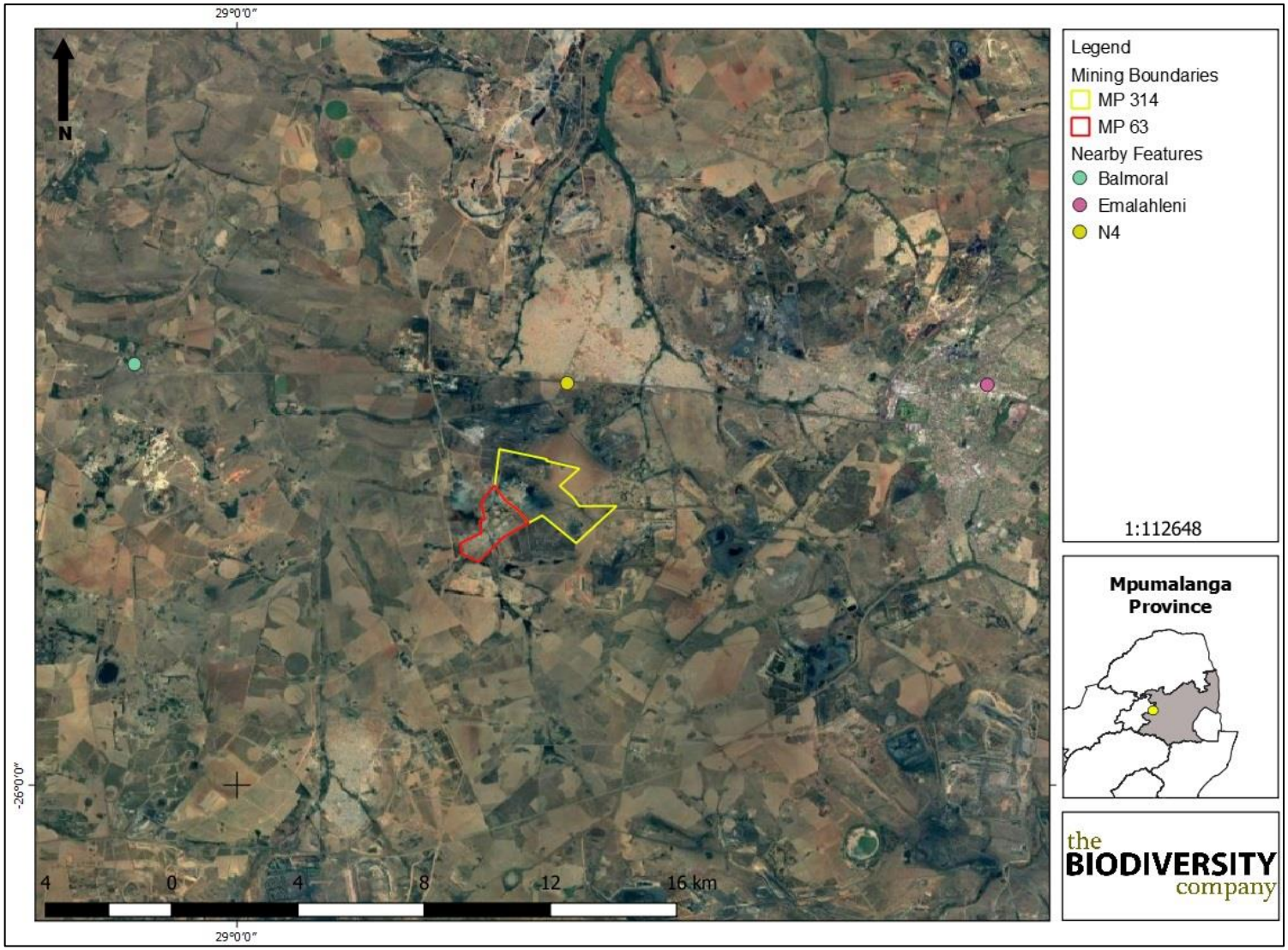

Figure 5-1 Locality map of the project area

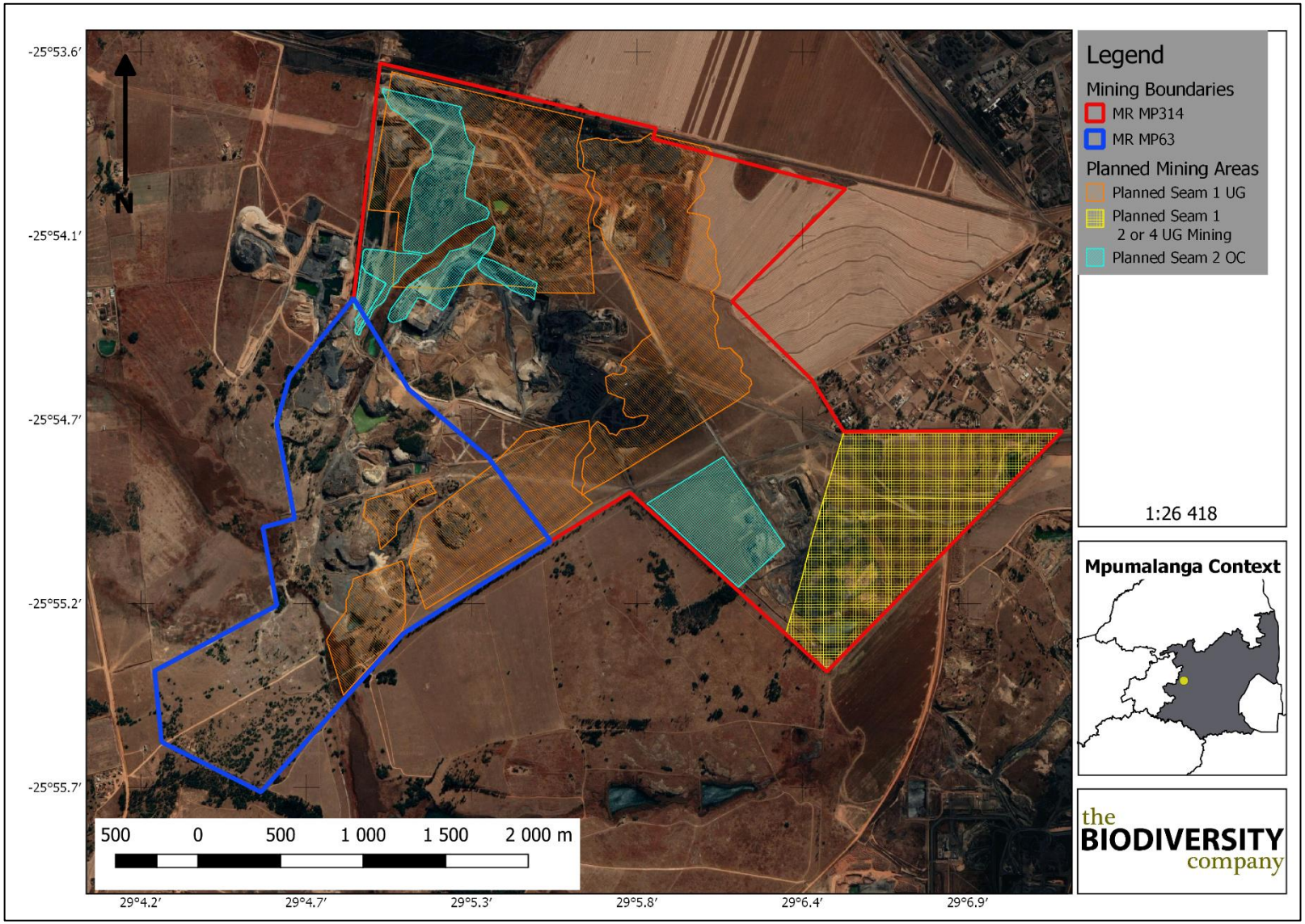

Figure 5-2 Extent of proposed open cast and underground mining areas

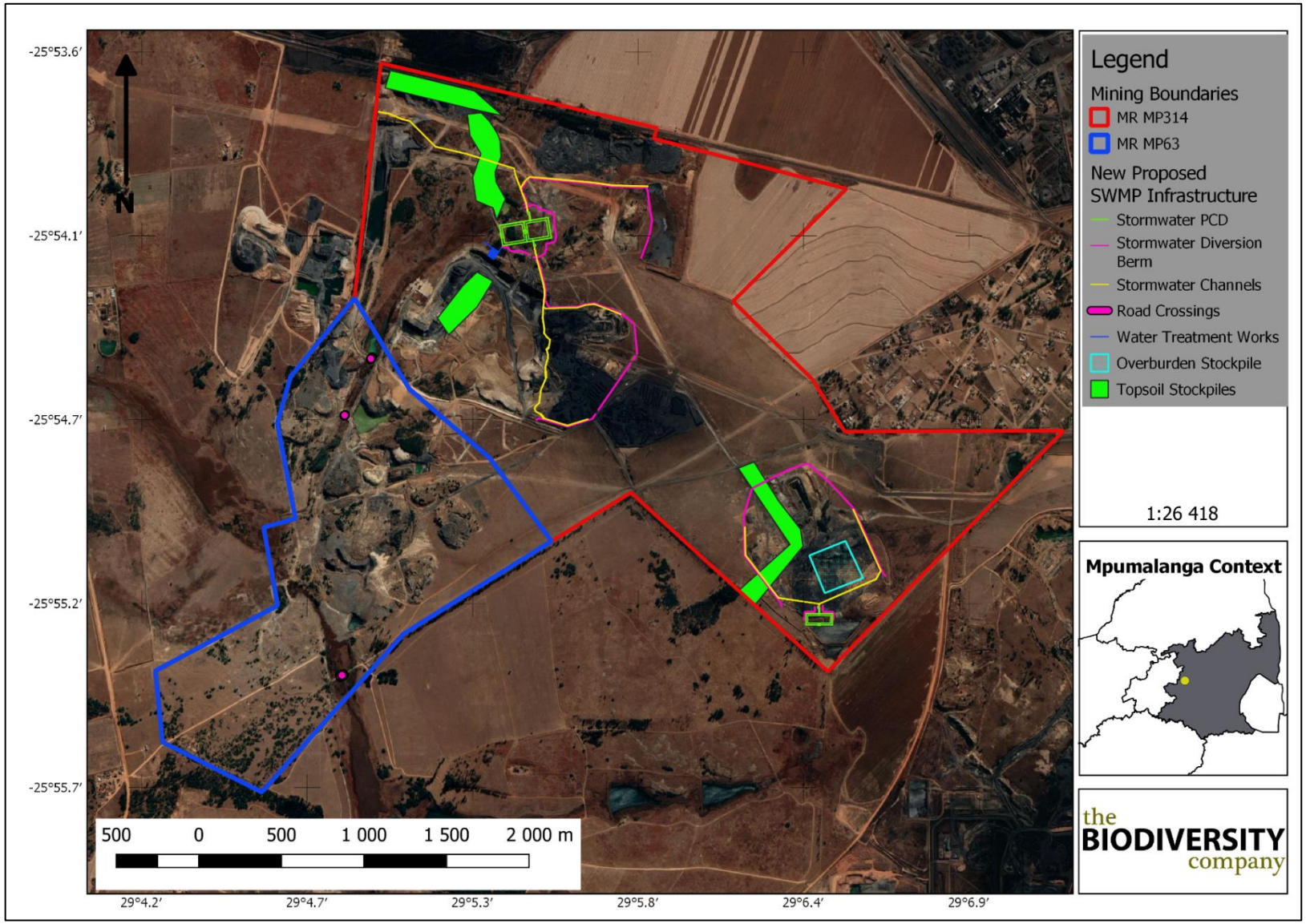

Figure 5-3 Layout map indicating new stormwater management infrastructure

6. Legislative and Policy Framework

6.1 National Water Act (Act No. 36 of 1998)

The Department of Water & Sanitation (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 (NWA) (Act No. 36 of 1998) 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; and
- 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.

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): "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 which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

Wetlands have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

6.2 National Environmental Management Act (Act No. 107 of 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.

7. Methodologies

7.1 Wetland Assessment

The following information sources were considered for the desktop assessment;

- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel *et al*., 2011);
- The Mpumalanga Highveld Wetlands; and
- Contour data (5m).

7.2 Wetland Identification and Mapping

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

7.2.1 Desktop Assessment

The following information sources were considered for the desktop assessment:

- NASA Shuttle Radar Topography Mission Global 1 arc second digital elevation data
- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel et al., 2011);
- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer, H., et al., 2018); and
- Contour data (5 m).

7.2.2 Delineation

The wetland areas were delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 7-1. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.

