Universal Coal
NBC Colliery

agriculture, rural development, land & environmental affairs
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

DRAFT BASIC ASSESSMENT REPORT

SUBMITTED FOR ENVIRONMENTAL AUTHORISATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) (NEMA) AND REGULATION 16(1) AND 19 OF THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REGULATIONS, 2014 (AS AMENDED).

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VOLUME 2

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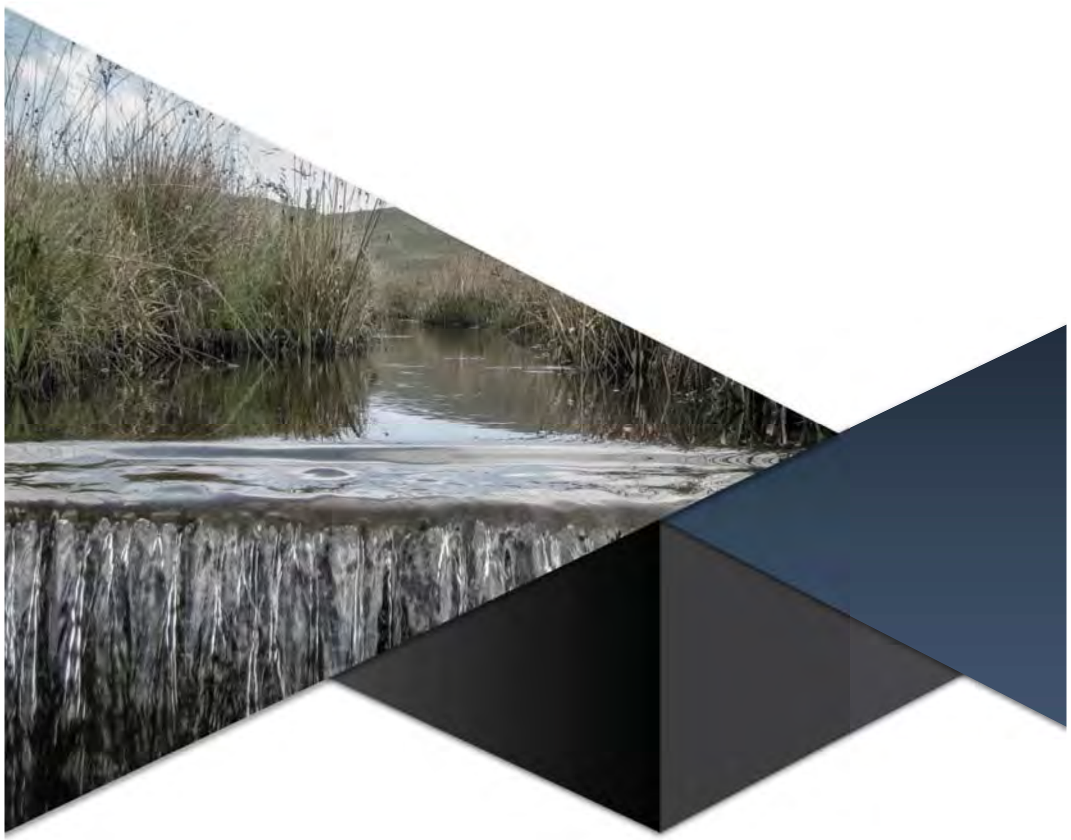
NBC Colliery, Universal Coal
D2809 Road Realignment
Wetland Risk Assessment



Ecology International
Sustainability through Collaboration

NBC Colliery, Universal Coal: D2809 Road Realignment
Wetland Risk Assessment

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I, **KIEREN BREMNER DUNNE**, in my capacity as a specialist consultant, hereby declare that I -

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- 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;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998), regulations and any guidelines that have relevance to the proposed activity;
- based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability;
- undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered; and
- as a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member.

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Date

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ACRONYMS

CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs (now Department of Water and Sanitation)
DWS	Department of Water and Sanitation
EC	Ecological Category
FEPA	Freshwater Ecosystem Priority Area
NBA	National Biodiversity Assessment
NFEPA	National Freshwater Ecosystem Priority Areas project
NWRS	National Water Resource Strategy)
PES	Present Ecological State
SAIAB	South African Institute for Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
WMA	Water Management Areas
WRC	Water Research Commission
WWF	Worldwide Fund for Nature

1 INTRODUCTION

1.1 Project Description

Ecology International (Pty) Ltd were appointed as independent biodiversity specialists to conduct a detailed risk assessment of the proposed realignment of the D2809 Provincial Road adjacent to the NBC Colliery, Mpumalanga (Figure 1).

1.2 Terms of Reference

It was understood that the scope of work would entail conducting a risk assessment in accordance with GN509 for the construction and operational activities associated with the proposed realignment of the D2809 Provincial Road in order to determine activities regarded as being of low risk to associated watercourses, and those that are regarded as having a moderate to high risk to associated watercourses.

1.3 Assumptions and Limitations

A freshwater assessment was conducted by Ecology International (2021) for the NBC Consolidation Project with the proposed road realignment study area falling within the area assessed. This information was used to inform the assessment of risk to wetlands present within 500 m of the proposed activities.

2 GENERAL CHARACTERISTICS

2.1 Biophysical Attributes

2.1.1 Climate

According to Kleynhans *et al.* (2007), the study area is located within the Highveld Ecoregion, with rainfall seasonality being early to mid-summer, and mean annual temperatures ranging from 12°C to 18°C. Mean annual precipitation of the quaternary catchment is approximately 714.7 mm/annum, with a potential evaporation of 1863.5 mm/annum (Macfarlane et al., 2008).

2.1.2 Geology

Geology underlying the study area is made up of elements from the Madzaringwe Formation of the Permian coal-bearing Ecca group (part of the Karoo Supergroup; *Council for Geoscience*, 2005). Rocks are quartzite, shale, dolerite, diabase and basalt (Mucina & Rutherford, 2012).

2.1.3 Regional Vegetation

The entire study area is situated in the Grassland Biome and within the Mesic Highveld Grassland Bioregion. The study area is situated within the Eastern Highveld Grassland vegetation type.

The Eastern Highveld Grassland vegetation occurs between Belfast in the east and the eastern side of Johannesburg in the west, extending southwards to Bethal, Ermelo and west of Piet Retief. The landscape comprises moderately undulating plains, including low hills and pan depressions. The grasslands are generally short and dense, with small, scattered rocky outcrops and with wiry, sour grasses and some woody species.

The Eastern Highveld Grassland is regarded as Endangered, with only a very small fraction conserved in statutory reserves. Some 44% has been transformed primarily by cultivation, mines, plantations, urbanisation and the construction of dams (Mucina & Rutherford, 2012).

2.1.4 Freshwater Bioregional Context

The study area is located within the Southern Temperate Highveld freshwater ecoregion, which is delimited by the South African interior plateau sub-region of the Highveld aquatic ecoregion, of which the main habitat type, in terms of watercourses, is regarded as Savannah-Dry Forest Rivers. Aquatic biotas within this bioregion have mixed tropical and temperate affinities, sharing species between the Limpopo and Zambezi systems. The Southern Temperate Highveld freshwater ecoregion is considered to be bio-regionally outstanding in its biological distinctiveness and its conservation status is regarded as Endangered. The ecoregion is defined by the temperate upland rivers and seasonal pans (Nel et al., 2004; Darwall et al., 2009; Scott, 2013).

2.1.5 Associated Aquatic Ecosystems

The NWRS-1 originally established 19 Water Management Areas within South Africa and proposed the establishment of the 19 Catchment Management Agencies to correspond to these areas. In rethinking the management model and based on viability assessments with respect to water resources management, available funding, capacity, skills and expertise in regulation and oversight, as well as to improve integrated water systems management, the original 19 designated WMAs have been consolidated into nine WMAs.

The study area is located predominantly within the newly revised Olifants Water Management Area (WMA), which now also includes the Letaba River catchment. Accordingly, the main rivers include the Elands River, the Wilge River, the Steelpoort River, the Olifants River, and the Letaba River. The Olifants River originates to the east of Johannesburg and flows in a northerly direction before gently turning to the east. It is joined by the Letaba River before it enters into Mozambique.

The study area is located within the upper reaches of the B41A quaternary catchment. The watercourses associated with the proposed road realignment comprise several non-perennial watercourses, and more specifically various wetland systems. Watercourses drain west into the Skilferlaagtespruit, which flows into the Grootspruit (sub-quaternary B41A-01025) and, after its confluence with the Langspruit (sub-quaternary B41A-01002), it becomes the Steelpoort River.

2.1.6 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water Affairs (DWA; now Department of Water and Sanitation, or DWS), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims to:

- Identify Freshwater Ecosystem Priority Areas (hereafter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and
- Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development. The second aim comprises a national and sub-national component. The national component aims to align DWS and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems. The sub-national component aims to use three case study areas to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes at a sub-national level (Driver et al., 2011). The project further aims to maximize synergies and alignment with other national level initiatives such as the National Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation.

Based on current outputs of the NFEPA project (Nel et al., 2011; Figure 2), the proposed road realignment is situated within a single FEPA catchment. The FEPA catchment is designated as such on the basis of the catchment being considered a fish sanctuary for two species of fish, namely *Enteromius anoplus* (Chubbyhead Barb) and *Opsaridium peringueyi* (Southern Barred Minnow), and two river ecosystem types, namely Permanent/Seasonal Highveld Mountain and Upper Foothill streams. The surrounding area directly west of the proposed realignment is classified as Fish Support Area, also for *Enteromius anoplus* (Chubbyhead Barb) and *Opsaridium peringueyi* (Southern Barred Minnow).

Further, SANBI recently undertook a wetland mapping exercise for the Mpumalanga Highveld region in order to expand on the detailed wetland delineations undertaken in adjacent catchments, for inclusion into the NFEPA project (Mbona et al., 2015). Mpumalanga Tourism and Parks Agency (MTPA) recognises that wetlands are specialised systems that perform various ecological functions and play an integral role in biodiversity conservation. The project sought to map the extent, distribution, condition and type of freshwater ecosystems in the Mpumalanga Highveld coal belt. The delineations were based on identifying wetlands on Spot 5 imagery within the Mpumalanga Highveld boundary and supported by Google Earth imagery, 1:50 000 contour lines, 1:50 000 river lines, data from previous studies in the area, and data from the original NFEPA wetlands layer. Hydrogeomorphic (HGM) units were identified at a desktop level and confirmed by means of ground-truthing. According to Mbona et al. (2015), while various wetland areas were noted to be associated with the study area, only one wetland unit, classified as a depressional wetland and associated with a larger wetland cluster, was identified as a FEPA wetland based on the revised wetland mapping inventory for the Mpumalanga Highveld region (Figure 2). The southern portion of the proposed road realignment falls within the aforementioned wetland cluster area.

2.1.7 Mpumalanga Biodiversity Sector Plan

A systematic conservation plan for Mpumalanga was published as the 'Mpumalanga Biodiversity Sector Plan' (Mpumalanga Tourism and Parks Agency, 2014), with the aim to maintain biodiversity conservation targets. In the plan, the most important habitat categories to be taken into consideration in any environmental assessment process are:

- Critical Biodiversity Areas (CBAs): Areas that are required to meet biodiversity targets for species, ecosystems or ecological processes. These need to be kept in a natural or near-natural state, with no further loss of habitat or species. This category is split into:
  - CBA Irreplaceable Areas: These areas are required to meet biodiversity pattern and/or ecological processes targets. They are further subdivided into:
    - Irreplaceable: representing the only localities for which the conservation targets for one or more of the biodiversity features contained within can be achieved, I.e., there are no alternative sites available;
    - High Irreplaceable: representing areas of significantly high biodiversity value, but there are alternate sites within which the targets can be met for the biodiversity features contained within, but there aren't many;
  - CBA: Irreplaceable Linkages: These are areas within Landscape Corridors that, due to modification of the natural landscape, represent the only remaining and highly constrained linkages which, if lost, would result in the breakage of the large corridor network as a whole. Their conservation is vital in maintaining the linkage of the corridor and its associated biodiversity related processes;
  - CBA Optimal Areas: Areas selected to meet biodiversity pattern and/or biodiversity process targets. Alternative sites might be available to meet biodiversity targets. These areas can furthermore, support suitable habitat for red and orange listed faunal and floral species;
- Ecological Support Areas (ESAs): Areas determined to be functional but not necessarily entirely natural areas, which are required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the CBAs. Mpumalanga distinguishes following categories related to biodiversity outside Protected Areas:
  - ESA Species Specific: Areas required for the persistence of specific species. They may be modified, but a change in current land use to anything other than rehabilitated land, would most likely result in a loss of that species from the area identified; and
  - ESA Corridors: These facilitate ecological and climate change processes and to create a linked landscape for the conservation of species within a fragmented landscape.

According to the latest revision of the freshwater component of the provincial biodiversity sector plan (Mpumalanga Tourism and Parks Agency, 2019), the study area is primarily associated with 'Heavily Modified' and 'Ecological Support Areas' (Figure 3).

Table 1 presents a summary of the attributes associated with the area under study.

Table 1: Summary of relevant site attributes

Political Region	Mpumalanga
Level 1 Ecoregion	Highveld
Level 2 Ecoregion	11.02
Freshwater Ecoregion	Southern Temperate Highveld
Geomorphic Province	Northeastern Highveld
Geology	Madzaringwe Formation of the Permian coal-bearing Ecca group
Vegetation Type	Eastern Highveld Grassland
Water Management Area	Olifants
Wetland Vegetation Type	Mesic Highveld Grassland Group 4
Secondary Catchment	B4
Quaternary Catchment	B41A
Watercourse	Unnamed tributaries of the Steelpoort River
Stream Order	Various
Slope Class	Source Zones
NFEPA Status	Wetland Cluster, River FEPA, Fish Support Area

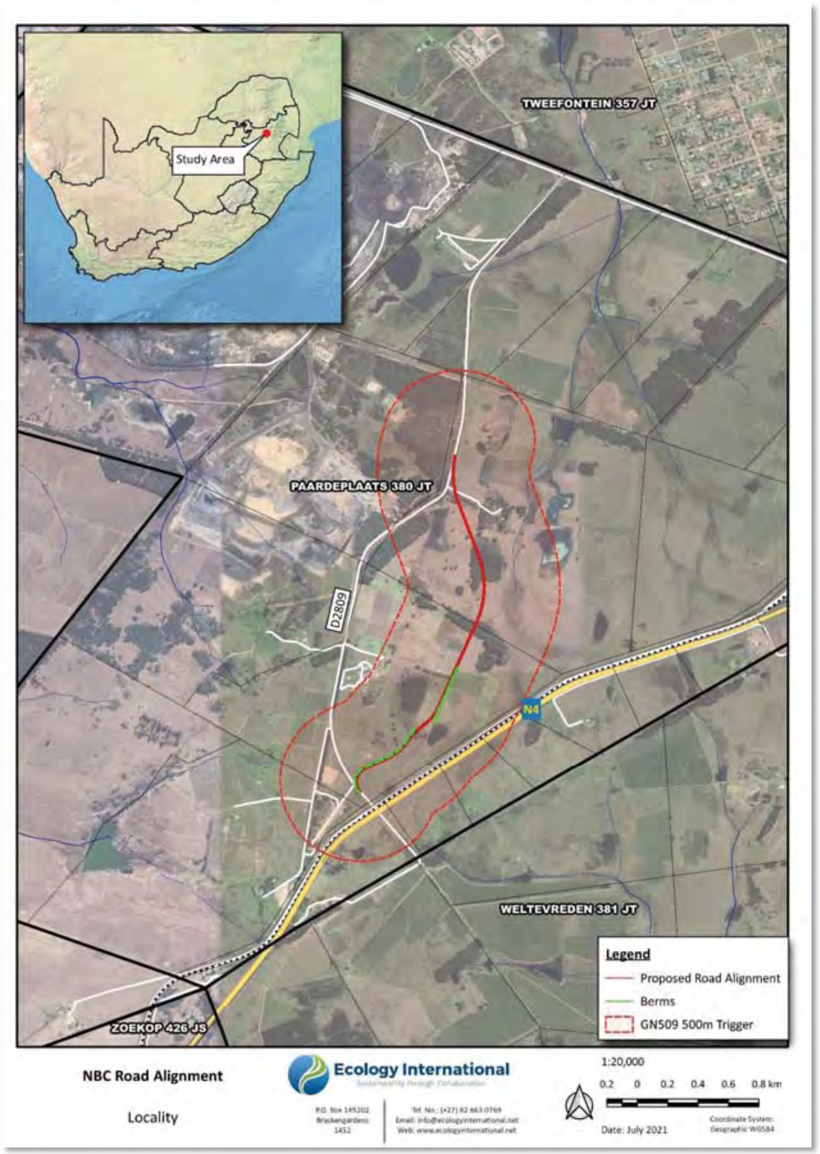

Figure 1: Locality Map

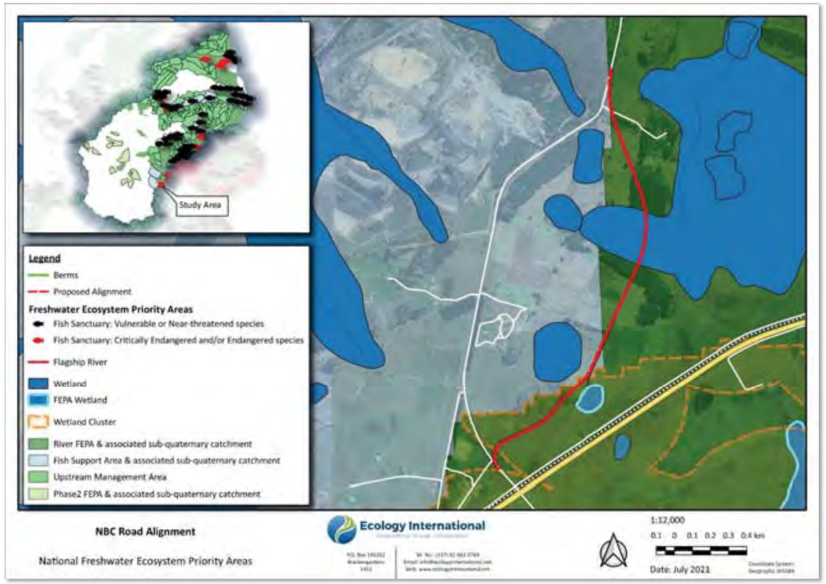

Figure 2: National Freshwater Ecosystem Priority Areas associated with the proposed alignment.

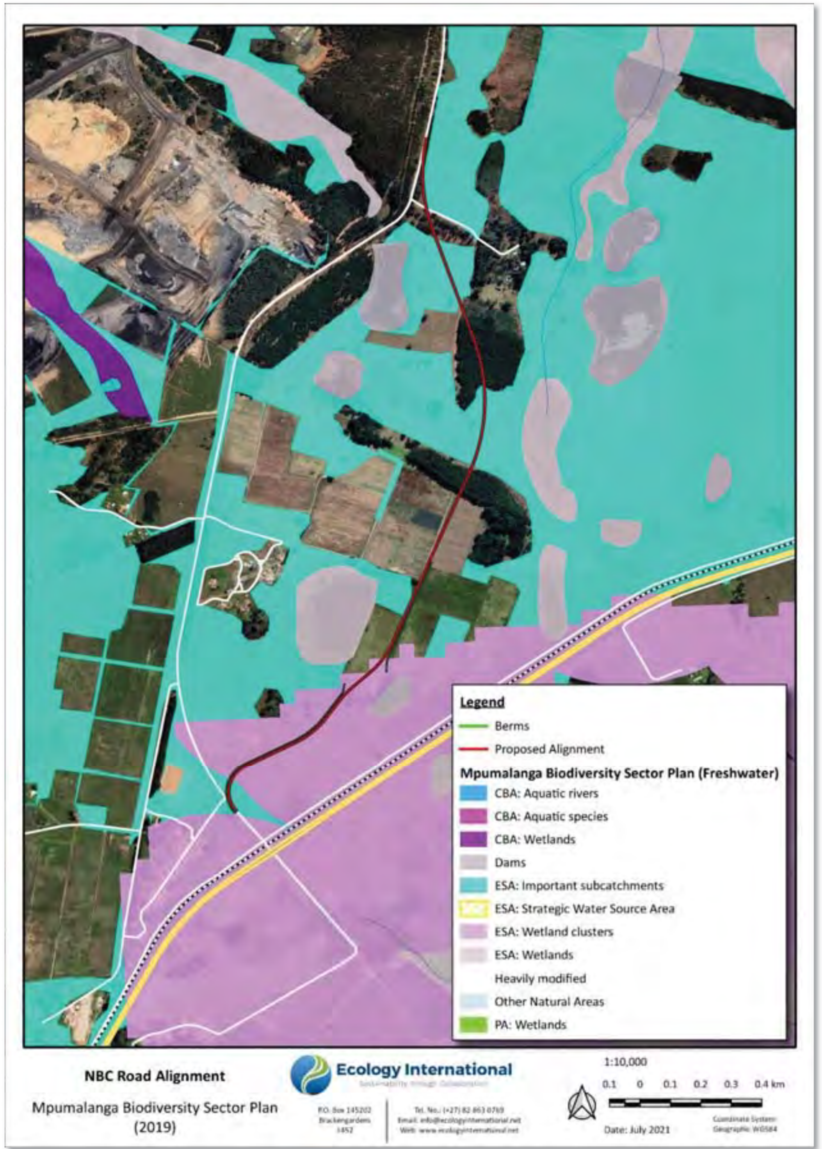

Figure 3: Mpumalanga Biodiversity Sector Plan categories for the freshwater ecosystem component associated with the proposed alignment.

3 RESULTS

3.1 Wetland Ecosystem Assessment

The wetland delineations, data analysis and interpretation as presented by Ecology International (2021) were used in the compilation of the wetland risk assessment required for the proposed road realignment project. Wetland areas associated with the proposed road realignment as well as those within the 500 m zone of regulation were considered (Figure 4).

3.1.1 System Characterisation

The watercourses within the study area were classified according to the classification system (Ollis et al., 2013) as Inland Systems, falling within the Highveld Aquatic Ecoregion, and the Mesic Highveld Grassland Group 4 Wetland Vegetation Type (Mbona et al., 2015). These watercourses were further classified at Level 3 and Level 4 of the classification system as summarised in the table below.

Table 2: Characterisation of the watercourses associated with the study and 500 m investigation areas according to the Classification System (Ollis et. al., 2013).

Level 3: Landscape unit	Level 4: HGM Type
Valley floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	Unchannelled valley-bottom wetland: a valley-bottom wetland without a river channel running through it.
Slope: an inclined stretch of ground typically located on the side of a mountain, hill or valley, not forming part of a valley floor. Includes scarp slopes, mid-slopes and foot-slopes.	Hillslope seep: a wetland located on gently to steeply sloping land and dominated by colluvial (I.e., gravity-driven) unidirectional movement of water and material down-slope.
Plain: an extensive area of low relief, generally characterized by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located in a valley.	Depression/pan: an inland aquatic ecosystem with closed or near-closed elevation contours, which increases in depth, and within which water typically accumulates.

Eighteen (18) hydro-geomorphic (HGM) units (Figure 4; Appendix A) were identified within the vicinity of the proposed road realignment and its associated 500 m zone of regulation comprising various unchanneled valley bottom wetlands, hillslope seep wetlands (including a sheet rock wetland), and depressions/pans. Furthermore, five (5) impoundments were observed. The various HGM units identified were further assessed, the results of which are presented in the sections that follow. The impoundments, while mapped and indicated in Figure 4 were regarded as artificial systems and were thus not subjected to further analysis in terms of the WET-Health, WET-Ecoservices, and Ecological Importance and Sensitivity tools.

3.1.2 Present Ecological State

The health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition (Macfarlane et al., 2009). The wetlands associated with the proposed road realignment and its associated 500 m zone of regulation have been impacted by a long history of agricultural and recreational land uses as well as impacts related to mining.

The major impacts to the wetlands/watercourses identified through the health assessments can be summarised as follows:

- Numerous impoundments were observed within the 500 m zone of regulation and the affected wetlands have been impacted in terms of the geomorphology as well as water quality due to the presence of trout dams on these systems. Further, deep and shallow flooding by the observed impoundments has resulted in severe alterations to the natural wetting regimes.
- Historical plantations and infestations of *Acacia mearrnsii* (Wattle), *Populus x canescens* (Poplars) and *Eucalyptus* sp. (Bluegums) have resulted in impacts to the wetlands present with alterations to the natural water retention and distribution profiles of the wetlands present, as well as impacts to subsurface water supply.
- Historical cultivation has impacted the integrity of the natural vegetation and resulted in an increased potential for impacts to water quality and increased sediment loads within the catchment.
- The presence of linear infrastructure such as roads and powerlines has resulted in fragmentation of the wetlands in some areas, alterations to the natural water retention and distribution profiles, altered vegetation structure, and disruptions to the natural flow paths.

The identified wetlands were assessed according to the WET-Health methodology as described by Macfarlane *et al.* (2008) and were broadly classified as Largely Natural (Category B), Moderately Modified (Category C), and Largely Modified (Category D). The results of these assessments (Ecology International, 2021) are presented graphically in Figure 5. Appendix A provides a summary of the Present Ecological State scores.

3.1.3 Wetland Ecological Service Provision

The general features of each HGM unit were assessed in terms of function, and the overall importance of the HGM unit was then determined at a landscape level. Appendix A provides a detailed summary of the results. The systems associated with the proposed road realignment and its associated 500 m zone of regulation may be regarded as of Intermediate to Moderately High (Figure 6) importance in terms of service provision and functionality.

Key services provided are generally related to streamflow regulation, sediment trapping and the assimilation of toxicants and nutrients from the surrounding land use activities. Biodiversity maintenance is regarded as high to very high across almost all the HGM units indicating the importance for conservation of these systems as well as their role in the provision of habitat and natural migration corridors. Erosion control and flood attenuation services were also generally regarded as important services, albeit to a lesser extent.

3.1.4 Ecological Importance and Sensitivity

Ecological Importance and Sensitivity for each wetland was evaluated in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits

Appendix A provides a detailed summary of the EIS scores of the delineated wetlands. The wetlands associated with the proposed road realignment and its associated 500 m zone of regulation were regarded as of Moderate and High Ecological Importance and Sensitivity (Figure 7), being important in terms of ecological importance (biodiversity maintenance) and their hydrological functions. Direct human benefits were related to the provision of water for agropastoral activities, as well as for recreational use and tourism (I.e., Trout fishing and birding opportunities), however, these were generally associated with the valley bottom systems rather than with the hillslope seeps.

4 BUFFER ZONES AND NO-GO AREAS

Buffer zones associated with water resources have been shown to perform a wide range of functions and have been proposed as a standard measure to protect water resources and associated biodiversity on this basis. These functions can include (Macfarlane & Bredin, 2016):

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

Given that the application is for a road realignment (linear infrastructure), the application of buffer zones is of limited value in this scenario. However, it is strongly recommended that all activities associated with the proposed project remain outside of the delineated wetland boundaries.

5 RISK ASSESSMENT

Any activities associated with a natural system, whether historic, current, or proposed, will impact on the surrounding environment, usually in a negative way. The purpose of this phase of the study was to identify and assess the significance of the potential impacts and to provide a description of the mitigation required to limit the perceived impacts on the natural environment. In determining the impacts associated with the proposed activities, due consideration was given to previous impacting factors affecting the associated freshwater ecosystem within the study area.

There is a key difference between the approach of the ecological consultant and that of the ecological researcher. In consultancy, judgements have to be made and advice provided that is based on the best available evidence, combined with collective experience and professional opinion. The available evidence may not be especially good, potentially leading to over-simplification of ecological systems and responses, and do contain a considerable deal of uncertainty. This is opposed to ecological research, where evidence needs to be compelling before conclusions are reached and research is published (Hill & Arnold, 2012). The best option available to the consulting industry is to push for more research to be conducted to address its questions. However, such research is often of a baseline nature and thus attracts little interest by larger institutions that need to do innovative research to be able to publish and attract the necessary funding. Clients in need of ecological assessments are used to funding such assessments but are seldom willing to fund further research to monitor the effects of developments. Furthermore, a review to test the accuracy of the predictions of an ecologist following completion of the development is very rarely undertaken, which means the capacity to predict the future is not tested and therefore remains unknown (Hill & Arnold, 2012).

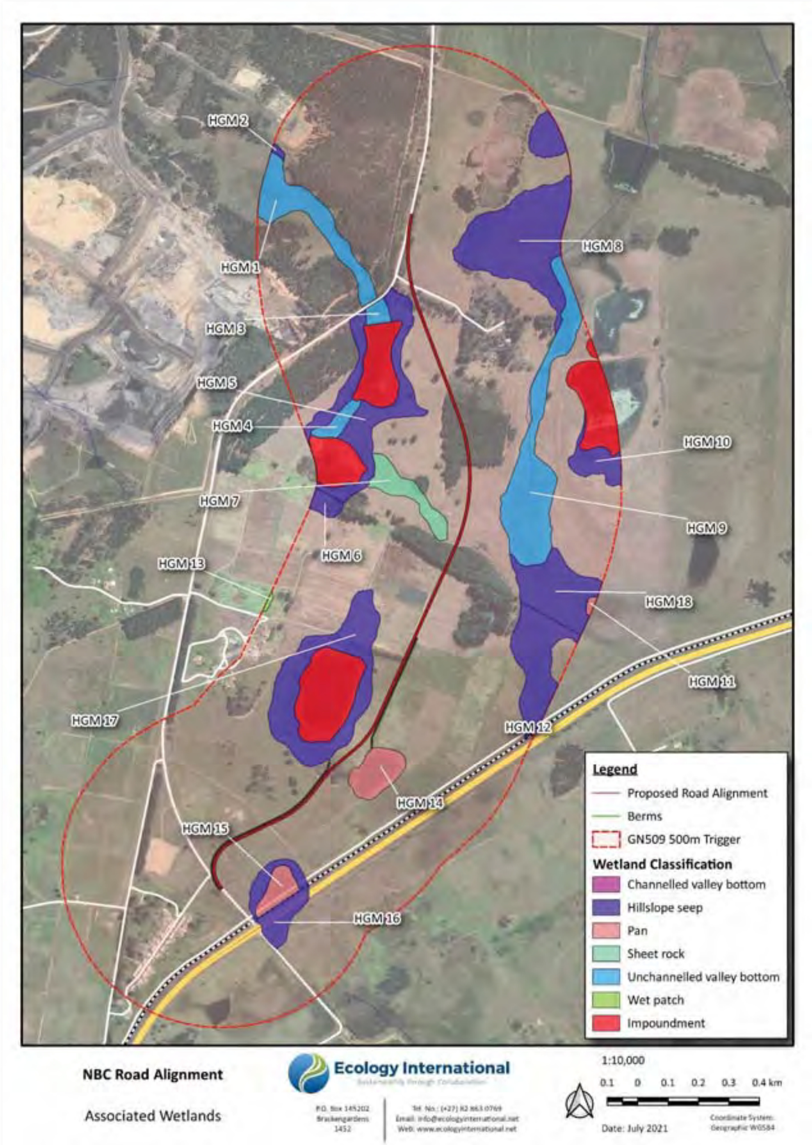

Figure 4: The location of the wetlands/watercourses in the vicinity of the proposed road realignment and its associated 500 m zone of regulation.

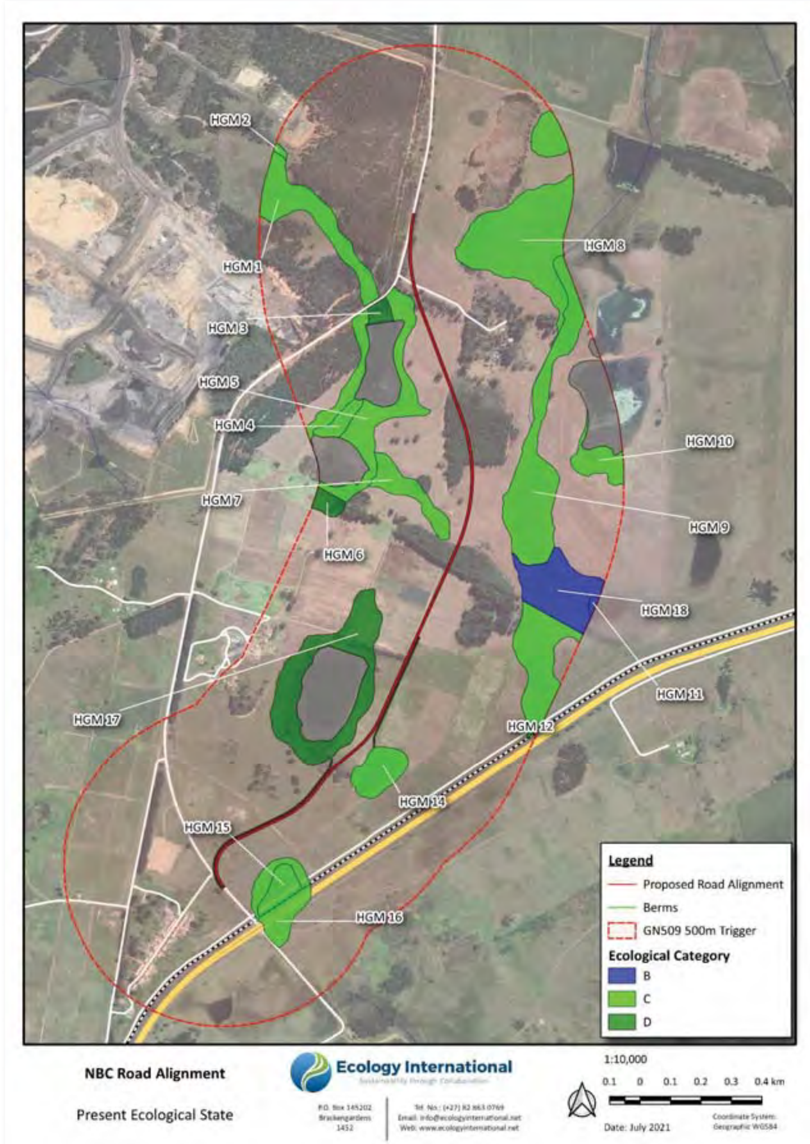

Figure 5: The Present Ecological State of the wetlands/watercourses within the proposed road realignment and its associated 500 m zone of regulation.

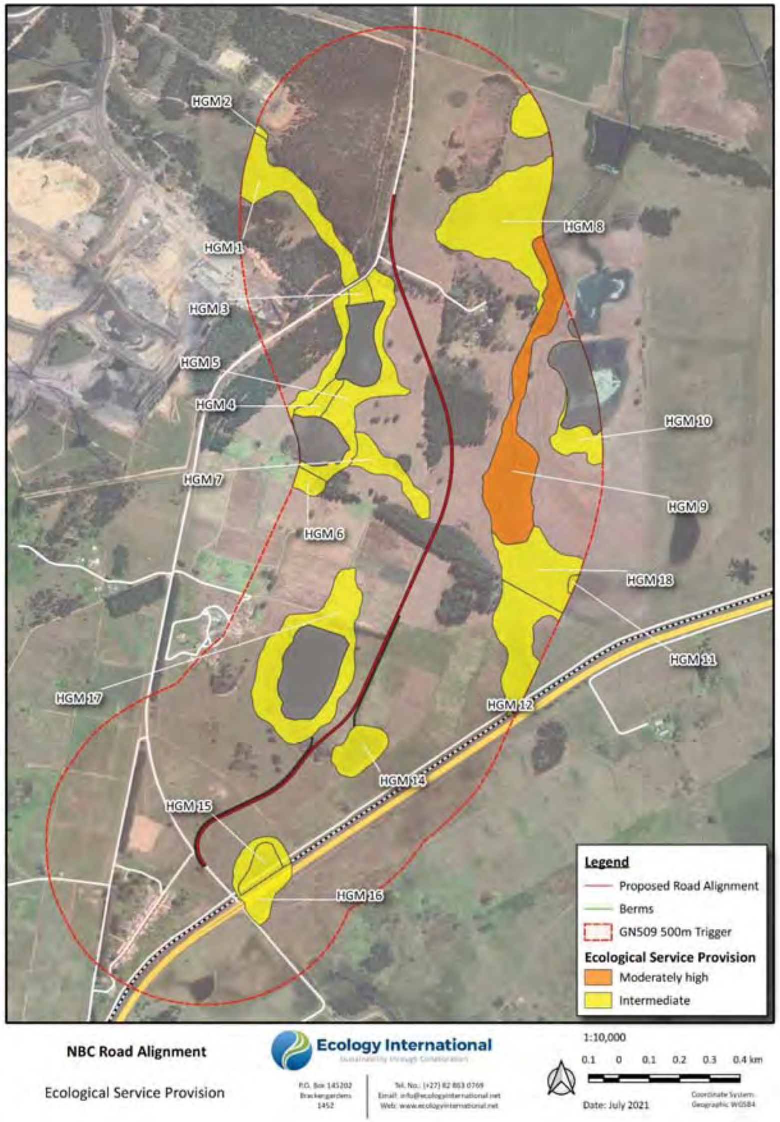

Figure 6: Ecological Service Provision of the wetlands/watercourses within the proposed road realignment and its associated 500 m zone of regulation.

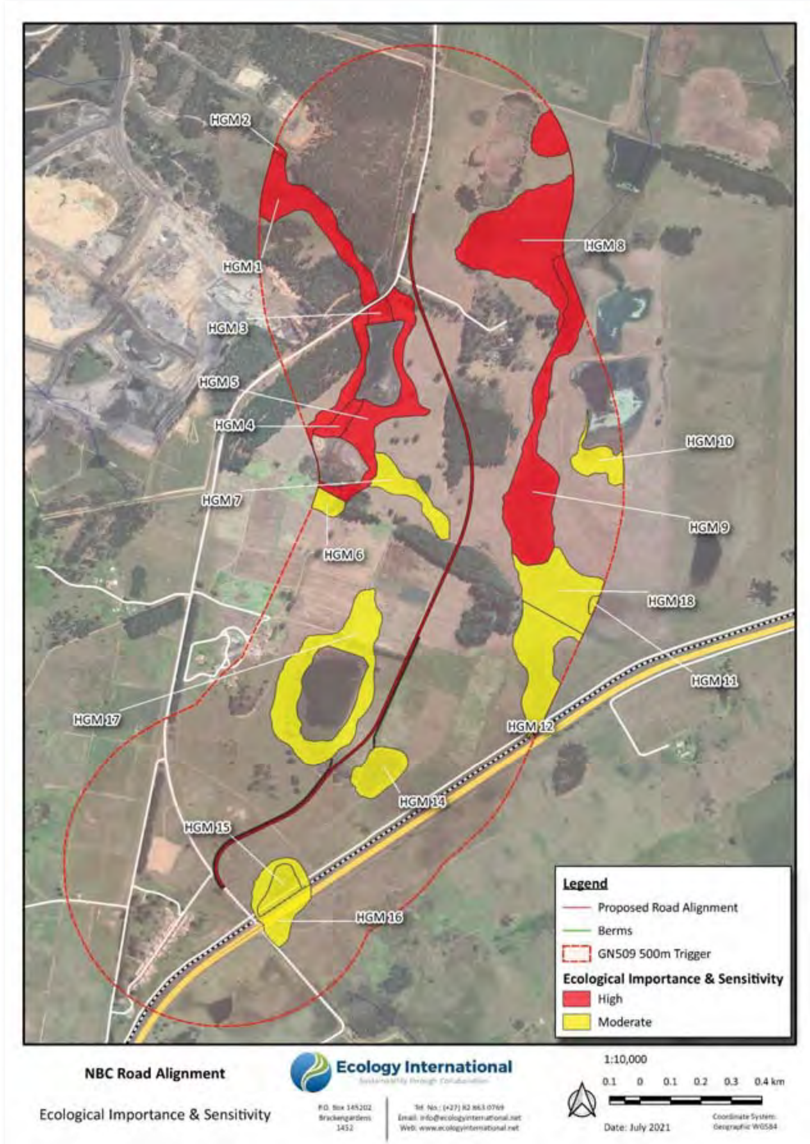

Figure 7: Ecological Importance and Sensitivity of the wetlands/watercourses within the proposed road realignment and its associated 500 m zone of regulation.

Predictions on future changes on ecosystems and populations once a development has happened are seldom straightforward, except in cases such as the total loss of a habitat to development. However, most development impacts are indirect, subtle, and cumulative or unfold over several years following construction or commencement of mining. Whilst a possible mechanism for an impact to occur can usually be identified, the actual likelihood of occurrence and its severity are much harder to describe (Hill & Arnold, 2012).

A closely related issue is that of the effectiveness of ecological mitigation which stems from ecological assessments (including freshwater ecological assessments), as well as in response to legal and planning policy requirements for development. Many recommendations may be incorporated into planning conditions or become conditions of protected species licences, but these recommendations are implemented to varying degrees, with most compliance being for the latter category (I.e., protected species) because there is a regulatory framework for implementation. What is often missing is the follow-up monitoring and assessment of the mitigation with sufficient scientific rigour or duration to determine whether the mitigation, compensation or enhancement measure has actually worked in the way intended (Hill & Arnold, 2012).