- The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);

- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

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

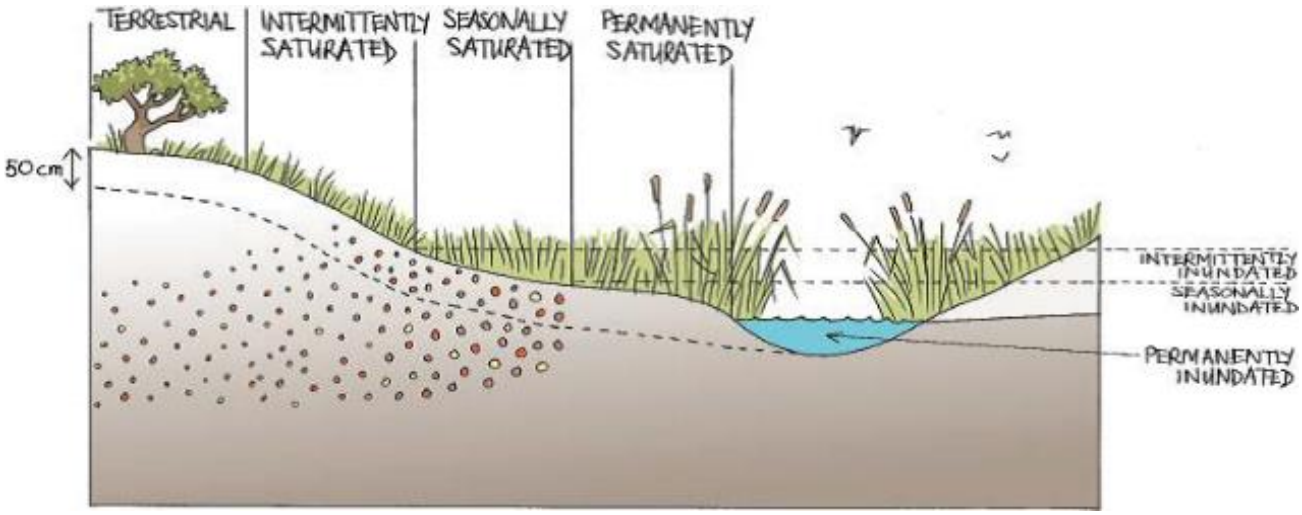

Figure 7-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013)

7.2.3 Present Ecological Status

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present State categories are provided in Table 7-1.

Table 7-1 Summary of the Present Ecological State categories (Macfarlane, et al., 2009)

Impact Category	Description	Impact Score Range	Present State Category
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**

7.2.4 Ecosystem Services

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*., 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 7-2).

Table 7-2 Classes for determining the likely extent to which a benefit is being supplied (Kotze et al., 2009)

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

7.2.5 Ecological Importance and Sensitivity

The method used for the Ecological Importance and Sensitivity (EIS) determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 7-3.

Table 7-3 Description of Ecological Importance and Sensitivity categories.

EIS category	Range of mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

7.2.6 Buffer Determination

The "*Buffer zone guidelines for wetlands, rivers and estuaries*" (Macfarlane and Bredin 2017) was used to determine the appropriate wetland buffer zone for the proposed activity (in this case the category transportation infrastructure, paved roads).

8. Receiving Environment

8.1 Wetland Delineation and Description

The wetland areas were delineated in accordance with the DWAF (2005) guidelines (see Figure 8-6). During the field survey, one main unchanneled valley bottom (HGM 1) and two hillslope seeps (HGM 2 and 3) were identified (see Figure 8-2). The unchanneled valley bottom originates from drainage lines, which likely has been modified to channel flow. Various mining components are located within close proximity to HGM 1, which increases modification to the wetland in various ways, including increased inputs from water stored in waste impoundments and evaporation/attenuation ponds.

Significant modification and degradation has resulted in surface and sub-surface flow dynamics being altered with an input of Transported Technosols (see Section 8.4.1-"Hydromorphic Soils") that according to DWAF (2005) cannot be classified as a hydromorphic soil form. A large portion of the upper reaches of HGM 1 has therefore been determined to be artificial and therefore irrelevant to the wetland assessment. Additionally, four other systems have also been deemed to be artificial of which two are located to the eastern side of the mining right area and the other two joining HGM 3 from the north. The latter have been altered significantly by artificial surface run-off, which has resulted in the formation of wetland areas via anthropogenic water inputs (predominantly trenches flowing into the systems (see Figure 8-1)). Therefore, even though wetland properties are present within these two systems, it is the specialist's opinion that these systems will be lost once all anthropogenic inputs are removed. These anthropogenic inputs have also created seeps surrounding the artificial systems due to increased sub-surface contributes. All artificial systems have been disregarded from this system.

Figure 8-1 Trenches diverting overland flow to artificial wetlands

Figure 8-2 *Example of unchanneled valley bottom wetlands identified within the MRA (HGM 1)*

A hillslope seep (see Figure 8-3) approximately 0.88 ha is size (although only delineated within the MRA) has been identified and is surrounded by crop fields which is the main contributor to the modification of this wetland. The wetland area was burnt prior to the assessment which has resulted in limitation in regard to hydrophytes, ultimately rendering hydromorphic soils the main indicator.

Figure 8-3 HGM 2- Hillslope Seep

The second hillslope seep (HGM 3) surrounds HGM 1, which emphasises the role of this wetland in regard to the regulation of sub-surface flows into HGM 1 (see Figure 8-4). This system too has been heavily modified by surrounding mining activities, which favours conditions for non-obligate wetland plants like *Imperata cylindrica*. It is well documented by the likes of (Sieben *et al.,* 2014) that *Imperata cylindrica* prefers sandy soils and thrives in disturbed areas, ultimately limiting the use of *Imperata cylindrica* as a wetland indicator for this wetland. Transects were carried out to determine the extent of the delineations, during which the focus was shifted to hydromorphic soils, which according to DWAF (2005) is the most important factor relating to wetland identification.

Figure 8-4 *Indication of Imperata cylindrica across the entire hillslope relevant to HGM 3*

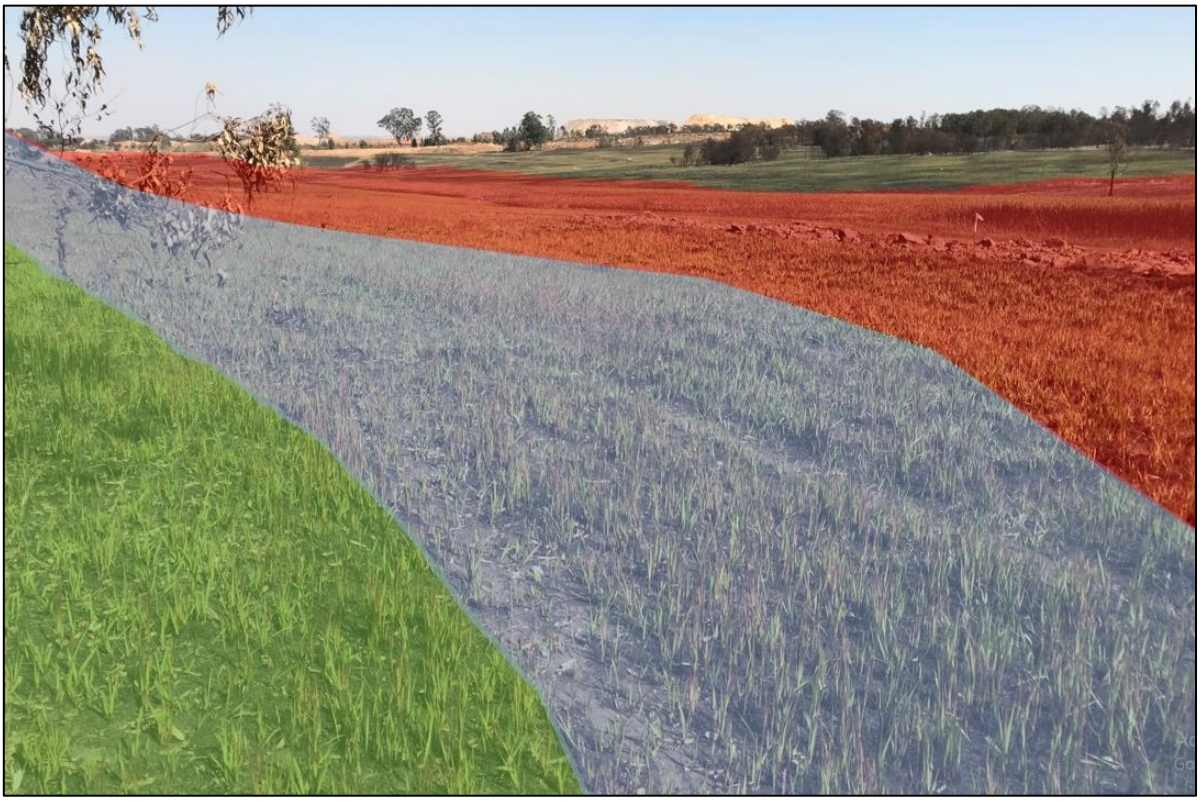

Figure 8-5 *Conceptual illustrations of delineations adjacent to HGM 1. Red: HGM 1. Blue: HGM 2. Green: Terrestrial.*

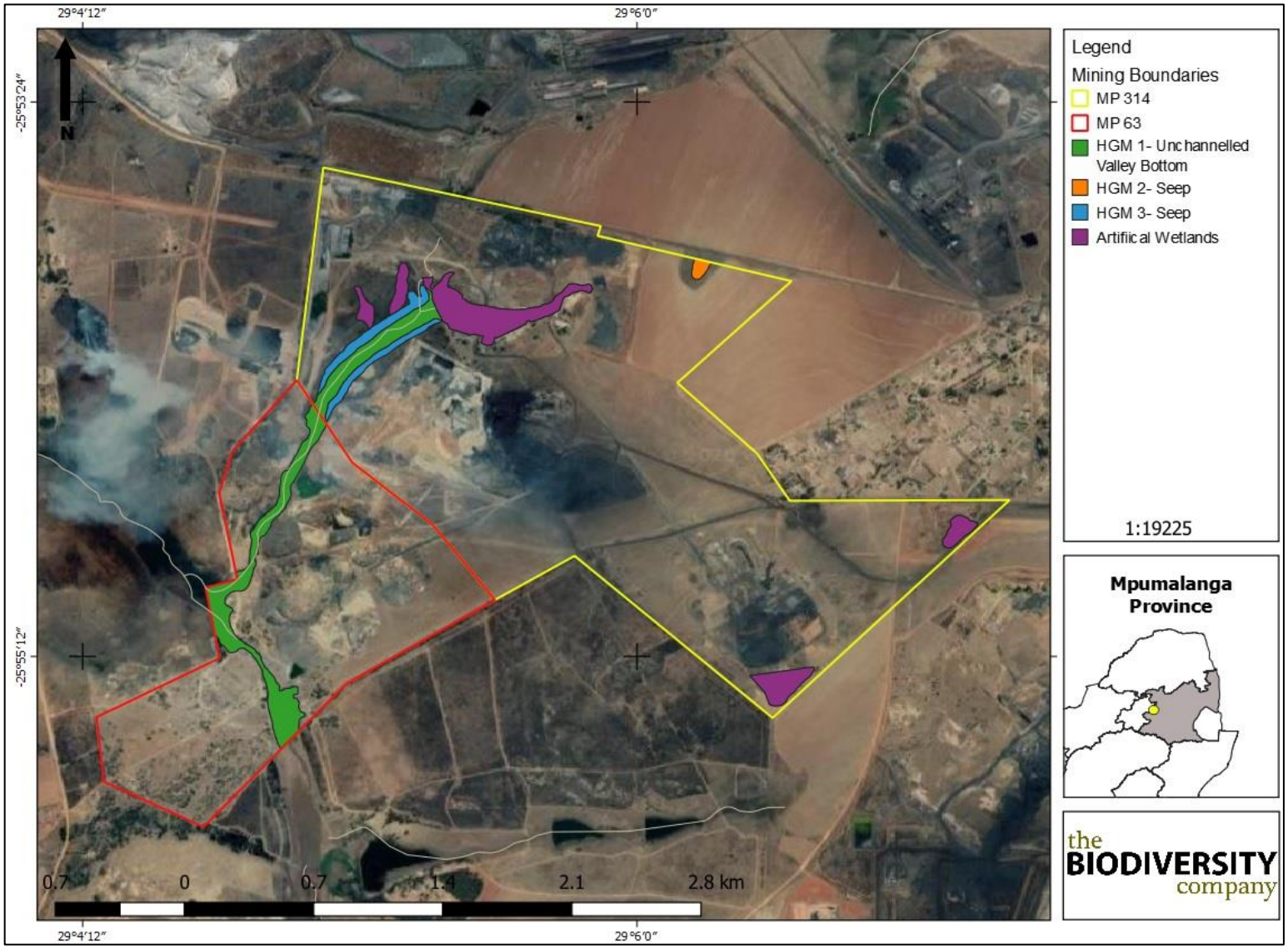

Figure 8-6 Delineation of wetlands within the MRA

8.2 Wetland Unit Identification

The wetland classification as per SANBI guidelines (Ollis *et al.,* 2013) is presented in Table 8-1. Two wetland types were identified within the project area, namely an unchanneled valley bottom wetland (HGM 1) and two hillslope seeps (HGM 2 and 3).