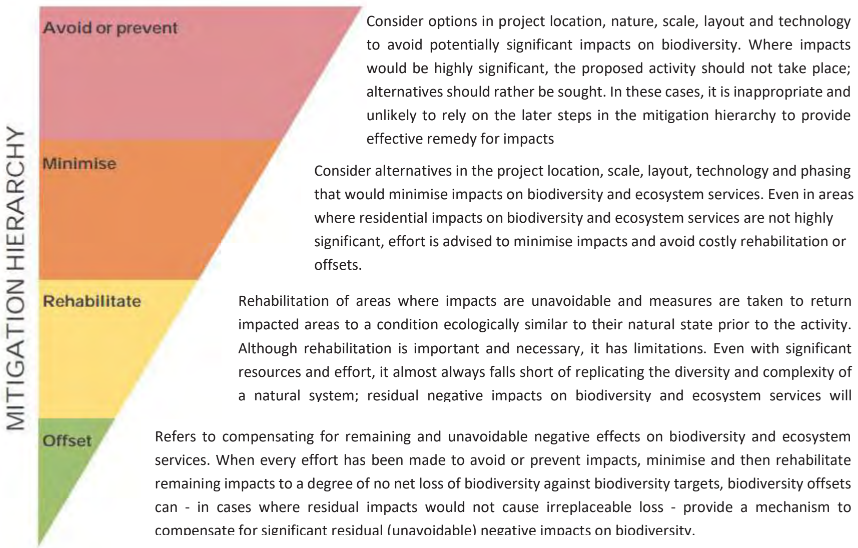

Figure 8: The mitigation hierarchy

Many impacts are not only a result of the direct impact on a particular species or habitat unit, but rather due to what is known as the '*Edge Effect'*, which can be explained as follows: Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type and abundance of species they contain. At the periphery of natural patches, influences of neighbouring environments become apparent; this then is the '*Edge Effect'*. Patch edges may be subjected to

degradation due factors such as increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other negative agents. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat to survive in the long term. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder, 2004).

5.1 Risk Assessment Approach

The assessment of potential risks posed by the identified Section 21 (c) and (i) water uses was based on the Risk Matrix Tool as defined by Department of Water and Sanitation Notice 509 of 2016. The Risk Matrix Tool was developed to assist in quantifying expected impacts through application of a standardised protocol, with consideration given to severity of potential impacts of an activity on the flow regime, physico-chemical water quality, aquatic habitat and biota. Further considered within the protocol are: the spatial scale of the impact, the duration of the impact, the frequency of the impact, and the likelihood of the impact occurring.

Through the consideration of these elements, the risk posed by the activity on the associated freshwater ecosystem can be determined as follows:

- Severity + Spatial Scale + Duration **= Consequence;**
- Frequency of the Activity + Frequency of the Impact + Legal Issues + Detection = **Likelihood;**
- **Consequence X Likelihood = Risk**

Risk categories obtained through utilisation of the DWS Risk Assessment Tool thus serve as a guideline to establish the appropriate channel of authorisation of these water uses (I.e., General Authorisation or more detailed Water Use Licence Application).

5.2 Identification and Assessment of Potential Impacts

The range of typical impacts that can be expected for the proposed project are described in detail in the sections below. The various impacts have been split into construction phase impacts (which are limited to the duration of the construction phase) and operational phase impacts (which are permanent):

- Construction Phase Impacts:
  - Water and soil pollution;
  - Erosion and sedimentation;
  - Disturbance and compaction of soils;
  - Destruction of natural wetland vegetation and habitat;
  - Altered subsurface hydrology;
- Operational Phase Impacts:
  - Dust pollution;
  - Altered wetland hydrology and continued soil compaction;
  - Proliferation of alien and/or invasive plants;
  - Water and soil pollution;
  - Erosion and sedimentation.

5.2.1 Construction Phase Impacts

Water and Soil Pollution

During the construction phase, as activities are taking place adjacent to wetlands, there is a possibility that water quality may be impaired. Typically, impairment will occur as a consequence of sediment disturbance resulting in an increase in turbidity. Water quality may also be impaired as a consequence of accidental spillages and the intentional washing and rinsing of equipment. It is possible that hydrocarbons will be stored and used on site, as well as cement and other potential pollutants, which have the potential to result in impaired water quality.

Changes in water quality has the potential to cause a shift in aquatic species composition, favouring only tolerant species, resulting in the localised exclusion of sensitive species. Sudden drastic changes in water quality can also have chronic effects on aquatic biota leading to localised extinction. Pollution could also result in negative impacts to people and livestock that are reliant on water resources for drinking purposes.

Erosion and Sedimentation

Disturbance of the soils and clearing of the vegetation adjacent to sensitive wetland systems will expose the bare soils to the risk of erosion. Disturbed soils if not landscaped to the surrounding profile could also result in the formation of preferential flow paths, with resultant flow concentration also increasing the risk of erosion. Erosion poses a great risk to the geomorphological/functional integrity of wetlands and affects system hydrology. The associated increased sediment deposition has the potential to impact on geomorphological/hydrological functioning, as well as on water quality within the receiving environment.

Disturbance and Compaction of Soils and Altered Hydrology

The excavation and compaction of soils due to the proposed road realignment may alter the natural geomorphological and hydrological processes within the adjacent wetlands such as the subsurface movement of water. Compacted soils are also not ideal for supporting vegetation growth as they inhibit seed germination.

5.2.2 Operational Phase Impacts

Altered Hydrology

The proposed road realignment may alter the existing hydrological regime by intercepting and/or disrupting flow due to excavations and compaction of soils and hardened surfaces associated with the proposed road. The preferential flow of water along the proposed road can also lead to changes in water distribution and retention patterns within wetlands (use of river sand for bedding material, for example), could result in preferential flow of water along the road route, which could essentially drain wetland areas. Altered hydrological conditions within wetlands are also likely to affect vegetation characteristics, habitat and general ecological integrity within a system.

Proliferation of Alien and/or Invasive Plants

The proliferation of alien and/or invasive plants poses a risk to indigenous plant species and would be

facilitated by disturbance of natural vegetation and surface soil layers during vegetation clearing and general construction. Alien and/or invasive plant species have the ability to out-compete and replace indigenous flora, which will in turn impact on natural biodiversity. Although the impact is initiated during the construction phase, it is really an operational issue as recovery of vegetation community types is a long-term process. The significance of this impact is regarded as high as the incidence of alien and/or invasive species observed in the study and investigation areas, increases the potential for the spread of these species and a result of the proposed activities.

Erosion and Sedimentation

Construction activities associated with proposed road realignment could lower the natural base level within wetland crossings leading to preferential flow paths and head-cut formation. Long-term impacts have the potential to extend into the operational phase with the potential formation of active erosion gullies and the subsequent loss of wetland habitat.

5.2.3 Risk Assessment Ratings

Results following the application of the GN509 DWS risk assessment matric is provided in Appendix B. It should be clearly understood that, in determining the significance of potential impacts for the present study, the assessment of impact significance assumes that all mitigation measures as proposed within this report are implemented. In the event that some mitigation measures are not deemed feasible by the client, re-evaluation of the significance of the potential impacts post-mitigation will be required which takes into consideration the application of mitigation measures deemed by the client as feasible.

5.2.4 Mitigation Measures

The sections below provide the mitigation and management measures deemed necessary to prevent and minimise impacts on the receiving environment.

5.2.4.1 Construction Phase Mitigation

Pollution Control

- No construction equipment to be permitted within wetlands/watercourses;
- The proper storage and handling of hazardous substances (hydrocarbons and chemicals) is critical. Storage of potentially hazardous materials (E.g., fuel, oil, cement, bitumen, paint, etc.) should be outside of any drainage lines or wetland, or as specified by the Environmental Control Officer (ECO). This applies to storage of these materials and does not apply to normal operation or use of equipment in these areas;
- All employees handling fuels and other hazardous materials are to be properly trained. Storage containers must be regularly inspected to prevent leaks;
- Washing and cleaning of equipment should not be undertaken in or adjacent to wetlands/watercourses;
- Operation and storage of machinery and construction-related equipment must be done outside of wetlands/watercourses wherever possible;
- Ensure that suitable overnight facilities are provided for vehicles, away from any wetland/watercourse areas;
- Provide drip-trays beneath standing machinery;

- Routinely check machinery for oil or fuel leaks each day before construction activities begin;
- No vehicles or machinery may be refuelled or serviced within or directly adjacent to any wetland/watercourse;
- Spillages of fuels, oils and other potentially harmful chemicals should be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities (not to be disposed of within the natural environment). Any contaminated soil from the construction site must be removed and appropriately cleaned or disposed of;
- Sanitation – portable toilets to be provided where construction is occurring. Workers need to be encouraged to use these facilities and not the natural environment. Toilets should be located outside of the wetlands/watercourses and any drainage lines. Waste from chemical toilets should be disposed of regularly and in a responsible manner by a registered waste contractor;
- Provide adequate waste disposal facilities (bins) and encourage workers not to litter or dispose of solid waste in the natural environment but to use available facilities for waste disposal;
- No stockpiling should take place within a wetland/watercourse; and
- Ensure that any rubbish is regularly cleared from the site.

Erosion and Sediment Control

- Construction should take place during the dry, winter months to minimize soil erosion linked to high runoff rates;
- Any cleared or excavated material from the construction zone (including any foreign materials) should not be placed or stockpiled within wetlands/watercourses to reduce the possibility of material being washed downstream;
- Any erosion points created during construction should be filled and stabilized immediately;
- No stockpiling should take place within any of the wetlands/watercourses;
- Limit the extent of the construction servitude to as small an area as possible;
- Soils should be landscaped to the natural landscape profile with care taken to ensure that no preferential flow paths or berms remain;
- Weather forecasts from the South African Weather Bureau should be monitored to avoid exposing soil or building works or materials during a storm event and appropriate action must be taken in advance to protect construction works should a storm event be forecasted; and
- Any disturbed or cleared areas should be revegetated as soon as possible to ensure basal cover is restored as soon as possible.

Clearing of Vegetation

- Keep the clearing of vegetation to a minimum and attempt to ensure that clearing occurs in parallel with the construction progress where practically possible. No construction equipment to be permitted within wetlands/watercourses;
- The construction zone should be clearly demarcated prior to the commencement of construction activities to ensure that construction vehicles do not disturb wetland/watercourse areas;
- Any alien and/or invasive plants encountered should be removed from the site and appropriately disposed of; and

- Rehabilitate disturbed areas as soon as practically possible with indigenous wetland and/or riparian vegetation.

Culvert and Berm Installations

- No piped culverts should be permitted at any point along the proposed road realignment. Instead, surface flows and subsurface hydrology should be maintained making use of box culverts, appropriately installed at the correct levels in line with the surface topography to ensure impacts as a result of the onset of erosion and the creation of preferential flow paths are minimised;
- Stormwater control berms must be incorporated in such a manner as to prevent the formation of preferential flow paths and the creation of high energy runoff during rainfall events, which has the potential to result in the onset of erosion; and
- If necessary, energy dissipating structures and flow spreaders should be included in the design of the proposed stormwater berms and the box culverts.

Site Access

- The construction footprint should be kept as small as possible;
- Use existing access routes as far as possible before creating new ones;
- Any additional access routes should be designed to limit potential impact on the environment, bearing in mind areas that are already showing reduced groundcover and erosion; and
- Wherever possible, making new tracks with a grader must be avoided, and a new vehicle track is to be created by simply driving over the grass cover without removing grass cover/topsoil. The same track is to be used to access areas and widening and creating alternative or parallel tracks must not be allowed. Likewise, the same vehicle turning areas are to be used.

General

- Construction activities should take place over as short a time period as possible, thereby limiting risk of erosion and sedimentation. It is advised to complete small sections at a time before continuing with the next section;
- No physical damage should be done to any aspects of the wetlands present;
- Ensure that construction activities are carefully monitored to limit unnecessary impacts to wetland areas;
- Minimise additional disturbance by limiting the use of heavy vehicles and personnel during clean-up operations;
- No open fires to be permitted on construction sites;
- Smoking must not be permitted in areas considered to be a fire hazard;
- Ensure adequate firefighting equipment is available and train workers on how to use it;
- Ensure that all workers on site know the proper procedure in case of a fire occurring on site;
- Keep outside of sensitive habitat types that have been identified for protection/conservation;
- Inform site staff that under no circumstance may firewood or medicinal plants be harvested from wetland areas; and
- No wild animal may under any circumstance be hunted, snared, captured, injured, killed, harmed in any way or removed from the site.

5.2.4.2 Operational Phase Mitigation

Monitoring and Management

- Regular inspections and maintenance of the road route must be undertaken during the operational phase;
- Dust generated due to increased vehicle movement must be managed on an ongoing basis to prevent impacts to the surrounding wetland vegetation through smothering; and
- No vehicles should be allowed to drive indiscriminately within wetland areas and use should be made of existing roads, if necessary, personnel should do inspections on foot.

Alien and Invasive Plant Control

- All areas disturbed by construction activities apart from the constructed road must be rehabilitated to their former state once construction activities have ceased and should be monitored afterwards to prevent disturbed areas from being colonised by alien and/or invasive plant species;
- Re-vegetation of disturbed areas must use indigenous plants including locally-common indigenous grasses, sedges and trees/shrubs; and
- Implement an alien and invasive plant species control programme to ensure that these plants are actively managed and eradicated from the site, with adequate monitoring and follow-up measures (particularly within the first 12 – 24 months of operation). This will need to include any disturbed areas created during construction that may have become colonized by alien and/or invasive plant species.

Erosion Control

- All foreign construction materials and structures to be removed from the study area post-construction;
- The road route should the regularly inspected for emerging erosion features;
- Any erosion features noted should be immediately stabilised through measures such as plugging, soil mattresses, rock packs, silt traps or sandbags;
- Erosion features that have been stabilized should be monitored at regular intervals during the operational phase in order to assess whether further protection works are required; and
- Re-instate indigenous vegetation as soon as practically possible once corrective measures have been implemented to stabilise disturbed areas. Monitor re-vegetation to ensure wetland areas are well covered and protected from further erosion.

6 CONCLUSION

Eighteen HGM units were identified within the vicinity of the proposed road realignment and its associated 500 m zone of regulation comprising various unchanneled valley bottom wetlands, hillslope seep wetlands (including a sheet rock wetland), and depressions/pans. Furthermore, five impoundments were observed. The Present Ecological States of the identified wetlands were broadly classified as Largely Natural (Category B), Moderately Modified (Category C), and Largely Modified (Category D). In terms of ecological service provision, the systems present may be regarded as of Intermediate to Moderately High importance in terms of service provision and functionality. EIS scores of the delineated wetlands were regarded as of Moderate and High Ecological Importance and Sensitivity.

For the purpose of the assessment of potential impacts associated with the proposed road realignment project, the following activities were considered:

- The realignment of the D2809 provincial road and the inclusion of two stormwater berms on the southern portion of the proposed road; and
- Operation of the road.

The range of typical impacts that can be expected for the proposed project include water and soil pollution, erosion and sedimentation, disturbance and compaction of soils, destruction of natural wetland vegetation and habitat, altered hydrology and the proliferation of alien and/or invasive plants. According to the results of the DWS risk assessment, however, should the mitigation measures as proposed in this report be strictly adhered to, it is the opinion of the ecologist that impacts may be kept to low risk ratings for both the construction and the operational phases of the proposed road realignment project.

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APPENDIX A – DESCRIPTION OF THE VARIOUS HGM UNITS ASSOCIATED WITH THE PROPOSED ROAD REALIGNMENT AND ITS ASSOCIATED 500 M ZONE OF REGULATION

Name	HGM_unit	Present Ecological State	Ecoservice Provision	Ecological Importance & Sensitivity
HGM 1	Unchannelled valley bottom	C	1.9	2.50
HGM 2	Hillslope seep	C	1.9	2.53
HGM 3	Unchannelled valley bottom	D	1.9	2.17
HGM 4	Unchannelled valley bottom	C	1.9	2.53
HGM 5	Hillslope seep	C	1.9	2.53
HGM 6	Hillslope seep	D	1.6	1.94
HGM 7	Sheet rock	C	1.9	1.72
HGM 8	Hillslope seep	C	1.9	2.06
HGM 9	Unchannelled valley bottom	C	2.0	2.17
HGM 10	Hillslope seep	C	1.9	1.94
HGM 11	Pan	B	1.4	1.94
HGM 12	Hillslope seep	C	1.9	1.92
HGM 13	Wet patch	-	-	-
HGM 14	Pan	C	1.9	1.94
HGM 15	Pan	C	1.4	1.50
HGM 16	Hillslope seep	C	1.4	1.25
HGM 17	Hillslope seep	D	1.3	1.44
HGM 18	Hillslope seep	B	2.0	2.03

APPENDIX B – DWS RISK ASSESSMENT

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)
NAME and REGISTRATION No of SACNASP Professional member: Kieren Bremner Reg no. 119341
Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

No.	Phases	Activity	Aspect	Impact	Severity: Flow Regime	Severity: Physico & Chemical (Water Quality)	Severity: Habitat (Geomorph + Vegetation)	Severity: Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
1	Construction	Construction of the road and stormwater berms	Access to site and vehicle movement	Damage to wetlands and direct and indirect loss of wetland habitat. Disturbance to wetland flora and fauna. Impeding surface water flow and alterations to the natural sub-surface flows. Creation of preferential flows. Increased erosion risk. Increased sediment	1	1	2	2	**1.5**	1	1	**3.5**	5	3	5	1	**14**	**49**	Low Risk
			Site clearing: vegetation removal and compaction		1	2	2	2	**1.75**	1	1	**3.75**	5	3	5	1	**14**	**52.5**	Low Risk
			Installation of culverts for maintenance of subsurface hydrology.		1	1	3	2	**1.75**	1	1	**3.75**	5	3	5	1	**14**	**52.5**	Low Risk
2	Operation	Operation of the road	Increased vehicle traffic	Impaired water quality (ingress of hydrocarbons). Suffocation of vegetation due to generation of dust. Continued compaction of soils. Erosion and sedimentation. Proliferation of AIPs.	2	1	1	2	**1.5**	1	1	**3.5**	5	1	5	2	**13**	**45.5**	Low Risk
			Dust control		1	3	2	2	**2**	1	1	**4**	5	1	5	2	**13**	**52**	Low Risk
			Stormwater management		2	2	1	1	**1.5**	1	1	**3.5**	3	1	5	2	**11**	**38.5**	Low Risk
			Maintenance activities		1	2	2	2	**1.75**	1	1	**3.75**	1	1	5	2	**9**	**33.8**	Low Risk
			Culvert Operation		1	1	2	3	**1.75**	1	1	**3.75**	4	1	5	2	**12**	**45**	Low Risk

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23 July 2021

Att: Ms Natasha Higgitt
South African Heritage Resources Agency
PO Box 4637
Cape Town
8000

By email: nhiggitt@sahra.org.za

Dear Ms Higgitt,

Re: Heritage Opinion regarding the Proposed Road Realignment by the NBC Colliery, near eMakhazeni (Belfast), eMakhazeni Local Municipality, Nkangala District Municipality, Mpumalanga Province.

1. INTRODUCTION

In 2012 PGS Heritage was appointed to undertake a Heritage Impact Assessment (HIA) for the proposed Exxaro Paardeplaats Colliery. The project area is located near eMakhazeni (Belfast) and is situated in the eMakhazeni Local Municipality, Nkangala District Municipality, Mpumalanga Province (Refer to **Appendix A and B).** During this survey, the proposed road realignment formed part of the study area and was also indicated on a map that was submitted as part of the HIA report.

In 2021, PGS Heritage (Pty) Ltd (PGS) was appointed by CIGroup Environmental (Pty) Ltd (CIGroup) to undertake an HIA for the Glisa and Paardeplaats Sections of the NBC Colliery (NBC). The study area for this assessment was the same as the one previously assessed by PGS. Further field assessments and a revisit to all the heritage sites identified in 2012 was undertaken.

Currently, NBC wants to build the road realignment. CIGroup approached PGS, who corresponded with SAHRA on the matter. SAHRA recommended that a field assessment of the proposed road realignment be undertaken and that the findings of the field assessment be presented to SAHRA in letter format. This document represents this letter that was recommended by SAHRA.

The scope of work for the heritage opinion is to establish whether any heritage impact assessment or any other heritage work would be required for the proposed development. Please note that this heritage opinion is based on a previous heritage impact assessments (2012 & 2021) undertaken by PGS in the area, as well as a site visit conducted on Friday, 16 July 2021.

2. DESCRIPTION OF PROPOSED DEVELOPMENT

The proposed development is described as follows:

- Permanent Realignment of the D 2809 Provincial Gravel Road on Portion 13 and 30 of the farm Paardeplaats 380 JT to Portion 13 and 29 of the farm Paardeplaats 380 JT.

3. METHODOLOGY

The process consisted of the following:

Step I – Physical Survey: The fieldwork comprised a field assessment of the proposed road realignment route as well as a site visit to five sites located in proximity to the proposed road realignment. While the field assessment of the proposed road realignment was aimed at identifying any archaeological and heritage sites that may be located within the proposed road realignment footprint, the visit to the five nearby sites was aimed at establishing to actual boundaries of these sites.

This fieldwork was undertaken primarily by foot over the course of one day by an experienced fieldwork team from PGS consisting of two archaeologists (Cherene de Bruyn and Michelle Sachse). The fieldwork was undertaken on Friday, 16 July 2021.

Step II – Letter: The final step comprised the compilation of this letter.

4. ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations regarding this study and report exist:

- Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. In the event that any graves or burial places are located during the development, the procedures and requirements pertaining to graves and burials will apply as set out below.

- The road realignment layout and footprint as depicted in this report were provided by the client. As a result, these were the areas assessed during the fieldwork. Should any additional development footprints located outside of these study area boundaries be required, such additional areas will have to be assessed in the field by an experienced archaeologist/heritage specialist before construction.

5. FIELDWORK

5.1. Fieldwork undertaken in 2012

PGS completed a HIA for the proposed Exxaro Paardeplaats project in 2012. During the fieldwork for the 2012 study, a total of 32 heritage sites, including 22 heritage structures, seven cemeteries and three areas with historical mining shafts were identified. The proposed road realignment was located within the study area assessed for the purposes of this 2012 report. No sites were identified within the road realignment footprint.

5.2. Fieldwork undertaken in 2021

A second site visit was undertaken by PGS in 2021. The fieldwork comprised additional field assessments within the same study area that was assessed in 2012, and included revisits to all the sites identified in 2012. The fieldwork was undertaken from Monday, 19 April 2021 to Wednesday 21 April 2021. An additional 13 heritage sites were identified during the survey, including the remains of two historic structures, a contemporary farmstead and structure, one historic coal mine shaft, three reservoirs with associated structures, three demolished structures, an animal drinking trough, and a single grave. The propsed road realignment was located within this study area and no new sites were identified within the footprint of the road realignment (Refer to **Appendix C)**.

5.3. Fieldwork undertaken for the Proposed Road Realignment in 2021

Subsequent to the recommendations made by SAHRA for the proposed road realignment to be specifically assessed in the field, and for the results of this focused field assessment to be submitted in a letter to SAHRA, a third site visit was undertaken by an experienced fieldwork team from PGS on Friday, 16 July 2021. The fieldwork team consisted of two archaeologists (Cherene de Bruyn and Michelle Sacshe). The aim of the survey was to specifically address the recommendations made by SAHRA and the proposed road realignment was assessed in detail as a result. Additionally, all previously identified sites located in proximity to the road realignment was also visited to establish the actual boundaries of these sites. During the fieldwork, no new heritage sites were identified within the proposed road realignment.

The following five previously identified heritage sites located in proximity to the proposed road realignment was also visited to establish their actual boundaries. Refer to **Table 1** below.

Table 1 - Identified Heritage Sites and their Location in Relation to the Road realignment.

Site	GPS	Distance from Road Deviation Footprint
PP 05 - Cemetery	S 25.725210 E 30.015134	The closest distance between the proposed road realignment and the actual boundary of site **PP 05** is approximately 68m.
PP 30 – Historic Homestead	S 25.718530 E 30.017220	The closest distance between the proposed road realignment and the actual boundary of site **PP 30** is approximately 70m.
PP 32 – Remains of Historic Homesteads with the Risk for Unmarked Graves	S 25.723070 E 30.015850	The closest distance between the proposed road realignmnet and the actual boundary of site **PP 32** is approximately 61m.
PP 38 - Reservoir with Associated Structures	S 25.729260 E 30.013751	The closest distance between the proposed road realignment and the actual boundary of site **PP 38** is approximately 50m.
PP 41 – Small Stone Structure	S 25.716593 E 30.014553	The closest distance between the proposed road realignment and the actual boundary of site **PP 41** is approximately 25m.

5.4. Photographs

Figure 1 - General view of a section of the northern part of the proposed road realignment.

Figure 2 – General view of a section of the southern part of the proposed road realignment.

Figure 3 - General view of the cemetery at site PP 5 as taken on 16 July 2021.

Figure 4 - View of the remains of the historic homestead at PP 30 as taken on 16 July 2021.

Figure 5 - General view of the remains of the historic homestead at site PP 32. This photograph was taken on 16 July 2021.

Figure 6 – General view of the reservoir and associated structural remains at site PP 38. This photograph was taken on 16 July 2021.

Figure 7 - View of the remains of the stone structure at PP 41 as taken on 16 July 2021.

6. PALAEONTOLOGY

The Palaeontological Desktop Assessment (PDA) was compiled by Banzai Environmental (Butler, 2021). The proposed development is primarily underlain by the Vryheid Formation of the Ecca Group (Karoo Supergroup). According to the South African Heritage, Resources Information System the project area is located in an area with Very High sensitivity (red), as such the Palaeontological Sensitivity of these rocks is Very High. As such, a full Environmental Impact Assessment (EIA) level Palaeontological Impact Assessment (PIA) report is recommended to assess the value and prominence of fossils in the development area and the effect of the proposed development on the palaeontological heritage. This EIA level PIA is part of the measures recommended in the HIA undertaken in 2021. Refer to **Appendix D**.

7. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations can be made:

- Despite three field assessments, including one focused specifically on the proposed road realignment, no heritage sites were identified within this footprint area.

- Five heritage sites were previously identified in proximity to the proposed road realignment. The closest distances between the proposed road realignment and these sites are indicated in **Table 1** above. The closest distance between any of these sites and the proposed road realignment is a distance of 25m expected between the road realignment and the stone structure at site **PP 41.** This site is of low significance and does not require any mitigation. The second closest distance between any of these sites and the proposed road realignment is a distance of 50m between it and site **PP 38**, which comprises a reservoir and associated structural remains. This site is also of low heritage significance and requires no further mitigation. The three other sites are located 61m (**PP 32** – Historic Homestead with the Risk for Unmarked Graves), 68m (**PP 05** – Cemetery), and 70m (**PP 30** – Historic Homestead) from the proposed road realignment. It is clear from these distances measured between the road realignment and the actual boundaries of these sites that the construction of the proposed road realignment does not pose any threat to these three sites. Please note that as an additional measure, monitoring of these three sites (**PP 05, PP 30** and **PP 32**) is recommended during the construction of the road.

- No further heritage impact assessmens or reports are required for the proposed road realignment.

- As recommended by the PDA undertaken for the recent HIA, an EIA level PIA must be undertaken by a specialist palaeontologist. This must be undertaken long before the construction of the road realigment also starts.

- Although the proposed construction of the road realignment is not expected to have any impact on sites **PP 05, PP 30** and **PP 32**, to absolutely ensure the *in situ* preservation of these sites, monitoring of the sites by a specialist archaeologist must be undertaken during the construction of the road realignment.

Please contact me should there be any enquiries.

Sincerely

Polke Birkholtz
Director
PGS Heritage

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Cherene de Bruyn
Archaeologist
PGS Heritage

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Appendix A

Locality Plan

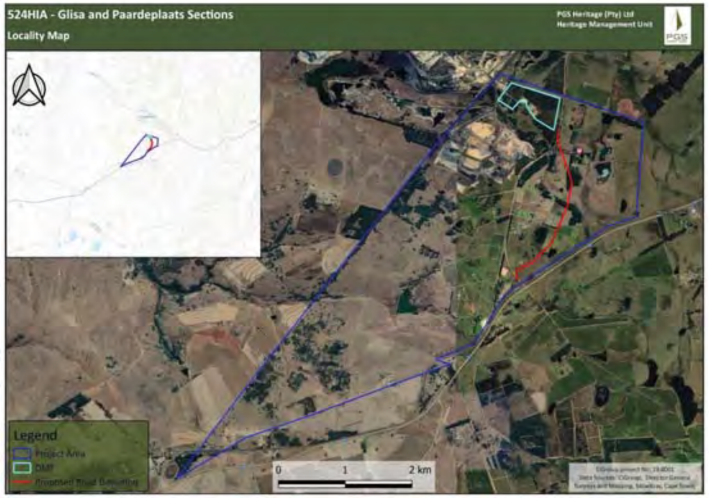

Figure 8 - Locality plan depicting the study area assessed as part of the previous two HIA reports in dark blue with the proposed road realignment in red.

Appendix B

View Of The Proposed Road Realignment

Figure 9 - Closer view of the area where the road realignment is proposed.

Appendix C

Heritage Survey

Figure 10 – Map showing the tracks recorded during the previous HIA in green line with the tracks recorded during the field assessment for the proposed road realignment depicted in yellow. Previously recorded heritage sites are also depicted.

Appendix C

Distances between Heritage Site Boundaries and the Proposed Road Realignment

Figure 11 - Map showing the actual boundaries of the heritage sites in green line. The measured distances between these site boundaries and the proposed road realignment are also shown.

Appendix D

Palaeontology

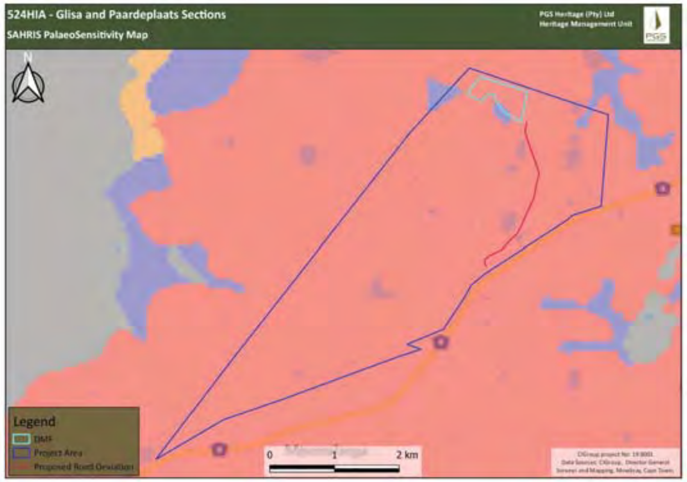

Figure 12 – Depiction of the project areas on the Palaeontological Sensitivity Map of SAHRA.

NBC Colliery, Universal Coal: NBC Consolidation Project

Freshwater Ecosystem Baseline & Impact Assessment

Ecology International
Sustainability through Collaboration

NBC Colliery, Universal Coal:
NBC Consolidation Project
Freshwater Ecosystem Baseline & Impact Assessment

CIGroup Project Ref. No. 19.0001
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Ecology International
Sustainability through Collaboration

June 2021

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NBC Consolidation Project *Freshwater Ecosystem Assessment*

Declaration of Independence by Specialist

I, **KIEREN BREMNER DUNNE**, in my capacity as a specialist consultant, hereby declare that I -

- act as an independent consultant;
- 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;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998), regulations and any guidelines that have relevance to the proposed activity;
- based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability;
- undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered; and
- as a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member.

23 June 2021
Date

Kieren Bremner Dunne Pr.Sci.Nat.
Senior specialist
Ecology International (Pty) Ltd
SACNASP Reg. No. 119341
(Aquatic Science)

Declaration of Independence by Specialist

I, **BYRON GRANT**, in my capacity as a specialist consultant, hereby declare that I -

- act as an independent consultant;
- 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;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
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Byron Grant Pr.Sci.Nat.
Director & Principal Specialist
SACNASP Reg. No. 400275/08
(Aquatic Science, Ecological Science & Zoological Science)

23 June 2021

Date

EXECUTIVE SUMMARY

Ecology International (Pty) Ltd was appointed as independent biodiversity specialists by Commodity Inspections Group (Pty) Ltd to conduct a detailed assessment of the wetland and instream aquatic ecosystems associated with the North Block Complex (NBC) Consolidation Project to inform the necessary environmental and water use authorisation processes, including the assessment of potential risks associated with the proposed activities. A field assessment was carried out from the 13^{th} – 16^{th} April 2021.

The study area is largely situated in the Olifants WMA in the upper reaches of the Steelpoort River catchment (B41A). Watercourses draining to the north and east form part of the surrounding catchment's river Freshwater Ecological Priority Areas (FEPAs), while the catchment draining to the west has been classified as a Fish Support Area. Only one wetland unit (associated with a larger wetland cluster) was identified as a FEPA wetland based on the revised wetland mapping inventory for the Mpumalanga Highveld region.

According to the latest revision of the freshwater component of the Mpumalanga Biodiversity Sector Plan (2019), the study area is primarily associated with 'Heavily Modified' and 'Ecological Support Areas', with isolated 'Critical Biodiversity Areas' associated with the western catchment.

The Integrated Paardeplaats Section is situated in an area comprising plateau grasslands, mountain slopes and shallow valleys. As such, the terrain lends itself to the formation of numerous hillslope seep wetlands and the presence of valley bottom wetland features becoming more channelled further downstream. Of the approximately 2482 hectares making up the Integrated Paardeplaats Section, approximately 440.22 hectares comprise wetland habitat. Ninety hydro-geomorphic (HGM) units were identified within the study area, which were broadly classified as Largely Natural (Category B), Moderately Modified (Category C), Largely Modified (Category D) and Seriously Modified (Category E) according to the latest revised WET-Health methodology (Version 2).

Key services provided are generally related to streamflow regulation, sediment trapping and the assimilation of toxicants and nutrients from the surrounding land use activities. Biodiversity maintenance is regarded as high to very high across almost all the HGM units indicating the importance for conservation of these systems as well as their role in the provision of habitat and natural migration corridors. Erosion control and flood attenuation services were also generally regarded as important services, albeit to a lesser extent. Direct human benefits were related to the provision of water for agropastoral activities, as well as for recreational use and tourism (I.e., Trout fishing and birding opportunities), however, these were generally associated with the valley bottom systems rather than with the hillslope seeps. The identified HGM units were regarded as of Moderate and High Ecological Importance and Sensitivity across the study area.

Watercourses associated with the study area were largely limited to source zones and as such, many of the sites sampled, were situated either within impoundments, depressions or valley bottom wetlands. While electrical conductivities were noted as high throughout the Integrated Paardeplaats Section, water quality was generally not likely to be a limiting factor to either diatom or the macroinvertebrate assemblages likely to occur, with both macroinvertebrate species tolerant of moderately impaired water quality, as well as sensitive diatom assemblages indicating Good to High water quality throughout the Integrated Paardeplaats Section. A contributing factor to the water quality observed may likely be related to the high incidence of Hillslope Seeps, which generally provide water purification services to the downstream water resources due to their slow diffuse flows.

The habitat assessment (IHI) applied to NBC 7 and site 7 on the Skilferlaagtespruit, site 4B downstream of the Mahim Dam, and to site NBC 2, revealed impacts associated with erosion (site 4B) and impacts related to the spread and incidence of dense patches of alien weeds and trees. However, only site 4B was found to deviate from the RQOs (Ecological Category C) for the catchment.

The results of the Macroinvertebrate Response Assessment Index (MIRAI) indicated that the downstream resources associated with the Integrated Paardeplaats Section may be considered to be in a Largely Natural (site NBC 7), Moderately Modified (site 7 on the Skilferlaagtespruit) and Moderately to Largely Modified (site NBC 2) state. The Ecological Category obtained for site NBC 2 fell slightly below the RQO for a stream in the B41A catchment, with the main driver of change likely related to flow modification as a result of upstream impoundments within the study area.

According to Cleanstream (2020), the ecological state of the Skilferlaagtespruit downstream of the study area may be considered Moderately Modified (Ecological Category C). This is, however, based on the assumption that although not sampled, all eight expected fish species are still present in this section of the Skilferlaagtespruit, albeit in reduced frequency of occurrence. However, the confidence of the ecological state score will increase as more surveys are conducted to verify the presence/absence of fish species within this river reach. The primary impacts responsible for deterioration in the fish assemblage are expected to be related to reduced flows (flow modification by dams in catchment), sedimentation of bottom substrates (increased erosion primarily associated with agricultural activities) and the potential presence of alien fish species.

With the expansion of the NBC into the Paardeplaats Section and the proposed Life of Mine (LoM), it was determined that the proposed opencast pit will result in the loss of 86.74 hectares of wetlands consisting predominantly of hillslope seepage wetlands. Wetland systems affected include the upper reaches of tributaries draining into the Glisa Section of the NBC Consolidation area, as well as wetland systems draining westwards and forming part of the upper Steelpoort River catchment and the FEPA designated Fish Sanctuary Area.

The range of potential impacts anticipated as a result of the proposed activities ranged from High to Moderately Low even with the implementation of mitigation measures and have been identified as follows:

- Construction/Operational Phase Impacts
    - Loss of wetland and aquatic habitat;
    - Fragmentation of watercourses;
    - Disturbance and degradation of wetland and aquatic habitat;
    - Increased sediment transport and deposition in wetland and aquatic habitat;
    - Water quality deterioration; and

    - Impact on provincial freshwater conservation targets.
- Post-closure Phase Impacts
    - Water quality deterioration;
    - Increased surface runoff into wetland and aquatic habitat; and
    - Invasive plant species encroachment.

Based on the outcomes of the impact assessment, it is the opinion of the ecologist that should mining proceed as per the LoM plan, the loss of wetland habitat is unlikely to be successfully mitigated on-site. Accordingly, the development of a wetland mitigation and offset strategy is required in order to determine the feasibility of wetland offset potential. In doing so, cognisance is to be given as to the status of the downstream biota and the hydrological provisioning services provided by the wetlands present within the Paardeplaats Section. In this regard, a hydrological assessment of the potential impact of the proposed mining activities on the downstream Skilferlaagtespruit is required in order to fully understand the implications of mining through the wetlands present within the Paardeplaats Section and establish an Ecological Reserve for the Skilferlaagtespruit. Flow loggers that are able to collect continuous data from both the Skilferlaagtespruit draining the Paardeplaats Section as well as the tributary draining the current Glisa Section of the mine are therefore highly recommended to establish baseline data, and the placement thereof should align with final biomonitoring sites selected (see below).

In addition, an amendment to the current routine biomonitoring programme is required in order to develop management actions for the different sections of the mine. In this respect, all additional sites assessed during the present study (including site NBC 7) are to be included within the routine biomonitoring studies going forward, with an additional biomonitoring point established on the tributary draining the Glisa Section downstream of the current biomonitoring Site 4B, but upstream of the confluence with the main stem of the Skilferlaagtespruit. This latter biomonitoring point will assist in determining the spatial origin of impacts on the receiving Skilferlaagtespruit, if any, and therefore allow for management actions to be better focused.

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ACRONYMS

ASPT	Average Score Per Taxon
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs (now Department of Water and Sanitation)
DWS	Department of Water and Sanitation
EC	Ecological Category
FEPA	Freshwater Ecosystem Priority Area
FRAI	Fish Response Assessment Index
IHAS	Invertebrate Habitat Assessment System
IHI	Index for Habitat Integrity
MIRAI	Macro-Invertebrate Response Assessment Index
NBA	National Biodiversity Assessment
NFEPA	National Freshwater Ecosystem Priority Areas project
NWRS	National Water Resource Strategy)
PES	Present Ecological State
REMP	River EcoStatus Monitoring Programme
RHP	River Health Programme
SAIAB	South African Institute for Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SASS5	South African Scoring System, Version 5
WMA	Water Management Areas
WRC	Water Research Commission
WWF	Worldwide Fund for Nature

1 INTRODUCTION

Ecology International (Pty) Ltd were appointed as independent biodiversity specialists by Commodity Inspections Group (Pty) Ltd to conduct a detailed assessment of the wetland and instream aquatic ecosystems associated with the proposed Integrated Paardeplaats Section as part of the North Block Complex (NBC) Consolidation Project to inform the necessary environmental and water use authorisation processes, including the assessment of potential risks associated with the proposed activities.

The Scope of Work for the study may be defined as follows:

- Undertake a desktop review of available literature to describe the baseline environment;
- Define applicable legislative requirements;
- Undertake a site visit to verify baseline information and address any knowledge gaps;
- Address the potential for ecological impacts and risks to occur as a result of the proposed activities, including the following:
  - A detailed impact assessment for activities being applied for and occurring with the regulated area;
  - Identify both current and possible negative future impacts on any identified wetlands and watercourses as a result of the proposed activities; and
  - Recommend mitigation, management and monitoring measures to avoid and/or lessen potential impacts on wetlands/watercourses delineated within the study area and the implementation of suitable rehabilitation measures, should this be required.

A detailed description of the methodology used to address the above Scope of Work is provided in Appendix A.

2 DESCRIPTION OF THE PROPERTY

The NBC consists of three mining sections namely the Eerstelingsfontein Section, the Glisa Section, and the Paardeplaats Section (Figure 1). The focus of this process will be on the Glisa and Paardeplaats Sections. Table 1 presents the Glisa and Paardeplaats Sections Mining Right (MR), Environmental Authorisation (EA), and Integrated Water Use License (IWUL) reference numbers as issued in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002; MPRDA), the National Environmental Management Act, 1998 (Act No. 107 of 1998; NEMA), and where applicable, the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008; NEM:WA), and the National Water Act, 1998 (Act No. 36 of 1998; NWA) respectively.

Table 1: Summary of relevant site attributes

REFERENCE	GLISA SECTION	PAARDEPLAATS SECTION
MR	MP 30/5/1/2/1/236 MR	MP 30/5/1/2/2/10090 MR
EA	17/2/3N-4, 17/2/3N-235, & 17/2/3GNK13	-
IWUL	License No.: 06/B41A/ABCFGIJ/1002 File No.: 27/2/2/B141/3/9	06/B41A/CGIJ/8880

The Section 102 Consolidation and Integrated Environmental Application (IEA) focuses on the following:

- Consolidation of the Glisa Section MR and Environmental Management Plan (EMP) into the Paardeplaats Section (MP 30/5/1/2/2/10090 MR);
- Inclusion of Portion 24 of the farm Paardeplaats 380 JT into the Paardeplaats Section MR; and
- IEA for listed activities triggered in terms of the NEMA and NEM:WA within the MR areas and Portion 24 of the farm Paardeplaats 380 JT.

Figure 2 presents the individual areas associated with the consolidation and IEA application process, namely the Glisa Section MR area, the Paardeplaats Section MR area and Portion 24 of the farm Paardeplaats 380 JT. For the purposes of distinction, the current mining Sections will be referred to in this report as the Glisa Section and Paardeplaats Section, Portion 24 of the farm Paardeplaats 380 JT will be referred to in this report as Portion 24, and the area applicable to the Section 102 Consolidation and IEA application (I.e., both Sections and Portion 24) will be referred to as the Integrated Paardeplaats Section (MP 30/5/1/2/2/10090 MR) (Figure 3).

2.1 Property Description

A total of thirteen farm portions relate to the Integrated Paardeplaats Section. Portion 1, 2, 3, 4, and 5 of the farm Paardeplaats 380 JT apply to the Glisa Section MR, whilst the Remaining Extent of Portion 13, Portion 28, 29, 30 and 40 of the farm Paardeplaats 380 JT, and the Remaining Extent (RE) and Portion 2 of the farm Paardeplaats 425 JS, apply to the Paardeplaats Section (Table 2). Portion 24 of the farm Paardeplaats 380 JT is the additional portion being requested through this process (Table 2).

Table 2: Property details for the Integrated Paardeplaats Section

FARM NAMES	Paardeplaats 380 JT & Paardeplaats 425 JS		
APPLICATION AREA	2,463.78 hectares (ha)		
MAGISTERIAL DISTRICT	Nkangala District Municipality (DM) and the Emakhazeni Local Municipality (LM)		
DISTANCE AND DIRECTION FROM NEAREST TOWN	5 kilometres (km) South of the town of eMakhazeni (Belfast) and approximately 1 km South of the closest formal settlement, Siyathuthuka Township		
21 DIGIT SURVEYOR GENERAL CODE FOR EACH FARM PORTION	Paardeplaats 380 JT	Portion 1	T0JT00000000038000001
	Paardeplaats 380 JT	Portion 2	T0JT00000000038000002
	Paardeplaats 380 JT	Portion 3	T0JT00000000038000003
	Paardeplaats 380 JT	Portion 4	T0JT00000000038000004
	Paardeplaats 380 JT	Portion 5	T0JT00000000038000005
	Paardeplaats 380 JT	Portion 13	T0JT00000000038000013
	Paardeplaats 380 JT	Portion 24	T0JT00000000038000024
	Paardeplaats 380 JT	Portion 28	T0JT00000000038000028
	Paardeplaats 380 JT	Portion 29	T0JT00000000038000029
	Paardeplaats 380 JT	Portion 30	T0JT00000000038000030
	Paardeplaats 380 JT	Portion 40	T0JT00000000038000040
	Paardeplaats 425 JS	Remaining Extent	T0JS00000000042500000
	Paardeplaats 425 JS	Portion 2	T0JS00000000042500002

2.2 Locality Map

The Integrated Paardeplaats Section farm portions are presented in Figure 4, whilst the location of the Integrated Paardeplaats Section within the District and Local Municipalities is presented in Figure 5.

Figure 1: Location of the NBC Glisa, Paardeplaats and Eerstelingsfontein Sections

Figure 2: Location of the Glisa Section, Paardeplaats Section and Portion 24.

Figure 3: Location of the Integrated Paardeplaats Section

Figure 4: Farm Portions Applicable to the Integrated Paardeplaats Section

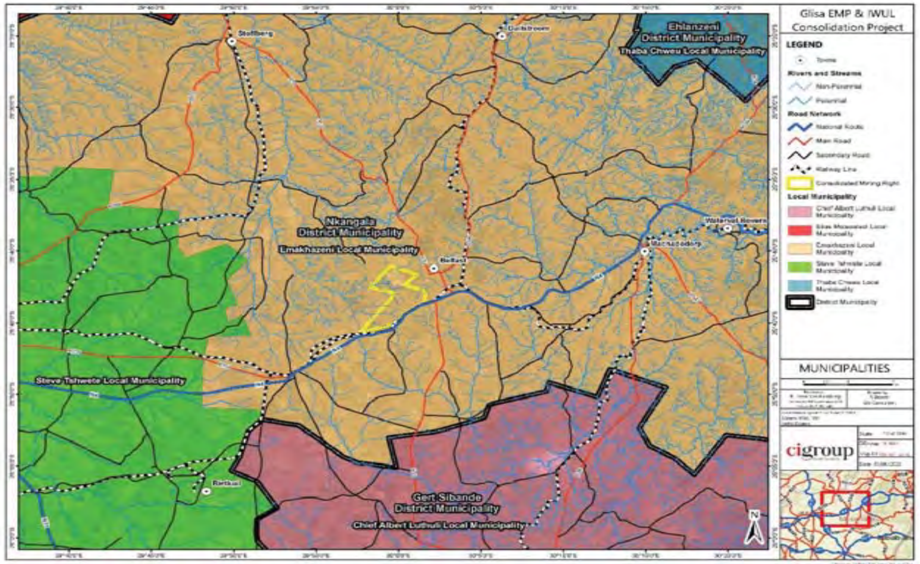


Figure 5: Municipal location of the Integrated Paardeplaats Section

3 DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY

3.1 Description of the Activities to be Undertaken

3.1.1 Current Activities

3.1.1.1. Glisa Section

Mining started at the Glisa Section in 1890 using underground mining methods. From 2006, mining was undertaken by opencast mining methods with underground pillars being reclaimed. This opencast mining method is still in force at the Glisa Section. Coal is crushed and screened at stationary plants whilst other coal products are processed at the main Crushing, Screening and Washing Plant (CSWP) located in the Glisa Section. In addition to mining and coal processing, the Glisa Section also consists of infrastructure such as roads, offices, workshops, stockpiles, pipelines, and a Water Treatment Plant (WTP).

NBC has an existing supply agreement with Eskom to supply steady and secure coal for selected Eskom coal fired power stations. The Glisa Section has been the source of this coal for many years; however, the Glisa Section Life of Mine (LoM) is nearing its end and a resultant reduction in Run of Mine (RoM) coal is occurring. In order to meet its contractual obligations to Eskom, NBC intend to supply Eskom with coal from the adjoining Paardeplaats Section.

NBC, through the utilisation of the Glisa Section infrastructure, intends to limit the disturbance of additional natural areas in the Paardeplaats Section. In so doing, the utilisation of the existing infrastructure at the Glisa Section is paramount. Existing infrastructure at the Glisa Section is licensed in terms of the MPRDA and the NEMA and all of the existing infrastructure at the Section will continue to be used in support of mining activities in the Integrated Paardeplaats Section. The infrastructure that will continued to be used and which does not require licensing in terms of this application includes, the following (Figure 6):

- RoM stockpile areas at the crushing and screening plants, E.g., Gijima, and the main CSWP;
- Product stockpiles at the crushing and screening plants and main CSWP;
- Haul roads, including existing river diversions, culverts, and drains;
- Stormwater management infrastructure, including existing dams and channels;
- Magazine and explosives area;
- Workshops, administrative offices, mining contractor offices, and security offices, including ablution facilities, septic tanks, and French drains;
- Fuel bays, above and below ground diesel storage tanks, wash bays, and salvage areas; and
- Waste management areas.

Figure 6: Existing Infrastructure Layout at the Glisa Section.

3.1.1.1 Water Treatment Plant

The WTP for the Glisa Section spans an area of approximately 0.67 ha on Portion 24 of Paardeplaats 380JT and is fully operational. The design treatment capacity of the WTP is 1.5 megalitres per day (Ml/d) on average over a 30-day cycle, equating to an average of 62.5 cubic metres per hour (m^3/h). Proxa designed and constructed the WTP on behalf of the previous mine owner, Exxaro, and have been operating the WTP since 2017. The WTP processes (Figure 7) entail chemical precipitation in combination with Ultrafiltration (UF) and Reverse Osmosis (RO) technologies. Additional brine treatment is designed for to ensure a zero-brine discharge.

RO is a water treatment process whereby dissolved salts, such as sodium, chloride, calcium carbonate, and calcium sulphate may be separated from water by forcing the water through a semi-permeable membrane under high pressure. The water diffuses through the membrane and the dissolved salts remain behind as the liquid by-product. The liquid by-product generated by the WTP process is routed to a filter press which produces Gypsum by-product (25% moisture content) which is stored within a concrete based, bunded storage area on site.

The process water pipelines (dirty water collection and product water pipelines) traverse Portions 2, 3, 4, 5 and 24 of Paardeplaats 380JT. The purpose of the WTP is to treat water within the dams and voids at the Glisa and Paardeplaats Sections which have been impacted on by historical and current mining activities. The WTP is supported by a significant pipeline network to transfer feed water from the collection points to the WTP for treatment, as well as the pipeline routes from the plant to the discharge point and clean water storage locations. The location of the WTP and the layout of the associated pipelines are shown in Figure 8. The collection points, represented by the red dots in Figure 8, are referred to as:

- Blue Gum Evaporation Dam;
- Block B, Void B1;
- Block C, Void C1; and
- Dirty Water Dam.

The collection points are located within un-rehabilitated voids from historical opencast mining by previous owners of the mine. These voids contain poor quality water mainly from runoff. The voids are licensed in terms of the current Glisa IWUL (License No.: 06/B41A/ABCFGIJ/1002; File No.: 27/2/2/B141/3/9). Water is collected from the collection points by means of sumps within which pumps are located.

Existing infrastructure at the WTP in the Glisa Section is licensed in terms of the MPRDA and the NEMA and all of the existing infrastructure for the WTP will continue to be used in support of the Paardeplaats Section mining activities. The infrastructure that will continued to be used and which does not require licensing in terms of this application includes, the following (Figure 9):

- WTP and pipeline reticulation system, including discharge pipeline and electrical supply through a 500 Kilovolt Ampere (kVA) mini-substation;
- Gypsum storage areas at the WTP; and
- Waste management areas.

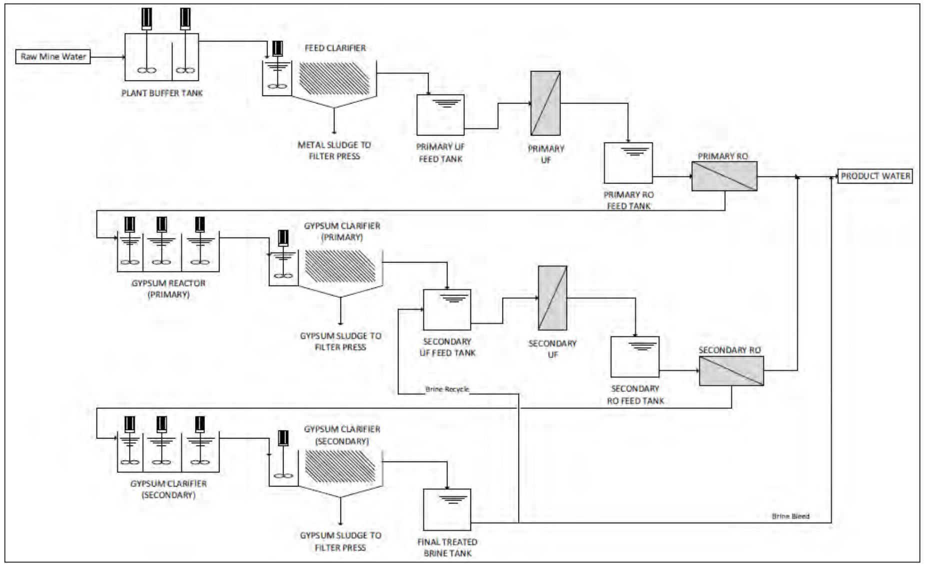


Figure 7: Overview of the WTP Process (Proxa, 2013).

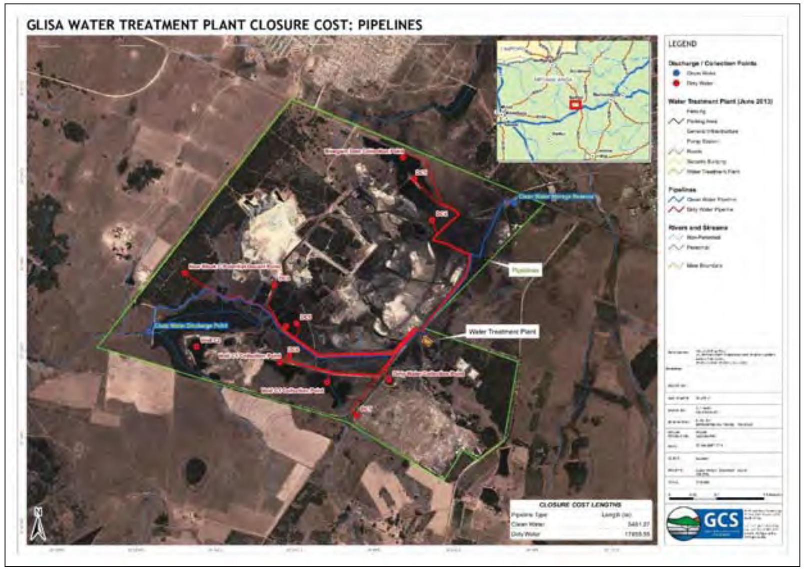


Figure 8: WTP and Pipeline Location (GCS, 2014).

Figure 9: Existing Infrastructure Layout for the WTP (GCS, 2014).

3.1.2 Paardeplaats Section

The Paardeplaats Section is an operational section which adjoins the Glisa Section. Mining is undertaken by opencast mining methods. Mining at the Paardeplaats Section will focus on Portion 30 of the farm Paardeplaats 380 JT for the first ten years of the MR, before expanding to other farm portions.

As RoM reduces at the Glisa Section, the shortfall will be addressed through coal mined at the Paardeplaats Section. The Paardeplaats Section is an open cast mining operation where bench mining techniques are employed to access the coal seams. The 2 Seam Burden is removed with Dozers doing roll-over of the 2 Seam burden into the previous 2 Seam voids, and the upper burden seams are removed with the truck and shove mining method. Coal seams 4, 3 and 2 will be mined for processing. Seam 1 appears in certain areas only and is highly weathered and contaminated with inseam shales and is not suitable to mined and will be left in situ in the pit. The Paardeplaats Section has an estimated RoM supply rate of 4.2 – 4.4 mtpa which relate to 2.4 – 2.6 mtpa of product, supplying Eskom's Komati and Arnot power stations, as well as an estimated RoM supply rate of 1.7 mtpa of export coal which equates to 1.0 mtpa of export product.

3.1.2.1 Resource Details

The Integrated Paardeplaats Section falls within the Witbank Coal Field which is close to the north-eastern edge of the Karoo Basin. The Karoo sequence is represented by the Dwyka Formation consisting of diamictite and the overlaying Ecca Group. The coal seams of the Witbank Coal Field are found at the base of the Vryheid Formation of the Ecca Group and the strata in which coal seams occur consist predominantly of fine, medium and course grained sandstone with subordinate mudstone, shale, siltstone, and carbonaceous shale.

All five coal seams of the Witbank Coal Field occur within the Integrated Paardeplaats Section. The number 2 and 4 seams are more extensively developed than seams 1, 3 and 5. In the far north–east portion of the Paardeplaats Section a dolerite sill, likely a post depositional feature related to the Lesotho Basalts, is believed to have completely displaced coal seams (EIMS, 2014). The coal seams are relatively flat-lying, and the average seam thickness is as follows:

- The Number (No.) 1 seam has an average thickness of 0.34 metres (m);
- The No. 2 seam has an average thickness of 5.37 m;
- The No. 3 seam has an average of 0.78 m;
- The No. 4 seam has an average thickness of 3.04 m; and
- The No. 5 seam has an average thickness of 0.62 m.

The No. 1, 2, 4 and 5 seams can be mined whilst the No. 3 seam, although persistent across the entire coal filed, has been determined to be too thin to be considered an economically viable resource.

Mining at the Paardeplaats Section entails opencast mining. The open cast mining method was selected due to the shallowness of the target coal seams present within the MR area. The open cast mining will be undertaken as a hybrid of roll-over and bench/box cut mining techniques. The use of the two respective techniques is dependent on the number of seams present as well as the overburden thickness. The roll-over technique will be utilised where only a single seam is present and where the overburden has a corresponding thickness of less than 20 m. The bench/box-cut technique will be utilised where two or more seams are present, and the overburden has a thickness of greater than 20 m.

The creation of the opencast was initiated through a stripping operation which removes topsoil and exposes the overburden of the first proposed cut. Initial topsoil was hauled to a designated area and stored for use in rehabilitation. When steady state is reached, topsoil will be replaced in a continuous operation. The overburden is then drilled and blasted. The removal of overburden is undertaken in two phases namely, the top portion will be loaded and hauled, and the lower portion dozed. This will ensure that backfilling is adequately addressed, and that concurrent rehabilitation may take place.

Once the overburden has been removed and dozed, the coal seams are drilled and blasted and then transferred to the Glisa Section for mineral processing by means of standard load and hauls operations. It is anticipated that after the first four (4) cuts, a steady state will be reached. The schematics presented in Figures 10 – 13 describes the mining method in more detail, with the mining direction being from left to right, and depicts the following:

- A section through the general stratigraphic sequence;
- The box cut is excavated after removal of the topsoil and subsoil;
- Coal is removed from the box cut, subsoil from cut 2 and topsoil from cut 3;
- The overburden from cut 2 is drilled and blasted;
- The topmost part of the overburden is loaded and hauled to a stockpile due to insufficient pit room availability;
- The bottom part is dozed over;
- Coal is removed from cut 2 and subsoil from cut 3;
- Cut 3 overburden is blasted;
- The top part of the blasted overburden is hauled and placed at the beginning of the low wall;
- The bottom part of cut 3 is dozed over and the cleaned coal face;
- Coal is removed from cut 3 and subsoil from cut 4; and
- Overburden from cut 4 is blasted.

At this point the pit is now in a ready state and no more material is stockpiled as it can now be accommodated in the pit. Concurrent rehabilitation can now logically follow as soon as the subsoil gets stripped in the front and replaced in the back. The same is true for the topsoil which gets placed over the subsoil in a continuous process.

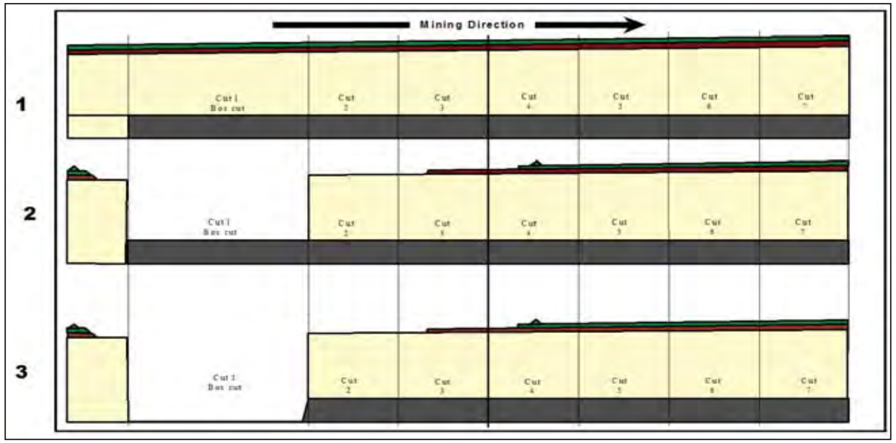


Figure 10: Mining Method steps 1-3.

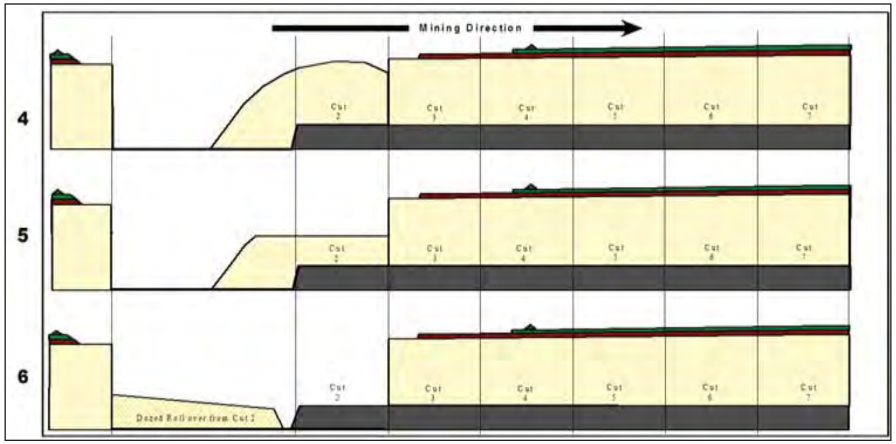


Figure 11: Mining Method steps 4-6.

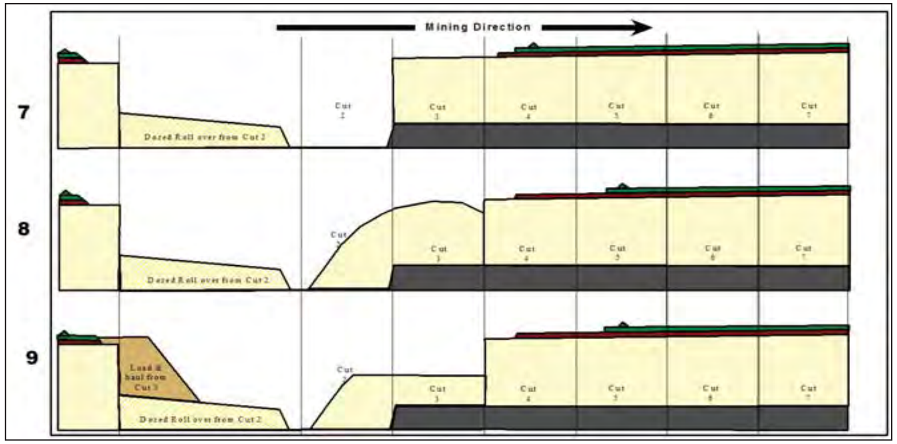


Figure 12: Mining Method steps 7-9.

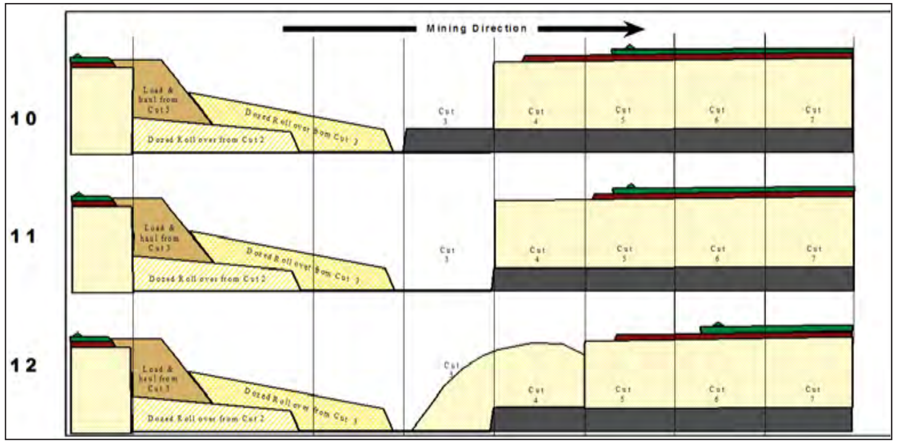


Figure 13: Mining Method steps 10-12.

Due to the proximity of the Glisa and Paardeplaats Sections, all mineral processing and waste disposal for the Paardeplaats Section is being undertake at the Glisa Section. For this reason NBC require the consolidation of the Sections into the Integrated Paardeplaats Section to align with the Paardeplaats Section LoM which currently extends until 25 September 2038. Coal will be crushed at stationary plants prior to processing being undertaken at the main CSWP located in the Glisa Section. Water treatment will also be undertaken at the WTP in the Glisa Section.

3.1.3 Proposed Activities

3.1.3.1 Existing Infrastructure Changes

NBC require the following changes to existing infrastructure:

- Expansion of the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Expansion of the existing WTP pipeline network on all farm portions associated with the Integrated Paardeplaats Section; and
- Widening of haul roads between the mining sections and processing plants.

3.1.3.2 New Infrastructure Required

In order to ensure the continuation of mineral processing and water treatment activities for the Integrated Paardeplaats Section in support of the mining activities taking place, NBC require new infrastructure within the Integrated Paardeplaats Section in support operation activities in the Section. This new infrastructure includes the following (Figures 14 - 16):

- A RoM pad on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- A PCD at the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Additional stormwater management infrastructure including diversion channels around the CSWP, and diversion channels around the administrative, contractor, workshop, and security offices on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Rerouting of a powerline at the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT to ensure a clear footprint area for the PCD;
- A RoM pad on Portion 24 of the farm Paardeplaats 380 JT;
- An additional crushing and screening plant on Portion 24 of the farm Paardeplaats 380 JT;
- A mining contractors office, workshop, and conservancy tank on Portion 24 of the farm Paardeplaats 380 JT;
- A PCD on Portion 24 of the farm Paardeplaats 380 JT;
- Stormwater management infrastructure, including diversion channels, for the above-mentioned infrastructure on Portion 24 of the farm Paardeplaats 380 JT;
- A powerline extension from the existing network to supply power to the infrastructure on Portion 24 of the farm Paardeplaats 380 JT;
- Pipelines between the PCD, Plant and the WTP on Portion 24 of the farm Paardeplaats 380 JT;
- A conveyor between the RoM Pad on Portion 24 of the farm Paardeplaats 380 JT and the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- An emulsion silo adjacent to the magazine yard on Portion 24 of the farm Paardeplaats 380 JT;
- Haul roads and a dewatering pipeline within the active mining area on Portion 30 of the farm Paardeplaats 380 JT and planned mining areas on Potion 13, 28, 29 and 40 of the the farm Paardeplaats 380 JT and Portion 2 and Remaining Extent of the farm Paardeplaats 425 JS;
- Backfill areas on Portion 1, 3, 4 and 5 of the farm Paardeplaats 380 JT; and
- Discard Management Facility (DMF) on Portion 24 of the farm Paardeplaats 380 JT.

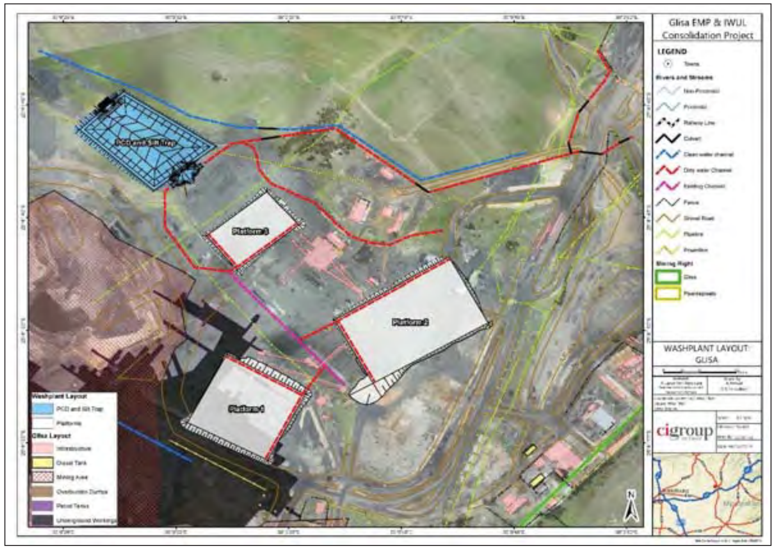


Figure 14: Proposed Site Layout around the Glisa Section CSWP.

Figure 15: Proposed Site Layout on Portion 24 of the Farm Paardeplaats 380 JT.

Figure 16: Proposed Backfill Areas in the Glisa Section and DMF on Portion 24.

4 ASSUMPTIONS AND LIMITATIONS

To obtain a comprehensive understanding of the dynamics and diversity of the wetlands/watercourses present within the study area and its immediate surrounds, studies should include investigations through the different seasons of the year, over a number of years, and extensive sampling of the area. This is particularly relevant where seasonal limitations to biodiversity assessments exist for the area of the proposed activity. Due to project time constraints inherent with Environmental Authorisation application processes, such long-term research is seldom feasible, and information contained within this report is based on a single field survey conducted during a single season as well as review of biodiversity-related studies conducted by the mine over the years. Where possible, additional information was added from available sources and previous studies conducted in the area.

Furthermore, detailed assessment of the wetlands/watercourses within and in the vicinity of the study area was not carried out as part of this assessment and historical wetland studies and delineations were reviewed, scrutinised and amended based on the observations of the site visit carried out from the 13th – 16th April 2021. It is therefore possible that some discrepancies in the delineation and data provided may occur in some places.

5 LEGISLATIVE FRAMEWORK

The aquatic and wetlands assessment aims to support the following regulations, regulatory procedures and guidelines:

- Section 24 of the Constitution of the Republic of South Africa ,1996 (Act No. 108 of 1996);
- The Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA); and
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA).

6 GENERAL CHARACTERISTICS

6.1 Biophysical Attributes

6.1.1 Climate

According to Kleynhans *et al.* (2007), the study area is located within the Highveld Ecoregion, with rainfall seasonality being early to mid-summer, and mean annual temperatures ranging from 12°C to 18°C. Mean annual precipitation of the quaternary catchment is approximately 714.7 mm/annum, with a potential evaporation of 1863.5 mm/annum (Macfarlane et al., 2008).

6.1.2 Geology

Geology underlying the study area is made up of elements from the Madzaringwe Formation of the Permian coal-bearing Ecca group (part of the Karoo Supergroup; *Council for Geoscience*, 2005). Rocks are quartzite, shale, dolerite, diabase and basalt (Mucina and Rutherford, 2012).

6.1.3 Regional vegetation

The entire study area is situated in the Grassland Biome and within the Mesic Highveld Grassland Bioregion. The western portion of the Glisa Section is situated within the Steenkampsberg Montane Grassland vegetation type, while the remaining extent (the eastern portion of the Glisa Section and the Paardeplaats Section) of the study area is situated within the Eastern Highveld Grassland vegetation type.

The Steenkampsberg Montane Grassland vegetation type occurs along the Steenkampsberg escarpment that extends from the headwaters of the Waterval River in mountains north-west of Lydenburg, extending southwards through Dullstroom towards Belfast, then eastwards through Machadodorp to Bambi and Elandshoogte. The Steenkampsberg Montane Grassland is regarded as poorly protected but over 70% is still natural. The landscape is mountainous with plateau grasslands, mountain slopes and shallow valleys and the grasslands are short with a high forb density.

The Eastern Highveld Grassland vegetation occurs between Belfast in the east and the eastern side of Johannesburg in the west, extending southwards to Bethal, Ermelo and west of Piet Retief. The landscape comprises moderately undulating plains, including low hills and pan depressions. The grasslands are generally short and dense, with small, scattered rocky outcrops and with wiry, sour grasses and some woody species. The Eastern Highveld Grassland is regarded as Endangered, with only a very small fraction conserved in statutory reserves. Some 44% has been transformed primarily by cultivation, mines, plantations, urbanisation and the construction of dams (Mucina & Rutherford, 2012).

6.1.4 Freshwater bioregional Context

The study area is located within the Southern Temperate Highveld freshwater ecoregion, which is delimited by the South African interior plateau sub-region of the Highveld aquatic ecoregion, of which the main habitat type, in terms of watercourses, is regarded as Savannah-Dry Forest Rivers. Aquatic biotas within this bioregion have mixed tropical and temperate affinities, sharing species between the Limpopo and Zambezi systems. The Southern Temperate Highveld freshwater ecoregion is considered to be bio-regionally outstanding in its biological distinctiveness and its conservation status is regarded as Endangered. The ecoregion is defined by the temperate upland rivers and seasonal pans (Nel et al., 2004; Darwall et al., 2009; Scott, 2013).

6.1.5 Associated Aquatic Ecosystems

The NWRS-1 originally established 19 Water Management Areas within South Africa and proposed the establishment of the 19 Catchment Management Agencies to correspond to these areas. In rethinking the management model and based on viability assessments with respect to water resources management, available funding, capacity, skills and expertise in regulation and oversight, as well as to improve integrated water systems management, the original 19 designated WMAs have been consolidated into nine WMAs.

The study area is located predominantly within the newly revised Olifants Water Management Area (WMA), which now also includes the Letaba River catchment. Accordingly, the main rivers include the Elands River, the Wilge River, the Steelpoort River, the Olifants River, and the Letaba River. The Olifants River originates to the east of Johannesburg and flows in a northerly direction before gently turning to the east. It is joined

by the Letaba River before it enters into Mozambique. Two small isolated areas (one on the Paardeplaats Section eastern boundary and one on the Paardeplaats Section southern boundary) fall within the Inkomati-Usuthu WMA.

The study area is located within the upper reaches of the B41A quaternary catchment, with the two isolated areas within the Inkomati-Ushutho WMA area located within the upper reaches of the X11D quaternary catchment. As such, several non-perennial watercourses, and more specifically various wetland systems, are associated with the study area as historically delineated by Wetland Consulting Services. Watercourses draining to the west flow into the Skilferlaagtespruit, while the watercourses draining northwards flow into the Langspruit. The Skilferlaagtespruit flows into the Grootspruit (sub-quaternary B41A-01025) and, after its confluence with the Langspruit (sub-quaternary B41A-01002), it becomes the Steelpoort River.

6.1.6 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water Affairs (DWA; now Department of Water and Sanitation, or DWS), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims to:

- Identify Freshwater Ecosystem Priority Areas (hereafter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and
- Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development. The second aim comprises a national and sub-national component. The national component aims to align DWS and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems. The sub-national component aims to use three case study areas to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes at a sub-national level (Driver et al., 2011). The project further aims to maximize synergies and alignment with other national level initiatives such as the National Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation.

Based on current outputs of the NFEPA project (Nel et al., 2011; Figure 17), the catchments located on the northern and eastern extents of the study site are classified as being part of a single FEPA catchment, with the eastern watercourses also forming part of a designated wetland cluster. These northern and eastern catchments were classified as a FEPA catchment on the basis of the catchment being considered a fish sanctuary for two species of fish, namely *Enteromius anoplus* (Chubbyhead Barb) and *Opsaridium peringueyi* (Southern Barred Minnow), and two river ecosystem types, namely Permanent/Seasonal Highveld Mountain and Upper Foothill streams. In contrast, the southern and western catchments, which form part of a single larger sub-quaternary catchment, is classified as Fish Support Area, also for *Enteromius anoplus* (Chubbyhead

Barb) and *Opsaridium peringueyi* (Southern Barred Minnow). See further Section 7.2.5 for information pertaining to the taxonomy of *E. anoplus* within the catchments associated with the present study area.

Further, SANBI recently undertook a wetland mapping exercise for the Mpumalanga Highveld region in order to expand on the detailed wetland delineations undertaken in adjacent catchments, for inclusion into the NFEPA project (Mbona et al., 2015). Mpumalanga Tourism and Parks Agency (MTPA) recognises that wetlands are specialised systems that perform various ecological functions and play an integral role in biodiversity conservation. The project sought to map the extent, distribution, condition and type of freshwater ecosystems in the Mpumalanga Highveld coal belt. The delineations were based on identifying wetlands on Spot 5 imagery within the Mpumalanga Highveld boundary and supported by Google Earth imagery, 1:50 000 contour lines, 1:50 000 river lines, data from previous studies in the area, and data from the original NFEPA wetlands layer. Hydrogeomorphic (HGM) units were identified at a desktop level and confirmed by means of ground-truthing. According to Mbona et al. (2015), while various wetland areas were noted to be associated with the study area, only one wetland unit, classified as a depressional wetland associated with a larger wetland cluster, was identified as a FEPA wetland based on the revised wetland mapping inventory for the Mpumalanga Highveld region (Figure 17).

6.1.7 Mpumalanga Biodiversity Sector Plan

A systematic conservation plan for Mpumalanga was published as the 'Mpumalanga Biodiversity Sector Plan' (Mpumalanga Tourism and Parks Agency, 2014), with the aim to maintain biodiversity conservation targets. In the plan, the most important habitat categories to be taken into consideration
in any environmental assessment process are:

- Critical Biodiversity Areas (CBAs): Areas that are required to meet biodiversity targets for species, ecosystems or ecological processes. These need to be kept in a natural or near-natural state, with no further loss of habitat or species. This category is split into:
    - CBA Irreplaceable Areas: These areas are required to meet biodiversity pattern and/or ecological processes targets. They are further subdivided into:
        - Irreplaceable: representing the only localities for which the conservation targets for one or more of the biodiversity features contained within can be achieved, i.e. there are no alternative sites available;
        - High Irreplaceable: representing areas of significantly high biodiversity value, but there are alternate sites within which the targets can be met for the biodiversity features contained within, but there aren't many;
    - CBA: Irreplaceable Linkages: These are areas within Landscape Corridors that, due to modification of the natural landscape, represent the only remaining and highly constrained linkages which, if lost, would result in the breakage of the large corridor network as a whole. Their conservation is vital in maintaining the linkage of the corridor and its associated biodiversity related processes;
    - CBA Optimal Areas: Areas selected to meet biodiversity pattern and/or biodiversity process targets. Alternative sites might be available to meet biodiversity targets. These areas can furthermore, support suitable habitat for red and orange listed faunal and floral species;

- Ecological Support Areas (ESAs): Areas determined to be functional but not necessarily entirely natural areas, which are required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the CBAs. Mpumalanga distinguishes following categories related to biodiversity outside Protected Areas:
    - ESA Species Specific: Areas required for the persistence of specific species. They may be modified, but a change in current land use to anything other than rehabilitated land, would most likely result in a loss of that species from the area identified; and
    - ESA Corridors: These facilitate ecological and climate change processes and to create a linked landscape for the conservation of species within a fragmented landscape.

According to the latest revision of the freshwater component of the provincial biodiversity sector plan (Mpumalanga Tourism and Parks Agency, 2019), the study area is primarily associated with 'Heavily Modified' and 'Ecological Support Areas', with isolated 'Critical Biodiversity Areas (Figure 18).

Table 3 presents a summary of the attributes associated with the area under study.