Table 8-1 Wetland classification as per SANBI guideline (Ollis et al., 2013)

Wetland System	Level 1	Level 2		Level 3	Level 4		
	System	**DWS Ecoregion/s**	**NFEPA Wet Veg Group/s**	**Landscape Unit**	**4A (HGM)**	**4B**	**4C**
HGM 1	Inland	Highveld	Mesic Highveld Group 4	Valley Floor	Unchanneled Valley Bottom	N/A	N/A
HGM 2	Inland	Highveld	Mesic Highveld Group 4	Hillslope	Hillslope Seep	Without Channelled Outflow	N/A
HGM 3	Inland	Highveld	Mesic Highveld Group 4	Hillslope	Hillslope Seep	Without Channelled Outflow	N/A

8.3 Wetland Unit Setting

HGM 1, as mentioned in Figure 8-7, is located on the "valley floor" landscape unit. Unchanneled valley bottom wetlands are typically found on valley-floors where the landscape does not allow high energy flows. Figure 8-7 illustrates a diagram of a typical unchanneled valley bottom, showing the dominant movement of water into, through and out of the system.

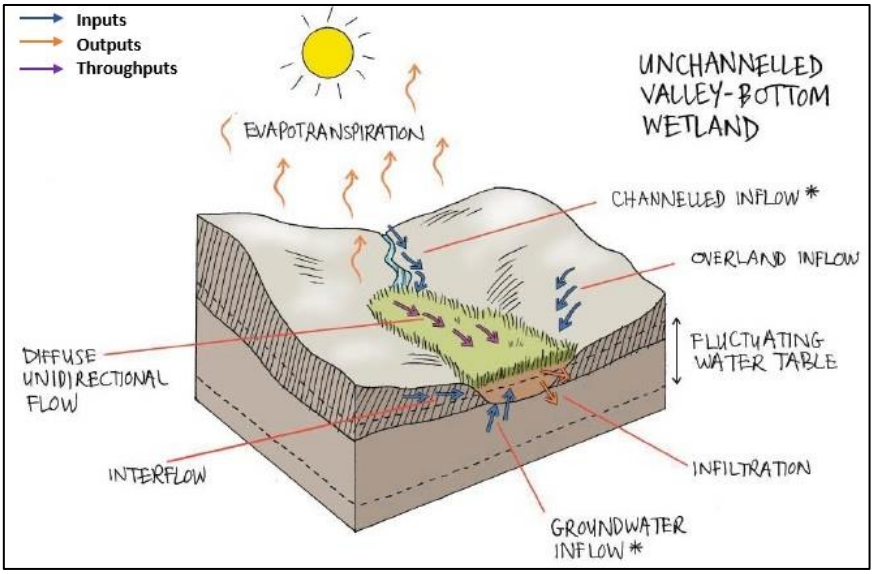

Figure 8-7 Amalgamated diagram of the HGM type, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

HGM 2 and 3 are located within slopes, as indicated in Figure 8-8. Hillslope seeps are characterised by colluvial movement of material. These systems are fed by very diffuse sub-surface flows which seep out at very slow rates, ultimately ensuring that no direct surface water connects this wetland with other water courses within the valleys. Figure 8-8 illustrates a diagram of a typical seep, showing the dominant movement of water into, through and out of the system.

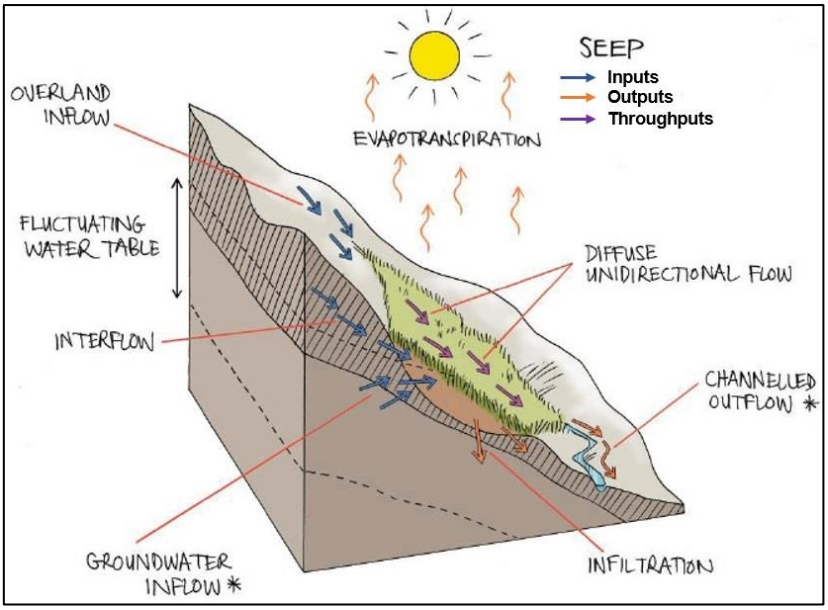

Figure 8-8 Amalgamated diagram of the HGM type, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al., 2013)

8.4 Wetland Indicators

8.4.1 Hydromorphic Soils

According to (DWAF, 2005), soils are the most important characteristic of wetlands in order to accurately identify and delineate wetland areas. Three dominant soil forms were identified within all three identified HGM units, namely the Tshiombo (see Figure 8-9) and Dundee soil forms as well as Transported Technosols (see Figure 8-10).

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

The Tshiombo soil form consists of an Orthic topsoil on top of a Neocutanic horizon, which in turn is underlain by an unconsolidated material with signs of wetness. The soil family group identified for the Tshiombo soil form is “212” due to the chromic colour of the topsoil, the brown colour of the Neocutanic horizon as well as the luvic textural contrast of the Neocutanic horizon.

Transported Technosols is defined by the Soil Classification Working Group (2018) as being soil material that has been intentionally transported and includes anthropogenic material. These soils include waste material (waste rock, tailings material etc.) The Transported Technosols on-site have been identified as a Witbank soil form with the family group “1100”, which emphasises anthropogenic material covering natural soil.

Orthic A 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 A topsoil to another (i.e. colouration, structure etc) (Soil Classification Working Group, 2018).

The Neocutanic horizon is associated with recent depositions and unconsolidated soils. Any soil form can develop out of a Neocutanic horizon, depending on the climatic and topographical conditions). Some properties pertaining to other diagnostic soil horizons will be present within a Neocutanic horizon but will lack main properties necessary to classify the relevant soil type.

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

Figure 8-9 Neocutanic horizons with signs of wetness

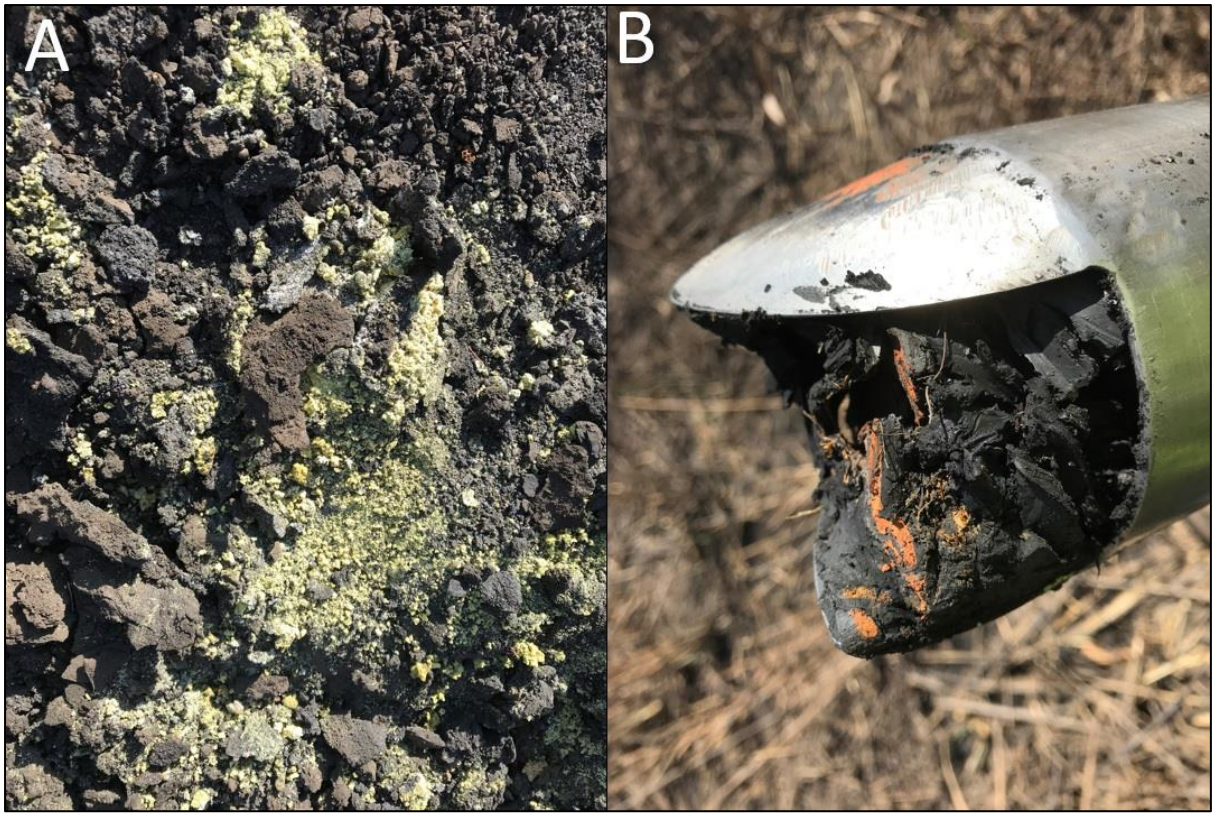

Figure 8-10 Transported Technosols identified within wetlands. A: Overburden material with salt precipitation. B: Coal from waste impoundments identified within wetlands (including signs of wetness)

8.4.2 Hydrophytes

Vegetation plays a considerable role in identifying, classifying and accurately delineating wetlands (DWAF, 2005). During the site visit, four dominant hydrophyte species were identified, including *Schoenoplectus spp., Imperata cylindrica, Phragmites australis* and *Typha capensis* (see Figure 8-11).

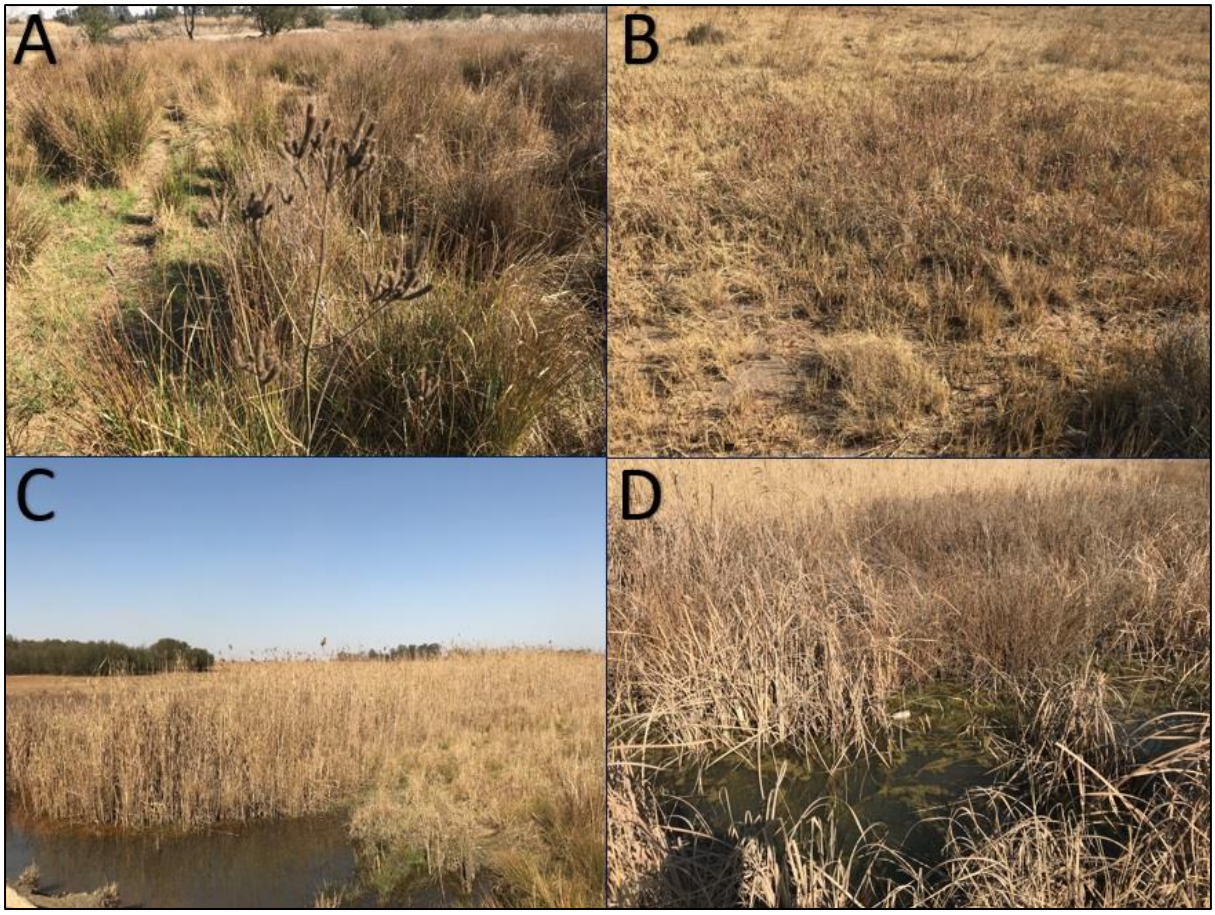

Figure 8-11 Hydrophytes identified within the delineated wetlands. A: Verbena and Schoenoplectus spp. B: Imperata cylindrica. C: Phragmites Australis. Typha capensis