Table 3: Summary of relevant site attributes

Political Region	Mpumalanga
Level 1 Ecoregion	Highveld
Level 2 Ecoregion	11.02
Freshwater Ecoregion	Southern Temperate Highveld
Geomorphic Province	Northeastern Highveld
Geology	Madzaringwe Formation of the Permian coal-bearing Ecca group
Vegetation Type	Steenkampsberg Montane Grassland and Eastern Highveld Grassland
Water Management Area	Olifants and Inkomati-Usuthu
Wetland Vegetation Type	Mesic Highveld Grassland Group 4 and 6
Secondary Catchment	B4 and X1
Quaternary Catchment	B41A and X11D
Watercourse	Unnamed tributaries of the Steelpoort River
Stream Order	Various
Slope Class	Source Zones
NFEPA Status	Wetland Cluster, River FEPA, Fish Support Area

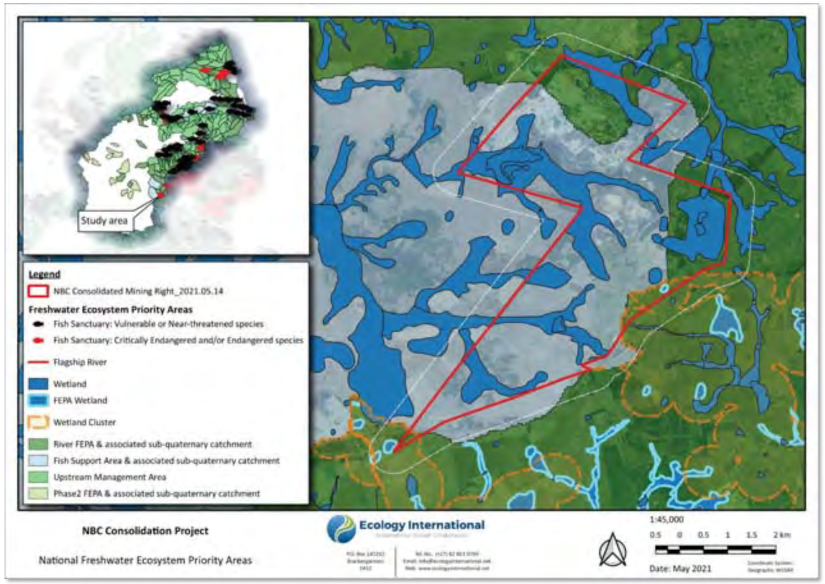


Figure 17: National Freshwater Ecosystem Priority Areas associated with the study area.

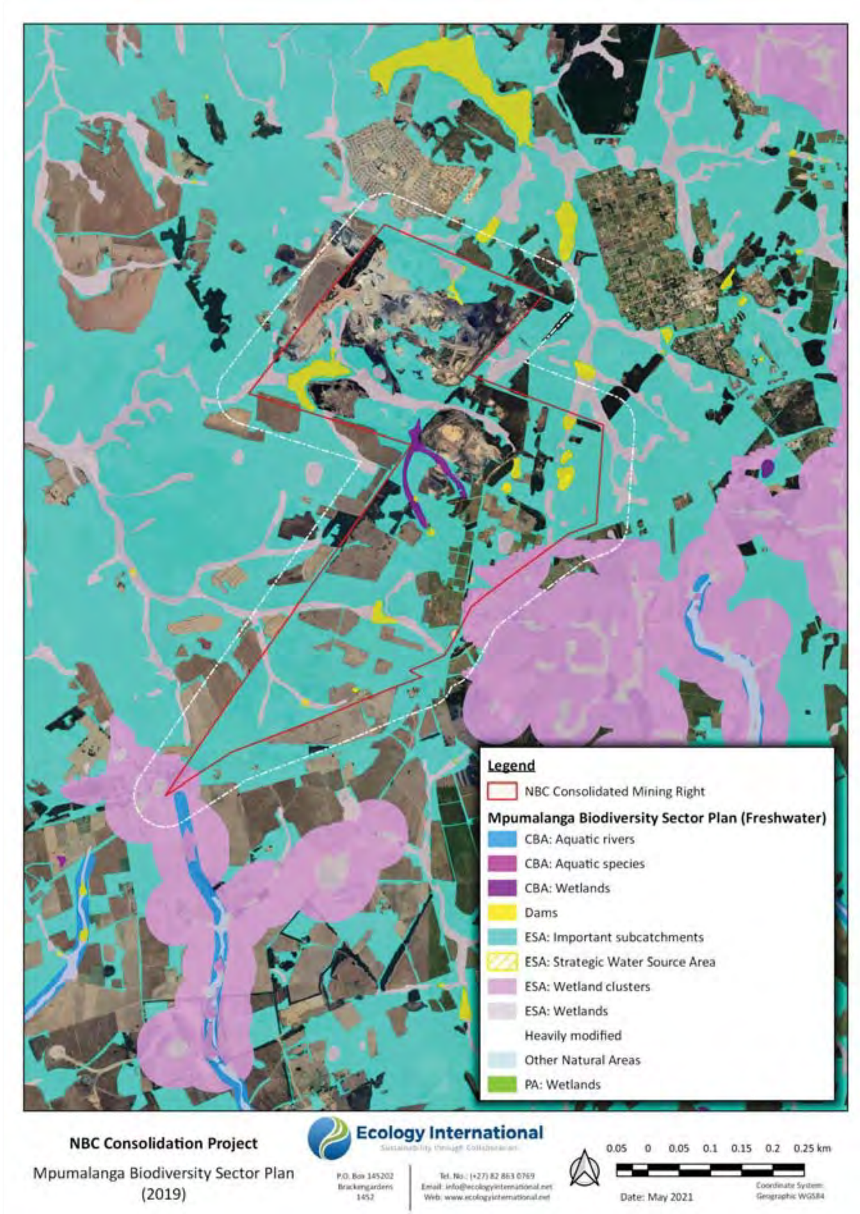


Figure 18: Mpumalanga Biodiversity Sector Plan (2019).

7 RESULTS

7.1 Wetland Ecosystem

7.1.1 Wetland Delineation

The wetlands/watercourses as historically delineated by Wetland Consulting Services were scrutinised at a desktop level following the field assessment carried out from 13th – 16th April 2021. These delineations were updated accordingly, however, it must be noted that detailed field delineations were not carried out as part of this study (Figure 19).

7.1.2 System Characterisation

The watercourses within the study area were classified according to the classification system (Ollis *et al.,* 2013) as Inland Systems, falling within the Highveld Aquatic Ecoregion, and the Mesic Highveld Grassland Group 4 and Group 6 Wetland Vegetation Types (Mbona *et al.*, 2015). These watercourses were further classified at Level 3 and Level 4 of the classification system as summarised in the table below.

Table 4: Characterisation of the watercourses associated with the study and 500 m investigation areas according to the Classification System (Ollis *et. al.,* 2013).

Level 3: Landscape unit	Level 4: HGM Type
Valley floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	Channelled valley-bottom wetland: a valley-bottom wetland with a river channel running through it.
	Unchannelled valley-bottom wetland: a valley-bottom wetland without a river channel running through it.
Slope: an inclined stretch of ground typically located on the side of a mountain, hill or valley, not forming part of a valley floor. Includes scarp slopes, mid-slopes and foot-slopes.	Hillslope seep: a wetland located on gently to steeply sloping land and dominated by colluvial (I.e., gravity-driven) unidirectional movement of water and material down-slope.
Plain: an extensive area of low relief, generally characterized by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located in a valley.	Depression: an inland aquatic ecosystem with closed or near-closed elevation contours, which increases in depth, and within which water typically accumulates.

Ninety (90) hydro-geomorphic (HGM) units (Figure 19; Appendix B) were identified within the study area comprising a total of 440.22 hectares of which 311.63 hectares comprised Hillslope Seep wetlands, 29.95 hectares comprised Channelled Valley Bottom wetlands, 86.99 hectares comprised Unchannelled Valley Bottoms, and 10.28 hectares comprised Depressions (or Pans). In addition, 20 impoundments were observed within the study area covering 75.75 hectares in extent, while 14 mine water bodies covering 66.57 hectares were observed. It is also important to note that these HGM units were assessed only within the study area and some of the systems observed formed part of greater wetland systems falling outside of the bounds of investigation associated with this study.

The various HGM units identified were further assessed, the results of which are presented in the sections that follow. Both the impoundments and the mine waterbodies, while mapped and indicated in Figure 19 were

regarded as artificial systems and were thus not subjected to further analysis in terms of the WET-Health, WET-Ecoservices, and Ecological Importance and Sensitivity tools.

7.1.3 Present Ecological State

The health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition (Macfarlane *et al.,* 2009). The wetlands associated with the project area have been impacted by a long history of agricultural and recreational land uses as well as impacts related to mining.

The major impacts to the wetlands/watercourses identified through the health assessments can be summarised as follows:

- Historical opencast and underground mining activities have been taking place in the vicinity of the study area since 1980, with impacts to water quality and fragmentation of the wetland systems observed.
- HGM units severely affected by fragmentation include HGM 1, 2, 3, 23, 46, 47 and 48.
- The upper portions of HGM 9 and HGM 10 have been destroyed due to infilling and stockpiling.
- Surface infrastructure development such as offices, the mining complex, roads, trenches and stockpiles have resulted in direct losses of wetland habitat over the years, and impacts to the natural hydrological setting, as well as the creation of preferential flow paths and altered water retention and distribution profiles.
- Geomorphological changes include impacts relating to sedimentation and deposition as a result of the clearing of vegetation for roads and infrastructure.
- Impaired water quality related to the historical mining activities at the Glisa Section has affected HGM 1, 2, 3 and 16, however, opencast mining activities are likely to have resulted in impacts to the regional aquifer, which may impact water quality of the associated valley bottom wetlands present in the study area.
- Numerous impoundments were observed on wetland systems throughout the study area. HGM 24, HGM 25, HGM 31, HGM 32 and HGM 33 have been impacted in terms of the geomorphology as well as water quality due to the presence of trout dams on these systems. Further, deep and shallow flooding by the observed impoundments has resulted in severe alterations to the natural wetting regimes of HGM 16, 23, 27, 43, 47, 58, 67, 69, 77 and 80.
- Historical plantations and infestations of *Acacia mearrnsii* (Wattle), *Populus x canescens* (Poplars) and *Eucalyptus* sp (Bluegums) have resulted in impacts to HGM 1, 2, 19, 20, 21, 22, 23, 29, 52, 55, 67, 74, 76, 78, 83 and 86.
- Historical modifications to the landscape in the vicinity of HGM 62, 63, 71 and 72 have impacted on the geomorphological and vegetation integrity of these systems.
- Historical cultivation has impacted the integrity of the natural vegetation in the vicinity of HGM 68, while ongoing cultivation activities in the catchment of HGM 76, 79, 81, 83, 86 and 87 increase the potential for impacts to water quality and increased sediment loads within the catchment.

The identified wetlands were assessed according to the WET-Health methodology as described by Macfarlane *et al.* (2008) and were broadly classified as Largely Natural (Category B), Moderately Modified (Category C), Largely Modified (Category D) and Seriously Modified (Category E). The results of these assessments (derived from both desktop and field-based verification) are presented graphically in Figure 20, whereas Appendix C provides a summary of the Present Ecological State scores.

7.1.4 Wetland Ecological Service Provision

The general features of each HGM unit were assessed in terms of function, and the overall importance of the HGM unit was then determined at a landscape level. Appendix D provides a detailed summary of the results. The systems associated with the Integrated Paardeplaats Section may be regarded as of Moderately Low to Moderately High (Figure 21) importance in terms of service provision and functionality.

Key services provided are generally related to streamflow regulation, sediment trapping and the assimilation of toxicants and nutrients from the surrounding land use activities. Biodiversity maintenance is regarded as high to very high across almost all the HGM units indicating the importance for conservation of these systems as well as their role in the provision of habitat and natural migration corridors. Erosion control and flood attenuation services were also generally regarded as important services, albeit to a lesser extent.

7.1.5 Ecological Importance and Sensitivity

Ecological Importance and Sensitivity for each wetland was evaluated in terms of:

- Ecological Importance;
- Hydrological Functions; and
- Direct Human Benefits

Appendix E provides a detailed summary of the EIS scores of the delineated wetlands. The wetlands associated with the Integrated Paardeplaats Section were regarded as of Moderate and High Ecological Importance and Sensitivity (Figure 22), being important in terms of ecological importance (biodiversity maintenance) and their hydrological functions. Direct human benefits were related to the provision of water for agropastoral activities, as well as for recreational use and tourism (I.e., Trout fishing and birding opportunities), however, these were generally associated with the valley bottom systems rather than with the hillslope seeps.

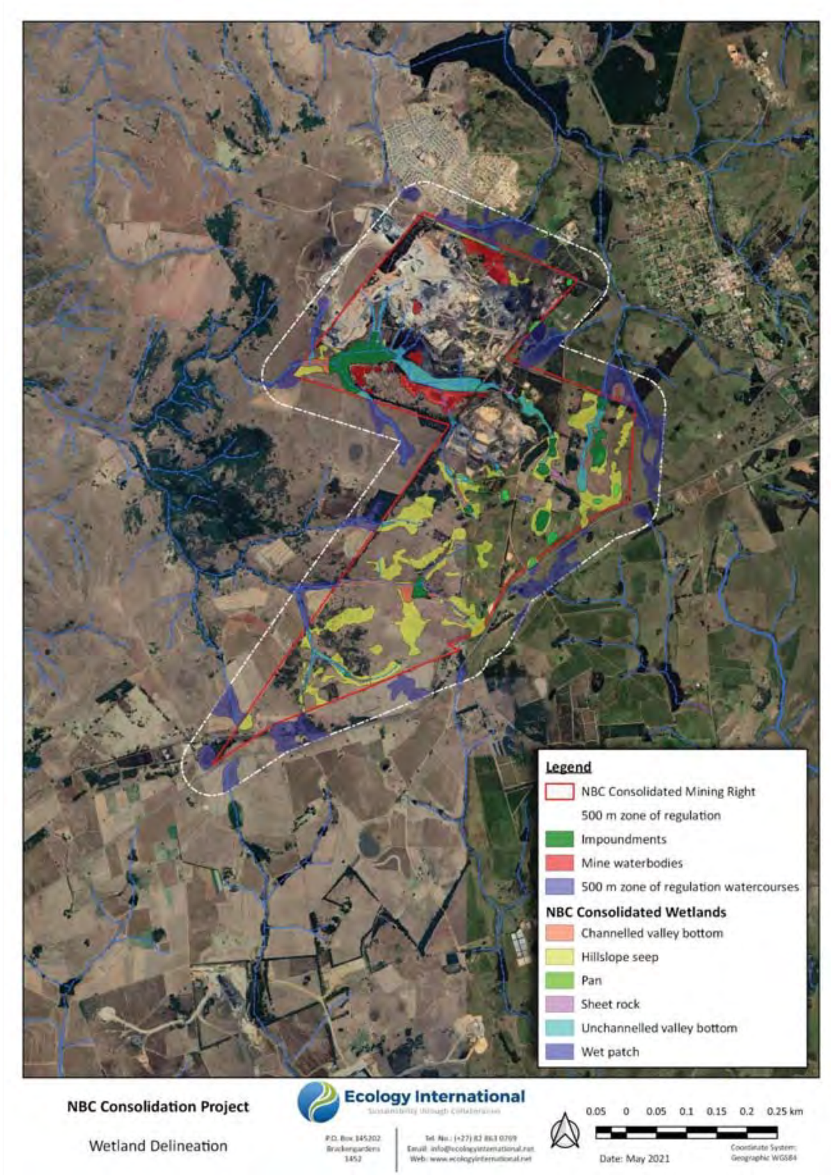


Figure 19: The location of the wetlands/watercourses within the study area.

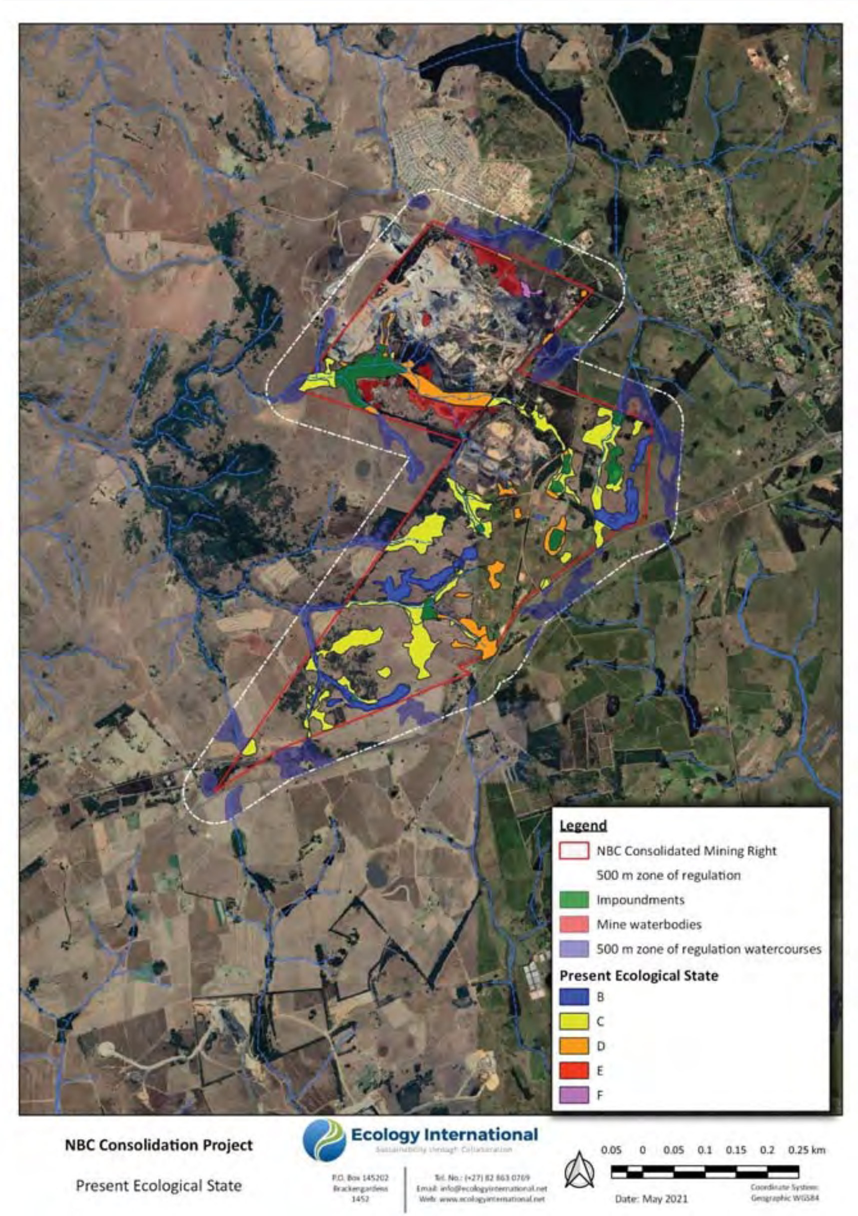


Figure 20: The Present Ecological State of the wetlands/watercourses within the study area.

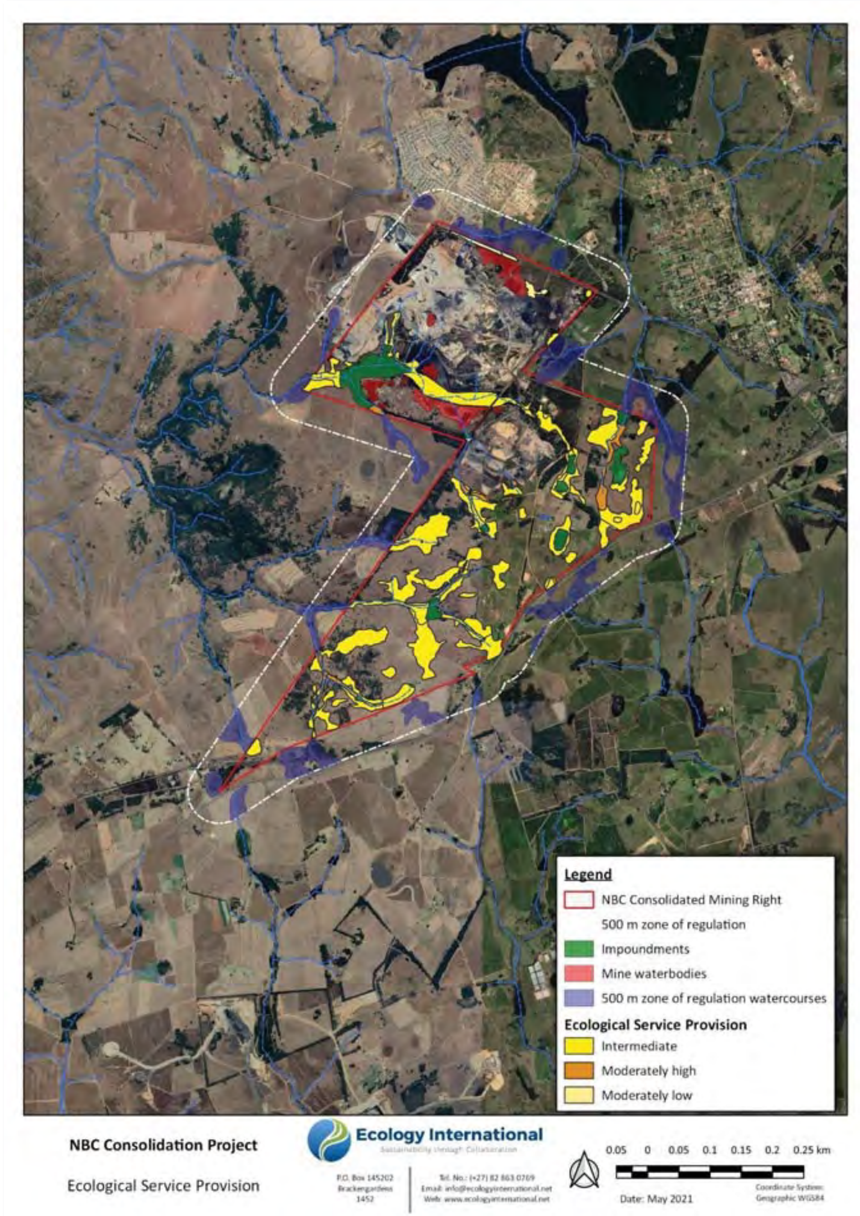


Figure 21: Ecological Service Provision of the wetlands/watercourses within the study area.

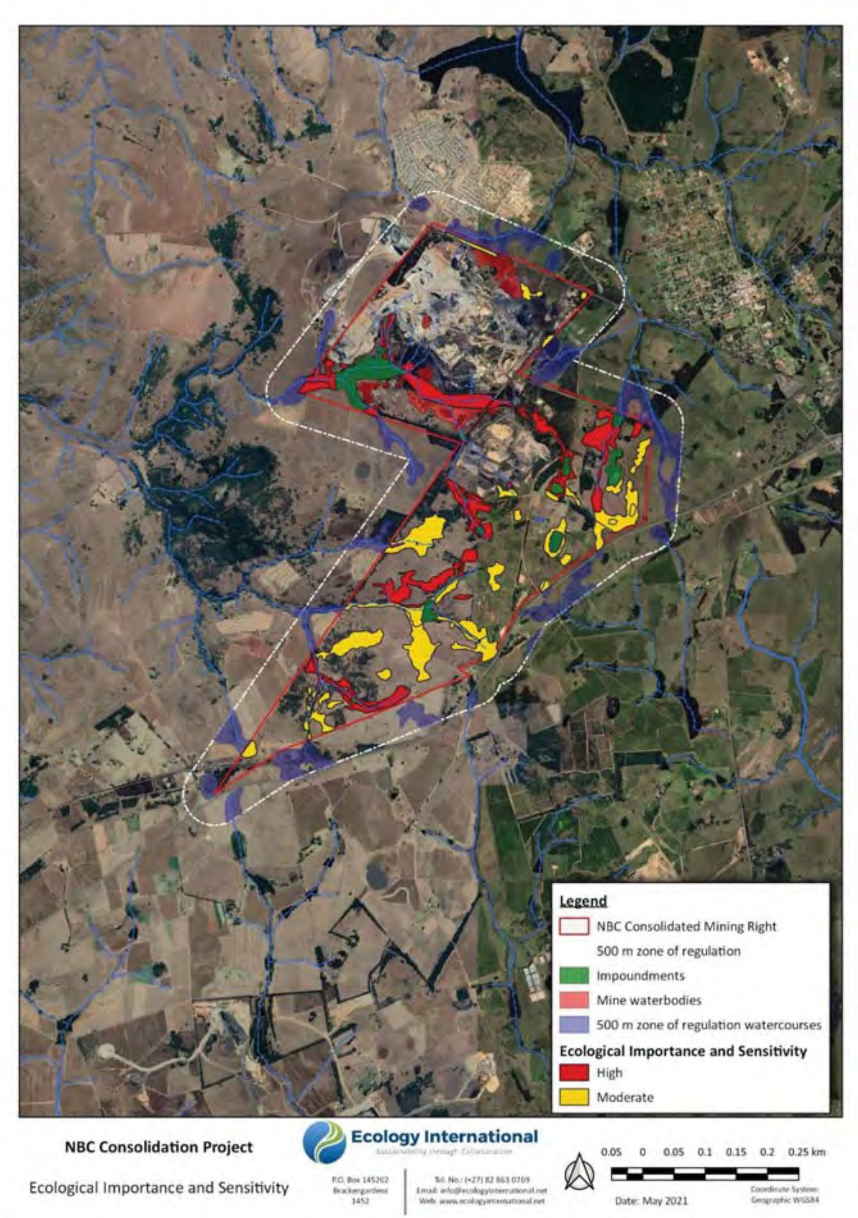


Figure 22: Ecological Importance and Sensitivity of the wetlands/watercourses within the study area.

7.2 Aquatic Assessment

7.2.1 Selection of Sampling Sites

A long-term biomonitoring program has been in place at the Glisa Section of the Intergrated Paardeplaats Section, which has sought to identify potential spatial and temporal impacts associated with the operation of the mine on the receiving aquatic environment. Given the availability of recent data (September 2019 and July 2020), a full assessment of all the watercourses associated with this portion of the study area was considered unnecessary. For the purposes of this study, the available historical data was reviewed and used to characterise and contextualise the receiving aquatic environment associated with the Glisa Section. While an aquatic baseline assessment of the Paardeplaats Section was carried out in 2011, a more recent assessment was required to reflect the current baseline conditions.

Co-ordinates and a brief description of each site considered in the current assessment is provided in Table 5 and presented graphically in Figure 23. Photographs of the sites visited at the time of the April 2021 field assessment are provided in Appendix F.

Table 5: Description of sampling sites considered during the present study.

	Site	Co-ordinates	Description	Protocols
Glisa Section biomonitoring sites	Ptn 24 (US)	25°42'39.12"S 30° 0'6.21"E	Upstream wetland draining Portion 24	Water quality, habitat integrity, diatoms
	2 (US Dam)	25°42'54.92"S 29°59'50.65"E	Dam at inflow into existing Glisa Coal Mine study area and should exclude most potential Glisa impacts (mining and river diversion).	Water quality, habitat integrity, macroinvertebrates, fish, diatoms
	1B	25°42'43.02"S 29°59'53.94"E	Upstream part of Mahim Dam	Diatoms
	4A (Mahim Dam)	25°42'27.35"S 29°58'41.13"E	Mahim Dam, downstream of most Glisa Coal Mine potential and existing impacts.	Water quality, habitat integrity, macroinvertebrates, fish
	4B (DS)	25°42'26.22"S 29°58'28.13"E	Tributary draining away from Mahim Dam and exiting the western boundary of the Glisa property.	Water quality, habitat integrity, macroinvertebrates, fish, diatoms
	5* (Blue Gum Dam)	25°41'19.60"S 30° 0'11.20"E	Site in stream draining in northerly direction, downstream of all existing Glisa Coal Mine impacts.	Water quality, habitat integrity, macroinvertebrates, diatoms
	7* (Skilferlaagtespruit)	25°42'11.10"S 29°55'8.00"E	Site in Skilferlaagtespruit (Steelpoort) some distance downstream of Glisa study area. This site is downstream of existing and potential future Glisa Coal Mine activities, and has good potential as a biomonitoring site.	Water quality, habitat integrity, macroinvertebrates, fish

	Pan 1	25°41'41.30"S 30° 0'59.76"E	Non-perennial pan in NE corner of study area	Water quality, habitat integrity, macroinvertebrates, diatoms
Additional sites assessed during April/June 2021	NBC 1	25°44'29.37"S 29°59'34.33"E	Water storage dam located on a channelled valley bottom wetland	Water quality, macroinvertebrates, diatoms
	NBC 2	25°44'21.08"S 29°58'49.00"E	Channelled valley bottom flowing into an unnamed tributary of the Steelpoort River.	Water quality, habitat integrity, macroinvertebrates, diatoms
	NBC 3	25°42'43.37"S 30° 1'17.29"E	Farm dam in valley bottom wetland draining into the Langspruit	Water quality, macroinvertebrates, diatoms
	NBC 4	25°43'5.52"S 30° 0'51.16"E	Farm dam in a valley bottom wetland	Water quality, macroinvertebrates, diatoms
	NBC 5	25°43'13.49"S 30° 1'13.99"E	Farm dam in valley bottom wetland draining into the Langspruit	Water quality, macroinvertebrates, diatoms
	NBC 6	25°43'29.97"S 30° 1'27.60"E	Seasonal depression	Water quality, diatoms
	NBC 7	25°43'56.81"S 29°57'2.82"E	Site located on the Skilferlaagtespruit downstream of the Paardeplaats section and upstream of confluence of the Glisa tributary	Water quality, habitat integrity, macroinvertebrates, fish
	NBC 8	25°43'44.70"S 30° 0'44.37"E	Seasonal pan modified into a permanent storage dam	Water quality, diatoms
	NBC 9	25°44'47.96"S 29°58'24.45"E	Unchannelled valley bottom flowing into an unnamed tributary of the Steelpoort River	Water quality, diatoms

7.2.2 Water Quality

Aquatic communities are influenced by numerous natural and human-induced factors, including physical, chemical and biological factors. The assessment of water quality variables in conjunction with assessment of biological assemblages is therefore important for the interpretation of results obtained during biological investigations. Table 6 provides the *in situ* water quality data obtained at each site applicable to this study during the most recent biomonitoring survey conducted in February 2020 and the aquatic baseline assessment carried out in April 2021.

Within the Olifants WMA, the classification and development of Resource Quality Objectives (RQOs) was completed (see Department of Water and Sanitation, 2016a). While RQOs for water quality were not gazetted for the quaternary catchments associated with present study area, the Department of Water and Sanitation did undertake the development of an Integrated Water Quality Management Plan (IWQMP) for the Olifants WMA in which Water Quality Planning Limits (WQPLs) were developed at a finer scale (management units) to

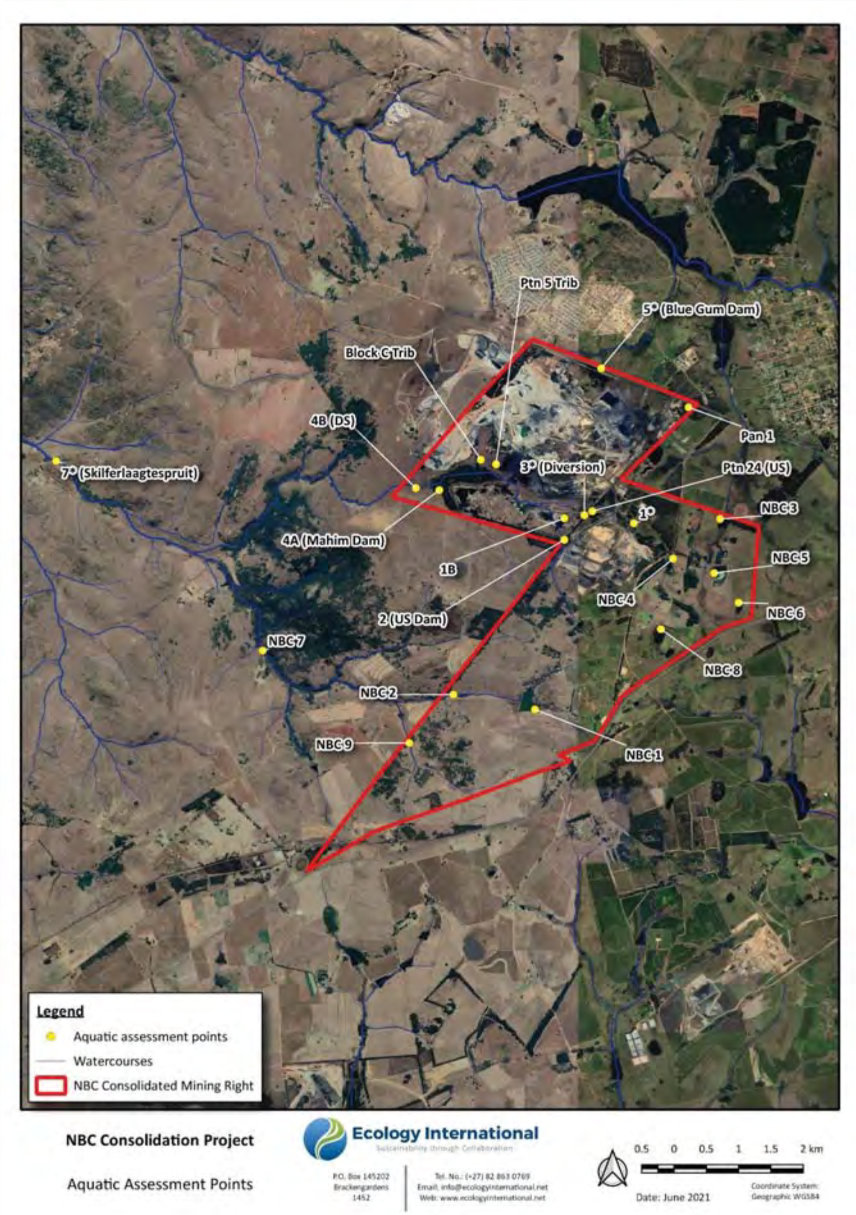


Figure 23: Aquatic assessment points

help achieve the management class and RQOs for particular areas, as they are set at a finer resolution and take local users and uses into account. The objective of using WQPLs is to provide a mechanism through which the balance between sustainable and optimal water use and protection of the water resource can be achieved. What is important is that WQPLs are aligned to the RQOs and do not contradict the objectives gazetted (Department of Water and Sanitation, 2016b). As such, *in situ* water quality data collected during the study were compared to WQPLs developed for Management Unit 66 of the Steelpoort sub-catchment.

Table 6: *In situ* water quality variables determined at the time of the February 2020 and April 2021 field surveys. Values noted to exceed designated WQPLs are indicated in red

	Site	Temp. (°C)	pH	Electrical conductivity (mS/m)	Dissolved oxygen	
					(mg/ℓ)	(% sat)
RQO*		-	-	-	-	-
WQPL**		-	6.5-8.4	30.00	9.00	-
Glisa Section biomonitoring sites (Cleanstream, 2020)	Ptn 24 (US)	21.5	6.5	159.8	-	-
	2 (US Dam)	24.4	6.7	114.4	5.7	84.6
	1B	19.9	6.9	245.0	5.2	70.3
	4A (Mahim Dam)	22.3	6.9	257.0	6.2	98.9
	4B (DS)	26.6	6.6	145.9	2.8	42.2
	5* (Blue Gum Dam)	22.0	8.4	138.6	8.0	124.0
	7* (Skilferlaagtespruit)	19.2	6.9	50.2	7.3	101.3
	Pan 1	27.6	6.6	70.2	4.1	64.9
Additional sites assessed during April/June 2021	NBC 1	17.2	7.90	136.0[1]	7.02	77.5
	NBC 2	18.6	7.57	138.1[1]	8.06	84.1
	NBC 3	17.2	7.27	142.4[1]	2.89	29.9
	NBC 4	20.9	8.43	143.7[1]	8.70	98.8
	NBC 5	21.0	7.79	140.8[1]	6.37	71.3
	NBC 6	20.5	6.93	138.9[1]	5.91	68.4
	NBC 7	8.4	7.84	12.52	11.77	101.4
	NBC 8	22.9	7.94	137.5[1]	8.28	98.5
	NBC 9	15.3	6.60	138.7[1]	5.49	54.8

* Resource Quality Objective for RU54 (Department of Water and Sanitation, 2016a)

** Water Quality Planning Limit for Management Unit 59 of the Steelpoort sub-catchment (Department of Water and Sanitation, 2016b)

[1] Review of data collected during June 2021 and parallel tests conducted between two instruments suggested that the instrument utilised during April 2021 was defective and provided artificially elevated electrical conductivity values

During the February 2020 biomonitoring assessment, high electrical conductivity values were observed in the Mahim Dam (represented by sites 1B and 4A. The Mahim Dam and the Blue Gum Dam form part of the dirty water system for the NBC and as such, high salinities are to be expected. Similarly, high salinities were observed throughout the Paardeplaats Section during the April 2021 field assessment. However, parallel testing of two instruments produced by the same manufacturer during a follow-up assessment conducted in June 2021 indicated that the instrument utilised during the April 2021 assessment was defective, providing incorrect readings at the time of the assessment. Nevertheless, it would be valuable to reassess these values in future monitoring surveys to identify any emerging trends or impacts, especially as the study area is situated within the upper reaches of the Steelpoort River catchment and has been identified as important in terms of fish support.

pH values at all sites were found to fall within the guideline values stipulated for optimal aquatic life, with the exception of Site NBC 4, where the pH was observed as somewhat alkaline during the April 2021 assessment.

In situ dissolved oxygen values obtained for the study area during the present study, while below the WQPL value for the management unit (with the exception being Site NBC 7 during the June 2021 assessment), were not deemed to be of concern at most sites when taken in context of the characteristics of the associated watercourses with the exception of sites 4B, Pan 1, NBC 3, NBC 6, NBC 9. The extremely low values observed at sites 4B and NBC 3 are usually indicative of extremely polluted and/or stagnant systems with either a high chemical or biological oxygen demand, the latter often being the case in wetland systems or impoundments.

7.2.3 Aquatic Habitat

The Integrated Paardeplaats Section falls within the upper reaches of the Steelpoort River catchment in an area comprising plateau grasslands, mountain slopes and shallow valleys. As such, the terrain lends itself to the formation of numerous hillslope seep wetlands and the presence of valley bottom wetland features becoming more channelled further downstream.

7.2.3.1 Index for Habitat Integrity

Habitat integrity refers to the maintenance of a balanced, integrated composition of physico-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region. The habitat integrity status of a watercourse will essentially provide the template for a certain level of biotic integrity to be realised. In this sense, the assessment of the habitat integrity of a river can be seen as a pre-cursor of the assessment of biotic integrity. It follows that in this context habitat integrity and biotic integrity together constitutes ecological integrity.

The ecological condition of the instream and riparian habitat associated with the study area was determined through the application of the Index for Habitat Integrity, Version 2 (IHI-96-2; Kleynhans, *pers. comm.*, 2015), which was also used to provide a surrogate for the riparian vegetation component of the integrated EcoStatus model. While the recently upgraded IHI-96-2 replaces the relatively comprehensive and expensive IHI assessment model developed by Kleynhans (1996), it is important to note that the IHI-96-2 does not replace the IHI model developed by Kleynhans et al. (2008a), which should preferably be applied where sufficient data is available (i.e. intermediate and comprehensive Reserve Determinations). Consequently, the IHI-96-2 model is meant to be used in cases where a relatively large number of river reaches needs to be assessed, budget and time provisions are limited, and/or detailed available information is lacking (I.e., rapid Reserve Determinations and for RHP purposes). Since time on site was limited, the use of aerial photography and observations made during the field assessment were used to inform the adapted IHI model, which allows for a rapid, field-based, visual assessment of modifications to a number of pre-selected biophysical drivers within a localised portion of the associated hydrogeomorphic unit (Kemper, 1999). Further, it is important to note that this index is only applicable to channelled watercourses. For the assessment of habitat for unchanneled valley bottom wetlands, depressions and hillslope seep wetlands refer to Section 7.1.3. Table 7 presents the results obtained following the application of the IHI approach within the channelled valley bottom system at site NBC 2 during the April 2021 freshwater assessment as well as the results obtained at site 4B and site 7 during the February 2020 biomonitoring assessment.

Table 7: Index for Habitat Integrity (IHI) values obtained for the instream and riparian components at each site.

		Site	Component	RQO*	IHI Value	Ecological Category
Glisa Section biomonitoring sites (Cleanstream, 2020)		4B (DS)	Instream	C	47	D
			Riparian	C	59	C/D
		7* (Skilferlaagtespruit)	Instream	C	74	C
			Riparian	C	77	B/C
Additional sites assessed during 2021	Apr-21	NBC 2	Instream	C	80	B/C
			Riparian	C	70	C
	Jun-21	NBC 7	Instream	C	87	B
			Riparian	C	70	C

* Resource Quality Objective for RU54, quaternary catchment B41A (Department of Water and Sanitation, 2016a)

According to Cleanstream (2020) as well as the assessment carried out at site NBC 7 in June 2021, the Skilferlaagtespruit has been impacted by invasive alien trees (mainly *Acacia mearnsii* [Wattle]), erosion and increased sedimentation due to trampling by cattle. At site 4B (downstream of Mahim Dam), alien invasive weeds, such as *Conyza bonariensis* were problematic, while inundation, impacts to water quality and the colonisation of monospecific stands of *Typha* reeds have resulted in a deviation from the required RQO for the catchment.

At site NBC2, the instream integrity was categorised as Largely Natural to Moderately Modified (Ecological Category B/C, while the riparian integrity was categorised as Largely Natural (Ecological Category C). Instream impacts were largely related to elevated Electrical Conductivity concentrations, while impacts to the riparian zone were limited to dense stands of *Acacia mearnsii* (Wattle).

Habitat integrity in the Skilferlaagtespruit as well as at site NBC 2 fell within the RQOs for streams within this portion of the Steelpoort River catchment and more specifically, within the B41A quaternary catchment.

7.2.3.2 Invertebrate Habitat Assessment System

The Invertebrate Habitat Assessment System (IHAS, Version 2.2), developed by McMillan (1998), has routinely been used in conjunction with the South African Scoring System (SASS) as a measure for the variability in the amount and quantity of aquatic macroinvertebrate biotopes available for sampling. However, according to a recent study conducted within the Mpumalanga and Western Cape regions, the IHAS method does not produce reliable scores with regard to the suitability of habitat at sampling sites for aquatic macroinvertebrates and the performance of the IHAS seems to vary between geomorphologic zones and between biotope groups (Ollis et al., 2006). Therefore, more testing of the IHAS method is required before any final conclusion can be made regarding the accuracy of the index.

Further, the IHAS index was developed for use within riverine systems. The watercourses associated with the study area comprised largely wetland habitat and impoundments and as such, the IHAS index was not considered suitable for the majority of the watercourses such as was sampled within the study area. The establishment of impoundments, however, generally leads to the creation of new biotopes for exploitation by waterborne biota, such as a shoreline with marginal vegetation, open water and bottom substrate (See Appendix F for site photographs). An adaptation of the IHAS method was retained for the purposes of this assessment, as the basic data remains of value and is suitable for the comparison of sampling effort across the various sites based on available invertebrate habitat. Results are presented relative to an "ideal" aquatic macroinvertebrate sampling habitat and need to be interpreted with caution taking into consideration the nature of the watercourse surveyed. Results obtained during the February 2020 biomonitoring assessment, as well as the April/June 2021 freshwater assessment are presented in Figure 24 and Table 8.

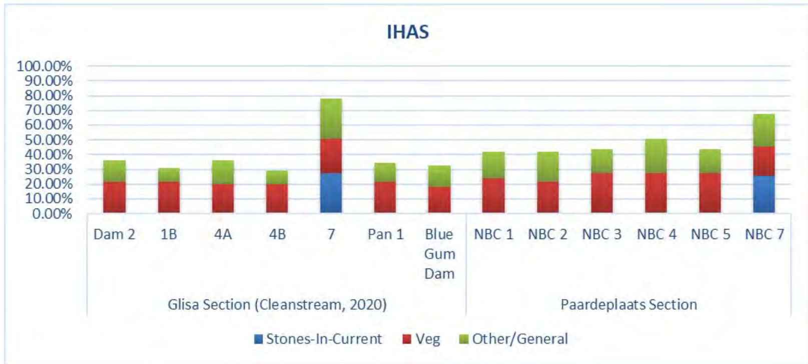


Figure 24: IHAS biotope values for sites assessed during the aquatic biomonitoring assessment

Table 8: Adapted IHAS values obtained within the study area during the February 2020 and April 2021 assessments

	Site	IHAS Score	Description
Glisa Section biomonitoring sites (Cleanstream, 2020)	**Dam 2**	36.36	Poor
	1B	30.91	Poor
	4A	36.36	Poor
	4B (DS)	29.09	Poor

	7* (Skilferlaagtespruit)	78.18	Excellent
	Pan 1	34.55	Poor
	Blue Gum Dam	32.73	Poor
Additional sites assessed during April/June 2021	**NBC 1**	41.82	Poor
	NBC 2	41.82	Poor
	NBC 3	43.64	Poor
	NBC 4	50.91	Poor
	NBC 5	43.64	Poor
	NBC 7	67.27	Good

All of the sites sampled were determined to have poor availability of habitat for colonisation by aquatic macroinvertebrates with the exception of site 7 on the Skilferlaagtespruit. This is largely as a consequence of the impounded nature of the systems at each site. Lack of hydraulic diversity in these systems and the dominance of vegetation and mud deposits will have played a large role in shaping the aquatic macroinvertebrate assemblages expected to occur at each site. Species expected to occur at these sites were likely to be limited to those with a preference for the water column and those adapted for survival in aquatic vegetation and the muddy substrates observed.

7.2.4 Aquatic Macroinvertebrates

According to Darwall et al. (2009), two species of Crabs, 14 species of Molluscs and approximately 58 species Odonata (dragonflies and damselflies) have distribution ranges that extend across the study area. During the February 2020 biomonitoring survey (Cleanstream, 2020), a total of 33 aquatic macroinvertebrate families (representing 11 orders) were sampled across the sampling sites within the Glisa Section. During the April 2021 assessment, a total of 36 aquatic macroinvertebrate families (representing 11 orders and including a species of Copepoda) were sampled across the Paardeplaats Section.

The macroinvertebrate data collected at each site during the February 2020 and April/June 2021 assessments are presented in Table 9 and Appendix G. It should be noted that the SASS5 protocol was developed specifically for flowing rivers and streams. As such, as the majority of the sites comprised wetlands and/or impoundments (with the exception of the Skilferlaagtespruit and the channelled system in the vicinity of NBC 2), the SASS5 and MIRAI should be applied and interpreted with caution. The results do, however, still provide valuable information and a basis of comparison which may be used as a measure of spatial impact.

All of the sites were dominated by taxa tolerant of very low and low water quality (Figure 25). The presence of taxa with a requirement for unmodified physico-chemical conditions at all of the sites (with the exception of site 4B), indicates that water quality was generally not likely to be a limiting factor of the assemblages observed. Species from the order Hemiptera were noted to represent the most abundant aquatic macroinvertebrates at all the sites. Assemblage patterns of aquatic macroinvertebrates reflect the geohydrological regime of a particular site, thus, the lack of hydraulic diversity within many of the sites sampled, was likely to contribute to the incidence of a high diversity of air-breathing taxa (Figure 25) with a preference for aquatic and marginal vegetation.

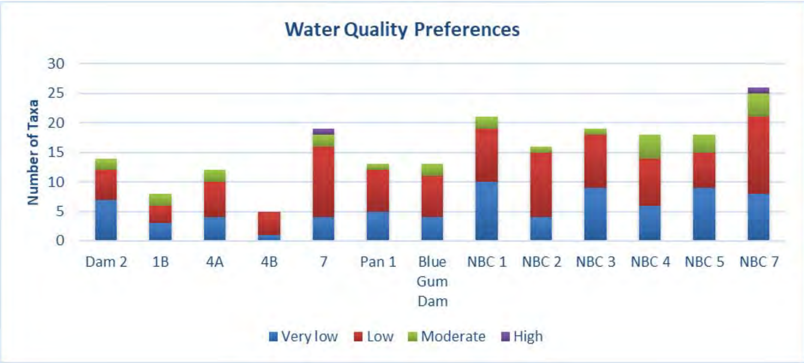
Table 9: Aquatic macroinvertebrate results obtained from the study area during the February 2020 and April 2021 assessments

	Site	No. of Orders	No. of Taxa	SASS5 score	ASPT
Glisa Section biomonitoring sites (Cleanstream, 2020)	**Dam 2**	6	14	60	4.29
	1B	5	8	36	4.50
	4A	9	13	60	4.62
	4B	4	5	22	4.40
	7	9	19	101	5.32
	Pan 1	4	13	56	4.31
	Blue Gum Dam	6	13	59	4.54
Additional sites assessed during April 2021	**NBC 1**	8	22	88	4.00
	NBC 2	9	17	83	4.88
	NBC 3	10	20	81	4.05
	NBC 4	8	18	88	4.89
	NBC 5	9	19	82	4.32
	NBC 7	11	27	139	5.15

Of interest was the fact that the assessment of Site NBC 7 as well as biomonitoring Site 7 which was reassessed during the June 2021 follow-up assessment indicated that the flow conditions as well as the aquatic macroinvertebrate assemblages at both sites were very similar, suggesting that the biota observed at Site 7 during routine biomonitoring activities conducted on behalf of the mine are driven to a significant degree by the draining the Paardeplaats section. Further, it was noted that the data collected at the routine biomonitoring Site 7 during the June 2021 assessment displayed greater diversity than data collected during biomonitoring activities conducted in September 2019 and February 2020.

7.2.4.1 Present Ecological State

Due to the nature of the associated watercourses and the lack of suitable indices for the assessment of lentic ecosystems, no determination of the Present Ecological State based on biotic assemblages could be conducted for sites within the impoundments, pans or unchanneled valley bottom systems present on the majority of the Integrated Paardeplaats Section. For this reason, the Macro-Invertebrate Response Assessment Index (MIRAI; Thirion, 2008) was only applied to NBC 7 and site 7 on the Skilferlaagtespruit and NBC 2 within a channelled system to determine the Present Ecological State (PES) according to the most acceptable method. Chutter (1998) developed the SASS protocol as an indicator of water quality. It has since become clear that SASS gives an indication of more than mere water quality, but rather a general indication of the present state of the invertebrate community. Because SASS was developed for application in the broad synoptic assessment required for the River Health Programme (RHP; now the River EcoStatus Monitoring Programme (REMP)), it does not have a particularly strong cause-effect basis. The aim of the MIRAI, on the other hand, is to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community (assemblage) from the reference condition (Thirion, 2008). This does not preclude the calculation of SASS scores should they be required. However, the use of the MIRAI is now the accepted approach for determining



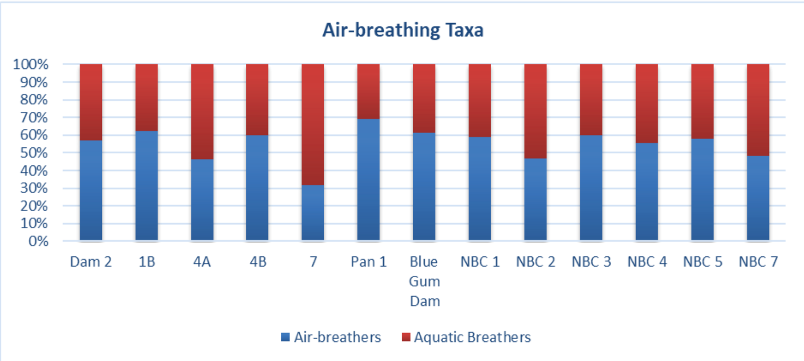


Figure 25: Aquatic macroinvertebrate assemblage preference profiles based on Thirion (2008; revised 2016) for taxa collected during the February 2020 and April 2021 aquatic assessments.

the Present Ecological State of riverine watercourses and as such is used by the Department within the River EcoStatus Monitoring Programme (REMP; previously the River Health Programme purposes, or RHP).

The results of the MIRAI applied to data obtained in the February 2020 and April 2021 assessments (Table 10) indicate that the downstream resources associated with the Integrated Paardeplaats Section may be considered to be in a Largely Natural to Moderately Modified (site NBC 7), Moderately Modified (site 7 on the Skilferlaagtespruit) and Moderately to Largely Modified (site NBC 2) state. The Ecological Category obtained for site NBC 2 falls slightly below the RQO for a stream in the B41A catchment. The main driver of change was determined to be related to flow modification, likely related to upstream impoundments within the study area.

Table 10: PES of the aquatic macroinvertebrate assemblages of sites assessed during the February 2020 and April 2021 assessments.

		Site	RQO*	MIRAI Score	Ecological Category
Glisa Section biomonitoring site (Cleanstream, 2020)		7* (Skilferlaagtespruit)	C	76.45	C
Additional site assessed during 2021	Apr-21	NBC 2	C	58.79	C/D
	Jun-21	NBC 7	C	79.2	B/C

* Resource Quality Objective for RU54, quaternary catchment B41A (Department of Water and Sanitation, 2016a)

7.2.5 Ichthyofauna

According to Cleanstream (2020), an estimated eight fish species (Table 11) are expected to occur within the reaches currently included within the mine's active biomonitoring programme. Previous biomonitoring assessments conducted for the mine have confirmed the presence of three of the eight expected fish species at Site 7 within the Skilferlaagtespruit which drains both the Glisa and Paardeplaats sections of the mine, including *Enteromius* sp. 'Lowveld-Incomati' (a member of the Chubbyhead Barb group; previously identified as *Enteromius anoplus*), *Enteromius* sp. *nov. 'South Africa'* (Sidespot Barb; previously identified as *Enteromius neefi)* and *Clarias gariepinus* (Sharptooth Catfish). Further, while *Enteromius* sp. 'Lowveld-Incomati' is routinely noted as being the dominant species present at biomonitoring Site 7, *Enteromius* sp. *nov. 'South Africa'* appears to co-exist with the species in all biomonitoring assessments conducted thus far. In contrast, *Clarias gariepinus* appears to be transient at the Site 7, with only one individual having been recorded at the site during the February 2018 assessment.

During June 2021, an assessment of biomonitoring Site 7 was conducted, and results from previous biomonitoring assessments was validated, with *Enteromius* sp. 'Lowveld-Incomati' confirmed to dominate the assemblage, with the co-existence of *Enteromius* sp. *nov. 'South Africa'*. Assessment of an additional site within the Skilferlaagtespruit upstream of the Glisa tributary (Site NBC7) during June 2021 further confirmed the presence of *Enteromius* sp. 'Lowveld-Incomati' within the upper reaches, along with a single juvenile specimen of the alien and invasive *Micropterus cf. salmoides* (Largemouth Bass). However, the June 2021 assessment did suggest that the number of fish species expected to occur within the Skilferlaagtespruit was likely less than that estimated by Cleanstream (2020).

Table 11: Fish species expected and confirmed to be present within the Skilferlaagtespruit (Cleanstream, 2020)

Scientific Name	Common Name	Conservation Status*	Presence Confirmed
Amphilius uranoscopus	Stargazer (Mountain-Catfish)	LC	
Chiloglanis pretoriae	Shortspine Suckermouth	LC	
Clarias gariepinus	Sharptooth Catfish	LC	X
Enteromius sp. 'Lowveld-Incomati'	Chubbyhead Barb group	DD	X
Enteromius sp. nov. 'South Africa'	Sidespot Barb	NT	X
Labeobarbus polylepis	Bushveld Smallscale Yellowfish	LC	
Pseudocrenilabrus philander	Southern mouthbrooder	LC	
Tilapia sparrmanii	Banded Tilapia	LC	

* DD = Data Deficient; LC = Least Concern; NT = Near Threatened

It should be noted that recent taxonomic studies on species previously identified within the larger area has resulted in changes to the scientific names of some species expected to be present. These include the following:

- *Enteromius sp.* 'Lowveld-Incomati' (member of the Chubbyhead Barb complex; currently regarded as Data Deficient). It is recognised that many records currently ascribed to *E. motebensis* and *E. anoplus* in the eastern Lowveld may be synonymous with a new species *Enteromius sp. nov. "Ohrigstad"* proposed by Engelbrecht & Van Der Bank (1996), which was assessed previously as taxonomically Data Deficient by Darwall et al. (2009). Further genetic studies done on the Chubbyhead Barb complex by Da Costa (2012) suggested further separation of the complex into distinct lineages, with the species collected within the present study area corresponding with Lineage E, which included almost all specimens from the Incomati River system (except some morphologically distinct specimens included into clades A and D, respectively) and specimens from Limpopo River system. This lineage was further subdivided into three minor groups: 1) sub-group 1 with unique haplotype from the Olifants River (Limpopo system); 2) sub-group 2 with seven populations from five rivers of the Crocodile River (Incomati system); and 3) sub-group 3 with mixing populations from Limpopo and Incomati systems (Da Costa, 2012). Based on the spatial distribution of sample records from Da Costa (2012), the species collected during the routine biomonitoring assessments conducted for the mine appear to most likely correspond with sub-group 3 of Lineage E as assessed by Da Costa (2012). Further still, preliminary genetic analyses of the *Enteromius* group conducted at a finer scale by Mpumalanga Tourism and Parks Agency within the Klein Dwars, Groot Dwars, Spekboom and Ohrigstad catchments (unpublished data) suggests even further genetic differentiation within the group and suggested the high likelihood of several undescribed species belonging to the species complex to be present within the upper catchments of the larger Steelpoort River catchment. Although the conservation status of the species complex itself has been determined to be of Least Concern (Woodford, 2017), the very recent studies of Kambikambi et al. (2021) have described several new species from the complex, while more new species descriptions expected. Consequently, the results obtained by Kambikambi et al. (2021) indicate that the current IUCN Red List assessment of *E. anoplus* is obsolete. It is therefore clear that further studies are required to understand the geographic ranges and thus conservation status of the unique populations of this *Enteromius* group to determine the significance of those specimens present within the Skilferlaagtespruit at biomonitoring Site 7 where the species is determined to be dominant, and the conservation status for the lineage present within the Skilferlaagtespruit as such is considered Data Deficient;

- *Enteromius sp. nov. 'South Africa'* (Sidespot Barb; currently regarded as Near Threatened). Similar to *Enteromius neefi* Greenwood, 1962 which was described from the Kabompo River in northern Zambia, and identified as *Enteromius sp. 'neefi cf. South Africa'* in Darwall et al. (2009). Populations of the southern *Enteromius cf. neefi* occur in headwater streams of the Limpopo system south to the Phongolo River and south-west into the Vaal River in South Africa and Swaziland. The taxonomic status of the southern *Enteromius cf. neefi* still needs to be determined, but it is likely they are an undescribed species. The recent Red List assessment was based only in the southern *Enteromius cf. neefi* and was referred to as *Enteromius sp. nov. 'South Africa'* (Roux & Hoffman, 2017). Although the geographical distribution is fairly widespread within the Limpopo System in South Africa, many subpopulations are isolated and are severely impacted on by threats. In Swaziland, only a single record was found in over 200 collection sites and it was assessed as regionally Critically Endangered in Swaziland (Bills et al., 2004). The species is experiencing continuous threats such as forestry and associated sedimentation and river crossings preventing fish movement as well as stream regulation and mining with associated pollution. Although it is known from a large number of locations and is still widespread, the impacts of the multiple threats for the species could lead to its decline and it is thus assessed as Near Threatened within the latest IUCN Red List Assessment, although is it acknowledged that this species should be monitored to assess the impacts of these threats (Roux & Hoffman, 2017).

Underestimation of species diversity has been identified as a major impediment to implementation of effective conservation strategies to prevent biodiversity loss (see Bickford et al., 2007). For example, recent studies conducted by Chakona et al. (2015) between geographically isolated populations of the Goldie Barb (*Enteromius pallidus*) added to a growing body of evidence that freshwater fish diversity in southern Africa has been underestimated, and that major taxonomic revision is required in order to properly inform on their conservation status and actions required to ensure long-term diversity.

7.2.5.1 Present Ecological State

According to Cleanstream (2020), the ecological state of the Skilferlaagtespruit downstream of the study area may be considered moderately modified (Ecological Category C). This is, however, based on the assumption that although not sampled, all eight expected fish species are still present in this section of the Skilferlaagtespruit, albeit in reduced frequency of occurrence. However, the confidence of the ecological state score will increase as more surveys are conducted to verify the presence/absence of fish species within this river reach.

The primary impacts responsible for deterioration in the fish assemblage are expected to be related to reduced flows (flow modification by dams in catchment), sedimentation of bottom substrates (increased erosion primarily associated with agricultural activities) and the potential presence of alien fish species.

7.2.5.2 Non-native Species

For the purpose of the present study, alien species are defined as those that have been introduced from outside the political boundaries of South Africa, whereas extralimital species are species native to South Africa that have been translocated into areas where they do not naturally occur. Within the context of the present study, non-native species are therefore collectively taken to include both alien and extralimital species. Non-native species identified during the present study include:

- *Oncorhynchus mykiss* (Rainbow Trout): According to a local land owner, at least two dams within the north-eastern extent of the study area corresponding to sites NBC 3 and NBC 5, have prevously been stocked with *Oncorhynchus mykiss* (Rainbow Trout) fro recreational purposes. With its native distribution range being the western seaboard of the United States of America, Canada and north-western Mexico, eggs of this species were first successfully imported into South Africa in 1897. Fish hatched were used as breeding stock, and consignments of ova being sent to various parts of southern Africa from 1899 onwards and establishing within the Lydenberg disctrict as early as the mid-1920's (De Moor & Bruton, 1988). According to the unified framework proposed by Blackburn et al. (2011), *O. mykiss* can be classified as a fully invasive species, with individuals dispersing, surviving and reproducing at multiple sites across a greater or lesser spectrum of habitats and extent of occurrence (Ellender & Weyl, 2014).

- *Micropterus cf. salmoides* (Largemouth Bass): During the June 2021 assessment, a juvenile *Micropterus cf. salmoides* (Largemouth Bass) was confirmed within the Skilferlaagtespruit at Site NBC7. This species was imported from the United Kingdom in 1928 for sport fishing and aquaculture and has subsequently had a major detrimental impact on indigenous fish species. According to the unified framework proposed by Blackburn et al. (2011), *Micropterus salmoides* can be classified as a fully invasive species, with individuals dispersing, surviving and reproducing at multiple sites across a greater or lesser spectrum of habitats and extent of occurrence (Ellender & Weyl, 2014). *Micropterus salmoides* is regarded as a visual predator, requiring good water clarity to locate prey items and feed. Propagules of the species are likely to have entered the watercourse due to overflow of farm dams where the species was stocked, but due to depth restrictions within the lotic sections of the Skilferlaagtespruit, only individuals of the smaller size classes are expected to be present within the stream channel for any duration of time. Nevertheless, even at the smaller size classes, their impact on the small indigenous fish species present is likely to be significant owing to their highly predatory nature.

7.2.6 Diatom Assemblages

Given the nature of the watercourses associated with the NBC Consolidation project and the need to provide a biological basis for monitoring potential impacts associated with the current and proposed activities, the assessment of the diatom assemblage present at all biomonitoring sites was deemed a suitable tool. Table 12 provides a summary of the results obtained following a detailed assessment of the diatom assemblages at selected sites during the February 2020 biomonitoring assessment and the April 2021 assessment, whereas Appendix H provides a list of diatom species sampled in April 2021.

7.2.6.1 2 (DS Dam)

The diatom-based water quality of DAM 2 in February 2020 was *High* with an SPI score of 19.4 (Ecological Category A; Table 12). Pollution Tolerant Valves (PTVs) made up 6% of the total count in February 2020, which suggested that organic pollution levels were very low. Nutrient levels and salinity concentrations were elevated. Species diversity was moderate and the diatom community was dominated by *Achnanthidium minutissimum,* suggesting that fresh inundation recently occurred and that oxygenation rates were high and biological water quality was high. The sub-dominance of *Encyonopsis subminuta* and *Synedra rumpens* further reflect the high biological water quality at the time of sampling. *Brachysira neoexilis* was also dominant and while found in clean, oligo- to mesotrophic waters, is tolerant to mining effluents, especially effluents containing uranium (Cattaneo et al. 2004; Herlory, 2013). This could be an indication of possible mining impact; however, additional monitoring data would be needed to substantiate this, as other key indicator species associated with mining impact occurred at very low abundance. No valve deformities were noted suggesting that toxicity levels were below detection limits at the time of sampling or bio-availability was limited.

Table 12: Diatom results obtained for sites assessed during the February 2020 and April 2021 assessments

	Site	No species	SPI score*	Water Quality Class	Category	PTV (%)	Valve deformities (%)**
Glisa Section biomonitoring sites (Cleanstream, 2020)	2 (US Dam)	16	19.4	High	A	6	0
	Pan 1	28	14.2	Good	B/C	32	0
	4B (DS)	31	13.1	Moderate	C	44	0
Additional sites assessed during April 2021	NBC 1	20	18.2	High	A	6.5	0.5
	NBC 2	38	16.1	Good	B	11	0
	NBC 3	36	13.7	Moderate	C	37.5	0
	NBC 4	13	18.6	High	A	6	0
	NBC 5	29	13.4	Moderate	C	39.5	0.5
	NBC 6	29	17.2	Moderate	A/B	10	0
	NBC 8	18	16.8	Good	B	10.5	0
	NBC 9	29	17.9	High	A/B	4	0

*SPI tends to be more sensitive to organic pollution, as opposed to salts and metals more often associated with mining activities.
**Valve deformities generally indicate the presence of metals which may cause toxicity.

7.2.6.2 Pan 1

Within Pan 1, the biological water quality of the pan is characterised as *Good* and the driving metric associated with biological water quality change is organic pollution. However, according to Cleanstream (2020), there has been a steady but slight deterioration in biological water quality between 2017 and 2020 due to increasing organic pollution. This may be associated with the adjacent settlement. An increase in the abundance of indicator species associated with industrial activity has also been observed in 2019 and 2020, suggesting increased impacts due to mining over the past two years. The 2020 diatom results indicated that in the wet season, the impact of the mine is exacerbated when good rain periods occur and runoff is increased. Valve deformities have been present at various times throughout monitoring, but within general threshold limits, suggesting that the bio-availability of metals is limited or absent.

7.2.6.3 Site 4B (DS)

The biological water quality of Site 4B is characterised as *Moderate* but is variable, with conditions deteriorating in the wet season. The driving metrics associated with biological water quality change is organic pollution and nutrient levels. According to Cleanstream (2020) inundation in 2020 resulted in increased organic pollution, salinity concentrations and nutrient levels suggesting that increased runoff contributed to deteriorated biological water quality. No valve deformities were noted throughout monitoring, suggesting that the bio-availability of metals is absent. Key indicator species associated with industrial effluent, occurring at higher abundance in February 2020 compared to September 2019 included *Navicula veneta* and *Brachysira neoexilis*, suggesting that increased runoff contributed to deteriorated biological water quality. No valve deformities were noted suggesting that metal toxicity levels were below detection limits at the time of sampling or bio-availability was limited.

7.2.6.4 NBC 1

Site NBC 1 obtained a Specific Pollution sensitivity Index (SPI) score of 18.2, reflecting *High* biological water quality (Ecological Category A; Table 12). Nutrient levels and salinity concentrations were regarded as moderate based on the diatom assemblage collected, while organic pollution levels were considered low. Valve deformities occurred at an abundance of 0.5% and within general threshold limits, suggesting that metal toxicity was below detection limits, with limited bio-availability. Further analysis of the various indices within OMNIDIA suggested pollution levels were moderate at the time of sampling. The diatom community consisted mainly of species from the genus *Achnanthidium*, associated with elevated flow and high oxygenation rates. Other dominant and sub-dominant species generally had a preference for acidic, oligotrophic waters and included *Fragilaria crotonensis, Brachysira neoexilis* and *Nitzschia acidoclinata*. Diatom data indicates that anthropogenic related impacts are minimal.

7.2.6.5 NBC 2

Site NBC 2 obtained a SPI score of 16.1, reflecting *Good* biological water quality (Ecological Category B; Table 12). Nutrient levels and salinity concentrations were regarded as moderate based on the diatom assemblage collected, while organic pollution levels were considered low. No valve deformities were noted within the diatom assemblage collected at Site NBC 2 during April 2021, suggesting that metal toxicity was below detection limits, with limited bio-availability. Further analysis of the various indices within OMNIDIA suggested pollution levels were moderate at the time of sampling.

The diatom community generally had a preference for *Good* to *High* biological water quality and consisted mainly of species from the genus *Achnanthidium*, which has a preference for high oxygenation rates and recent elevated flow. *Eunotia* species with a preference for acidic conditions and very sensitive to deteriorated water quality was also dominant and included *Eunotia minor* and *Eunotia paludosa*. Recently elevated flow resulted in an influx of nutrient and organic loading as reflected by the dominance of *Gomphonema parvulum*. Diatom data indicates that anthropogenic related impacts are minimal.

7.2.6.6 NBC 3

Site NBC 3 obtained a SPI score of 13.7, reflecting *Moderate* biological water quality (Ecological Category C; Table 12). Nutrient levels, organic pollution and salinity concentrations were regarded as moderate based on the diatom assemblage collected. No valve deformities were noted within the diatom assemblage collected at Site NBC 3 during April 2021, suggesting that metal toxicity was below detection limits, with limited bio-availability. Further analysis of the various indices within OMNIDIA suggested pollution levels were moderate at the time of sampling. Species from the genus *Achnanthidium* were dominant reflecting high oxygenation rates and recent inundation. While sensitive species were present, their abundance was generally low while species with a preference for *Moderate* water quality was prolific at all abundance levels. Runoff entering the dam may contain higher nutrient and organic loads resulting in some deterioration of the overall biological water quality of the dam. Key indicator species for anthropogenic impact occurred at low abundance suggesting that while some impact is evident, it is not considered a concern.

7.2.6.7 NBC 4

Site NBC 4 obtained a SPI score of 18.6, reflecting *High* biological water quality (Ecological Category A; Table 12). Based on the diatom assemblage collected, nutrient levels and organic pollution levels were considered low while salinity concentrations were regarded as moderate. No valve deformities were noted within the diatom assemblage collected at NBC 4 during April 2021, suggesting that metal toxicity was below detection limits, with limited bio-availability. Further analysis of the various indices within OMNIDIA suggested pollution levels were slight at the time of sampling. Dominant species had a preference for acidic, electrolyte poor, oligotrophic water and included *Brachysira neoexilis* and *Eunotia naegeli* which dominated the community by 86%. Diatom data indicates that anthropogenic related impacts are minimal.

7.2.6.8 NBC 5

Site NBC 5 obtained a SPI score of 13.4, reflecting *Moderate* biological water quality (Ecological Category C; Table 12). Nutrient levels, organic pollution and salinity concentrations were regarded as moderate based on the diatom assemblage collected. Valve deformities occurred at an abundance of 0.5% and within general threshold limits, suggesting that metal toxicity was below detection limits, with limited bio-availability. Further analysis of the various indices within OMNIDIA suggested pollution levels were moderate at the time of sampling. Species associated with elevated flow dominated the diatom community and included *Achnanthidium minutissimum* and *Synedra rumpens*. This suggested that the dam was recently inundated by water containing elevated nutrient and organic loads. *Synedra rumpens* are well adapted to high sedimentation rates (Van de Vijver et al., 2002) influenced by water temperature and water level fluctuations (Kelly et al., 2005). While sensitive species were present, their abundance was generally low while species with a preference for *Moderate* water quality was prolific at all abundance levels. Key indicator species for anthropogenic impact occurred at low abundance suggesting that while some impact is evident, it is not considered a concern.

7.2.6.9 NBC 6

Site NBC 6 obtained a SPI score of 17.2, reflecting *High* biological water quality (Ecological Category A/B; Table 12). In addition, salinity concentrations and organic pollution levels were regarded as low, while nutrient levels were considered very low. Analysis of the various indices within OMNIDIA suggested pollution levels were slight. No valve deformities were noted within the diatom assemblage collected at Site D6 during March 2021, suggesting that metal toxicity was below detection limits, with limited bio-availability. The diatom community consisted mainly of species that generally have a preference for oligotrophic, acidic conditions. The dominant *Eunotia* and *Frustulia* species are very sensitive to deteriorated water quality. Diatom data indicates that anthropogenic related impacts are minimal.

7.2.6.10 NBC 8

Site NBC 8 obtained a SPI score of 16.8, reflecting *Good* biological water quality (Ecological Category B; Table 12). Salinity concentrations were regarded as moderate based on the diatom assemblage collected, while nutrient levels and organic pollution levels were considered low. No valve deformities were noted within the diatom assemblage collected at Site NBC 8 during April 2021, suggesting that metal toxicity was below detection limits, with limited bio-availability. Further analysis of the various indices within OMNIDIA suggested pollution levels were slight at the time of sampling. Dominant species had a preference for acidic, electrolyte poor, oligotrophic water and included *Brachysira neoexilis* and a variety of *Eunotia* species. Diatom data indicates that anthropogenic related impacts are minimal.

7.2.6.11 NBC 9

Site NBC 9 obtained a SPI score of 17.9, reflecting *High* biological water quality (Ecological Category A/B; Table 12). In addition, salinity concentrations nutrient levels and organic pollution levels were regarded as low. Analysis of the various indices within OMNIDIA suggested pollution levels were slight. No valve deformities were noted within the diatom assemblage collected at NBC 9 during April 2021, suggesting that metal toxicity was below detection limits, with limited bio-availability. The diatom community consisted mainly of species that generally have a preference for oligotrophic, acidic conditions and very sensitive to deteriorated water quality that included a variety of *Eunotia* species, *Gomphonema parvulum* var. *parvulius* and *Fragilaria crotonensis*. The dominant *Eunotia* and *Frustulia* species are very sensitive to deteriorated water quality. Diatom data indicates that anthropogenic related impacts are minimal.

7.2.6.12 Synthesis and summary

Assessment of the diatom assemblage determined that the biological water quality at the majority of the sites were *Good* to *High* with sensitive species dominating. Site NBC 3, NBC 5 and 4B were the only sites with *Moderate* biological water quality. The diatom data suggested that runoff entering these dams may contain higher nutrient and organic loads resulting in some deterioration of the overall biological water quality.

Diatom assemblage data for the Paardeplaats Section (Glisa Section data unavailable) was further subjected to hierarchical cluster analysis and non-metric multi-dimensional scaling (MDS), the results for which are presented as Figure 26 and Figure 27. The cluster analysis revealed different levels of similarity and groupings between sites which were confirmed in the MDS ordination. Broad groupings of the diatom assemblages associated with the more natural wetland systems as opposed to those systems that were heavily impounded were observed as well as similarities of species occurring along the same linear system such as with NBC 3 and NBC 5, and NBC 1 and NBC 2. NBC 6 (situated in a natural depression) and NBC 9 (situated on an unchanneled valley bottom) were regarded as indicative of the diatom assemblages to be expected in the natural and relatively unimpacted HGM units throughout the site.

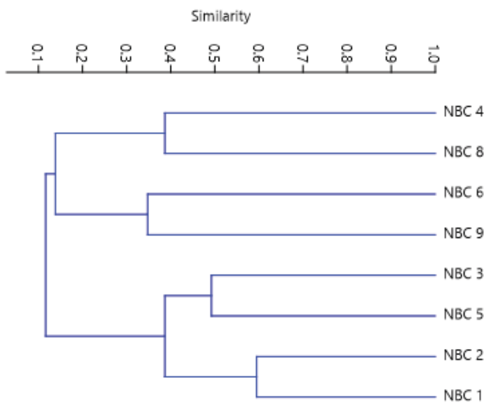


Figure 26: Bray-Curtis similarity ranked cluster analysis based on diatom assemblages collected during April 2021

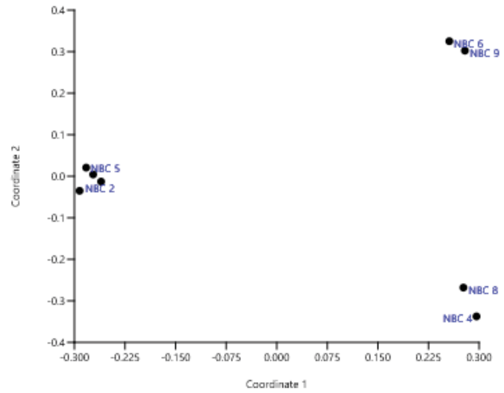


Figure 27: Non-metric multi-dimensional scaling (MDS) ordination of diatom assemblages based on the Bray-Curtis similarity matrix

7.2.7 Aquatic Toxicity

The addition of toxicity tests to evaluate water quality for water bodies affected by effluent discharge is helpful in adding causal information to water quality assessments, as standard rapid bioassessment methods represent a summation parameter that integrates several overlapping effects on fauna such as saproby, toxins, habitat degradation and physical disturbances.

According to Cleanstream (2020), water for toxicological testing at the Glisa Section of the NBC was limited to selected pollution control dams (PCDs) (I.e., the Gijima and Blue Gum Dams) to evaluate the toxicity of the mine water present. This was done by means of a screening-level toxicity assessment utilizing four levels of biological hierarchy. The results of the February 2020 assessment at sites applicable to the present study area are presented in Table 13.

Table 13: Toxicity results and hazard classifications obtained within the study area during the February 2020 biomonitoring survey (Cleanstream, 2020)

Site	% Stimulation (+) / Inhibition (-)		% Mortality		Hazard Classification
	Allivibrio fischeri bioluminescent test	*Selenastrum capricornutum* test	*Daphnia magna* acute toxicity test	*Poecilia reticulata* acute toxicity test	
Gijima	51%	10%	10%	0%	Class I – No acute hazard
Blue Gum Dam	44%	9%	0%	0%	Class I – No acute hazard

The screening results indicated a low level of toxicological risk to the aquatic macroinvertebrate assemblages at the Blue Gum Dam. Despite the low levels of toxicity observed, it is important to note that bacterial stimulation under natural circumstances, while not regarded as a significant acute toxicological threat to the receiving environment, does highlight potential impact in both PCDs. The results indicate some level of impact on the lower trophic levels, correlating with the water quality data which indicates somewhat impaired water quality in the mine PCDs (Section 7.2.2).

8 BUFFER ZONES AND NO-GO AREAS

Buffer zones associated with water resources have been shown to perform a wide range of functions and have been proposed as a standard measure to protect water resources and associated biodiversity on this basis. These functions can include (Macfarlane & Bredin, 2016):

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

However, despite the range of functions potentially provided by buffer zones, buffer zones are unable to address all water resource-related problems. For example, buffers can do little to address impacts such as hydrological changes caused by stream flow reduction activities or changes in flow brought about by abstractions or upstream impoundments. Buffer zones are also not the appropriate tool for mitigating against point-source discharges (E.g., sewage outflows), which can be more effectively managed by targeting these areas through specific source-directed controls (Macfarlane & Bredin, 2016).

Within the context of the proposed activities, the determination of relevant buffer requirements by means of the approach of Macfarlane & Bredin (2016) was not deemed to be applicable. Instead, set-back distances for proposed activities are to be reflective of relevant legislation (Government Notice 704 of the National Water Act, Act 36 of 1998, as published in Government Gazette 20119).

A buffer of 100 m, in line with the 100 m zone of regulation triggered by GN 704 is regarded as sufficient for wetlands outside of the proposed opencast activities to limit impacts related to ancillary mining activities, however, for the proposed opencast mining activities, buffers are unlikely to be of value in terms of mitigating impacts to the watercourses present within the study area. A hydro-pedological assessment and/or input from a geo-hydro specialist will be necessary to determine appropriate distances to mitigate impacts to the associated hillslope seeps.

9 IMPACT ASSESSMENT

Any activities associated with a natural system, whether historic, current, or proposed, will impact on the surrounding environment, usually in a negative way. The purpose of this phase of the study was to identify and assess the significance of the potential impacts and to provide a description of the mitigation required to limit the perceived impacts on the natural environment. In determining the impacts associated with the proposed activities, due consideration was given to previous impacting factors affecting the associated freshwater ecosystem within the study area.

There is a key difference between the approach of the ecological consultant and that of the ecological researcher. In consultancy, judgements have to be made and advice provided that is based on the best available evidence, combined with collective experience and professional opinion. The available evidence may

not be especially good, potentially leading to over-simplification of ecological systems and responses, and do contain a considerable deal of uncertainty. This is opposed to ecological research, where evidence needs to be compelling before conclusions are reached and research is published (Hill & Arnold, 2012). The best option available to the consulting industry is to push for more research to be conducted to address its questions. However, such research is often of a baseline nature and thus attracts little interest by larger institutions that need to do innovative research to be able to publish and attract the necessary funding. Clients in need of ecological assessments are used to funding such assessments, but are seldom willing to fund further research to monitor the effects of developments. Furthermore, a review to test the accuracy of the predictions of an ecologist following completion of the development is very rarely undertaken, which means the capacity to predict the future is not tested and therefore remains unknown (Hill & Arnold, 2012).

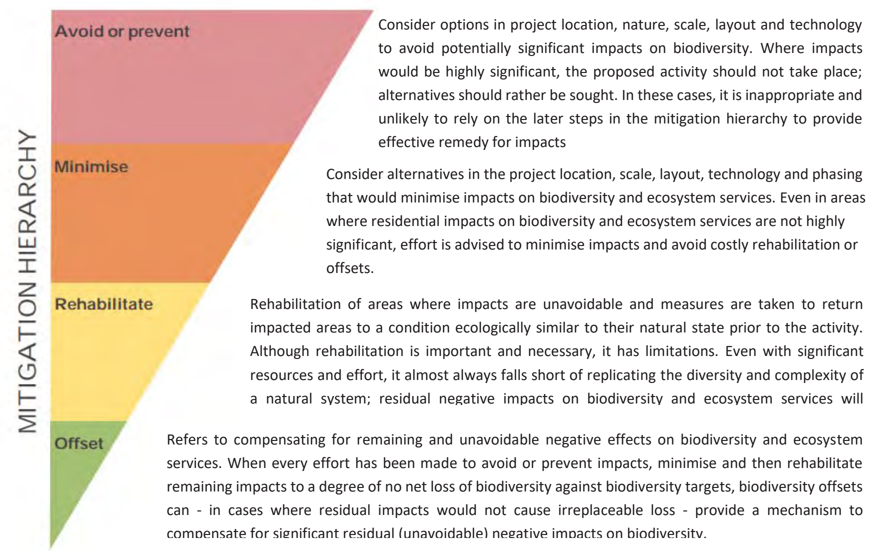


Figure 28: The mitigation hierarchy

Predictions on future changes on ecosystems and populations once a development has happened are seldom straightforward, except in cases such as the total loss of a habitat to development. However, most development impacts are indirect, subtle, and cumulative or unfold over several years following construction or commencement of mining. Whilst a possible mechanism for an impact to occur can usually be identified, the actual likelihood of occurrence and its severity are much harder to describe (Hill & Arnold, 2012).