8.5 General Functional Description

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

Hillslope seeps are well documented by (Kotze *et al*., 2008) to be associated with sub-surface ground water flows. These systems tend to contribute to flood attenuation given their diffuse nature. This attenuation only occurs while the soil within the wetland is not yet fully saturated. The accumulation of organic material and sediment contributes to prolonged levels of saturation due to this deposition slowing down the sub-surface movement of water. Water typically accumulates in the upper slope (above the seep). The accumulation of organic matter additionally is essential in the denitrification process involved with nitrate assimilation. Seeps generally also improve the quality of water by removing excess nutrient and inorganic pollutants originating from agriculture, industrial or mine activities. The diffuse nature of flows ensures the assimilation of nitrates, toxicants and phosphates with erosion control being one of the Eco Services provided very little by the wetland given the nature of a typical seep's position on slopes.

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.

8.6 Ecological Functional Assessment

The ecosystem services provided by the wetland units identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). The summarised results for HGM 1, 2 and 3 are shown in Table 8-2. The average ecosystem services score has been determined to be "Intermediate" for HGM 1 and "Moderately Low" for HGM 2 and 3.

Table 8-2 The ecosystem services being provided by the HGM types

Wetland Unit					HGM 1	HGM 2	HGM 3
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		2.3	1.9	1.7
			Streamflow regulation		2.1	1.8	1.7
			Water Quality enhancement benefits	Sediment trapping	2.4	2.0	2.1
				Phosphate assimilation	2.6	2.3	2.2
				Nitrate assimilation	2.5	2.2	2.3
				Toxicant assimilation	2.6	2.1	2.0
				Erosion control	2.4	1.9	1.8
			Carbon storage		1.8	1.6	1.6
	Direct Benefits	**Biodiversity maintenance**			1.1	1.4	1.2
		Provisioning benefits	Provisioning of water for human use		0.2	0.3	0.4
			Provisioning of harvestable resources		0.0	0.0	0.0
			Provisioning of cultivated foods		0.0	0.0	0.0
		Cultural benefits	Cultural heritage		0.0	0.0	0.0
			Tourism and recreation		0.0	0.0	0.0
			Education and research		0.6	0.8	1.0
Average Eco Services Score					1.4	1.2	1.2

Table 8-3 illustrates the ecosystem services rated "High" for the delineated wetlands with summarised descriptions of these ecosystem services. For HGM 1, seven ecosystem services have been rated high with HGM 2 and 3 characterised by three ecosystem services rated "High".

Table 8-3 Ecosystem services scored "High" for the delineated wetlands

EcoService	HGM 1	HGM 2	HGM 3	Justification of High Score
Flood attenuation	✓			The slope of the wetland, the size of the wetland relevant to it's sub-catchment as well as the surface roughness within HGM 1 contributes to this ecosystem service score.
Streamflow regulation	✓			This high score is attributed to the presence of other watercourses downstream of the wetland, the reduction in evapotranspiration due to frosting as well as the presence of underlying geology with strong sub-surface flow connotations.
Sediment trapping	✓		✓	The high score determined for "Sediment Trapping" is mainly described to the evidence of sediment trapping (see Figure 8-12) as well as the fact that there are no dams upstream of the wetlands to trap sediments before entering the relevant wetlands.
Phosphate assimilation	✓	✓	✓	The high scores rated for the assimilation of phosphates, nitrates and other toxicants are high due to the potential of contamination via these parameters. The higher the potential for contamination is, the higher these wetlands are rated due to the importance of these systems to assimilate contaminants.
Nitrate assimilation	✓	✓	✓	
Toxicant assimilation	✓	✓		
Erosion control	✓			The slope of the wetland and the high density of hydrophytes within HGM 1 contributes to the high level of erosion control within HGM 1.

Figure 8-12 Sediment inputs and trapping within HGM 1

8.7 The Ecological Health Assessment

The PES for the assessed HGM types is presented in Table 8-4. The overall PES classes for HGM 1, 2 and 3 has been determined to be "Critically Modified", "Largely Modified" and "Moderately Modified" respectively.

Table 8-4 Summary of the scores for the wetland PES

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	**Score**	**Rating**	**Score**	**Rating**	**Score**
HGM 1	F: Critically Modified	8.3	E: Seriously Modified	6.5	F: Critically Modified	9.2
Overall PES Score	8.0		Overall PES Class		F: Critically Modified	
HGM 2	D: Largely Modified	5.1	C: Moderately Modified	2.3	F: Critically Modified	9.1
Overall PES Score	5.7		Overall PES Class		D: Largely Modified	
HGM 3	C: Moderately Modified	3.9	B: Largely Natural	1.8	D: Largely Modified	4.6
Overall PES Score	3.5		Overall PES Class		C: Moderately Modified	

The hydrology score for all three HGM units (especially HGM 1) has been affected by increased overland flow from the surrounding land use (mining) as well as the presence of drains and gullies (see Figure 8-13). The geomorphology component of HGM 1 has been modified the most, predominantly by the presence of drains and gullies (as mentioned) as well as wetland crossings (Figure 8-14). The vegetation component has been affected by means of the surrounding land use. Mining activities and components have resulted in a large-scale degradation and removal of vegetation. See Figure 8-15 for a comparison of vegetation patterns in 2010 compared to 2019.

Figure 8-13 Components contributing to an increase of water inputs within delineated wetlands. A: Artificial surfaces within close proximity to HGM 1. B: Drainage lines/gullies within the wetland's catchments

Figure 8-14 Example of a wetland crossing (blue arrow indicating position and direction of flow)

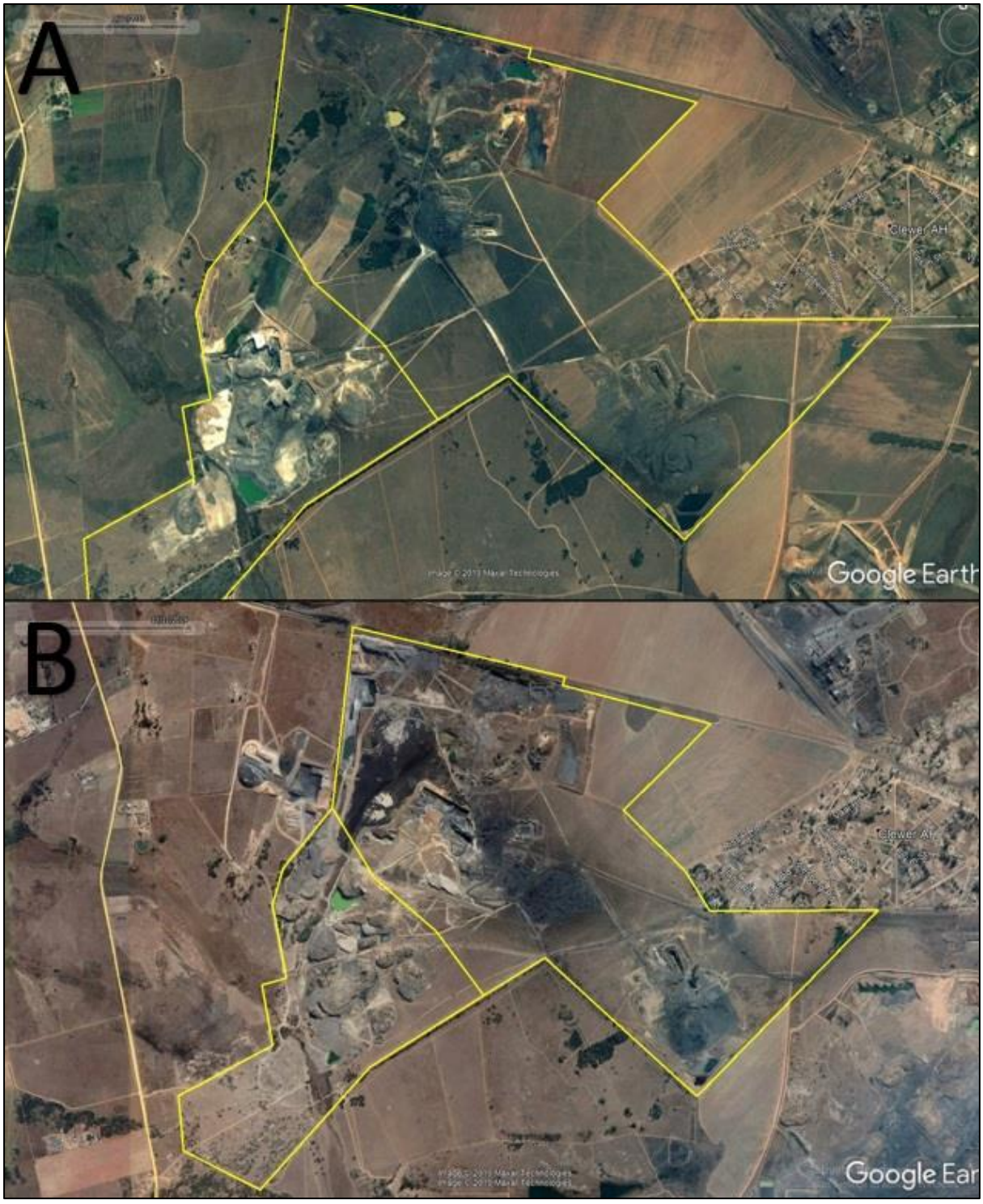

Figure 8-15 Loss of vegetation over 9 years. A: Aerial imagery in 2010. B: Aerial imagery 2019.

8.8 The Ecological Importance & Sensitivity Assessment

The wetland EIS assessment was applied to the HGM units described in the previous section in order to assess the levels of sensitivity and ecological importance of the wetlands. The results of the assessment are shown in Table 8-5.

Table 8-5 The EIS results for the delineated HGM types

Wetland Importance & Sensitivity	Importance		
	HGM 1	**HGM 2**	**HGM 3**
Ecological importance and sensitivity	**2.3**	**1.6**	**1.7**
Hydrological/functional importance	**2.0**	**1.6**	**1.2**
Direct human benefits	**0.3**	**0.2**	**0.3**

A “High” level of EIS have been scored for HGM 1, with HGM 2 and 3 being scored “Intermediate”. The “High” score relevant to HGM 1 is attributed to the sensitivity of unchanneled valley bottom wetlands to low flows. Furthermore, the modification and deterioration of water quality from contaminated mine water (see Figure 8-16) has resulted in a loss of habitat and the use of watercourses as breeding sites.