A closely related issue is that of the effectiveness of ecological mitigation which stems from ecological assessments (including freshwater ecological assessments), as well as in response to legal and planning policy requirements for development. Many recommendations may be incorporated into planning conditions or become conditions of protected species licences, but these recommendations are implemented to varying degrees, with most compliance being for the latter category (I.e., protected species) because there is a regulatory framework for implementation. What is often missing is the follow-up monitoring and assessment of the mitigation with sufficient scientific rigour or duration to determine whether the mitigation, compensation or enhancement measure has actually worked in the way intended (Hill & Arnold, 2012).

Many impacts are not only a result of the direct impact on a particular species or habitat unit, but rather due to what is known as the '*Edge Effect'*, which can be explained as follows: Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type and abundance of species they contain. At the periphery of natural patches, influences of neighbouring environments become apparent; this then is the '*Edge Effect'*. Patch edges may be subjected to degradation due factors such as increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other negative agents. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat to survive in the long term. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder, 2004).

9.1 Impact Assessment Approach

Potential impacts of the proposed activity on the environment were assessed in terms a formalised method, whereby a typical risk assessment process was undertaken to determine the significance of the potential impacts without the application of mitigation/management measures (WOMM). Once the significance of the impacts without the application of mitigation/management measures was known, the impacts were then re-evaluated, taking cognisance of the application of proposed mitigation/management measures provided to reduce the impact (WMM), thus enabling an understanding of the overall impact after the implementation of mitigation/management measures. The process that was undertaken is described in the section below.

In determining the significance of potential impacts for the present study, the following should be clearly noted:

- *the assessment of impacts at the time of writing was done independent of other specialist reports (E.g., surface water hydrology, groundwater, wetlands, etc.) that were still being compiled or still to be initiated at the time of writing. Accordingly, the assessment of impact significance may require revision following review of supporting specialist reports;*
- *the assessment of impacts post-mitigation assumed that <u>all mitigation measures as proposed within this report are implemented</u>. In the event that some mitigation measures are not deemed feasible by the client, re-evaluation of the significance of the potential impacts post-mitigation will be required which takes into consideration the application of mitigation measures deemed by the client as feasible.*

The **EXTENT** refers to the impact footprint. What that means is that if a species were to be lost then the extent would be global because that species would be lost to the world. If human health is threatened, then the impact is likely to be no more than local and possibly (in the case of a nuclear power station) regional.

The **DURATION** is the period of time for which the impact would be manifest. Importantly, the concept of reversibility is taken into consideration in the scoring. In other words, the longer the impact endures, the less likely is the reversibility of the impact.

The **MAGNITUDE** is the measure of the potential severity of the impact on the associated environment. As with duration, the concept of reversibility should be taken into account when considering the magnitude of the potential impact.

Table 14: Descriptors and scoring for the EXTENT of an impact

Descriptors	Definitions	Score
Site only	The impact remains within the footprint or cadastral boundary of the site.	1
Local	The impact extends beyond the footprint or cadastral boundary of the site, to include the immediately adjacent and surrounding areas.	2
Regional	The impact includes the greater surrounding area within which the site is located.	3
National	The scale/extent of the impact is applicable to the Republic of South Africa.	4
Global	The scale /extent of the impact is global (I.e., world-wide).	5

Table 15: Descriptors and scoring for the DURATION of an impact

Descriptors	Definitions	Score
Temporary	The impact endures for only a short period of time (0-1 years).	1
Short term	The impact continues to manifest for a period of between 1-5 years.	2
Medium term	The impact continues to manifest for a period of 5-15 years.	3
Long term	The impact will cease after the operational life of the activity.	4
Permanent	The impact will continue indefinitely.	5

Table 16: Descriptors and scoring for the MAGNITUDE of an impact

Descriptors	Definitions	Score
Negligible	The ecosystem pattern, process and functioning are not affected, although there is a small negative impact on quality of the ecosystem.	1
Minor	Minor impact - a minor impact on the environment and processes will occur.	2
Low	Low impact - slight impact on ecosystem pattern, process and functioning.	4
Moderate	Valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way.	6
High	The environment is affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily cease. Valued, important, sensitive or vulnerable systems or communities are substantially affected.	8
Very High	The environment is affected to the extent that the ecosystem pattern, process and functions are completely destroyed and may permanently cease.	10

The **LIKELIHOOD** is the likelihood of the impact manifesting. Although likelihood and probability may be considered interchangeable, the term likelihood is preferred as probability has a very specific mathematical and/ or statistical connotation. As such the expectation created by the term probability is that there will be an accurate empirically or mathematically defined expression of risk, which is not necessarily required.

Table 17: Descriptors and scoring for the LIKELIHOOD of an impact

Descriptors	Definitions	Score
Very improbable / Rare	Where it is highly unlikely that the impact will occur, either because of design or because of historic experience	1
Unlikely	Improbable – where the impact is unlikely to occur (some possibility), either because of design or historic experience.	2
Probable	there is a distinct probability that the impact will occur (< 50% chance of occurring)	3
Highly Probable	Most likely that the impact will occur (50 – 90% chance of occurring)	4
Definite	The impact will occur regardless of any prevention or mitigating measures (>90% chance of occurring).	5

The **SIGNIFICANCE** of impacts is derived through a synthesis of ratings of all criteria in the following calculation:

(Extent + Duration + Magnitude) x Likelihood = Significance

Table 18: Descriptors for the SIGNIFICANCE score of an impact

Descriptors	Definitions	Score
Low	The perceived impact will not have a noticeable negative influence on the environment and is unlikely to require management intervention that would incur significant cost.	**0 – 19**
Low to Moderate	The perceived impact is considered acceptable, and application of recommended mitigation measures recommended.	**20 – 39**
Moderate	The perceived impact is likely to have a negative effect on the receiving ecosystem, and is likely to influence the decision to approve the activity. Implementation of mitigation measures is required, as is routine monitoring to ensure effectiveness of recommended mitigation measures.	**40 – 59**
Moderate to High	The perceived impact will have a significant impact on the receiving ecosystem, and will likely to have an influence on the decision-making process. Strict implementation of mitigation measures as provided is required, and strict monitoring and high levels of compliance and enforcement in respect of the impact in question are required.	**60 – 79**
High	The impact on the receiving ecosystem is considered of high significant and likely to be irreversible, and therefore highly likely to result in a fatal flaw for the project. Alternatives to the proposed activity are to be investigated as impact will have an influence on the decision-making process.	**80 - 100**

9.2 Identification and Assessment of Potential Impacts

All wetlands located within the direct footprint of the proposed opencast pit will be permanently destroyed by mining. This will result in the loss of 86.74 hectares of wetlands (Table 19 and Figure 29) consisting predominantly of hillslope seepage wetlands. Wetland systems affected include the upper reaches of tributaries draining into the Glisa Section of the NBC Consolidation area, as well as wetland systems draining westwards and forming part of the upper Steelpoort River catchment. Should mining proceed as per the Life of Mine plan, the loss of wetland habitat cannot be successfully mitigated and it is likely that offsets will need

to be considered.

The range of potential impacts anticipated as a result of the proposed activities have been identified in line with the nature of the proposed activities, the proximity of these activities to the watercourses within the study area, as well as according to the baseline conditions and sensitivities identified in Section 7 of this report and are described in detail in the sections below. Due to the nature of the proposed project the various potential impacts have been split into operational phase impacts (considerable overlap, with activities and impacts likely to continue for the lifespan of the project), and post-closure phase impacts, which are likely to encompass latent impacts following closure:

- Construction/Operational Phase Impacts
    - Loss of wetland and aquatic habitat;
    - Fragmentation of watercourses;
    - Disturbance and degradation of wetland and aquatic habitat;
    - Increased sediment transport and deposition in wetland and aquatic habitat;
    - Water quality deterioration; and
    - Impact on provincial freshwater conservation targets.
- Post-closure Phase Impacts
    - Water quality deterioration;
    - Increased surface runoff into wetland and aquatic habitat; and
    - Invasive plant species encroachment.

Table 19: HGM units and their extents to be directly lost as a result of the proposed LoM plan

Name	HGM_unit	PES	Ecoservice	EIS	Area (Ha)	Hectare Equivalents
HGM 45	Hillslope seep	D	Intermediate	Moderate	3.21	1.926
HGM 46	Unchannelled valley bottom	D	Moderately high	High	0.68	0.408
HGM 47	Hillslope seep	C	Intermediate	High	19.54	13.678
HGM 48	Unchannelled valley bottom	C	Moderately high	High	1.4	0.98
HGM 27	Hillslope seep	D	Intermediate	Moderate	1.2	0.72
HGM 26	Hillslope seep	C	Intermediate	High	1.39	0.973
HGM 25	Unchannelled valley bottom	C	Intermediate	High	0.47	0.329
HGM 51	Channelled valley bottom	D	Intermediate	High	0.22	0.132
HGM 50	Unchannelled valley bottom	C	Moderately high	High	1.76	1.232
HGM 49	Channelled valley bottom	C	Intermediate	High	2.98	2.086
HGM 72	Hillslope seep	D	Intermediate	Moderate	0.1	0.06
HGM 44	Pan	D	Intermediate	Moderate	1.74	1.044
HGM 39	Wet patch	-	-	-	1.04	0.624
HGM 54	Hillslope seep	B	Intermediate	High	6.27	5.016
HGM 55	Hillslope seep	B	Intermediate	High	9.29	7.432
HGM 63	Hillslope seep	D	Intermediate	Moderate	0.31	0.186
HGM 62	Channelled valley bottom	D	Intermediate	Moderate	0.97	0.582
HGM 60	Unchannelled valley bottom	B	Moderately high	High	0.11	0.088
HGM 59	Unchannelled valley bottom	B	Moderately high	High	0.05	0.04
HGM 56	Hillslope seep	B	Intermediate	High	15.41	12.328
HGM 58	Channelled valley bottom	C	Intermediate	Moderate	2.53	1.771
HGM 61	Hillslope seep	C	Intermediate	High	0.82	0.574

HGM 64	Hillslope seep	C	Intermediate	Moderate	4.17	2.919
HGM 67	Channelled valley bottom	C	Intermediate	Moderate	1.92	1.344
HGM 57	Hillslope seep	B	Intermediate	High	0.29	0.232
HGM 66	Hillslope seep	D	Intermediate	Moderate	0.69	0.414
HGM 69	Channelled valley bottom	D	Intermediate	Moderate	2.68	1.608
HGM 71	Hillslope seep	D	Intermediate	Moderate	3.72	2.232
HGM 70	Hillslope seep	C	Intermediate	Moderate	1.51	1.057
HGM 65	Hillslope seep	D	Intermediate	High	0.27	0.162
Total wetlands to be destroyed					**86.74***	**62.18**
Hillslope seeps					68.19	49.91
Channelled valley bottoms					11.3	7.52
Unchannelled valley bottoms					4.47	3.08
Depressions (or Pans)					1.74	1.04

*Calculations based on remaining wetlands on site as of 13-16 April 2021 field assessment and do not consider wetlands already destroyed as a result of mining activities, for full extent of wetlands lost on the Paardeplaats Section Refer to WCS, 2011. At the time of the April 2021 assessment, 5.5 hectares (3.85 hectare equivalents) of CBA wetland habitat had already been destroyed within the proposed LoM plan as a result of active mining. These calculations were not included in the table above and should be considered additionally for any offset strategies to be implemented.

9.3 Impact Assessment: Construction/Operational Phase

9.3.1 Loss of wetland and aquatic habitat

	Extent	Duration	Magnitude	Likelihood	Significance	Degree of Confidence
Pre-mitigation	Local	Permanent	Very High	Definite	**High**	High
	2	5	10	5	**85**	
Post-mitigation	Local	Permanent	Very High	Definite	**High**	High
	2	5	10	5	**85**	

The proposed Life of Mine plan will result in the permanent destruction of HGM units 44, 45, 46, 47, 48, 49, 50, 54, 55, 56, 58, 59, 61, 62, 64, 66 and portions of HGM units 25, 26, 27, 39, 57, 63, 65, 67, 69, 70 and 71 totalling 86.74 hectares (62.17 hectare equivalents) including habitat classified as CBA according to the MBSP, 2019. Opencast mining permanently alters the movement of water through the landscape due to changes in the soil structure and underlying stratigraphy and wetlands are unlikely to form post-mining.

Loss of wetland and aquatic habitat will result in loss of water supply and catchment yield to the downstream water resources and may result in indirect impacts to downgradient wetland habitat due to altered hydrology and desiccation. Specific mention is made of a natural spring upstream of HGM 25, and which will be destroyed should the proposed Life of Mine plan not be amended. This has the potential to result in loss of water supply and the associated habitat degradation to wetlands downstream of this point.

9.3.1.1 Proposed Mitigation: loss of wetland and aquatic habitat

The following management and mitigation measures are prescribed:

- Ensure that as far as possible and additional infrastructures are placed outside of delineated watercourse areas and their associated zones of regulation;
- Ensure that sound environmental management is in place during the planning phase;
- Design of infrastructure should be environmentally and structurally sound and all possible precautions taken to prevent spillage and/or seepage to the surface and groundwater resources present;

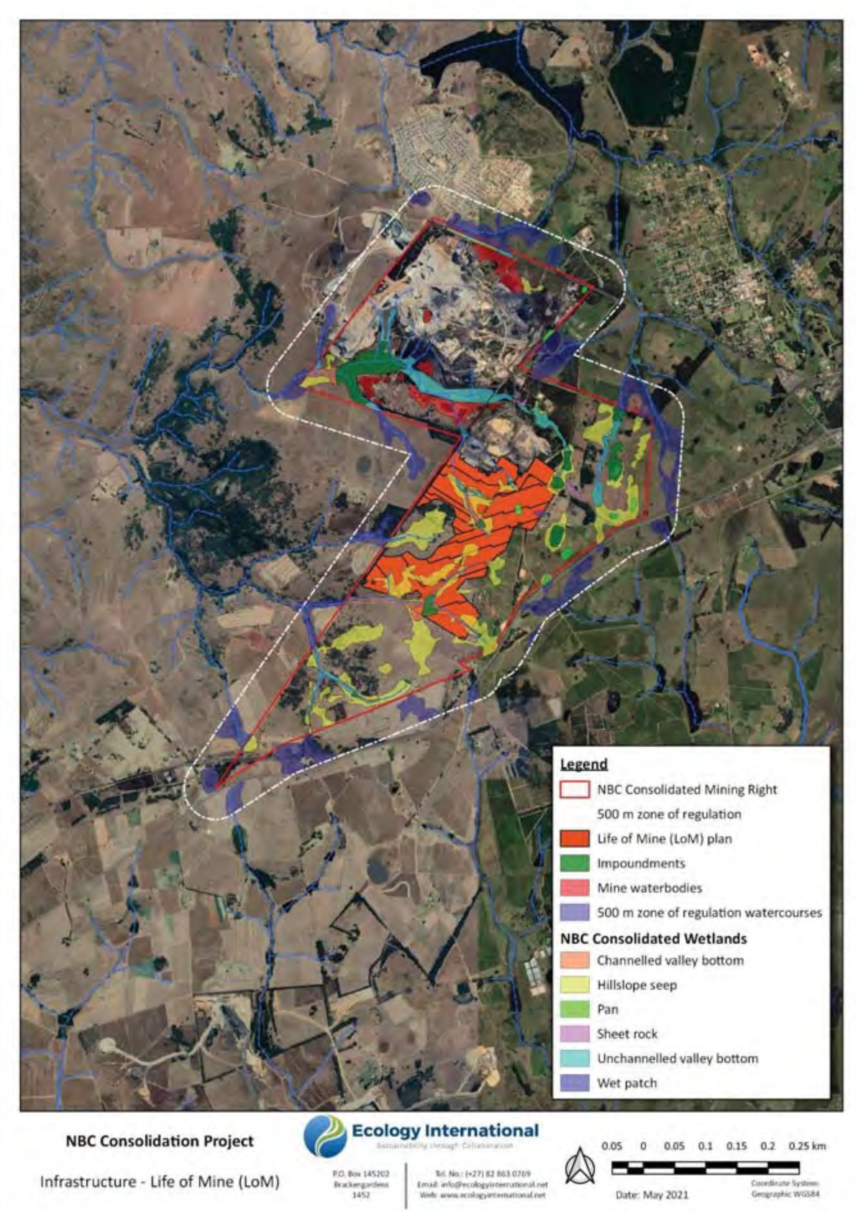


Figure 29: Proposed Life of Mine plan for the NBC Consolidation Project.

- It must be ensured that the design and construction of all infrastructures prevents failure;
- Limit the footprint area of the construction and operational activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils;
- Wetland areas outside of the opencast footprint should be fenced off and should be designated as No-go areas for all unauthorised personnel;
- Clean and dirty water separation systems to be implemented prior to the commencement of activities and to be maintained throughout the life of the proposed project; and
- Loss of wetland habitat, with special mention of Critical Biodiversity Areas (Refer to Section 6.1.7), will need to be mitigated with the implementation of a suitable wetland offset strategy.

9.3.2 Fragmentation of watercourses

	Extent	Duration	Magnitude	Likelihood	Significance	Degree of Confidence
Pre-mitigation	Local	Permanent	Very High	Definite	**High**	High
	2	5	10	5	**85**	
Post-mitigation	Local	Permanent	Very High	Definite	**High**	High
	2	5	10	5	**85**	

Habitat fragmentation has been linked to a variety of changes throughout ecological hierarchies, including alterations of individual dispersal behaviours, shifts in population dynamics, reductions in community complexity, and ecosystem-level changes through modifications of trophic cascades (Wofford et al., 2005). If metapopulations are involved, fragmentation of habitat can destroy critical dispersal pathways, eliminating re-establishment of extirpated populations and resulting in a ''debt of extinction'' (Wofford et al., 2005). Consequently, fragmentation of natural habitats is one of the main causes of biodiversity loss in linear watercourses.

The proposed Life of Mine will result in the loss of connectivity of HGM 63, a portion of HGM 67; HGM 68, HGM 69, HGM 70, HGM 71 and HGM 72 to watercourses further downstream. This has the potential to disrupt movement patterns of aquatic and terrestrial fauna within the associated catchment, limiting both upstream as well as downstream movement.

Road crossings, bridges, etc have the potential to result in further fragmentation of the remaining wetland and aquatic systems.

9.3.2.1 Proposed Mitigation: fragmentation of watercourses

The following management and mitigation measures are prescribed:

- Pipe culverts are not to be allowed at any watercourse crossings to limit opportunities of flow confinement and channel incision of the wetland units and drainage lines;

9.3.3 Disturbance and degradation of wetland and aquatic habitat

	Extent	Duration	Magnitude	Likelihood	Significance	Degree of Confidence
Pre-mitigation	Regional	Permanent	High	Definite	**High**	High
	3	5	8	5	**80**	
Post-mitigation	Local	Long term	Moderate	Highly Probable	**Moderate**	Moderate
	2	4	6	4	**48**	

Activities associated with construction and operation of the proposed project are likely to lead to several impacts to the remaining wetlands. These include:

- Compaction of soils, loss of indigenous vegetation, and the onset of erosion due to the movement of vehicles and heavy machinery;
- Disturbances of soils can lead to the formation of preferential flow paths, leading to the onset of erosion;
- Lowering of the local water table due to opencast mining activities, erosion gullies and trenches, resulting in desiccation and terrestrialisation of wetland and aquatic habitat;
- Disturbances of soils may lead to the proliferation of alien and invasive species. This has already been noted as a severe impact within the Glisa Section of the NBC Consolidation Project area. Dense patches of alien and invasive species noted within and around wetlands in the Paardeplaats Section have the potential to increase in severity. Linear watercourses are at greater risk due to the potential for distribution of identified alien and invasive plant species to travel great distances through movement of water.
- Suffocation of plant species due to dust pollution;
- Smothering of wetland habitat due to dumping and incorrect placement of stockpiles; and
- Influx of job-seekers to the surrounding areas, increasing human traffic, and the dependence of the rural community on the wetland resources available.

9.3.3.1 Proposed Mitigation: disturbance and degradation of wetland and aquatic habitat

If left unmitigated and uncontrolled, impacts have the potential to result in levels of degradation to wetlands that are irreversible. The following management and mitigation measures are prescribed:

- Ensure soil management programme is implemented and maintained to minimise erosion and sedimentation;
- All erosion noted within the project footprint should be remedied immediately and included as part of an ongoing rehabilitation plan;
- Active rehabilitation, re-sloping, and re-vegetation of disturbed areas immediately after construction and operational activities;
- Implement and maintain alien vegetation management programme;
- All delineated watercourses and their associated 100 m zones of regulation in terms of GN704 should be designated as "No-Go" areas and be off limits to all unauthorised vehicles and personnel, with the exception of approved construction and operational areas;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any delineated watercourses. All vehicles must remain on demarcated roads and within the project footprint;
- No material may be dumped or stockpiled within delineated watercourses;
- A suitable dust control program should be put in place.

9.3.4 Increased sediment transport and deposition in wetland and aquatic habitat

	Extent	Duration	Magnitude	Likelihood	Significance	Degree of Confidence
Pre-mitigation	Local	Long term	High	Definite	**Moderate to High**	High
	2	4	8	5	**70**	
Post-mitigation	Site only	Long term	Moderate	Highly Probable	**Moderate**	Moderate
	1	4	6	4	**44**	

The clearing of vegetation, stripping of topsoil and ongoing opencast mining activities can result in the movement of sediment into downstream and adjacent wetland and aquatic systems, particularly during rainfall events. Furthermore, the use of heavy machinery within the construction footprint will lead to soil compaction, increasing the runoff potential over topsoils and the reduction in stormwater infiltration into the soil profile, thereby increasing the likelihood of erosion gully formation and the deposition of sediment within the wetland systems. During operation, rainfall events can lead to the loss of soil from topsoil and overburden stockpiles, resulting in sediment movement into the watercourses associated with the study area. Further, the construction of various roads across wetlands and drainage lines throughout the study area through the installation of culverts will likely result in the confinement of flow ultimately leading to erosional processes which will further add to the sediment input into the aquatic ecosystem.

Sediment deposition has the potential to smother sensitive wetland habitat, leading to a loss of species diversity and dominance by species such as *Typha capensis* or *Phragmites australis*. Further, sediment deposition has the potential to alter the natural channels and flow paths of linear watercourses, thus increasing the potential for erosion in other areas.

Various impacts have been attributed to sedimentation of aquatic ecosystems, including reduction of light penetration (resulting in reduction in photosynthesis and subsequently, productivity), alteration of foraging dynamics of both carnivores and herbivores, impacting on predator and prey relationships, clogging of gills, rendering the watercourse unfit for various aquatic organisms, truncating and shifting the trophic pyramid, absorption of nutrients onto suspended particles, rendering them unavailable and thereby reducing the productivity of the watercourse, and filling of interstitial spaces, thereby destroying habitat for macro invertebrates and vertebrates owing to sedimentation, etc.

9.3.4.1 Proposed Mitigation: increased sediment transport and deposition in wetland and aquatic habitat

The following management and mitigation measures are prescribed:

- Measures must be put in place to attenuate water from infrastructure areas and reduce runoff. Attenuation measures during construction are to include but are not limited to - the use of sand bags, hessian sheets, silt fences, retention or replacement of vegetation and geotextiles such as soil cells which must be used in the protection of slopes;
- All stockpiles must be protected from erosion, stored on flat areas where runoff will be minimised, and be surrounded by bunds. Stockpiles must also only be stored for the minimum amount of time necessary;
- Delay vegetation clearing and clear only the minimum area required at any one time;
- Ensure soil management and stormwater management programmes are implemented and maintained to minimise erosion and sedimentation;

- All erosion noted within the project footprint should be remedied immediately and included as part of an ongoing rehabilitation plan;
- Active rehabilitation, re-sloping, and re-vegetation of disturbed areas immediately after construction and operational activities;
- Ensure that no incision and canalisation of the wetland features present takes place as a result of the proposed activities;
- All erosion noted within the project footprint should be remedied immediately and included as part of the ongoing rehabilitation plan; and
- Erosion berms should be installed on roadways and downstream of stockpiles to prevent gully formation and siltation of the freshwater resources.

9.3.5 Water Quality Deterioration

	Extent	Duration	Magnitude	Likelihood	Significance	Degree of Confidence
Pre-mitigation	Regional	Permanent	High	Definite	**High**	High
	3	5	8	5	**80**	
Post-mitigation	Regional	Medium term	Moderate	Probable	**Low to Moderate**	Moderate
	3	3	6	3	**36**	

Various stockpiles are expected to be associated with the proposed opencast mining activities. Stockpiles will be characterised by bare soil, steep side slopes that generate significant surface run-off. Run-off from these stockpiles is likely to be sediment-rich, while carbonaceous stockpiles might also generate acid rock drainage as pyrites in the overburden are exposed to oxygen. Where run-off from these stockpiles or poor containment of dirty water from the mining footprint enters the adjacent aquatic ecosystem, water quality deterioration is likely to result, including increases in turbidity, sulphates and metal concentrations (E.g., aluminium and iron), and potentially a drop in pH. Accordingly, aquatic assemblages are likely to be negatively affected, with a decrease in diversity expected.

Generally, the seepage of mine-impacted water from spoil deposits and stockpiles is a distinct risk in mining environments, with the implication that 1) new wetlands can occur in mining environments as water drains out of toe seep areas or 2) wetlands that are established can experience ingress of poorer quality water in terms of acidity, metals and sulphates (van der Waals, 2016). The change in water quality has an adverse effect on the ecological characteristics of the wetland systems and riverine environments into which the water ultimately flows, the extent of which is determined by the difference in pH and salt load of the polluted water compared to the natural wetland water (van der Waals, 2016).

The use of carbonaceous or spoil material in the construction of roads within the mine and the lack of confinement of such material is of further concern, as stormwater draining the site and entering into the valley-bottom aquatic ecosystems is likely to contain various contaminants associated with mining activities.

In addition to impaired water quality emanating from the opencast mining activities, spills and leaks of hazardous substances such as oil and fuel have the potential to enter the downstream watercourses, resulting in further water quality impairment.

Impaired water quality of the downstream watercourses has the potential to result in the loss of sensitive species as well as the loss of water supply for human use and loss of water quality in the Steelpoort River further downstream.

9.3.5.1 *Proposed Mitigation: water quality deterioration*

The following management and mitigation measures are prescribed:

- Clean and dirty water separation systems to be implemented prior to the commencement of activities and to be maintained throughout the life of the proposed project;
- Ensure that as far as possible all operational infrastructures are placed outside of wetland/riparian areas and their associated 32 or 100m zones of regulation respectively;
- All vehicles must be regularly inspected for leaks. Vehicles are to be maintained in good working order so as to reduce the probability of leakage of fuels and lubricants;
- Storage of potentially hazardous materials (including but not limited to fuel, oil, cement, bitumen etc.) must be above any 100-year flood line or outside the designated watercourse buffer, whichever is greater;
- A walled concrete platform, dedicated store with adequate flooring or bermed area must be used to accommodate chemicals such as fuel, oil, paint, herbicide and insecticides, as appropriate, in well-ventilated areas;
- Re-fuelling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly;
- Provide sufficient storage capacity to contain contaminated waters I.e. adopt a zero-discharge policy;
- Should contaminated water due to spillages or other unforeseen circumstances enter identified wetland or watercourse, a wetland/aquatic specialist must be consulted regarding implementation of suitable mitigation and/or rehabilitation measures;
- Surface water draining off contaminated areas containing hydrocarbons are required to be channelled towards a sump which will separate the chemicals and oils;
- No uncontrolled discharges to any surface water resources are permitted. Any discharge points need to be approved by the relevant authority;
- In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water and Sanitation (DWS) must be informed immediately; and
- Appropriate sanitary facilities must be provided for the duration of the operational activities and all waste must be removed to an appropriate waste facility. Under no circumstances may ablutions occur outside of the provided facilities;

9.3.6 Impact on Provincial Freshwater Conservation Targets

	Extent	Duration	Magnitude	Likelihood	Significance	Degree of Confidence
Pre-mitigation	Regional	Permanent	Moderate	Definite	**Moderate to High**	High
	3	5	6	5	**70**	
Post-mitigation	Regional	Medium term	Low	Highly Probable	**Moderate**	Moderate
	3	3	4	4	**40**	

The proposed activity is expected to impact on national protected areas targets as well as provincial freshwater conservation targets, both of which are expected to be cumulative if the impact is to be considered with other regional impacts that have or are expected to have on such areas.

9.3.6.1 *Proposed Mitigation: impact of provincial freshwater conservation targets*

The following management and mitigation measures are prescribed:

- A suitable wetland offset strategy may assist in mitigating this impact to some extent;
- Ongoing rehabilitation, mitigation of impacts and monitoring should be carried out to identify emerging impacts and trends so that the necessary preventative measures can be timeously implemented.

9.4 Impact Assessment: Closure and Post-closure Phase

9.4.1 Water Quality Deterioration

	Extent	Duration	Magnitude	Likelihood	Significance	Degree of Confidence
Pre-mitigation	Regional	Permanent	High	Definite	**High**	High
	3	5	8	5	**80**	
Post-mitigation	Local	Permanent	Low	Probable	Low to Moderate	Moderate
	2	5	4	3	**33**	

Following the completion of mining activities, it is assumed that the void of the opencast pits will be filled with unconsolidated material of differing physical properties. Given the changes in the physical properties of the infilled mine void area, the area is expected to become an area of drastically-increased recharge (some estimates from coal mine areas suggesting a 10-20-fold increase; van der Waals, 2016). The recharge into the filled-in material implies that water will percolate down to the original mine floor with a subsequent filling of the void until it decants at the lowest topographical elevation point. If there is an elevated pyrite content associated with fill material, these voids start generating sulphates and acid (van der Waals, 2016). The mine drainage water exiting the mine area at the decant point may potentially lead to the establishment of an acid and/or sulphate-rich seep. These have many wetland characteristics but with the difference that they are highly altered chemically and biologically (van der Waals, 2016). Under such circumstances, it is expected that biological assemblages within the associated watercourse are expected to be further altered through the deterioration of water quality, resulting in a locally depauperate aquatic assemblage being present. Such water quality deterioration is further likely to support only those aquatic macroinvertebrate taxa having a high tolerance to modified water quality, with the diatom assemblage expected to be dominated by species with a high affinity for industrial-impacted waters and a high proportion of valve deformities.

Impaired water quality of the downstream watercourses has the potential to result in the loss of sensitive species as well as the loss of water supply for human use and loss of water quality in the Steelpoort River further downstream.

9.4.1.1 *Proposed Mitigation: water quality deterioration*

The following management and mitigation measures are prescribed:

- During rehabilitation, no vehicles, heavy machinery or unauthorised personnel may be allowed to drive indiscriminately within any delineated watercourses. All vehicles must remain on demarcated roads and within the project area footprint;
- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly;
- To mitigate the potential impacts of decant, appropriate wetland rehabilitation design and implementation must ensure that wetland functionality of remaining wetlands is maintained and where necessary, restored;
- In the event of decant occurring and water quality and/or quantity negatively affecting the associated aquatic biota (as determined through routine biomonitoring activities), considering must be given to the construction and operation of a water treatment plant that will treat the water to a quantity and quality appropriate to be released back into the receiving aquatic ecosystem. Where water in excess of the ecological water requirements is available, such water may be distributed to surrounding communities;
- Financial provision must be made for the required water treatment facilities;
- It must be ensured that decant is of an acceptable water quality to meet the ecological requirements of the Steelpoort River as set in the Reserve and to prevent deviation from the RQOs.

9.4.2 Increased surface water runoff into wetland and aquatic habitat

	Extent	Duration	Magnitude	Likelihood	Significance	Degree of Confidence
Pre-mitigation	Regional	Permanent	High	Highly Probable	Moderate to High	High
	3	5	8	4	**64**	
Post-mitigation	Local	Permanent	Low	Unlikely	Low to Moderate	Moderate
	2	5	4	2	**22**	

Rehabilitated opencast areas are likely to be shaped to be free-draining and characterised by shallow compacted soils with sparce vegetation cover. The intensity of surface water runoff during rainfall events is thus likely to be much greater post-closer in comparison to the pre-mining scenario. Increased surface water runoff velocities and quantities, with a lower incidence of infiltration of water into soils, is likely to result in an increased potential for erosion and sedimentation of the wetland and aquatic habitats downstream.

9.4.2.1 Proposed Mitigation: surface water runoff into wetland and aquatic habitat

The following management and mitigation measures are prescribed:

- Good soil management should take place taking care not to mix topsoils and subsoils during stripping. Care should be taken to follow the soil management plan closely. Topsoils should not be stockpiled for extended periods and should be utilised in ongoing rehabilitation activities within 3 years or as indicated in the soil management program to prevent loss of soil viability;
- Topsoil depths on rehabilitated areas should be maximised as far as possible.
- Replaced soils should be appropriately shaped and profiled to the natural landscape profile and should be free draining;
- Steep slopes should be avoided to prevent erosion;
- As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils, vegetation clearance should be kept to a minimum;

- All areas where active erosion is observed should be ripped, re-profiled and seeded with indigenous grasses endemic to the region;
- Ongoing wetland rehabilitation is necessary both within and in the vicinity of the proposed study area and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season in order to identify any emerging issues, and to make recommendations on any trends, declines or improvements in the receiving environment.

9.4.3 Invasive Alien Plant Species Encroachment

	Extent	Duration	Magnitude	Likelihood	Significance	Degreee of Confidence
Pre-mitigation	Regional	Permanent	High	Highly Probable	Moderate to High	High
	3	5	8	4	**64**	
Post-mitigation	Site only	Long term	Minor	Probable	Low to Moderate	Moderate
	1	4	2	3	**21**	

Alien invasive flora are expected to increase within the area as they tend to invade areas that have been disturbed (E.g., on stockpiles, excavated or eroded areas, and rehabilitated areas). Such disturbed areas have the potential to act as seed areas that will ultimately facilitate the invasion of associated watercourses and riparian areas which will result in a decrease in the ecological state, ultimately impacting on the RQOs designated for the catchment. Alien species generally out-compete indigenous species for water, light, space and nutrients as they are adaptable to changing conditions and are able to easily invade a wide range of ecological niches, posing an ecological threat as they alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity, and modify food webs.

9.4.3.1 Proposed Mitigation: invasive alien plant species encroachment

The following management and mitigation measures are prescribed:

- An alien vegetation management plan to be implemented and managed for the life of the proposed project;
- The alien vegetation management plan should remain in place for a period of at least five years post-closure.
- Bi-annual vegetation surveys and alien vegetation clearing activities should take place to remove saplings of alien trees;
- Saplings should ideally be removed before they reach 1 m in height.

9.5 Cumulative Impacts

The freshwater ecology of this area has historically been heavily impacted as a result of various cumulative impacts as a result of extensive mining activities in the area. In addition, other impacts to the freshwater resources present in the vicinity of the proposed project include agricultural cultivation and grazing activities. The proposed underground activities have the potential to result in additional impacts to the wetland systems present including fragmentation of the systems, altered hydrology and terrain profiles, loss of biodiversity and altered vegetation structures.

9.6 Overarching Mitigation Measures

The following mitigation measures are seen as conditional should the proposed mining activities within the present study area be considered for approval:

The following additional mitigation measures pertain to the designated buffer zone:

- No activities, roads or infrastructure are to be located within the final designated buffer zone areas;
- Indigenous vegetation cover within the designated buffer zones are to be maintained at a minimum of 80% to ensure that the buffer remains functional, and must be assessed annually;
- Alien vegetation establishment within these buffer zone areas is to be strictly controlled through the development and implementation of a detailed alien management plan developed in accordance with the legislative requirements that considers management actions to be taken during all phases of the lifecycle of the mine, including post-closure management requirements.

Additional mitigation measures include:

- Implementation of the necessary monitoring and management programs to ensure the integrity of all water resources in the area during the construction, the operational lifespan of the mine, and post-closure (timeframe dependant on additional input from other specialist studies). This monitoring programme must ensure that there is no decrease in the health and functional integrity of the affected freshwater ecosystems;
- Ensure that all Best Management Guidelines as published by the Department of Water and Sanitation are employed and strictly adhered to during all phases of the mining process.

9.7 Wetland Mitigation and Offset Strategy

It is recommended that a detailed wetland mitigation and offset strategy be developed for the mine in order to ensure long-term wetland functioning within the catchment. Such a strategy must consider the feasibility of rehabilitation of the remaining wetlands on site, as well as the offsetting of the residual wetland loss resulting from the proposed mining through of wetlands.

9.7.1 General Principles of Offset Design and Implementation

A set of ten widely accepted principles for high quality biodiversity design and implementation which are based on a synthesis of best global practice have been published by the Business and Biodiversity Offset Programme (BBOP, 2009), and should be taken into account during the investigation of possible offsets. These include:

- Adherence to the mitigation hierarchy (Figure 30; I.e., offsets should only be considered as a last resort to address significant residual impacts).
- There are limits to what can be offset (areas where offsets are limited include Freshwater Ecosystem Priority Areas, Critical Biodiversity Areas or Ecological Support Areas, Critically Endangered or Endangered wetland types, species, habitats or ecosystems, focus areas for Protected Area expansion, etc.).
- Catchment context: offsets should be designed and implemented in the context of the broader landscape.
- No net loss: this overarching principle implies that losses due to project impacts and offset gains need to be balanced out. This essentially means:
  - Offsets need to target all values (pattern, process and ecosystem services) that are residually affected by a project's direct, indirect and cumulative impacts;
  - Offset policies usually require a like-for-like offset, although out-of-kind (trading up to areas of higher significance) may be considered in exceptional circumstances; and
  - Ideally, offsets should the established prior to project impacts.
- The size of the offset should take into account the risks and uncertainties about the success or performance of planned offset measures.

- Additional conservation outcomes – offsets need to be new contributions to conservation outcomes.
- Ensuring conservation outcomes – offsets need to be established preferably in perpetuity to ensure sustainable conservation outcomes, or at least for as long as the residual impact is present.
- Stakeholder participation – offsets should be designed and implemented in a transparent manner and with engagement of interested and affected parties.

9.7.2 Phased approach

The process of deciding whether an offset would be appropriate, designing an offset and providing for its successful implementation, is therefore best conducted in a phased approach.

During Phase 1, the primary focus of the proposed approach would be on trying to avoid having to provide an offset through application of the mitigation hierarchy and exploring alternatives, checking that the residual impacts are offsetable and, if so, determining the size of the offset required taking into account the full range of potentially significant residual impacts on direct and indirect ecosystem services. Following this, the feasibility of an offset is investigated, with consideration as to satisfying requirements, ensured security of the site, etc.

During Phase 2, the focus is on finding the most appropriate offset sites and activities to meet offset targets, comparing potentially suitable offset sites to achieve the desired outcomes and taking into consideration associated management and cost implications and any potential impacts on existing users of these sites. The outcome of Phase 2 would be the development of a draft Offset Report and associated Management Plan / Programme.

The wetland mitigation and offset strategy must consider the following:

- Onsite mitigation: the rehabilitation of wetlands that lie within the boundary of the mine but have been excluded from the mining footprint in order to ensure hectare equivalent gains;
- Offsite mitigation: the identification of suitable wetland habitat outside the boundaries of the mining area, and the implementation of rehabilitation measures that result in an additional gain in hectare equivalents in order to try meet any deficit in terms hectare equivalent targets;
- The creation of new wetlands on previously terrestrial/non-wetland areas; and
- The reintroduction of wetlands to the post-mining landscape. These wetlands may be within previously existing wetland habitat, but the catchment drivers and topography would have been completely transformed. The wetlands are therefore constructed to be compatible with the new landscape.

9.8 Monitoring and Management

Due to the presence of numerous wetland areas within the study area, the Wet-health and Wet-Ecoservices tools are to be used to re-evaluate PES and eco-services on an annual basis by a suitably qualified wetland specialist for the life of the proposed project and for a period of at least 5 years after the decommissioning and closure of the proposed project during the summer/wet monitoring season. In addition to these tools, vegetation transect monitoring of the various HGM units should take place on an annual basis by a suitably qualified wetland specialist with a strong botanical background to monitor any changes to the vegetation structure of the wetlands as a result of moisture stress.

Thereafter, monitoring is recommended every two years until the system is deemed appropriately rehabilitated. If monitoring results necessitate corrective action in terms of alien vegetation removal and erosion control, these corrective measures should be implemented immediately.

The Environmental Management Officer (EMO) must be present on-site during decommissioning and rehabilitation phases and must ensure that the wetland areas and their associated zones of regulation are clearly demarcated and that no unnecessary clearing of vegetation takes place.