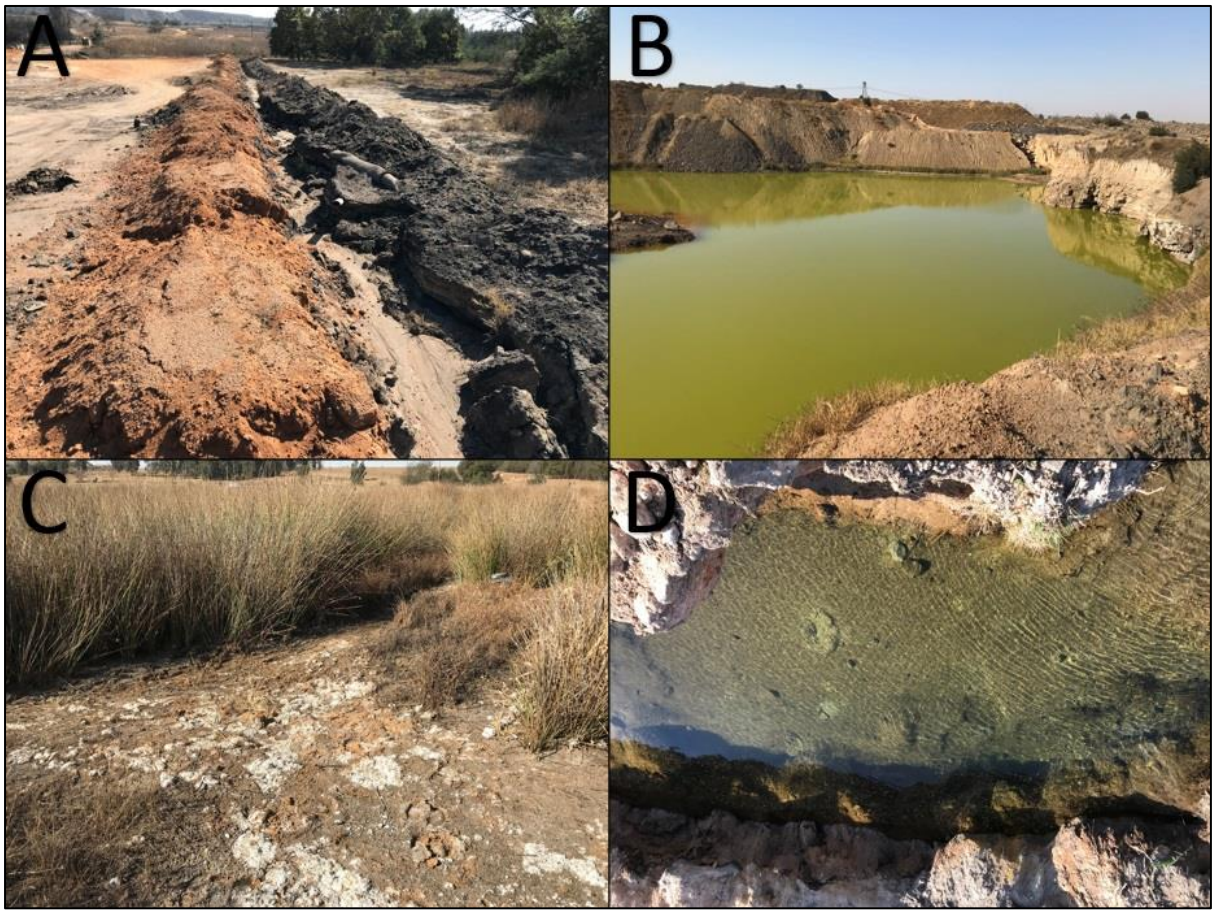

Figure 8-16 Sources of water contamination. A: Pathway for polluted surface water to the receptor (wetland). B: Stagnating, contaminated water in close proximity to HGM 1. C: Salt precipitation within HGM 1. D: Potential AMD.

The Hydrological/Functional Importance has been rated “Moderate” for all HGM units. The HGM units have been rated “Moderate” given the ability of the units to enhance water quality to a degree (see section “8.6”) for a detailed description of the indirect benefits gained from relevant ecosystem services. The following ecosystem services all contribute to the high hydrological/functional importance determined for the delineated wetland;

- Sediment trapping;

- Streamflow regulation;
- The assimilation of phosphates, nitrates and other toxicants;
- Flood attenuation; and
- Erosion control.

The Direct Human Benefits have been scored “Low” for all three HGM units due to very little to no signs or potential for cultural and religious activities or the potential for sustenance.

8.9 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 activities. The buffer zones calculated for the proposed open cast activities are 106 m with no buffer requirement for underground mining activities. Figure 8-17 illustrates the extent of the post-mitigation buffer zones (106 m) relevant to the delineated wetlands for the proposed open cast mining activities. For ancillary infrastructure, a post-mitigation buffer zone of 22 m was calculated.

Table 8-6 Pre- and post- mitigation threat ratings for the proposed open cast mining activities

Phase	Threat	Pre-Mitigation Threat Rating	Post-Mitigation Threat Rating
		Open Cast Mining	
Construction Phase	Alterations to flow volumes	High	Moderate
	Alterations of patterns of flows	High	Moderate
	Increase in sediment inputs and turbidity	High	Moderate
	Increased nutrient inputs	High	Moderate
	Inputs of toxic organic contaminants	High	Moderate
	Inputs of toxic heavy metals	High	Moderate
	Alterations of acidity (pH)	Moderate	Low
	Increased inputs of salts	Moderate	Low
	Change in water temperature	Moderate	Low
	Pathogen inputs	Very Low	Very Low
Operational Phase	Alterations to flow volumes	Very High	High
	Alterations of patterns of flows	Very High	High
	Increase in sediment inputs and turbidity	Very High	High
	Increased nutrient inputs	Very High	Very High
	Inputs of toxic organic contaminants	Very High	High
	Inputs of toxic heavy metals	Very High	High
	Alterations of acidity (pH)	Very High	High
	Increased inputs of salts	Very High	High
	Change in water temperature	Moderate	Moderate

	Pathogen inputs	Very Low	Very Low

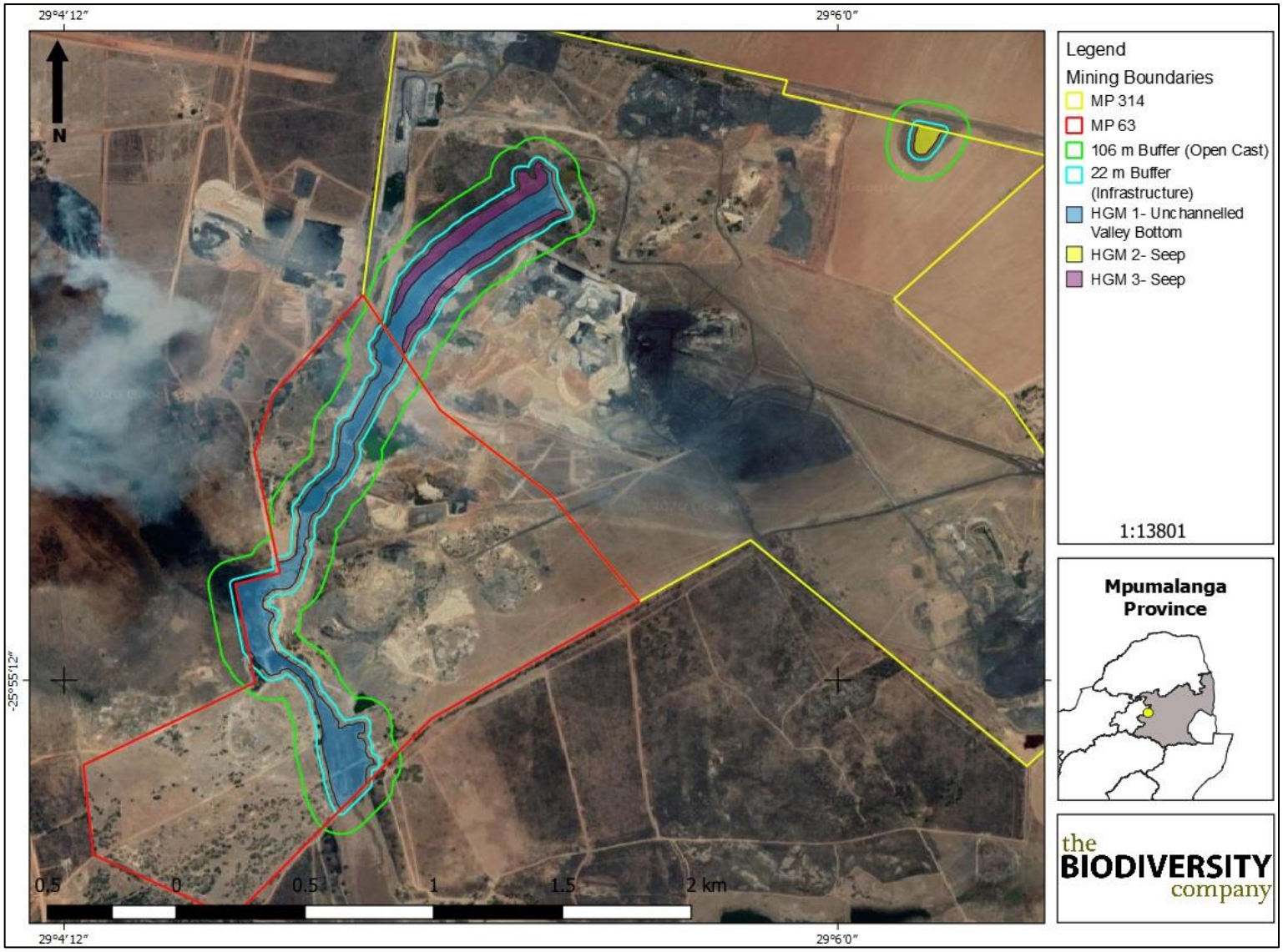

Figure 8-17 Open cast pit and infrastructure buffer requirement

9. Spatially Sensitive Mapping

9.1 Methodology

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

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

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

Table 9-1 Sensitivities relevant to the EIMS methodology

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

9.2 Feature Layer

Various delineated features make up the wetland features, which include artificial wetlands, HGM 1, HGM 2, HGM 3 as well as two sets of buffers calculated by means of the DWS buffer tool (for infrastructure and mining activities respectively).

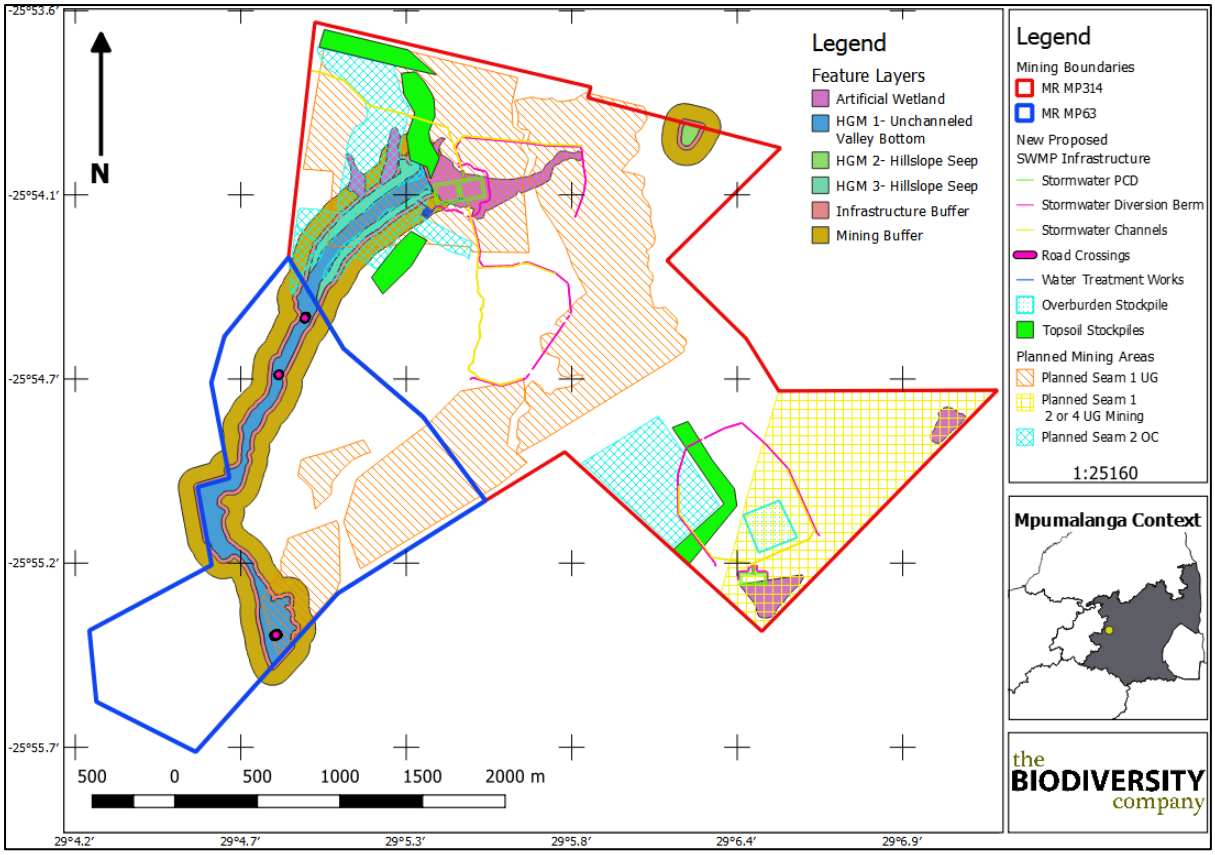

Figure 9-1 Feature layers within the mining boundaries

9.3 Overall Sensitivity

All features mentioned in Section 9.2- “Feature Layer” have been scored a sensitivity rating as per the EIMS methodology. HGM 1 and 3 have been scored “High” sensitivity ratings given the fact that these systems provide high levels of services and the fact that the proposed “Seam 2” open cast mine will impede into these systems. The buffer zones surrounding the latter two mentioned systems have been scored “Medium” sensitivity. The reason for the medium sensitivity can be ascribed to the lesser extent of functionality provided as opposed to that provided by the wetlands themselves.

The two artificial wetland systems joining HGM 1 and 3 from the north have been scored “Low” sensitivities. These systems are artificial, which decreases their sensitivity significantly. These two systems do however provide some level of functionality, ultimately rendering the systems “Low”. As for HGM 2, this system has been identified as being natural, which accounts for a high level of sensitivity. The proposed activities will however not impede into the delineated system, which has resulted in a decreased level of sensitivity (“Low”).

The buffer zones surrounding HGM 2 as well as the remainder of the artificial wetland systems have all been determined to be of “Least Concern”. It is worth noting that all areas not delineated as part of the features identified by the specialist also are of “Least Concern”.

The “High” sensitivity ratings for HGM 1 and 3 are somewhat consistent with Very High sensitivity rating provided by the Environmental Screening Tool, this is due to the presence of these wetland systems.

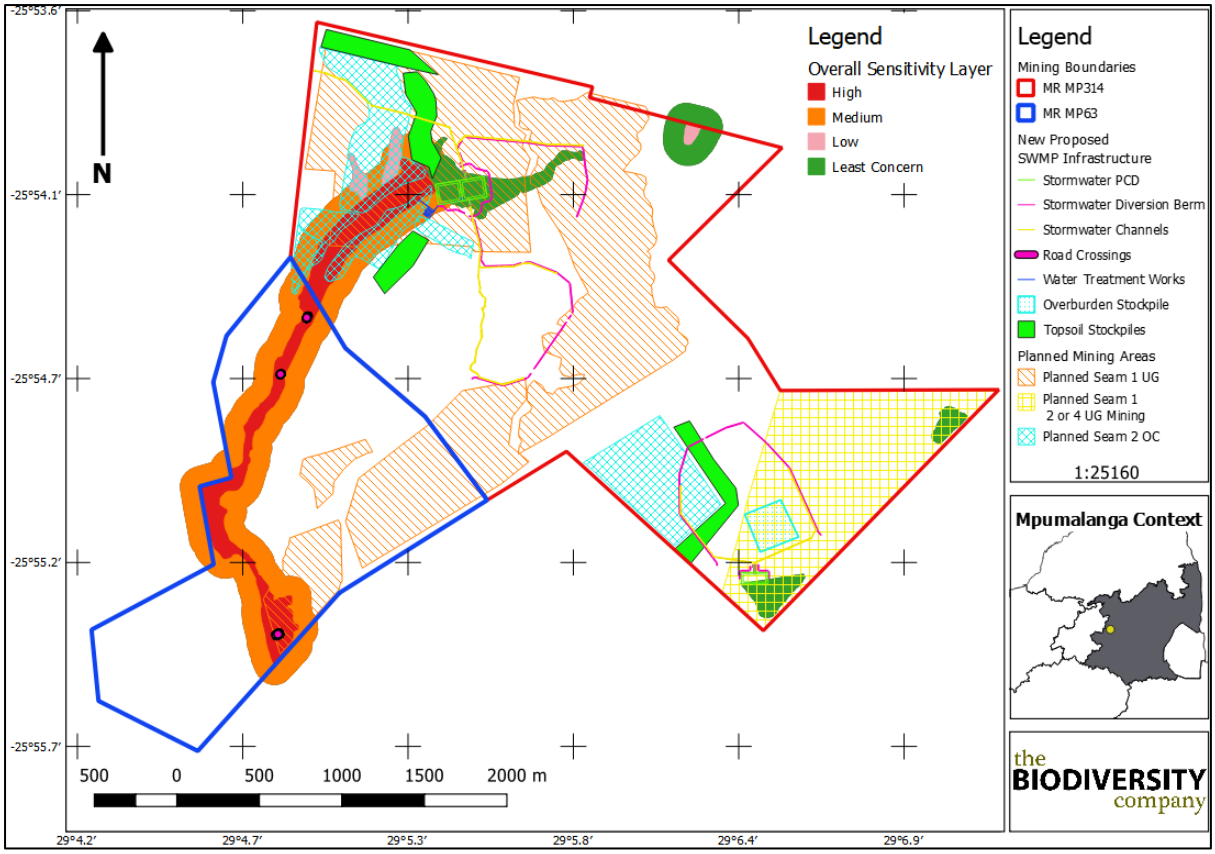

Figure 9-2 Overall sensitivity of identified features

9.4 Legislative Constraints

All areas within the identified wetlands' 500 m regulated area are subject to the National Water Act (NWA) Section 21 (C) and (I), as illustrated in Figure 9-3. HGM 1 and 3 will be impeded by the proposed open cast mining activities with no proposed activities expected to affect HGM 2. According to TBC (2019), a Water Use License (WUL) will be required for HGM 1 and 3 pertaining to the relevant mining activities impeding into the wetlands and their associated buffer zones. No authorisation is required for HGM 2 as well as the artificial systems.

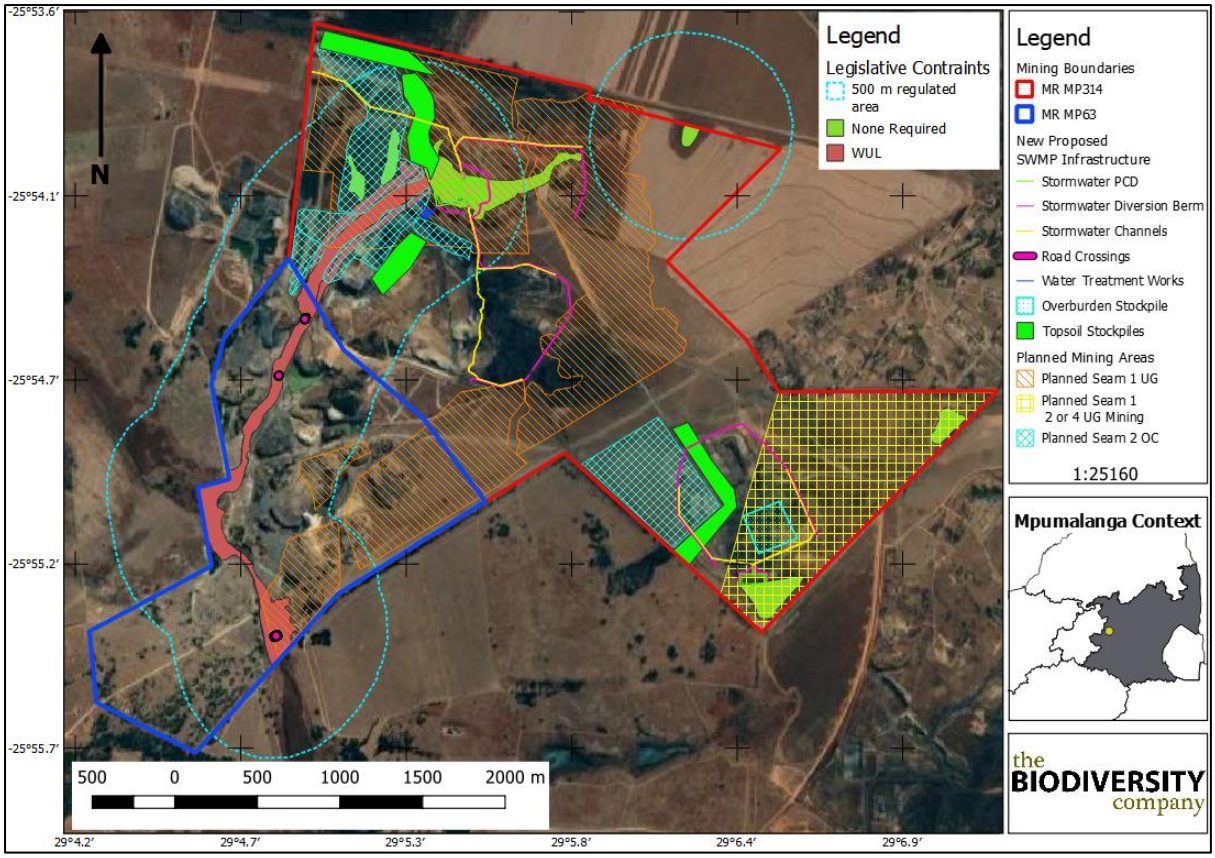

Figure 9-3 Legislative constraints relevant to identified features

10. Impact Assessment

10.1 Impact Assessment Methodology

An impact assessment methodology was provided by EIMS to determine the environmental risk associated with various aspects related to the proposed activities (open cast and underground mining with ancillary infrastructure). This impact assessment takes the following components into consideration;

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

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

10.2 Anticipated Impacts

The proposed mining as well as the surface infrastructure can be seen overlaid with the overall sensitivity (Figure 9-2). It is evident from the figure that the following may have a negative effect on more sensitive biodiversity features, most impacts involves the wetland and its associated buffer area:

- Planned Seam 2 OC (Affects the wetland, high sensitivity and affects the wetland buffer, medium sensitivity);
- Planned Seam 1 UG (Affects the wetland, high sensitivity and affects the wetland buffer, medium sensitivity);
- A portion of the stormwater PCD (Affects the wetland buffer, medium sensitivity);
- Water Treatment Works (Affects the wetland buffer, medium sensitivity); and
- A portion of the topsoil stockpile (Affects the wetland buffer, medium sensitivity).

10.3 Unplanned Events

The planned activities will have known impacts as discussed above; however, unplanned events may occur on any project and may have potential impacts which will need mitigation and management. A summary of the findings from a wetland perspective is presented in Table 10-1. Please note that not all potential unplanned events may be captured herein and this must therefore be managed throughout all phases of the project lifecycle.

Worst case scenario has been assumed (which includes open cast mining above underground mining where alternatives between the two are applicable), therefore, no subsidence has been assessed in such cases.

Table 10-1 Unplanned Events, Risks and their Management Measures

Unplanned Event	Potential Impact	Mitigation
Hydrocarbon spill into wetland habitat	Contamination of sediments and water resources associated with the spillage.	A spill response kit must be available at all times. The incident must be reported on and if necessary, a wetland specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Uncontrolled erosion	Sedimentation of downstream wetlands.	Erosion control measures must be put in place.
PCD overflow	The degradation of downstream water quality.	The overflow must be stopped immediately, and the impacted area remediated. Spill protection berms must be in place as well.

10.4 No-Go Option (Activity Alternative A2)

It is the specialist's opinion that in the event that none of the proposed activities be considered, that sensitive receptors will remain in degraded conditions unless significant anthropogenic interventions take place. The current sensitive receptors are in an already moderately to critically modified state, which will likely degrade even further taking into consideration the extent of historical and current mining activities within the area, and particularly the delineated wetlands.

Without the latter mentioned mining activities, and without considerable rehabilitation of the area it is unlikely that the delineated wetland will recover to such a capacity that beneficial functioning is provided. To summarise, the no-go option will result in zero additional impacts

but could result in little improvement of to the state and functioning of the wetlands with rehabilitation of the area.

10.5 Planning Phase

This section pertains to Activity Alternative A1.

10.5.1 Open Cast Mining (Seam 2)

The final significance rating has been determined to be “Low” given the duration of planning activities, the lower magnitude of impacts and the fact that roads already are in existence throughout the project area, which will be utilised during the planning phase.

10.5.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.5.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities within 500 m of the delineated wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.5.1.3 Irreplaceable loss of Resources

The planning phase of the relevant activities is not expected to result in irreplaceable loss of wetlands.

10.5.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

10.5.2 Underground Mining (Seam 1)

The final significance rating has been determined to be “Low” given the duration of planning activities, the lower magnitude of impacts and the fact that roads already are in existence throughout the project area, which will be utilised during the planning phase.