10 CONCLUSION

The Integrated Paardeplaats Section is situated in an area comprising plateau grasslands, mountain slopes and shallow valleys. As such, the terrain lends itself to the formation of numerous hillslope seep wetlands and the presence of valley bottom wetland features becoming more channelled further downstream. Of the approximately 2482 hectares making up the Integrated Paardeplaats Section, approximately 440.22 hectares comprise wetland habitat. Ninety HGM units were identified within the study area, which were broadly classified as Largely Natural (Category B), Moderately Modified (Category C), Largely Modified (Category D) and Seriously Modified (Category E) according to the latest revised WET-Health methodology (Version 2).

Key services provided are generally related to streamflow regulation, sediment trapping and the assimilation of toxicants and nutrients from the surrounding land use activities. Biodiversity maintenance is regarded as high to very high across almost all the HGM units indicating the importance for conservation of these systems as well as their role in the provision of habitat and natural migration corridors. Erosion control and flood attenuation services were also generally regarded as important services, albeit to a lesser extent. Direct human benefits were related to the provision of water for agropastoral activities, as well as for recreational use and tourism (I.e., Trout fishing and birding opportunities), however, these were generally associated with the valley bottom systems rather than with the hillslope seeps. The identified HGM units were regarded as of Moderate and High Ecological Importance and Sensitivity across the study area.

Watercourses associated with the study area were largely limited to source zones and as such, many of the sites sampled, were situated either within impoundments, depressions or valley bottom wetlands. While electrical conductivities were noted as high throughout the Integrated Paardeplaats Section, water quality was generally not likely to be a limiting factor of to either diatom or the macroinvertebrate assemblages likely to occur, with both macroinvertebrate species tolerant of moderately impaired water quality, as well as sensitive diatom assemblages indicating Good to High water quality throughout the Integrated Paardeplaats Section. A contributing factor to the water quality observed may likely be related to the high incidence of Hillslope Seeps, which generally provide water purification services to the downstream water resources due to their slow diffuse flows.

The habitat assessment (IHI) applied to NBC 7 and site 7 on the Skilferlaagtespruit, site 4B downstream of the Mahim Dam, and to site NBC 2, revealed impacts associated with erosion (site 4B) and impacts related to the spread and incidence of dense patches of alien weeds and trees. However, only site 4B was found to deviate from the RQOs (Ecological Category C) for the catchment.

The results of the MIRAI indicated that the downstream resources associated with the Integrated Paardeplaats Section may be considered to be in a Largely Natural (site NBC 7), Moderately Modified (site 7 on the

Skilferlaagtespruit) and Moderately to Largely Modified (site NBC 2) state. The Ecological Category obtained for site NBC 2 fell slightly below the RQO for a stream in the B41A catchment, with the main driver of change likely related to flow modification as a result of upstream impoundments within the study area.

According to Cleanstream (2020), the ecological state of the Skilferlaagtespruit downstream of the study area may be considered Moderately Modified (Ecological Category C). This is, however, based on the assumption that although not sampled, all eight expected fish species are still present in this section of the Skilferlaagtespruit, albeit in reduced frequency of occurrence. However, the confidence of the ecological state score will increase as more surveys are conducted to verify the presence/absence of fish species within this river reach. The primary impacts responsible for deterioration in the fish assemblage are expected to be related to reduced flows (flow modification by dams in catchment), sedimentation of bottom substrates (increased erosion primarily associated with agricultural activities) and the potential presence of alien fish species.

With the expansion of the NBC into the Paardeplaats Section and the proposed LoM, it was determined that the proposed opencast pit will result in the loss of 86.74 hectares of wetlands consisting predominantly of hillslope seepage wetlands. Wetland systems affected include the upper reaches of tributaries draining into the Glisa Section of the NBC Consolidation area, as well as wetland systems draining westwards and forming part of the upper Steelpoort River catchment and the FEPA designated Fish Sanctuary Area.

The range of potential impacts anticipated as a result of the proposed activities ranged from High to Moderately Low even with the implementation of mitigation measures and have been identified as follows:

- Construction/Operational Phase Impacts
  - Loss of wetland and aquatic habitat;
  - Fragmentation of watercourses;
  - Disturbance and degradation of wetland and aquatic habitat;
  - Increased sediment transport and deposition in wetland and aquatic habitat;
  - Water quality deterioration; and
  - Impact on provincial freshwater conservation targets.
- Post-closure Phase Impacts
  - Water quality deterioration;
  - Increased surface runoff into wetland and aquatic habitat; and
  - Invasive plant species encroachment.

Based on the outcomes of the impact assessment, it is the opinion of the ecologist that should mining proceed as per the LoM plan, the loss of wetland habitat is unlikely to be successfully mitigated on-site. Accordingly, the development of a wetland mitigation and offset strategy is required in order to determine the feasibility of wetland offset potential. In doing so, cognisance is to be given as to the status of the downstream biota and the hydrological provisioning services provided by the wetlands present within the Paardeplaats Section. In this regard, a hydrological assessment of the potential impact of the proposed mining activities on the downstream Skilferlaagtespruit is required in order to fully understand the implications of mining through the wetlands present within the Paardeplaats Section and to establish an Ecological Reserve for the Skilferlaagtespruit. Flow loggers that are able to collect continuous data from both the Skilferlaagtespruit draining the Paardeplaats Section as well as the tributary draining the current Glisa Section of the mine are therefore highly recommended to establish baseline data, and the placement thereof should align with final biomonitoring sites selected (see below).

In addition, an amendment to the current routine biomonitoring programme is required in order to develop management actions for the different sections of the mine. In this respect, all additional sites assessed during the present study (including site NBC 7) are to be included within the routine biomonitoring studies going forward, with an additional biomonitoring point established on the tributary draining the Glisa Section downstream of the current biomonitoring Site 4B, but upstream of the confluence with the main stem of the Skilferlaagtespruit. This latter biomonitoring point will assist in determining the spatial origin of impacts on the receiving Skilferlaagtespruit, if any, and therefore allow for management actions to be better focused.

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APPENDIX A - METHODOLOGY

WETLAND ECOLOGICAL ASSESSMENT

Classification system for wetlands and other aquatic ecosystems

The freshwater systems were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis et al., 2013).

Table 20: Proposed classification structure for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table 21: Hydrogeomorphic (HGM) Unit for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	B	C
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	B	C
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

At Level 3, a distinction is made between four Landscape units (Table 14) on the basis of the landscape setting (i.e. topographical position) within which an HGM unit is situated, as follows (Ollis *et al.,* 2013):

- Slope: an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley.
- Valley floor: The base of a valley, situated between two distinct valley side-slopes.
- Plain: an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.
- Bench (hilltop/saddle/shelf): an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Seven primary HGM types are recognised for Inland Systems at Level 4A (Table 15):

- River: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
- Channelled valley bottom wetland: a valley-bottom wetland with a river channel running through it.
- Unchannelled valley bottom wetland: a valley-bottom wetland without a river channel running through it.
- Floodplain wetland: the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank.

- Depression: a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- Wetland Flat: a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat.
- Seep: a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

WET-Health

The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management.

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Central to WET-Health is the characterisation of HGM units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described in the section above.

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 State score. This takes the form of assessing the spatial extent of the impact of individual activities and then separately assessing the intensity of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The impact scores, and Present State categories are provided in the table below.

Table 22: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

Impact category	Description	Impact score range	Present State category
None	Unmodified, natural	0-0.9	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.	1-1.9	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.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat resources are still recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

WET-Ecoservices

The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by *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 service is provided:

- Flood attenuation
- Stream flow regulation
- Sediment trapping
- Phosphate trapping
- Nitrate removal
- Toxicant removal
- Erosion control
- Carbon storage
- Maintenance of biodiversity
- Water supply for human use
- Natural resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the watercourses. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the watercourses.

Table 23: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

Ecological Importance and Sensitivity

The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

Assessment criteria include the following:

- Ecological Importance and Sensitivity.
- Hydro-functional importance.
- Importance in terms of socio-cultural benefits.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category of the wetland being assessed.

Table 24: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1

AQUATIC ECOLOGICAL ASSESSMENT

In situ water quality

During the various field surveys, *in situ* water quality variables were measured at each site using an ExTech EC500 combination meter for measurement of temperature, pH, electrical conductivity, and Total Dissolved Solids, as well as an ExTech DO600 Portable Dissolved Oxygen Meter.

Index of Habitat Integrity, Version 2 (IHI-96-2)

The Index of Habitat Integrity (IHI, Version 2; Kleynhans, *pers. comm.*, 2015) aims to assess the number and severity of anthropogenic perturbations along a river/stream/wetland and the potential inflictions of damage toward the habitat integrity of the system (Dallas, 2005). Various abiotic (E.g., water abstraction, weirs, dams, pollution, dumping of rubble, etc.) and biotic (E.g., presence of alien plants and aquatic animals, etc.) factors are assessed, which represent some of the most important and easily quantifiable, anthropogenic impacts upon the system (Table 25).

In accordance with the original IHI approach (Kleynhans, 1996), the instream and riparian components were each analysed separately to yield two separate ecological conditions (i.e. Instream and Riparian components). However, it should be noted that the data for the riparian area is primarily interpreted in terms of the potential impact upon the instream component and as a result, may be skewed by a potentially deteriorated instream condition.

Table 25: Descriptions of criteria used in the assessment of habitat integrity (Kleynhans, 1996; cited from Dallas, 2005)

Criterion	Relevance
Water abstraction	Direct impact upon habitat type, abundance and size. Also impacted in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in the temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included
Water quality modification	Originates from point and diffuse sources. Measured directly, or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments.
Alien/Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Alien/Exotic	The disturbance of the stream bottom during feeding may influence the water quality and

aquatic fauna	increase turbidity. Dependent upon the species involved and their abundance
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river. Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

In accordance with the level of the impact created by the abovementioned criterion, the assessment of the severity of impact of the modifications is based on six descriptive categories with ratings ranging from 0 (no impact), 1 to 5 (small impact), 6 to 10 (moderate impact), 11 to 15 (large impact), 16 to 20 (serious impact) and 21 to 25 (critical impact; 9). It should be noted that a confidence level (high, medium, low) was also assigned to each of the scored metrics, based on available knowledge of the site and/or adjacent catchment.

Table 26: Descriptive of scoring guidelines for the assessment of modifications to habitat integrity (Kleynhans 1996; cited from Dallas, 2005)

Impact Category	Description	Score
None	No discernible impact or the factor is located in such a way that it has no impact on habitat quality diversity, size and variability.	0
Small	The modification is limited to a very few localities and the impact on habitat quality, diversity, size and variability is also very small.	1 - 5
Moderate	The modification is present at a small number of localities and the impact on habitat quality, diversity, size and variability is also limited.	6 - 10
Large	The modification is generally present with a clearly detrimental impact on quality habitat quality, diversity, size and variability. Large areas are, however, not influenced	11 - 15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability almost the whole of the defined section are affected. Only small areas are not influenced.	16 - 20
Critical	The modification is present overall with a high intensity; the habitat quality, diversity, size and variability in almost the whole of the defined section are detrimentally influenced.	21 - 25

Each of the allocated scores are then moderated by a weighting system (Table 27), which is based on the relative threat of the impact to the habitat integrity of the riverine system. The total score for each impact is equal to the assigned score multiplied by the weight of that impact. The estimated impacts (assigned score / maximum score [25] X allocated weighting) of all criteria are then summed together, expressed as a percentage and then subtracted from 100 to determine the Present Ecological State score (or Ecological Category) for the instream and riparian components, respectively.

Table 27: Criteria and weights used for the assessment of habitat integrity (Kleynhans, 1996; cited from Dallas, 2005)

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality modification	14	Water abstraction	13
Inundation	10	Inundation	11
Alien/Exotic macrophytes	9	Flow modification	12
Alien/Exotic aquatic fauna	8	Water quality	13
Solid waste disposal	6		
TOTAL	**100**	**TOTAL**	**100**

However, in cases where selected instream component criteria (I.e., water abstraction, flow, bed and channel modification, water quality and inundation) and/or any of the riparian component criteria exceeded ratings of large, serious or critical, an additional negative weight was applied. The aim of this is to accommodate the possible cumulative effect (and integrated) negative effects of such impacts (Kemper, 1999). The following rules were applied in this respect:

- Impact = Large, lower the integrity status by 33% of the weight for each criterion with such a rating.
- Impact = Serious, lower the integrity status by 67% of the weight for each criterion with such a rating.
- Impact = Critical, lower the integrity status by 100% of the weight for each criterion with such a rating.

Subsequently, the negative weights were added for both the instream and riparian facets of the assessment and the total additional negative weight subtracted from the provisionally determined integrity to arrive at a final habitat integrity estimate (Kemper, 1999). The eventual total scores for the instream and riparian zone components are then used to place the habitat integrity in a specific habitat integrity ecological category (Table 21).

Invertebrate Habitat Assessment System (IHAS), Version 2.2

Assessment of the available habitat for aquatic macroinvertebrate colonization at each of the sampling sites during rapid biomonitoring practices are vital to the correct interpretation of results obtained following biological assessments. It should be noted that the available methods for determining habitat quality are not specific to rapid biomonitoring assessments and are inherently too variable in their approach to achieve consistency amongst users.

Nevertheless, the Invertebrate Habitat Assessment System (IHAS) has routinely been used in conjunction with the South African Scoring System (SASS) as a measure of the variability of aquatic macroinvertebrate biotopes available during sampling (McMillan, 1998). The scoring system was traditionally split into two sections, namely the sampling habitat (comprising 55% of the total score) and the general stream characteristics (comprising 45% of the total score), which were summed together to provide a percentage and then categorized according to the values in Table 29.

Table 28: Ecological Categories for the habitat integrity scores (Kleynhans, 1999; cited from Dallas, 2005)

Score (% of Total)	Category	Description
90 - 100	A	Unmodified, natural.
80 - 89	B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
60-79	C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.
40-59	D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
20-39	E	The loss of natural habitat, biota and basic ecosystem functions is extensive.
0 - 19	F	Modifications have reached a critical level and there has been an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.

Table 29: Adapted IHAS Scores and associated description of available macroinvertebrate habitat (Dr. P. McMillan, pers. comm., 2006)

IHAS Score (%)	Description
>75	Excellent
65-74	Good
55-64	Adequate / Fair
<55	Poor

However, the lack of reliability and evidence of notable variability within the application of the IHAS method has prompted further field validation and testing, which implies a cautious interpretation of results obtained until these studies have been conducted (Ollis et al., 2006). In the interim and for the purpose of this assessment, the IHAS method was adapted by excluding the assessment of the general stream characteristics, which resulted in the calculation of a percentage score out of 55 that was then categorised by the aforementioned Table 27. Consequently, the assessment index describes the quantity, quality and diversity of available macroinvertebrate habitat relative to an "ideal" diversity of available habitat.

Aquatic Macroinvertebrates

Rapid biological monitoring (or biomonitoring) protocols have become important tools in the investigation of water quality and the determination of the overall ecosystem health (or integrity). This has largely been evident in the ability of standardized bio-assessment methods being able to assess the cumulative effect of water quality on biological systems over a period of time rather than only a snap-shot at the precise time of collection, as previously provided through routine chemical analysis of water.

While there are a number of indicator organisms that are used within these assessment indices, there is a general consensus that benthic macroinvertebrates are amongst the most sensitive components of the aquatic ecosystem. This was further supported by their largely non-mobile (or limited mobility) within reaches of associated watercourses, which also allows for the spatial analysis of disturbances potentially present within the adjacent catchment area. However, it should also be noted that their heterogeneous distribution within the water resource is a major limitation, as this results in both spatial and temporal variability within the collected macroinvertebrate assemblages (Dallas & Day, 2004).

The South African Scoring System, Version 5 (SASS5) is essentially a biological assessment index which determines the health of a river based on the aquatic macroinvertebrates collected on-site, whereby each taxon is allocated a score based on its perceived sensitivity/tolerance to environmental perturbations (Dallas, 1997). However, the method relies on a standardised sampling technique using a handheld net (300mm x 300mm, 1000µm mesh size) within each of the various habitats available for standardised sampling times and/or areas. Niche habitats (or biotopes) sampled during SASS5 application include:

- Stones (both in-current and out-of-current);
- Vegetation (both aquatic and marginal); and
- Gravel, sand and mud.

Once collection is complete, aquatic macroinvertebrates are identified to family level and a number of assemblage-specific parameters are calculated including the total SASS5 score, the number of taxa collected, and the Average Score per Taxa, which is the SASS score divided by the total number of taxa identified (Thirion et al., 1995; Davies & Day, 1998; Dickens & Graham, 2002; Gerber & Gabriel, 2002). The SASS bio-assessment index has been proven to be an effective and efficient means to assess water quality impairment and general river health (Dallas, 1997; Chutter, 1998).

To determine the Present Ecological State (PES; or Ecological Category) of the aquatic macroinvertebrates collected within the study area, the Macroinvertebrate Response Assessment Index (MIRAI) was applied. This biological index integrates the ecological requirements of the macroinvertebrate taxa in a community (or assemblage) and their response to flow modification, habitat change, water quality impairment and/or seasonality (Thirion, 2008). The presence and abundance of the aquatic macroinvertebrates collected are compared to a derived list of families/taxa expected to be present under natural, un-impacted (or reference) conditions. Consequently, the three (or four) metric groups utilised during the application of the MIRAI were combined within the model to derive the ecological condition of the site in terms of aquatic macroinvertebrates (Table 30).

Table 30: Allocation protocol for the determination of the PES (or Ecological Category) for aquatic macroinvertebrates following the MIRAI application

MIRAI Percentage	Category	Description
>89	A	Excellent Unimpaired; community structures and functions comparable to the best situation to be expected. Optimum community structure for stream size and habitat quality.
80-89	B	Very Good – Minimally impaired; largely natural with few modifications. A small change in community structure may have taken place but ecosystem functions are essentially unchanged.
60-79	C	Good – Moderately impaired; community structure and function less than the reference condition. Community composition lower than expected due to loss of some sensitive forms. Basic ecosystem functions are still predominantly unchanged.
40-59	D	Fair – Largely impaired; fewer families present than expected, due to loss of most intolerant forms. An extensive loss of basic ecosystem function has occurred.
20-39	E	Poor – Seriously impaired; few aquatic families present, due to loss of most intolerant forms. An extensive loss of basic ecosystem function has occurred.
<20	F	Very poor – Critically impaired; few aquatic families present. If high densities of organisms, then dominated by a few taxa. Only tolerant organisms present.

Ichthyofauna

Fish were collected by means of electro-narcosis, whereby an anode and a cathode are immersed in the water to temporarily stun fish in the near vicinity. Thereafter, the fish are easily scooped out by means of a hand net. A photographic record of fish collected was taken. All fish were identified in the field and released back into the river where possible.

Assessment of the PES of the fish assemblage of the watercourses downstream of the present study was conducted by means of the Fish Response Assessment Index (FRAI; Kleynhans 2008). The procedure followed to determine the fish Present Ecological State, or Ecological Category, is an integration of ecological requirements of fish species in an assemblage and their derived or observed responses to modified habitat conditions. In the case of the present assessment, the observed response was determined by means of fish sampling as well as a consideration of species requirements and driver changes (Kleynhans 2008). The expected fish species assemblage within the study area was derived from Kleynhans et al. (2008) and aquatic habitat sampled.

It should be emphasised that although the FRAI uses essentially the same information as the Fish Assemblage Integrity Index (FAII), it does not follow the same procedure. The FAII was developed for application in the broad synoptic assessment required for the River Health Programme, and subsequently does not offer a particularly strong cause-and-effect basis. The purpose of the FRAI, on the other hand, is to provide a habitat-based cause-and-effect underpinning to interpret the deviation of the fish assemblage from the perceived reference condition (Kleynhans, 2008).

The FRAI is based on the assessment of metrics within metric groups. These metrics are assessed in terms of:

- Habitat changes that are observed or derived;
- The impact of such habitat changes on species with particular preferences and tolerances; and
- The relationship between the drivers used in the FRAI and the various fish response metric groups are indicated in Figure 30. Table 31 provides the steps and procedures required for the calculation of the FRAI.

Interpretation of the FRAI score follows a descriptive procedure in which the FRAI score is classified into a particular PES Class or Ecological Category based on the integrity classes of (Kleynhans, 1999b). Each class gives a description of generally expected conditions for a specific range of FRAI scores (Table 32).

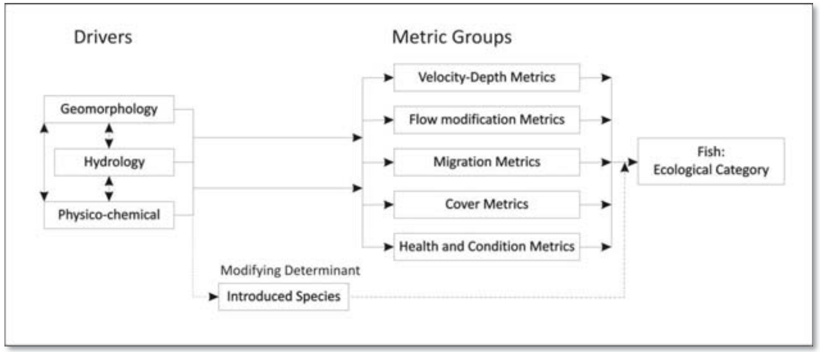

Figure 30: Relationship between drivers and fish metric groups

Table 31: Main steps and procedures in calculating the Fish Response Assessment Index

Step	Procedure
River section earmarked for assessment	As for study requirements and design
Determine reference fish assemblage: species and frequency of occurrence	• Use historical data & expert knowledge • Model: use ecoregional and other environmental information • Use expert fish reference frequency of occurrence database if available
Determine present state for drivers	• Hydrology • Physico-chemical • Geomorphology; or • Index of habitat integrity
Select representative sampling sites	Field survey in combination with other survey activities
Determine fish habitat condition at site	• Assess fish habitat potential Assess fish habitat condition
Representative fish sampling at site or in river section	• Sample all velocity depth classes per site if feasible • Sample at least three stream sections per site

Collate and analyse fish sampling data per site	Transform fish sampling data to frequency of occurrence ratings
Execute FRAI model	• Rate the FRAI metrics in each metric group • Enter species reference frequency of occurrence data • Enter species observed frequency of occurrence data • Determine weights for the metric groups • Obtain FRAI value and category • Present both modelled FRAI & adjusted FRAI.

Table 32: Allocation protocol for the determination of the PES/Ecological Category for fish following application of the FRAI

FRAI Percentage	Category	Description
90-100	**A**	Unmodified and natural. Community structures and functions comparable to the best situation to be expected. Optimum community structure for stream size and habitat quality.
80-89	**B**	Largely natural with few modifications. A small change in community structure may have taken place but ecosystem functions are essentially unchanged.
60-79	**C**	Moderately modified. Community structure and function less than the reference condition. Community composition lower than expected due to loss of some sensitive forms. Basic ecosystem functions are still predominantly unchanged.
40-59	**D**	Largely modified. Fewer species present then expected due to loss of most intolerant forms. An extensive loss of basic ecosystem function has occurred.
20-39	**E**	Seriously modified. Few species present due to loss of most intolerant forms. An extensive loss of basic ecosystem function has occurred.
0-19	**F**	Critically modified. Few species present. Only tolerant species present, if any.

APPENDIX B – DETAILED DESCRIPTION OF THE VARIOUS HGM UNITS WITHIN THE INTEGRATED PAARDEPLAATS SECTION

Name	HGM_unit	Area	Name	HGM_unit	Area
HGM 1	Hillslope seep	4.02	**HGM 46**	Unchannelled valley bottom	0.75
HGM 2	Unchannelled valley bottom	1.43	**HGM 47**	Hillslope seep	19.54
HGM 3	Hillslope seep	4.08	**HGM 48**	Unchannelled valley bottom	1.4
HGM 4	Pan	0.9	**HGM 49**	Channelled valley bottom	2.98
HGM 5	Pan	1.66	**HGM 50**	Unchannelled valley bottom	1.76
HGM 6	Unchannelled valley bottom	0.74	**HGM 51**	Channelled valley bottom	0.22
HGM 7	Hillslope seep	0.57	**HGM 52**	Hillslope seep	28.66
HGM 8	Hillslope seep	0.63	**HGM 53**	Unchannelled valley bottom	0.85
HGM 9	Unchannelled valley bottom	4.56	**HGM 54**	Hillslope seep	6.27
HGM 10	Unchannelled valley bottom	2.64	**HGM 55**	Hillslope seep	9.29
HGM 11	Hillslope seep	0.82	**HGM 56**	Hillslope seep	16.34
HGM 12	Hillslope seep	2.47	**HGM 57**	Hillslope seep	1.12
HGM 13	Unchannelled valley bottom	1.24	**HGM 58**	Channelled valley bottom	2.53
HGM 14	Channelled valley bottom	6.46	**HGM 59**	Unchannelled valley bottom	0.05
HGM 15	Hillslope seep	5.85	**HGM 60**	Unchannelled valley bottom	0.11
HGM 16	Unchannelled valley bottom	33.9	**HGM 61**	Hillslope seep	0.82
HGM 17	Unchannelled valley bottom	3.51	**HGM 62**	Channelled valley bottom	1.01
HGM 18	Channelled valley bottom	0.28	**HGM 63**	Hillslope seep	7.4
HGM 19	Sheet rock	0.97	**HGM 64**	Hillslope seep	4.17
HGM 20	Unchannelled valley bottom	1.19	**HGM 65**	Hillslope seep	1.61
HGM 21	Unchannelled valley bottom	8.1	**HGM 66**	Hillslope seep	0.69
HGM 22	Hillslope seep	1.21	**HGM 67**	Channelled valley bottom	12.08
HGM 23	Unchannelled valley bottom	0.66	**HGM 68**	Hillslope seep	25.57
HGM 24	Unchannelled valley bottom	0.58	**HGM 69**	Channelled valley bottom	3.19
HGM 25	Unchannelled valley bottom	0.89	**HGM 70**	Hillslope seep	2.2
HGM 26	Hillslope seep	7.89	**HGM 71**	Hillslope seep	7.31
HGM 27	Hillslope seep	1.72	**HGM 72**	Hillslope seep	11.53
HGM 28	Sheet rock	2.28	**HGM 73**	Hillslope seep	2.81
HGM 29	Hillslope seep	17.09	**HGM 74**	Hillslope seep	21.1
HGM 30	Hillslope seep	0.19	**HGM 75**	Unchannelled valley bottom	2.04
HGM 31	Unchannelled valley bottom	13.18	**HGM 76**	Hillslope seep	2.85
HGM 32	Hillslope seep	0.43	**HGM 77**	Unchannelled valley bottom	3.27
HGM 33	Hillslope seep	3.89	**HGM 78**	Hillslope seep	5.35

HGM 34	Hillslope seep	21.93	**HGM 79**	Hillslope seep	8.54
HGM 35	Pan	0.89	**HGM 80**	Channelled valley bottom	0.99
HGM 36	Pan	1.41	**HGM 81**	Hillslope seep	5.68
HGM 37	Hillslope seep	5.78	**HGM 82**	Hillslope seep	1.76
HGM 38	Hillslope seep	6.47	**HGM 83**	Hillslope seep	7.65
HGM 39	Wet patch	1.37	**HGM 84**	Unchannelled valley bottom	1.93
HGM 40	Pan	2.35	**HGM 85**	Channelled valley bottom	0.21
HGM 41	Pan	1.33	**HGM 86**	Hillslope seep	4.52
HGM 42	Hillslope seep	1.19	**HGM 87**	Hillslope seep	0.56
HGM 43	Hillslope seep	8.32	**HGM 88**	Hillslope seep	4.16
HGM 44	Pan	1.74	**HGM 89**	Hillslope seep	2.75
HGM 45	Hillslope seep	3.58	**HGM 90**	Unchannelled valley bottom	2.21
Total wetlands: 440.22 hectares					

APPENDIX C – SUMMARY OF THE HEALTH ASSESSMENT FOR THE IDENTIFIED WETLANDS

Name	HGM_unit	PES	Hectare Equivalents	Name	HGM_unit	PES	Hectare equivalents
HGM 1	Hillslope seep	E	2.01	**HGM 46**	Unchannelled valley bottom	D	0.45
HGM 2	Unchannelled valley bottom	D	0.858	**HGM 47**	Hillslope seep	C	13.678
HGM 3	Hillslope seep	F	1.632	**HGM 48**	Unchannelled valley bottom	C	0.98
HGM 4	Pan	D	0.54	**HGM 49**	Channelled valley bottom	C	2.086
HGM 5	Pan	D	0.996	**HGM 50**	Unchannelled valley bottom	C	1.232
HGM 6	Unchannelled valley bottom	D	0.444	**HGM 51**	Channelled valley bottom	D	0.132
HGM 7	Hillslope seep	C	0.399	**HGM 52**	Hillslope seep	C	20.062
HGM 8	Hillslope seep	C	0.441	**HGM 53**	Unchannelled valley bottom	C	0.595
HGM 9	Unchannelled valley bottom	D	2.736	**HGM 54**	Hillslope seep	B	5.016
HGM 10	Unchannelled valley bottom	D	1.584	**HGM 55**	Hillslope seep	B	7.432
HGM 11	Hillslope seep	D	0.492	**HGM 56**	Hillslope seep	B	13.072
HGM 12	Hillslope seep	C	1.729	**HGM 57**	Hillslope seep	B	0.896
HGM 13	Unchannelled valley bottom	B	0.992	**HGM 58**	Channelled valley bottom	C	1.771
HGM 14	Channelled valley bottom	C	4.522	**HGM 59**	Unchannelled valley bottom	B	0.04
HGM 15	Hillslope seep	C	4.095	**HGM 60**	Unchannelled valley bottom	B	0.088
HGM 16	Unchannelled valley bottom	D	20.34	**HGM 61**	Hillslope seep	C	0.574
HGM 17	Unchannelled valley bottom	C	2.457	**HGM 62**	Channelled valley bottom	D	0.606
HGM 18	Channelled valley bottom	C	0.196	**HGM 63**	Hillslope seep	D	4.44
HGM 19	Sheet rock	C	0.679	**HGM 64**	Hillslope seep	C	2.919
HGM 20	Unchannelled valley bottom	C	0.833	**HGM 65**	Hillslope seep	D	0.966
HGM 21	Unchannelled valley bottom	C	5.67	**HGM 66**	Hillslope seep	D	0.414
HGM 22	Hillslope seep	C	0.847	**HGM 67**	Channelled valley bottom	C	8.456
HGM 23	Unchannelled valley bottom	E	0.33	**HGM 68**	Hillslope seep	C	17.899
HGM 24	Unchannelled valley bottom	D	0.348	**HGM 69**	Channelled valley bottom	D	1.914
HGM 25	Unchannelled valley bottom	C	0.623	**HGM 70**	Hillslope seep	C	1.54
HGM 26	Hillslope seep	C	5.523	**HGM 71**	Hillslope seep	D	4.386
HGM 27	Hillslope seep	D	1.032	**HGM 72**	Hillslope seep	D	6.918
HGM 28	Sheet rock	C	1.596	**HGM 73**	Hillslope seep	C	1.967
HGM 29	Hillslope seep	C	11.963	**HGM 74**	Hillslope seep	C	14.77
HGM 30	Hillslope seep	C	0.133	**HGM 75**	Unchannelled valley bottom	B	1.632
HGM 31	Unchannelled valley bottom	C	9.226	**HGM 76**	Hillslope seep	C	1.995
HGM 32	Hillslope seep	C	0.301	**HGM 77**	Unchannelled valley bottom	B	2.616
HGM 33	Hillslope seep	C	2.723	**HGM 78**	Hillslope seep	C	3.745

HGM 34	Hillslope seep	B	17.544	**HGM 79**	Hillslope seep	B	6.832
HGM 35	Pan	B	0.712	**HGM 80**	Channelled valley bottom	B	0.792
HGM 36	Pan	B	1.128	**HGM 81**	Hillslope seep	B	4.544
HGM 37	Hillslope seep	C	4.046	**HGM 82**	Hillslope seep	B	1.408
HGM 38	Hillslope seep	B	5.176	**HGM 83**	Hillslope seep	C	5.355
HGM 39	Wet patch	-	0.822	**HGM 84**	Unchannelled valley bottom	B	1.544
HGM 40	Pan	C	1.645	**HGM 85**	Channelled valley bottom	C	0.147
HGM 41	Pan	C	0.931	**HGM 86**	Hillslope seep	C	3.164
HGM 42	Hillslope seep	C	0.833	**HGM 87**	Hillslope seep	C	0.392
HGM 43	Hillslope seep	D	4.992	**HGM 88**	Hillslope seep	C	2.912
HGM 44	Pan	D	1.044	**HGM 89**	Hillslope seep	C	1.925
HGM 45	Hillslope seep	D	2.148	**HGM 90**	Unchannelled valley bottom	D	1.326
Total Hectare Equivalents: 304.94 hectares							

APPENDIX D – SUMMARY OF THE ECOLOGICAL SERVICE PROVISION FOR THE IDENTIFIED WETLANDS

HGM unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Flood attenuation	1.3	1.3	1.4	1.3	1.3	2.1	1.8	1.8	2.1	2.1	1.8	2.0	1.6	2.1	2.0
Streamflow regulation	2.0	2.0	1.6	0.0	0.0	2.2	2.0	2.0	2.2	2.2	2.0	2.4	2.8	3.0	2.4
Sediment trapping	2.2	2.2	2.8	1.5	1.5	2.8	2.4	2.4	2.8	2.8	2.4	1.7	1.5	2.8	1.7
Phosphate assimilation	1.9	1.9	1.8	1.5	1.5	1.7	1.9	1.9	1.7	1.7	1.9	1.7	1.5	2.3	1.7
Nitrate assimilation	1.9	1.9	1.7	1.5	1.5	1.8	1.9	1.9	1.8	1.8	1.9	1.9	2.2	2.7	1.9
Toxicant assimilation	2.6	2.6	2.6	1.3	1.3	2.3	2.3	2.3	2.3	2.3	2.3	1.5	1.7	3.0	1.5
Erosion control	1.7	1.7	1.9	2.0	2.0	2.6	2.7	2.7	2.6	2.6	2.7	3.0	3.0	3.1	3.0
Carbon Storage	0.8	0.8	1.0	1.0	1.0	1.3	1.0	1.0	1.3	1.3	1.0	1.3	2.0	1.8	1.3
Biodiversity maintenance	0.8	0.8	0.9	3.1	3.1	2.4	2.5	2.5	2.4	2.4	2.5	3.3	3.2	2.1	3.3
Water Supply	0.8	0.8	0.9	1.0	1.0	0.7	0.5	0.5	0.7	0.7	0.5	1.6	2.5	2.2	1.6
Harvestable resources	0.4	0.4	0.4	1.2	1.2	0.4	0.4	0.4	0.4	0.4	0.4	1.2	1.2	0.4	1.2
Cultivated foods	0.4	0.4	0.4	1.2	1.2	0.4	0.4	0.4	0.4	0.4	0.4	2.2	1.2	0.4	2.2
Cultural value	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	1.0
Tourism and recreation	0.4	0.4	0.4	1.9	1.9	1.1	0.6	0.6	1.1	1.1	0.6	1.9	2.5	2.5	1.9
Education and research	0.3	0.3	0.3	1.5	1.5	0.8	0.8	0.8	0.8	0.8	0.8	1.5	1.5	1.0	1.5
SUM	17.3	17.3	18.1	21.1	21.1	22.4	21.3	21.3	22.4	22.4	21.3	28.0	29.4	29.2	28.0
Average score	1.2	1.2	1.2	1.4	1.4	1.5	1.4	1.4	1.5	1.5	1.4	1.9	2.0	1.9	1.9

HGM unit	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Flood attenuation	2.1	2.1	2.1	2.0	2.1	2.1	2.0	1.6	2.1	2.1	2.0	1.8	2.0	2.0	2.0
Streamflow regulation	3.0	3.0	3.0	2.4	3.0	3.0	2.4	0.6	3.0	3.0	2.4	2.2	2.4	2.4	2.4
Sediment trapping	2.8	2.8	2.8	1.7	2.8	2.8	1.7	1.5	2.8	2.8	1.7	1.8	1.7	1.7	1.7
Phosphate assimilation	2.3	2.3	2.3	1.7	2.3	2.3	1.7	1.2	2.3	2.3	1.7	1.7	1.7	1.7	1.7
Nitrate assimilation	2.7	2.7	2.7	1.9	2.7	2.7	1.9	1.1	2.7	2.7	1.9	1.8	1.9	1.9	1.9
Toxicant assimilation	3.0	3.0	3.0	1.5	3.0	3.0	1.5	1.5	3.0	3.0	1.5	1.6	1.5	1.5	1.5
Erosion control	3.1	3.1	3.1	3.0	3.1	3.1	3.0	1.0	3.1	3.1	3.0	2.5	3.0	3.0	3.0
Carbon Storage	1.8	1.8	1.8	1.3	1.8	1.8	1.3	0.0	1.8	1.8	1.3	0.5	1.3	1.3	1.3
Biodiversity maintenance	2.1	2.1	2.1	3.3	2.1	2.1	3.3	0.8	2.1	2.1	3.3	2.3	3.3	3.3	3.3
Water Supply	2.2	2.2	2.2	1.6	2.2	2.2	1.6	0.1	2.2	2.2	1.6	1.0	1.6	1.6	1.6
Harvestable resources	0.4	0.4	0.4	1.2	0.4	0.4	1.2	0.4	0.4	0.4	1.2	1.2	1.2	1.2	1.2
Cultivated foods	0.4	0.4	0.4	2.2	0.4	0.4	2.2	0.4	0.4	0.4	2.2	2.2	2.2	2.2	2.2
Cultural value	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0
Tourism and recreation	2.5	2.5	2.5	1.9	2.5	2.5	1.9	0.4	2.5	2.5	1.9	1.3	1.9	1.9	1.9
Education and research	1.0	1.0	1.0	1.5	1.0	1.0	1.5	0.3	1.0	1.0	1.5	0.5	1.5	1.5	1.5
SUM	29.2	29.2	29.2	28.0	29.2	29.2	28.0	10.7	29.2	29.2	28.0	23.4	28.0	28.0	28.0
Average score	1.9	1.9	1.9	1.9	1.9	1.9	1.9	0.7	1.9	1.9	1.9	1.6	1.9	1.9	1.9

HGM unit	31	32	33	34	35	36	37	38	40	41	42	43	44	45
Flood attenuation	1.6	2.0	2.0	2.0	1.3	1.3	2.0	2.0	1.3	1.3	1.8	1.8	1.3	1.8
Streamflow regulation	2.8	2.4	2.4	2.4	0.0	0.0	2.4	2.4	0.0	0.0	0.0	0.0	0.0	2.2
Sediment trapping	1.5	1.7	1.7	1.7	1.5	1.5	1.7	1.7	1.5	1.5	1.6	1.6	1.5	1.8
Phosphate assimilation	1.5	1.7	1.7	1.7	1.5	1.5	1.7	1.7	1.5	1.5	1.6	1.6	1.5	1.7
Nitrate assimilation	2.2	1.9	1.9	1.9	1.5	1.5	1.9	1.9	1.5	1.5	1.6	1.6	1.5	1.8
Toxicant assimilation	1.7	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.4	1.4	1.3	1.6
Erosion control	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	2.0	3.0	3.0	2.0	2.5
Carbon Storage	2.0	1.3	1.3	1.3	1.0	1.0	1.3	1.3	1.0	1.0	1.0	1.0	1.0	0.5
Biodiversity maintenance	3.2	3.3	3.3	3.3	3.1	3.1	3.3	3.3	3.1	3.1	3.2	3.2	3.1	2.3
Water Supply	2.5	1.6	1.6	1.6	1.0	1.0	1.6	1.6	1.0	1.0	0.2	0.2	1.0	1.0
Harvestable resources	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.4	0.4	1.2	1.2
Cultivated foods	1.2	2.2	2.2	2.2	1.2	1.2	2.2	2.2	1.2	1.2	0.4	0.4	1.2	2.2
Cultural value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0	1.0
Tourism and recreation	2.5	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.5	1.5	1.9	1.3
Education and research	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.3	1.3	1.5	0.5
SUM	29.4	28.0	28.0	28.0	21.1	21.1	28.0	28.0	21.1	21.1	18.9	18.9	21.1	23.4
Average score	2.0	1.9	1.9	1.9	1.4	1.4	1.9	1.9	1.4	1.4	1.3	1.3	1.4	1.6