10.5.2.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.5.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities within 500 m of the delineated wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.5.2.3 Irreplaceable loss of Resources

The planning phase of the relevant activities is not expected to result in irreplaceable loss of wetlands.

10.5.2.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 1 due to the fact that only underground mining has been proposed.

10.5.1 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the duration of planning activities, the lower magnitude of impacts and the fact that some infrastructure is already in existence throughout the project area, which will be utilised during the planning phase.

10.5.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.5.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities within 500 m of the delineated wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.5.1.3 Irreplaceable loss of Resources

The planning phase of the relevant activities is not expected to result in irreplaceable loss of wetlands.

10.5.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed infrastructure.

10.6 Construction Phase

This section pertains to Activity Alternative A1.

10.6.1 Open Cast Mining (Seam 2)

The final significance rating has been determined to be “Low” given the duration of construction activities, the lower magnitude of impacts and the fact that much of the area already has been transformed and disturbed. Additionally, various roads already are in existence which can be used during the proposed activities. Recommended mitigation measures are expected to ensure a decrease in final significance ratings from “Moderate” to “Low.

10.6.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.6.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.6.1.3 Irreplaceable loss of Resources

The construction phase of the relevant activities is unlikely to result in a loss of natural resources owing to the fact that the area is an existing mine with infrastructure and services in place.

10.6.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

10.6.2 Underground Mining (Seam 1) (Process Alternative P3b)

The final significance rating has been determined to be “Low” given the duration of construction activities, the lower magnitude of impacts and the fact that mining has already been undertaken to some extent in this area and some services are already available. Further to this, much of the area above ground is already transformed and disturbed. Additionally, various roads already are in existence which can be used during the proposed activities. Recommended mitigation measures are expected to ensure a decrease in final significance ratings from “Moderate” to “Low.

10.6.2.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.6.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.6.2.3 Irreplaceable loss of Resources

The construction phase of the relevant activities is unlikely to result in a loss of natural resources owing to the fact that the area is an existing mine with infrastructure and services in place.

10.6.2.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 1 due to the fact that only underground mining has been proposed.

10.6.1 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the duration of construction activities, the lower magnitude of impacts and the fact that much of the area already has been transformed and disturbed. Additionally, some infrastructure is already in existence which can be used during the proposed activities. Recommended mitigation measures are expected to ensure a decrease in final significance ratings from “Moderate” to “Low.

10.6.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.6.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.6.1.3 Irreplaceable loss of Resources

The construction phase of the relevant activities is unlikely to result in a loss of natural resources owing to the fact that the area is an existing mine with infrastructure and services in place.

10.6.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed infrastructure.

10.7 Operational Phase

This section pertains to Activity Alternative A1.

10.7.1 Open Cast Mining (Seam 2)

The final significance rating has been determined to be “High” given the duration of operational activities, the higher magnitude of impacts and the fact that a portion of the delineated wetland areas are expected to completely be lost. No mitigation is expected to decrease the final significance ratings for this phase due to the direct loss of wetlands in some areas.

10.7.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.7.1.2 Cumulative Impacts

The cumulative impact rating has been scored “High” given the extent of existing mining activities within 500 m of the wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.7.1.3 Irreplaceable loss of Resources

The operational phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources are of high sensitivity. Loss of these wetland systems would require a form of compensation.

10.7.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed. It is however worth noting that as an alternative, the extent of the proposed mining area can be amended to adhere to the assigned buffer area to ensure a considerable decrease in final significance ratings.

10.7.2 Underground Mining (Seam 1) (Process Alternative P3b)

The final significance rating has been determined to be “Medium” given the duration of operational activities, the higher magnitude of impacts and the fact that delineated wetland areas are expected to be undermined during this phase which could result in degradation by means of subsidence. Mitigation in the form of subsidence investigation and assurance of a suitable safety factor to avoid subsidence is expected to decrease the significance rating of this aspect.

10.7.2.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.7.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the desktop wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.7.2.3 Irreplaceable loss of Resources

The operational phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources are not considered to be of high sensitivity. Loss of these wetland systems would require a form of compensation.

10.7.2.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 1 due to the fact that only open cast mining has been proposed. It is however worth noting that as an alternative, the proposed mining area can be moved outside of the delineated wetland areas to ensure a significance decrease in final significance ratings.

10.7.1 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the duration of operational activities, but also taking into consideration the level of disturbance already inflicted on the area. Some infrastructure units will also encroach into wetland and buffer areas. Mitigation is expected to decrease the final significance ratings for this phase.

10.7.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.7.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Moderate” given the extent of existing mining activities within 500 m of the wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.7.1.3 Irreplaceable loss of Resources

The operational phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources are of high sensitivity. Loss of these wetland systems would require a form of compensation.

10.7.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed infrastructure.

10.8 Decommissioning Phase

This section pertains to Activity Alternative A1.

10.8.1 Open Cast Mining (Seam 2)

The final significance rating has been determined to be “Low” given the duration of decommissioning activities, the lower magnitude of impacts and the fact that the area is currently altered due to the mining activities. This phase of the project has the potential to provide rehabilitation of the wetlands and correct closure of the area.

10.8.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.8.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.8.1.3 Irreplaceable loss of Resources

The decommissioning phase of the relevant activities could result in a cessation of the loss of natural resources, but continued degradation of the systems due to the altered landscape and hydrology of the catchment.

10.8.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

10.8.2 Underground Mining (Seam 1) (Process Alternative P3b)

The final significance rating has been determined to be “Low” given the duration of decommissioning activities, the lower magnitude of impacts and the fact that the mining activities will be below ground and largely make use of existing infrastructure.

10.8.2.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.8.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities within 500 m of the wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.8.2.3 Irreplaceable loss of Resources

The decommissioning phase of the relevant activities could result in a cessation of the loss of natural resources, but continued degradation of the systems due to the altered landscape and geohydrology of the catchment.

10.8.2.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 1 due to the fact that only open cast mining has been proposed.

10.8.1 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the duration of decommissioning activities, the lower magnitude of impacts and the fact that the area is currently altered due to the mining activities. This phase of the project has the potential to provide rehabilitation of the wetlands and correct closure of the area.

10.8.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.8.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities within 500 m of the wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.8.1.3 Irreplaceable loss of Resources

The decommissioning phase of the relevant activities could result in a cessation of the loss of natural resources, but continued degradation of the systems due to the altered landscape and hydrology of the catchment.

10.8.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed infrastructure.

10.9 Rehabilitation Phase

This section pertains to Activity Alternative A1.

10.9.1 Open Cast Mining (Seam 2)

The final significance rating has been determined to be “Low” given the fact that rehabilitation is intended to restore the landscape and the associated functioning to an acceptable level. Rehabilitation of the area also has the potential to address some of the legacy issues associated with the project area.

10.9.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.9.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities within 500 m of the desktop wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.9.1.3 Irreplaceable loss of Resources

The rehabilitation phase of the relevant activities is not expected to result in a loss of natural resources.

10.9.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

10.9.2 Underground Mining (Seam 1) (Process Alternative P3b)

The final significance rating has been determined to be “Low” given the fact that rehabilitation will take place which is intended to restore the landscape and the associated functioning to an acceptable level. Rehabilitation of the area also has the potential to address some of the legacy issues associated with the project area.

10.9.2.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.9.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities within 500 m of the desktop wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.9.2.3 Irreplaceable loss of Resources

The rehabilitation phase of the relevant activities is not expected to result in a loss of natural resources.

10.9.2.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 1 due to the fact that only open cast mining has been proposed.

10.9.1 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the fact that rehabilitation is intended to restore the landscape and the associated functioning to an acceptable level. Rehabilitation of the area also has the potential to address some of the legacy issues associated with the project area.

10.9.1.1 Mitigation Measures

See Section 11 for detailed mitigation measures.

10.9.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities within 500 m of the desktop wetlands as well as the expected degradation of the wetlands as a result of mining activities.

10.9.1.3 Irreplaceable loss of Resources

The rehabilitation phase of the relevant activities is not expected to result in a loss of natural resources.

10.9.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed infrastructure.

11. Specialist Management Plan

Table 11-1 presents the recommended mitigation measures and the respective timeframes, targets and performance indicators for mining of the area. The mitigations within this section have been taken into consideration during the impact assessment in cases where the post-mitigation environmental risk is lower than that of the pre-mitigation environmental risk. It is advisable that these measures be re-considered and amended if required on selection of a preferred alternative, if applicable.

Table 11-1 Mitigation measures including requirements for timeframes, roles and responsibilities

Mitigation Measures	Phase	Timeframe	Responsible Party for Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)
• Underground workings must adhere to a safety factor that will avoid subsidence; • Any loss/alteration of flow dynamics must be quantified, and mitigation options to re-introduce water in a safe and environmentally friendly way must be assessed; • Existing roads must be used as much as possible; • Proper stripping and stockpiling techniques must be followed (see the Pedology assessment (TBC, 2020) for more detail); • Concurrent rehabilitation must be carried out rather than full rehabilitation after decommissioning only; • Monitoring of adjacent watercourses must be undertaken to assess the impact of AMD to these systems; and • Cut-off trenches must be incorporated into the open cast mining areas' design to decrease contamination of watercourses via AMD.	Operation & Closure	Permanent	Applicant / Contractor	Monthly surface and groundwater quantity and quality	Avoid or minimise the loss of water input, and impaired water quality	Water quality guidelines (DWS,1996)
• Separate clean and dirty water;	Construction & Operation	Ongoing	Applicant / Contractor	Biomonitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)

• Construct diversion berms and drains around working areas; • Incorporate green /soft engineering storm water measures. Avoid unnecessary vegetation clearing and avoid preferential surface flow paths; • No cleaning of vehicles, machines and equipment in water resources; • No servicing of machines, vehicles and equipment on site; • Storage of potential contaminants in bunded areas; • All contractors must have spill kits available and be trained in the correct use thereof; • All released water must be within DWAF (1996) water quality standards for aquatic ecosystems, and discharge must be managed to avoid scouring and erosion of the receiving systems; • Contain wastewater in a PCD. Contaminated water must not be discharged into the watercourses; • Clean and dirty water must be separated. This water should be looked at for treatment and then re-introduced to mitigate losses to the catchment water hydro-dynamics;						

• 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 must be provided for all personnel throughout the project area. • Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems; • All waste generated on-site must be adequately managed; and • Separation and recycling of different waste materials should be supported.						
• Implement a suitable stormwater management plan; • Construct cut-off berms downslope of working areas; • Demarcate footprint areas to be cleared to avoid unnecessary clearing; • Exposed areas must be ripped and vegetated to increase surface roughness;	Construction, Operation & Closure	Ongoing	Applicant / Contractor	Biomonitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)

• Create energy dissipation at discharge areas to prevent scouring; and • Temporary and permanent erosion control methods may include silt fences, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed areas, erosion mats, and mulching.							
• Separate clean and dirty water continue with surface water and biomonitoring programmes; • All chemicals and toxicants during construction must be stored in bunded areas; • 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 must be provided for all personnel throughout the project area;	Construction, Operation & Closure	Ongoing	Applicant / Contractor	Biomonitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)	

• Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems; and • All waste generated on-site must be adequately managed. Separation and recycling of different waste materials should be supported.						
• Clean vehicles on-site, and prioritise vehicles gaining access from surround areas.	Construction, Operation & Closure	Ongoing	Applicant / Contractor	Monthly inspections, with removal to be determined on a needs basis	Maintain drinking water quality standards	National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA): Category 1a/b: Invasive species requiring compulsory control. Remove and destroy.
• All surface infrastructure must be removed from the site; • Compacted areas must be ripped (perpendicularly) to a depth of 300 mm; • A seed mix must be applied to rehabilitated and bare areas; • Any gullies or dongas must also be backfilled; • The area must be shaped to a natural topography; • Trees (or vegetation stands) removed must be replaced; • No grazing must be permitted to allow for the recovery of the area; and • Attenuation ponds may be created in channels to retain water in the catchment.	Closure	Ongoing	Applicant	Biomonitoring (bi-annual) Wetland monitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)

• Rehabilitation of the area and shaping of the topography must minimise the ingress of water into the mining area; • Additionally, measures must also be considered to implement constructed wetlands at likely decant areas, and the planting of tree reduce groundwater recharge; • Decommission cut-off berms and drains last.; • Debris must be placed in preferential flow paths; • Compacted areas must be ripped (perpendicularly) to a depth of 300 mm; • A seed mix must be applied to rehabilitated and bare areas; • Any gullies or dongas must also be backfilled; and • The area must be shaped to a natural topography.	Closure	Ongoing	Applicant	Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)

12. Conclusion

12.1 Baseline Ecology

Three HGM units were identified, of which two have been largely modified by current and historic mining activities impeding into the wetland's buffer zones and, in some cases, into the wetland itself. Severe limitations exist regarding wetland identification, which has resulted in a section characterised by signs of wetness to be classified as an "artificial system" given the presence of transported Technosols as well as altered surface and sub-surface flow dynamics.

The delineated wetlands do provide a moderate to high level of service, especially regarding indirect benefits (water quality and flow regulation). Significant wetland habitat degradation has taken place due to impaired water quality, which has resulted in a lack of unique species.

A buffer zone 106 m in size has been calculated for all the wetlands on-site due to the high level of threats associated with open cast mining. No buffer zones are required for the underground mining activities due to the fact that very little to no surface impacts are associated with underground mining activities as well as the fact that the open cast mining's calculated buffer zone will conserve the wetland for any mining activity.

12.2 Impact Assessment

The operational phases of the open cast (Seam 2) has been scored a "High" final significance, with underground mining activities (Seam 1) being scored a "Medium". The mitigation hierarchy (Figure 12-1) has been considered for the proposed activities, of which avoidance (step 1) and minimising impacts (step 2) were achieved for all aspects except for the latter two (operational phases of Seam 1 and 2). Given the fact that rehabilitation (step 3) will not be sufficient due to the direct loss of wetland areas, the last step will have to be adhered to by the responsible party, which is wetland offsets.

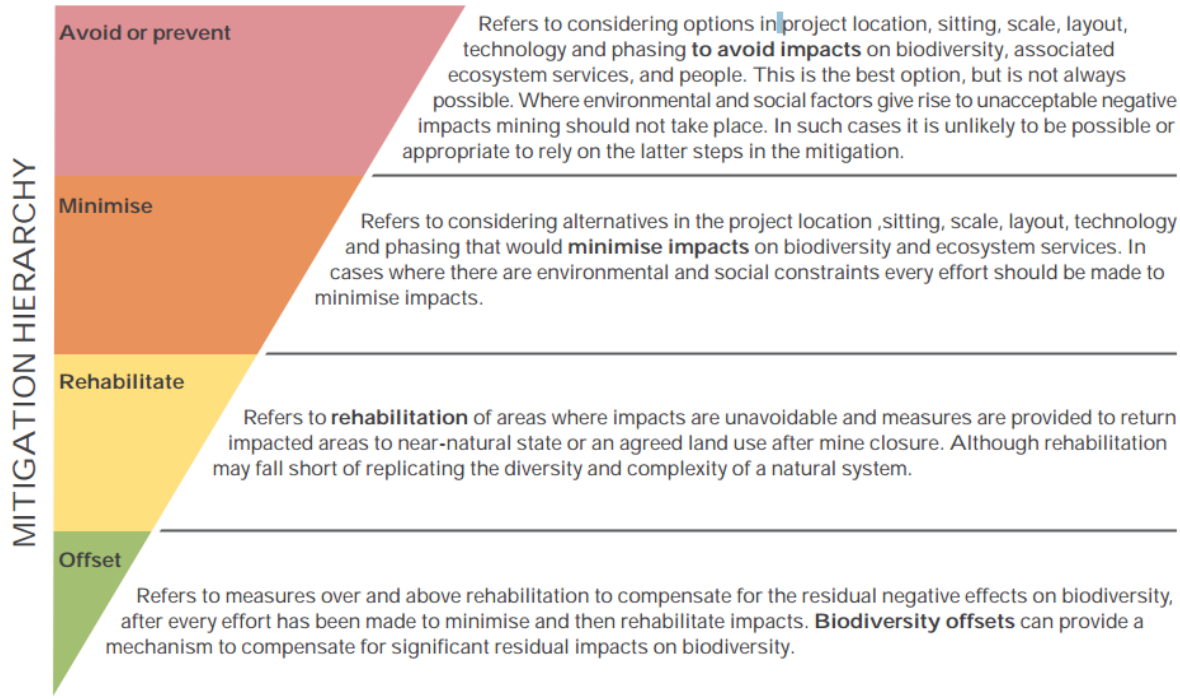

Figure 12-1 The mitigation hierarchy as described by the DEA (2013)

It is firstly recommended that the proposed open cast mining areas (Seam 2) be amended to adhere to the delineated wetland's buffer zone and that a subsidence assessment prescribe measures to avoid subsidence of the underground mining areas (Seam 1) to be permitted to proceed. If either of these requirements are not deemed feasible for the selected alternative, it is recommended that a wetland offset strategy (which according to (DEA, 2013) is the last resort) be compiled for the project. The wetland offset must be focussed on the extent of the wetland and associated buffer zone that will be lost, as indicated in the sensitivity sections (see Figure 9-2 specifically). The proposed wetland offset must incorporate onsite rehabilitation and must be implemented from the onset of the project until closure.

12.3 Specialist Recommendation

No fatal flaws were identified for the project. In the event underground mining is authorised, it is recommended that a subsidence assessment prescribe measures to avoid subsidence of the mined-out areas below the wetlands and buffer zones. In the event open cast mining of Seam 2 is authorised, it is recommended that the extent of the open cast area be amended to adhere to the buffer zone. If this is not feasible, then a direct loss of wetlands will occur. Due to the expected loss and also degradation of wetlands as a result of the project with either option, it is also recommended that on-site rehabilitation of the area be implemented to allow for some level of wetland compensation, this should be informed by an offset strategy.

13. Assumptions, Uncertainties and Gaps in Knowledge

The following aspects were considered as limitations:

- The wetlands within the MRA were the focus for the study, these systems were groundtruthed and further assessed. Wetland areas beyond the MRA but within the 500 m regulated area were only considered at a desktop level;
- Shapefiles of the subsidence risk areas have not been provided;
- The areas within (and especially surrounding drainage lines) the MRA have significantly been modified. This modification could lead to inaccuracies pertaining to delineations and identification of wetland indicators. The majority of wetland areas were covered in tailing material/silt which renders the dominant soil form in such an instance a Witbank soil form. The latter mentioned according to (DWAF, 2005) is classified as a terrestrial soil as opposed to hydromorphic soils;
- Some the delineated wetlands are characterised by artificial water inputs, which provides difficulties in identifying hydromorphic soils; and
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.

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15. Appendices

15.1 Specialist CV

Masters in Environmental Science and Hydropedology

Cell: +27 79 898 4056

Email: ivan@thebiodiversitycompany.com

Identity Number: 9401105251087

Date of birth: 10 January 1994

Profile Summary

Working experience throughout Southern Africa

Working experience in West-Africa

Specialist experience with mining, construction and agriculture.

Specialist expertise include hydropedology, pedology, land contamination, agricultural potential, land rehabilitation, rehabilitation management and wetlands resources.

Experience hydropedological modelling (HYDRUS model)

Areas of Interest

Mining, Oil & Gas, Renewable Energy & Bulk Services Infrastructure Development, Farming, Land contamination, Sustainability and Conservation.

Key Experience

- Environmental Impact Assessments (EIA)
- Environmental Management Programmes (EMP)
- Wetland delineations and ecological assessments
- Rehabilitation Plans and Monitoring
- Soil-and rock classification
- Level 1, 2 and 3 hydropedology assessments
- Agriculture potential assessments
- Land contamination assessments
- Modulation of surface- and subsurface flows (HYDRUS model)

Countries worked in

South Africa, Mozambique, Swaziland, Zimbabwe, Guinea

Nationality

South African

Languages

English – Proficient

Afrikaans – Proficient

Qualifications

- MSc (North-West University of Potchefstroom) – Hydropedology
- BSc Honours (North-West University of Potchefstroom) – Environmental geology-Pedology and rehabilitation
- BSc Environmental sciences
- Pr Sci Nat candidateship

SELECTED PROJECT EXPERIENCE

Project Name: Environmental impact assessment for the construction of Road DR08606 leading to Mlamli Hospital, Sterkspruit

Personal position / role on project: Wetland ecologist

Location: Sterkspruit, Eastern Cape Province, South Africa

Main project features: To conduct a wetland assessment, as a component of the environmental authorisation process and Water Use Licence Application (WULA) for the construction of Road DR08606 leading to Mlamli Hospital

Project Name: Biodiversity Baseline & Impact Assessment Report for the proposed Nondvo Dam Project

Personal position / role on project: Wetland ecologist

Location: Mbabane, Swaziland

Main project features: To conduct various assessments according to IFC standards in regard to delineation of wetlands and assessing ecosystem services.

Project Name: Agricultural Potential Assessment - Proposed Kalabasfontein Coal Mining Project Extension

Personal position / role on project: Project Manager and Soil Specialist.

Location: Bethal, Mpumalanga, South Africa

Main project features: To conduct a soil assessment to identify any sensitive resources that might be affected by the proposed mining activities and associated infrastructure as part of an environmental impact assessment.

Project Name: Soil assessment for the closure of the St Helena Shaft, Harmony

Personal position / role on project: Soil specialist

Location: Welkom, Free State, South Africa

Main project features: To conduct a thorough soil and fertility assessment to recommend relevant mitigation and rehabilitation measures to finalise closure at the relevant mine

Project Name: Wetland Functionality Assessment for the Environmental, Health and Socio-Economic Baseline Studies for Block 2 at Siguiri Gold Mine

Personal position / role on project: Wetland ecologist

Location: Siguiri, Guinea, West-Africa

Main project features: To conduct various assessments according to IUCN standards in regard to delineation of wetlands and assessing ecosystem services.

Project Name: Level 3 Hydropedological Assessment for the Sara Buffels Mining Project

Personal position / role on project: Hydropedologist

Location: Ermelo, Mpumalanga, South-Africa

Main project features: To conduct various assessments to determine the hillslope hydrology and to acquire information relevant to the vadose zone's hydraulic properties to quantify sub-surface flows by means of modelling.

Project Name: Level 3 Hydropedological Assessment for the Buffalo Coal Mining Project

Personal position / role on project: Hydropedologist

Location: Dundee, KwaZulu-Natal, South-Africa

Main project features: To conduct various assessments to determine the hillslope hydrology and to acquire information relevant to the vadose zone's hydraulic properties to quantify sub-surface flows by means of modelling

Project Name: Biodiversity Baseline & Impact Assessment for the proposed Tetereane 15MW Solar PV Plant

Personal position / role on project: Ecosystem Services Specialist

Location: Cuamba, Mozambique, Southern-Africa

Main project features: To conduct various assessments according to IUCN standards in regard to ecosystem services

Project Name: Land contamination assessment for the proposed Fleurhof Development

Personal position / role on project: Soil Specialist

Location: Fleurhof, South Africa

Main project features: To conduct assessments relevant to the determination of land contamination, including recommendations, mitigations and risk assessments.

OVERVIEW

An overview of the specialist technical expertise include the following:

- Ecological wetland assessment studies, including the integrity (health) and functioning of the wetland systems.
- Wetland offset strategy designs.
- Wetland rehabilitation plans.
- Monitoring plans for wetland systems.
- Soil classification and agricultural assessments.
- Stripping and stockpiling guidelines.
- Soil rehabilitation plans.
- Soil and stockpile monitoring plans.
- Hydropedological assessments.

TRAINING

Some of the more pertinent training undergone includes the following:

- Tools for a Wetland Assessment (Certificate of Competence) – Rhodes University 2018; and
- Workshop on digital soil mapping.

EMPLOYMENT EXPERIENCE

Internship at SRK consulting (January 2017-August 2017)

- **Field assistant** for SRK consulting during 2017 included the sampling of surface and groundwater as well as on site tests, the accumulation of various different data sets from field loggers, presenting and arranging the relevant data and ultimately using it for my own personal post-graduate studies.

Internship at The Biodiversity Company (August 2017-December 2017)

Employed as an intern (wetland and soil scientist) during the last few months of 2017. During this period, I was part of a variety of soil- and wetland projects, both as report writer and/or field assistant.

CURRENT EMPLOYMENT: The Biodiversity Company (January 2018 – Present)

- **Scientific report writing** to ensure that the relevant standards and requirements have been attained, namely local country legislation, as well as WB, EP and IFC requirements.

ACADEMIC QUALIFICATIONS

North-West University of Potchefstroom: MAGISTER SCIENTIAE (MSc) - Hydropedology:

Title: *Characterisation of vadose zone processes in a tailings facility*

North-West University of Potchefstroom (2016): BACCALAUREUS SCIENTIAE HONORIBUS (Hons) – Environmental Geology- Pedology and rehabilitation

North-West University of Potchefstroom (2015): BACCALAUREUS SCIENTIAE IN NATURAL AND ENVIRONMENTAL SCIENCES. Majors: Geology and Geography