HGM unit	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Flood attenuation	1.6	2.0	1.6	1.6	1.6	1.5	2.0	1.6	2.0	2.0	2.0	2.0	1.6	1.6	1.6
Streamflow regulation	2.8	2.4	2.8	2.8	2.8	2.0	2.4	2.8	2.4	2.4	2.4	2.4	2.8	2.8	2.8
Sediment trapping	1.5	1.7	1.5	1.5	1.5	1.7	1.7	1.5	1.7	1.7	1.7	1.7	1.5	1.5	1.5
Phosphate assimilation	1.5	1.7	1.5	1.3	1.5	0.9	1.7	1.5	1.7	1.7	1.7	1.7	1.3	1.5	1.5
Nitrate assimilation	2.2	1.9	2.2	1.9	2.2	1.4	1.9	2.2	1.9	1.9	1.9	1.9	1.9	2.2	2.2
Toxicant assimilation	1.7	1.5	1.7	1.5	1.7	1.2	1.5	1.7	1.5	1.5	1.5	1.5	1.5	1.7	1.7
Erosion control	3.0	3.0	3.0	3.0	3.0	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Carbon Storage	2.0	1.3	2.0	2.0	2.0	0.8	1.3	2.0	1.3	1.3	1.3	1.3	2.0	2.0	2.0
Biodiversity maintenance	3.2	3.3	3.2	3.2	3.2	2.1	3.3	3.2	3.3	3.3	3.3	3.3	3.2	3.2	3.2
Water Supply	2.5	1.6	2.5	2.5	2.5	1.5	1.6	2.5	1.6	1.6	1.6	1.6	2.5	2.5	2.5
Harvestable resources	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Cultivated foods	1.2	2.2	1.2	1.2	1.2	1.2	2.2	1.2	2.2	2.2	2.2	2.2	1.2	1.2	1.2
Cultural value	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Tourism and recreation	2.5	1.9	2.5	2.5	2.5	1.6	1.9	2.5	1.9	1.9	1.9	1.9	2.5	2.5	2.5
Education and research	1.5	1.5	1.5	1.5	1.5	0.8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
SUM	29.4	28.0	29.4	28.5	29.4	18.8	28.0	29.4	28.0	28.0	28.0	28.0	28.5	29.4	29.4
Average score	2.0	1.9	2.0	1.9	2.0	1.3	1.9	2.0	1.9	1.9	1.9	1.9	1.9	2.0	2.0

HGM unit	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Flood attenuation	2.0	1.8	1.8	1.8	1.8	2.0	1.6	2.0	1.5	2.0	1.8	2.0	1.8	2.0	1.6
Streamflow regulation	2.4	2.2	2.2	2.0	2.2	2.4	2.8	2.4	2.0	2.4	2.2	2.4	0.0	2.4	2.8
Sediment trapping	1.7	1.8	1.8	2.4	1.8	1.7	1.5	1.7	1.7	1.7	1.8	1.7	1.6	1.7	1.5
Phosphate assimilation	1.7	1.7	1.7	1.9	1.7	1.7	1.3	1.7	0.9	1.7	1.7	1.7	1.6	1.7	1.5
Nitrate assimilation	1.9	1.8	1.8	1.9	1.8	1.9	1.9	1.9	1.4	1.9	1.8	1.9	1.6	1.9	2.2
Toxicant assimilation	1.5	1.6	1.6	2.3	1.6	1.5	1.5	1.5	1.2	1.5	1.6	1.5	1.4	1.5	1.7
Erosion control	3.0	2.5	2.5	2.7	2.5	3.0	3.0	3.0	0.0	3.0	2.5	3.0	3.0	3.0	3.0
Carbon Storage	1.3	0.5	0.5	1.0	0.5	1.3	2.0	1.3	0.8	1.3	0.5	1.3	1.0	1.3	2.0
Biodiversity maintenance	3.3	2.3	2.3	2.5	2.3	3.3	3.2	3.3	2.1	3.3	2.3	3.3	3.2	3.3	3.2
Water Supply	1.6	1.0	1.0	0.5	1.0	1.6	2.5	1.6	1.5	1.6	1.0	1.6	0.2	1.6	2.5
Harvestable resources	1.2	1.2	1.2	0.4	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.4	1.2	1.2
Cultivated foods	2.2	2.2	2.2	0.4	2.2	2.2	1.2	2.2	1.2	2.2	2.2	2.2	0.4	2.2	1.2
Cultural value	1.0	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0	1.0
Tourism and recreation	1.9	1.3	1.3	0.6	1.3	1.9	2.5	1.9	1.6	1.9	1.3	1.9	1.5	1.9	2.5
Education and research	1.5	0.5	0.5	0.8	0.5	1.5	1.5	1.5	0.8	1.5	0.5	1.5	1.3	1.5	1.5
SUM	**28.0**	**23.4**	**23.4**	**21.3**	**23.4**	**28.0**	**28.5**	**28.0**	**18.8**	**28.0**	**23.4**	**28.0**	**18.9**	**28.0**	**29.4**
Average score	**1.9**	**1.6**	**1.6**	**1.4**	**1.6**	**1.9**	**1.9**	**1.9**	**1.3**	**1.9**	**1.6**	**1.9**	**1.3**	**1.9**	**2.0**

HGM unit	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Flood attenuation	1.8	1.6	2.0	2.0	1.6	2.0	1.8	2.0	1.6	1.6	2.0	2.0	1.8	2.0	1.6
Streamflow regulation	2.2	2.8	2.4	2.4	2.8	2.4	0.0	2.4	2.8	2.8	2.4	2.4	2.0	2.4	2.8
Sediment trapping	1.8	1.5	1.7	1.7	1.5	1.7	1.6	1.7	1.5	1.5	1.7	1.7	2.4	1.7	1.5
Phosphate assimilation	1.7	1.5	1.7	1.7	1.3	1.7	1.6	1.7	1.5	1.3	1.7	1.7	1.9	1.7	1.5
Nitrate assimilation	1.8	2.2	1.9	1.9	1.9	1.9	1.6	1.9	2.2	1.9	1.9	1.9	1.9	1.9	2.2
Toxicant assimilation	1.6	1.7	1.5	1.5	1.5	1.5	1.4	1.5	1.7	1.5	1.5	1.5	2.3	1.5	1.7
Erosion control	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.7	3.0	3.0
Carbon Storage	0.5	2.0	1.3	1.3	2.0	1.3	1.0	1.3	2.0	2.0	1.3	1.3	1.0	1.3	2.0
Biodiversity maintenance	2.3	3.2	3.3	3.3	3.2	3.3	3.2	3.3	3.2	3.2	3.3	3.3	2.5	3.3	3.2
Water Supply	1.0	2.5	1.6	1.6	2.5	1.6	0.2	1.6	2.5	2.5	1.6	1.6	0.5	1.6	2.5
Harvestable resources	1.2	1.2	1.2	1.2	1.2	1.2	0.4	1.2	1.2	1.2	1.2	1.2	0.4	1.2	1.2
Cultivated foods	2.2	1.2	2.2	2.2	1.2	2.2	0.4	2.2	1.2	1.2	2.2	2.2	0.4	2.2	1.2
Cultural value	1.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0	1.0
Tourism and recreation	1.3	2.5	1.9	1.9	2.5	1.9	1.5	1.9	2.5	2.5	1.9	1.9	0.6	1.9	2.5
Education and research	0.5	1.5	1.5	1.5	1.5	1.5	1.3	1.5	1.5	1.5	1.5	1.5	0.8	1.5	1.5
SUM	**23.4**	**29.4**	**28.0**	**28.0**	**28.5**	**28.0**	**18.9**	**28.0**	**29.4**	**28.5**	**28.0**	**28.0**	**21.3**	**28.0**	**29.4**
Average score	**1.6**	**2.0**	**1.9**	**1.9**	**1.9**	**1.9**	**1.3**	**1.9**	**2.0**	**1.9**	**1.9**	**1.9**	**1.4**	**1.9**	**2.0**

APPENDIX E – SUMMARY OF THE ECOLOGICAL IMPORTANCE AND SENSITIVITY SCORES FOR THE IDENTIFIED WETLANDS

	HGM unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ecological Importance and Sensitivity																
	Biodiversity support	0.08	0.08	0.17	0.67	0.83	0.83	0.83	0.92	1.08	1.08	0.92	0.92	1.08	1.08	1.00
	Presence of Red Data species	0.00	0.00	0.50	1.00	1.00	1.00	1.00	1.00	1.50	1.50	1.00	1.00	1.50	1.50	1.50
	Populations of unique species	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.50
	Migration/breeding/feeding sites	0.25	0.25	0.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Landscape scale	0.60	0.80	0.60	0.85	0.90	0.80	1.00	1.00	1.00	1.00	0.90	1.15	1.40	1.30	1.30
	Protection status of the wetland	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Protection status of the vegetation type	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Regional context of the ecological integrity	0.00	1.00	0.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00	2.00	3.00	2.00	2.00
	Size and rarity of the wetland type/s present	1.00	1.00	1.00	0.75	1.00	0.50	0.50	0.50	1.00	1.00	0.75	1.00	1.00	1.50	1.50
	Diversity of habitat types	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	1.00	1.00	0.75	0.75	1.00	1.00	1.00
	Sensitivity of the wetland	0.83	2.17	0.83	0.83	0.83	2.17	0.83	0.83	2.17	2.17	0.83	0.83	2.17	1.67	0.83
	Sensitivity to changes in floods	1.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	2.00	2.00	1.00	1.00	2.00	2.00	1.00
	Sensitivity to changes in low flows/dry season	1.00	3.00	1.00	1.00	1.00	3.00	1.00	1.00	3.00	3.00	1.00	1.00	3.00	2.00	1.00
	Sensitivity to changes in water quality	0.50	1.50	0.50	0.50	0.50	1.50	0.50	0.50	1.50	1.50	0.50	0.50	1.50	1.00	0.50
Hydro-Functional Importance																
Regulating and supporting benefits	**Flood attenuation**	1.25	1.25	1.50	1.25	1.25	2.00	1.75	1.75	2.00	2.00	1.75	2.00	1.50	2.00	2.00
Regulating and supporting benefits	**Streamflow regulation**	2.00	2.00	1.50	0.00	0.00	2.25	2.00	2.00	2.25	2.25	2.00	2.50	2.75	3.00	2.50
Regulating and supporting benefits – Water quality enhancement	*Sediment trapping*	2.25	2.25	2.75	1.50	1.50	2.75	2.50	2.50	2.75	2.75	2.50	1.50	1.50	2.75	1.50
Regulating and supporting benefits – Water quality enhancement	*Phosphate assimilation*	2.00	2.00	1.75	1.50	1.50	1.75	2.00	2.00	1.75	1.75	2.00	1.75	1.50	2.25	1.75
Regulating and supporting benefits – Water quality enhancement	*Nitrate assimilation*	1.75	1.75	1.75	1.50	1.50	1.75	2.00	2.00	1.75	1.75	2.00	2.00	2.25	2.50	2.00
Regulating and supporting benefits – Water quality enhancement	*Toxicant assimilation*	2.50	2.50	2.50	1.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	1.50	1.75	3.00	1.50
Regulating and supporting benefits – Water quality enhancement	*Erosion control*	1.50	1.50	2.00	2.00	2.00	2.50	2.75	2.75	2.50	2.50	2.75	3.00	3.00	3.00	3.00
Regulating and supporting benefits	**Carbon storage**	0.75	0.75	1.00	1.00	1.00	1.25	1.00	1.00	1.25	1.25	1.00	1.25	2.00	1.75	1.25
Direct Human Benefits																
Subsistence benefits	*Water for human use*	0.75	0.75	1.00	1.00	1.00	0.75	0.50	0.50	0.75	0.75	0.50	1.50	2.50	2.00	1.50
Subsistence benefits	*Harvestable resources*	0.50	0.50	0.50	1.25	1.50	0.50	0.50	0.50	0.50	0.50	0.50	1.25	1.25	0.50	1.25
Subsistence benefits	*Cultivated foods*	0.50	0.50	0.50	1.25	1.25	0.50	0.50	0.50	0.50	0.50	0.50	2.25	1.25	0.50	2.25
Cultural benefits	*Cultural heritage*	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00
Cultural benefits	*Tourism and recreation*	0.25	0.25	0.25	1.75	1.75	1.00	0.50	0.50	1.00	1.00	0.50	1.75	2.50	2.50	1.75
Cultural benefits	*Education and research*	0.25	0.25	0.25	1.50	1.50	0.75	0.75	0.75	0.75	0.75	0.75	1.50	1.50	1.00	1.50
	Ecological Importance and Sensitivity	0.83	2.17	0.83	0.85	0.90	2.17	1.00	1.00	2.17	2.17	0.92	1.15	2.17	1.67	1.30
	Hydrological/functional Importance	1.75	1.75	1.75	1.84	1.25	1.38	2.06	2.03	2.03	2.06	2.06	2.03	1.94	2.03	2.53
	Direct Human Benefits	0.38	0.38	0.42	1.29	1.33	0.58	0.46	0.46	0.58	0.58	0.46	1.54	1.67	1.08	1.54
	OVERALL IMPORTANCE	1.75	2.17	1.75	1.84	1.33	2.17	2.06	2.03	2.17	2.17	2.06	2.03	2.17	2.03	2.53

	HGM unit	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ecological Importance and Sensitivity																
	Biodiversity support	0.83	0.83	0.83	1.67	0.83	0.83	0.83	0.08	0.67	0.83	0.92	0.58	1.42	1.50	0.33
	Presence of Red Data species	1.00	1.00	1.00	2.00	1.00	1.00	1.00	0.00	0.50	1.00	1.00	0.50	2.00	1.50	0.50
	Populations of unique species	0.50	0.50	0.50	2.00	0.50	0.50	0.50	0.00	0.50	0.50	1.00	0.25	1.75	1.50	0.25
	Migration/breeding/feeding sites	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	1.00	1.00	0.75	1.00	0.50	1.50	0.25
	Landscape scale	1.40	1.20	1.00	1.60	1.15	1.25	1.15	0.50	0.85	1.10	1.30	1.10	1.70	1.45	0.80
	Protection status of the wetland	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Protection status of the vegetation type	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Regional context of the ecological integrity	1.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	1.00	2.00	2.00	1.00	2.00	2.00	2.00
	Size and rarity of the wetland type/s present	2.50	1.00	0.25	2.50	1.00	1.50	1.00	0.50	0.50	0.50	1.50	1.00	2.50	1.75	0.00
	Diversity of habitat types	1.50	1.00	0.75	1.50	0.75	0.75	0.75	0.00	0.75	1.00	1.00	1.50	2.00	1.50	0.00
	Sensitivity of the wetland	2.17	2.17	1.67	0.83	2.50	2.17	0.83	2.17	2.17	2.17	0.83	1.17	1.17	0.83	0.83
	Sensitivity to changes in floods	2.00	2.00	2.00	1.00	2.00	2.00	1.00	2.00	2.00	2.00	1.00	2.00	2.00	1.00	1.00
	Sensitivity to changes in low flows/dry season	3.00	3.00	2.00	1.00	3.00	3.00	1.00	3.00	3.00	3.00	1.00	1.00	1.00	1.00	1.00
	Sensitivity to changes in water quality	1.50	1.50	1.00	0.50	2.50	1.50	0.50	1.50	1.50	1.50	0.50	0.50	0.50	0.50	0.50
Hydro-Functional Importance																
Regulating and supporting benefits	**Flood attenuation**	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.50	2.00	2.00	2.00	1.75	2.00	2.00	2.00
Regulating and supporting benefits	**Streamflow regulation**	3.00	3.00	3.00	2.50	3.00	3.00	2.50	0.50	3.00	3.00	2.50	2.25	2.50	2.50	2.50
Regulating and supporting benefits – Water quality enhancement	*Sediment trapping*	2.75	2.75	2.75	1.50	2.75	2.75	1.50	1.50	2.75	2.75	1.50	1.75	2.50	1.50	1.50
Regulating and supporting benefits – Water quality enhancement	*Phosphate assimilation*	2.25	2.25	2.25	1.75	2.25	2.25	1.75	1.00	2.25	2.25	1.75	1.75	1.75	1.75	1.75
Regulating and supporting benefits – Water quality enhancement	*Nitrate assimilation*	2.50	2.50	2.50	2.00	2.50	2.50	2.00	2.00	2.50	2.50	2.00	1.75	2.00	2.00	2.00
Regulating and supporting benefits – Water quality enhancement	*Toxicant assimilation*	3.00	3.00	3.00	1.50	3.00	3.00	1.50	1.50	3.00	3.00	1.50	1.50	1.50	1.50	1.50
Regulating and supporting benefits – Water quality enhancement	*Erosion control*	3.00	3.00	3.00	3.00	3.00	3.00	3.00	1.00	3.00	3.00	3.00	2.50	3.00	3.00	3.00
Regulating and supporting benefits	**Carbon storage**	1.75	1.75	1.75	1.25	1.75	1.75	1.25	0.00	1.75	1.75	1.25	0.50	1.25	1.25	1.25
Direct Human Benefits																
Subsistence benefits	*Water for human use*	2.00	2.00	2.00	1.50	2.00	2.00	1.50	0.00	2.00	2.00	1.50	1.00	1.50	1.50	1.50
Subsistence benefits	*Harvestable resources*	0.50	0.50	0.50	1.25	0.50	0.50	1.25	0.50	0.50	0.50	1.25	1.25	1.25	1.25	1.25
Subsistence benefits	*Cultivated foods*	0.50	0.50	0.50	2.25	0.50	0.50	2.25	0.50	0.50	0.50	2.25	2.25	2.25	2.25	2.25
Cultural benefits	*Cultural heritage*	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00
Cultural benefits	*Tourism and recreation*	2.50	2.50	2.50	1.75	2.50	2.50	1.75	0.25	2.50	2.50	1.75	1.25	1.75	1.75	1.75
Cultural benefits	*Education and research*	1.00	1.00	1.00	1.50	1.00	1.00	1.50	0.25	1.00	1.00	1.50	0.50	1.50	1.50	1.50
	Ecological Importance and Sensitivity	2.17	2.17	1.67	1.67	2.50	2.17	1.15	2.17	2.17	2.17	1.30	1.17	1.70	1.50	0.83
	Hydrological/functional Importance	1.94	2.53	2.53	2.53	1.94	2.53	2.53	1.94	1.13	2.53	2.53	1.94	1.72	2.06	1.94
	Direct Human Benefits	1.08	1.08	1.08	1.54	1.08	1.08	1.54	0.25	1.08	1.08	1.54	1.21	1.54	1.54	1.54
	OVERALL IMPORTANCE	2.17	2.53	2.53	2.53	2.50	2.53	2.53	2.17	2.17	2.53	2.53	1.94	1.72	2.06	1.94

	HGM unit	31	32	33	34	35	36	37	38	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
	Ecological Importance and Sensitivity	**Ecological Importance and Sensitivity**																												
	Biodiversity support	1.92	0.33	0.33	1.75	1.92	1.92	1.92	1.92	1.50	1.50	1.08	1.08	1.33	1.83	1.83	1.83	1.83	1.87	1.37	0.42	1.70	0.75	2.00	2.00	2.00	2.00	0.83	1.50	1.50
	Presence of Red Data species	2.00	0.50	0.50	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.00	1.00	1.50	2.00	2.00	2.00	2.00	2.00	1.50	0.25	1.50	0.50	2.00	2.00	2.00	2.00	1.00	2.00	2.00
	Populations of unique species	1.75	0.25	0.25	1.75	1.75	1.75	1.75	1.75	1.00	1.00	0.75	0.75	1.00	1.50	1.50	1.50	1.50	1.60	1.60	0.00	1.60	0.25	1.50	1.50	1.50	1.50	0.50	1.50	1.50
	Migration/breeding/feeding sites	2.00	0.25	0.25	1.50	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.50	2.00	2.00	2.00	2.00	2.00	1.00	1.00	2.00	1.50	2.50	2.50	2.50	2.50	1.00	1.00	1.00
	Landscape scale	1.50	0.85	1.00	1.75	1.40	1.50	1.35	1.65	1.30	1.30	1.10	1.00	0.90	0.90	0.80	1.30	1.05	1.05	1.10	0.60	1.30	1.00	1.50	1.50	1.55	1.40	1.20	1.20	1.30
	Protection status of the wetland	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Protection status of the vegetation type	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Regional context of the ecological integrity	2.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	1.00	2.00	2.00	3.00	3.00	3.00	3.00	2.00	3.00	3.00
	Size and rarity of the wetland type/s present	1.50	0.25	1.00	2.00	0.50	1.00	1.00	1.50	1.00	1.00	1.00	1.50	1.00	1.00	0.50	1.50	1.00	1.00	1.00	0.00	1.50	0.75	1.50	1.50	1.75	1.00	1.00	0.00	0.00
	Diversity of habitat types	2.00	0.00	0.00	1.75	1.50	1.50	1.75	1.75	1.50	1.50	0.50	0.50	0.50	0.50	0.50	1.00	0.25	0.25	0.50	0.00	1.00	0.25	1.00	1.00	1.00	1.00	1.00	1.00	1.50
	Sensitivity of the wetland	2.17	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	2.17	0.83	2.17	1.67	2.17	1.67	0.83	2.17	0.83	0.83	0.83	0.83	1.67	2.17	2.17
	Sensitivity to changes in floods	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	2.00	2.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00
	Sensitivity to changes in low flows/dry season	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	1.00	3.00	2.00	3.00	2.00	1.00	3.00	1.00	1.00	1.00	1.00	2.00	3.00	3.00
	Sensitivity to changes in water quality	1.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	1.50	0.50	1.50	1.00	1.50	1.00	0.50	1.50	0.50	0.50	0.50	0.50	1.00	1.50	1.50
	Hydro-Functional Importance	**Hydro-Functional Importance**																												
Regulating and supporting benefits	**Flood attenuation**	1.50	2.00	2.00	2.00	1.25	1.25	2.00	2.00	1.25	1.25	1.75	1.75	1.25	1.75	1.50	2.00	1.50	1.50	1.50	1.50	2.00	1.50	2.00	2.00	2.00	2.00	1.50	1.50	1.50
Regulating and supporting benefits	**Streamflow regulation**	2.75	2.50	2.50	2.50	0.00	0.00	2.50	2.50	0.00	0.00	0.00	0.00	0.00	2.25	2.75	2.50	2.75	2.75	2.75	2.00	2.50	2.75	2.50	2.50	2.50	2.50	2.75	2.75	2.75
Water quality enhancement	*Sediment trapping*	1.50	1.50	1.50	1.50	1,5	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.75	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Water quality enhancement	*Phosphate assimilation*	1.50	1.75	1.75	1.75	1.50	1.50	1.75	1.75	1.50	1.50	1.50	1.50	1.50	1.75	1.50	1.75	1.50	1.25	1.50	1.00	1.75	1.50	1.75	1.75	1.75	1.75	1.25	1.50	1.50
Water quality enhancement	*Nitrate assimilation*	2.25	2.00	2.00	2.00	1.50	1.50	2.00	2.00	1.50	1.50	1.50	1.50	1.50	1.75	2.25	2.00	2.25	2.00	2.25	1.25	2.00	2.25	2.00	2.00	2.00	2.00	2.00	2.25	2.25
Water quality enhancement	*Toxicant assimilation*	1.75	1.50	1.50	1.50	1.25	1.25	1.50	1.50	1.25	1.25	1.25	0.50	1.25	1.50	1.75	1.50	1.75	1.50	1.75	1.25	1.50	1.75	1.50	1.50	1.50	1.50	1.50	1.75	1.75
Water quality enhancement	*Erosion control*	3.00	3.00	3.00	3.00	2.00	2.00	3.00	3.00	2.00	2.00	3.00	3.00	2.00	2.50	3.00	3.00	3.00	3.00	3.00	0.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Regulating and supporting benefits	**Carbon storage**	2.00	1.25	1.25	1.25	1.00	1.00	1.25	1.25	1.00	1.00	1.00	1.00	1.00	0.50	2.00	1.25	2.00	2.00	2.00	0.75	1.25	2.00	1.25	1.25	1.25	1.25	2.00	2.00	2.00
	Direct Human Benefits	**Direct Human Benefits**																												
Subsistence benefits	*Water for human use*	2.50	1.50	1.50	1.50	1.00	1.00	1.50	1.50	1.00	1.00	0.00	0.00	1.00	1.00	2.50	1.50	2.50	2.50	2.50	1.50	1.50	2.50	1.50	1.50	1.50	1.50	2.50	2.50	2.50
Subsistence benefits	*Harvestable resources*	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	0.50	0.50	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Subsistence benefits	*Cultivated foods*	1.25	2.25	2.25	2.25	1.25	1.25	2.25	2.25	1.25	1.25	0.50	0.50	1.25	2.25	1.25	2.25	1.25	1.25	1.25	1.25	2.25	1.25	2.25	2.25	2.25	2.25	1.25	1.25	1.25
Cultural benefits	*Cultural heritage*	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cultural benefits	*Tourism and recreation*	2.50	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.50	1.50	1.75	1.25	2.50	1.75	2.50	2.50	2.50	1.50	1.75	2.50	1.75	1.75	1.75	1.75	2.50	2.50	2.50
Cultural benefits	*Education and research*	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.25	1.25	1.50	0.50	1.50	1.50	1.50	1.50	1.50	0.75	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
	Ecological Importance and Sensitivity	2.17	0.85	1.00	1.75	1.92	1.92	1.92	1.92	1.50	1.50	1.10	1.08	1.33	1.83	2.17	1.83	2.17	1.87	2.17	1.67	1.70	2.17	2.00	2.00	2.00	2.00	1.67	2.17	2.17
	Hydrological/functional Importance	1.94	2.03	1.94	1.94	1.94	1.21	1.25	1.94	1.94	1.25	1.25	1.44	1.34	1.25	1.72	2.03	1.94	2.03	1.94	2.03	1.16	1.94	2.03	1.94	1.94	1.94	1.94	1.94	2.03
	Direct Human Benefits	1.67	1.54	1.54	1.54	1.29	1.29	1.54	1.54	1.29	1.29	0.63	0.63	1.29	1.21	1.67	1.54	1.67	1.67	1.67	1.21	1.54	1.67	1.54	1.54	1.54	1.54	1.67	1.67	1.67
	OVERALL IMPORTANCE	2.17	2.03	1.94	1.94	1.94	1.92	1.92	1.94	1.94	1.50	1.25	1.44	1.34	1.83	2.17	2.03	2.17	2.03	2.17	2.03	1.70	2.17	2.03	2.00	2.00	2.00	1.94	2.17	2.17

	HGM unit	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
	Ecological Importance and Sensitivity	**Ecological Importance and Sensitivity**																													
	Biodiversity support	1.17	0.83	0.83	0.67	0.67	0.83	1.17	1.00	0.83	0.83	1.33	0.83	0.83	0.83	1.33	1.33	2.00	2.00	2.00	2.00	2.00	1.33	1.33	1.67	1.50	1.33	1.33	0.83	0.83	1.17
	Presence of Red Data species	1.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.50	1.50	2.00	2.00	2.00	2.00	2.00	1.00	1.00	2.00	1.50	1.00	1.00	1.00	1.00	1.00
	Populations of unique species	1.00	0.50	0.50	0.50	0.50	0.50	1.00	0.50	0.50	0.50	2.00	0.50	0.50	0.50	1.00	1.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.50	1.50	1.50	1.50	0.50	0.50	1.00
	Migration/breeding/feeding sites	1.00	1.00	1.00	0.50	0.50	1.00	1.50	1.50	1.00	1.00	1.00	1.00	1.00	1.00	1.50	1.50	2.00	2.00	2.00	2.00	2.00	1.50	1.50	1.50	1.50	1.50	1.50	1.00	1.00	1.50
	Landscape scale	1.10	0.85	1.00	1.20	1.00	0.75	1.30	1.40	1.00	1.15	0.90	1.00	1.10	1.45	1.40	1.30	1.50	1.20	1.60	1.40	1.50	1.50	1.30	1.50	1.00	1.20	1.05	1.20	1.20	1.00
	Protection status of the wetland	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Protection status of the vegetation type	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Regional context of the ecological integrity	2.00	1.00	1.00	2.00	1.00	1.00	2.00	2.00	1.00	2.00	1.00	1.00	2.00	2.00	3.00	2.00	3.00	2.00	3.00	3.00	3.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00	2.00	1.00
	Size and rarity of the wetland type/s present	0.50	0.75	1.00	1.00	1.00	0.50	1.50	1.50	1.00	1.00	1.00	1.50	1.00	1.75	1.00	1.00	1.00	1.00	1.50	0.50	1.00	1.00	1.50	1.00	0.00	1.00	0.25	1.00	1.00	1.00
	Diversity of habitat types	1.00	0.50	1.00	1.00	1.00	0.25	1.00	1.50	1.00	0.75	0.50	0.50	0.50	1.50	1.00	1.50	1.50	1.00	1.50	1.50	1.50	1.50	1.00	1.50	1.00	1.00	1.00	1.00	1.00	1.00
	Sensitivity of the wetland	0.83	1.67	0.83	0.83	0.83	0.83	1.67	0.83	1.67	0.83	0.83	0.83	0.83	0.83	2.17	0.83	2.17	0.83	0.83	1.67	0.83	0.83	0.83	2.17	1.67	0.83	0.83	0.83	0.83	2.17
	Sensitivity to changes in floods	1.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00	2.00	1.00	1.00	1.00	1.00	2.00
	Sensitivity to changes in low flows/dry season	1.00	2.00	1.00	1.00	1.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	3.00	1.00	3.00	1.00	1.00	2.00	1.00	1.00	1.00	3.00	2.00	1.00	1.00	1.00	1.00	3.00
	Sensitivity to changes in water quality	0.50	1.00	0.50	0.50	0.50	0.50	1.00	0.50	1.00	0.50	0.50	0.50	0.50	0.50	1.50	0.50	1.50	0.50	0.50	1.00	0.50	0.50	0.50	1.50	1.00	0.50	0.50	0.50	0.50	1.50
	Hydro-Functional Importance	**Hydro-Functional Importance**																													
Regulating and supporting benefits	**Flood attenuation**	2.00	1.75	1.75	1.75	1.75	2.00	1.50	2.00	1.50	2.00	1.75	2.00	1.75	2.00	1.75	1.75	1.50	2.00	2.00	1.50	2.00	1.75	2.00	1.50	1.50	2.00	2.00	1.75	2.00	1.50
Regulating and supporting benefits	**Streamflow regulation**	2.50	2.25	2.25	2.00	2.25	2.50	2.75	2.50	2.00	2.50	2.25	2.50	0.00	2.50	2.75	2.25	2.75	2.50	2.50	2.75	2.50	0.00	2.50	2.75	2.75	2.50	2.50	2.00	0.00	2.75
Water quality enhancement	*Sediment trapping*	1.50	1.75	1.75	2.50	1.75	1.50	1.50	1.50	1.50	1.50	1.75	1.50	1.50	1.50	1.50	1.75	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	2.50	1.50	1.50
Water quality enhancement	*Phosphate assimilation*	1.75	1.75	1.75	2.00	1.75	1.75	1.25	1.75	1.00	1.75	1.75	1.75	1.50	1.75	1.50	1.75	1.50	1.75	1.75	1.25	1.75	1.50	1.75	1.50	1.25	1.75	1.75	2.00	1.75	1.50
Water quality enhancement	*Nitrate assimilation*	2.00	1.75	1.75	2.00	1.75	2.00	2.00	2.00	1.25	2.00	1.75	2.00	1.50	2.00	2.25	1.75	2.25	2.00	2.00	2.00	2.00	1.50	2.00	2.25	2.00	2.00	2.00	2.00	2.00	2.25
Water quality enhancement	*Toxicant assimilation*	1.50	1.50	1.50	2.25	1.50	1.50	1.50	1.50	1.25	1.50	1.50	1.50	1.25	1.50	1.75	1.50	1.75	1.50	1.50	1.50	1.50	1.25	1.50	1.75	1.50	1.50	1.50	2.25	1.50	1.75
Water quality enhancement	*Erosion control*	3.00	2.50	2.50	2.75	2.50	3.00	3.00	3.00	0.00	3.00	2.50	3.00	3.00	3.00	3.00	2.50	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.75	3.00	3.00	3.00
Regulating and supporting benefits	**Carbon storage**	1.25	0.50	0.50	1.00	0.50	1.25	2.00	1.25	0.75	1.25	0.50	1.25	1.00	1.25	2.00	0.50	2.00	1.25	1.25	2.00	1.25	1.00	1.25	2.00	2.00	1.25	1.25	1.00	1.25	2.00
	Direct Human Benefits	**Direct Human Benefits**																													
Subsistence benefits	*Water for human use*	1.50	1.00	1.00	0.50	1.00	1.50	2.50	1.50	1.50	1.50	1.00	1.50	0.00	1.50	2.50	1.00	2.50	1.50	1.50	2.50	1.50	0.00	1.50	2.50	2.50	1.50	1.50	0.50	1.50	2.50
Subsistence benefits	*Harvestable resources*	1.25	1.25	1.25	0.50	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	0.50	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	0.50	1.25	1.25	1.25	1.25	1.25	0.50	1.25	1.25
Subsistence benefits	*Cultivated foods*	2.25	2.25	2.25	0.50	2.25	2.25	1.25	2.25	1.25	2.25	2.25	2.25	0.50	2.25	1.25	2.25	1.25	2.25	2.25	1.25	2.25	0.50	2.25	1.25	1.25	2.25	2.25	0.50	2.25	1.25
Cultural benefits	*Cultural heritage*	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00
Cultural benefits	*Tourism and recreation*	1.75	1.25	1.25	0.50	1.25	1.75	2.50	1.75	1.50	1.75	1.25	1.75	1.50	1.75	2.50	1.25	2.50	1.75	1.75	2.50	1.75	1.50	1.75	2.50	2.50	1.75	1.75	0.50	1.75	2.50
Cultural benefits	*Education and research*	1.50	0.50	0.50	0.75	0.50	1.50	1.50	1.50	0.75	1.50	0.50	1.50	1.25	1.50	1.50	0.50	1.50	1.50	1.50	1.50	1.50	1.25	1.50	1.50	1.50	1.50	1.50	0.75	1.50	1.50
	Ecological Importance and Sensitivity	1.17	1.67	1.00	1.20	1.00	0.83	1.67	1.40	1.67	1.15	1.33	1.00	1.10	1.45	2.17	1.33	2.17	2.00	2.00	2.00	2.00	1.50	1.33	2.17	1.67	1.33	1.33	1.20	1.20	2.17
	Hydrological/functional Importance	2.03	1.94	1.72	1.72	2.03	1.72	1.94	1.94	1.94	1.16	1.94	1.72	1.94	1.44	1.94	2.06	1.72	2.03	1.94	1.94	1.94	1.94	1.44	1.94	2.03	1.94	1.94	1.91	2.06	1.63
	Direct Human Benefits	1.54	1.21	1.21	0.46	1.21	1.54	1.67	1.54	1.21	1.54	1.21	1.54	0.63	1.54	1.67	1.21	1.67	1.54	1.54	1.67	1.54	0.63	1.54	1.67	1.67	1.54	1.54	0.46	1.54	1.67
	OVERALL IMPORTANCE	2.03	1.94	1.72	1.72	2.03	1.72	1.94	1.94	1.94	1.54	1.94	1.72	1.94	1.54	2.17	2.06	2.17	2.03	2.00	2.00	2.00	1.94	1.54	2.17	2.03	1.94	1.94	1.91	2.06	2.17

APPENDIX F – PHOTOGRAPHS OF THE AQUATIC ASSESSMENT SITES (APRIL 2021)


NBC 1 – April 2021 - Impoundment


NBC 2 – April 2021 - Channelled valley bottom

NBC 3 – April 2021 - Impoundment

NBC 4 – April 2021 – Impoundment

NBC 5 – April 2021 – Impoundment

NBC 6 – April 2021 - Depression

NBC 7 – June 2021 – Stream: Downstream view

NBC 8 – April 2021 - Impounded depression

NBC 9 – April 2021 – Unchannelled valley bottom

APPENDIX G – AQUATIC MACROINVERTEBRATE DATA

	Glisa Section (Cleanstream, 2020)							Paardeplaats Section					
Taxon	**Dam 2**	**1B**	**4A**	**4B**	**7**	**Pan 1**	**Blue Gum Dam**	**NBC 1**	**NBC 2**	**NBC 3**	**NBC 4**	**NBC 5**	**NBC 7**
Turbellaria			1					1	B	1		A	A
Oligochaeta					A			B	1		1	A	
Hirudinea	1							1		A		B	
Potamonautidae				A	A				1				A
Hydracarina	A	1	B				A			A	A	B	A
Baetidae 1sp						1	1			B	A		
Baetidae 2spp								B	A			B	
Baetidae >2spp					B								B
Caenidae			A		B			1	1	B			B
Leptophlebiidae											1		B
Coenagrionidae	A	A	A			A	A	A	1	1		1	1
Aeshnidae	1	1	1		A	A	A	B			A	B	A
Corduliidae					1								
Gomphidae					A				A				A
Libellulidae	1			1	A	B	1	A			A		
Belostomatidae	A	A				1	A	A		A	A	A	A
Corixidae	B	1	B		B	B		B	B	C	B	C	D
Gerridae	1					A	1	A		A	B		1
Hydrometridae									1				
Naucoridae	A				B	A			B	A	A	A	B
Nepidae	1						1	A		1	A	1	
Notonectidae	B		A			1	A	A		B	B	A	1
Pleidae	A	1	A			A	A	A		C	B	B	A
Veliidae			A		1	A		A	1	A	A		
Hydropsychidae 1sp					1								1
Hydroptilidae										A			
Leptoceridae			1		1				A		1		
Dytiscidae		A	1	1	A		A	B	1	B	B	B	A
Elmidae													
Gyrinidae				1	B				B				A
Hydraenidae								A			A	1	
Hydrophilidae							1	B				1	A
Ceratopogonidae													A
Chironomidae	A		A		A			B	B	B	B	B	B
Culicidae		A						1		1			A
Dixidae									A				A
Simuliidae				A	B				1				B
Tipulidae					1								A
Ancylidae					A								
Bulinae								A				A	
Lymnaeidae	B		A					1		A			
Physidae						1	A					1	
Planorbinae						A				A			1
Sphaeridae													A
SASS5 Score	**60**	**36**	**60**	**22**	**101**	**56**	**59**	**88**	**83**	**81**	**88**	**82**	**139**
No. of Taxa	**14**	**8**	**13**	**5**	**19**	**13**	**13**	**22**	**17**	**20**	**18**	**19**	**27**
ASPT	**4.29**	**4.50**	**4.62**	**4.40**	**5.32**	**4.31**	**4.54**	**4.00**	**4.88**	**4.05**	**4.89**	**4.32**	**5.15**

APPENDIX H – DIATOM SPECIES LIST

Diatom species collected during April 2021. Abundance is indicated as:

- Red - low abundance.
- Yellow – moderate abundance.
- Green – dominant.

Species	NBC 1	NBC 2	NBC 3	NBC 4	MNC 5	NBC 6	NBC 8	NBC 9
Abnormal diatom valve (unidentified) or sum of deformities abundances	2				2			
Achnanthidium gracillimum (Meister) Lange-Bertalot			13					
Achnanthidium lineare W. Smith	24	16	7		8			
Achnanthidium macrocephalum (Hustedt) Round & Bukhtiyarova	23	6	18		1		3	
Achnanthidium minutissima Kützing (Czarnecki)	236	192	74	8	135	3	1	17
Achnanthidium species								
Adlafia minuscula (Grunow) Lange-Bertalot								
Aulacoseira ambigua (Grunow) Simonsen	4							
Aulacoseira crassipunctata Krammer								2
Aulacoseira granulata (Ehrenberg) Simonsen	4							
Aulacoseira subartica f. *subborealis* Nygaard								4
Brachysira neoexilis (Grunow) DG Mannt	17	8		327	1	4	68	6
Caloneis hyalina Hustedt								2
Chamaepinnularia mediocris (Krasske) Lange-Bertalot						9		
Cocconeis placentula Ehrenberg			6					
Cocconeis placentula var. *lineata* (Ehrenberg) Van Heurck			2					
Craticula molestiformis (Hustedt) Lange-Bertalot			3					
Cyclotella ocellata Pantocsek								
Cymbella naviculiformis Auerswald		2						
Cymbella species							2	3
Encyonema mesianum (Cholnoky) D.G. Mann							8	
Encyonema minutum (Hilse) DG Mann	3		8		3	2	1	
Encyonema species							1	
Encyonopsis cesatii (Rabenhorst) Krammer								
Encyonopsis subminuta Krammer & Reichardt	8							
Eolimna minima (Grunow) Lange-Bertalot	2		14			1		
Epithemia adnata (Kützing) Brébisson			1					
Eunotia bilunaris (Ehrenberg) Mills		1		9	3	73	27	
Eunotia exigua (Brébisson) Rabenhorst								1
Eunotia implicata Norpel. Lange-Bertalot & Alles		6						
Eunotia incisa Gregory						10		
Eunotia minor (Kützing) Grunow		31	1	1	1	96	9	74
Eunotia naegeli Migula				22			31	3
Eunotia paludosa Grunow		17				5		123
Eunotia rhomboidea Hustedt						2		
Eunotia species						5		2
Fragilaria capucina Desmazieres		11						
Fragilaria crotonensis Kitton	36							
Frustulia crassinervia (Brébisson) Lange-Bertalot & Krammer						37		19
Frustulia vulgaris (Thwaites) De Toni		1			6			
Frustulia weinholdii Hustedt								
Gomphonema acidoclinatum Lange-Bertalot & Reichardt							7	
Gomphonema acuminatum Ehrenberg	3	1	4					
Gomphonema aff. *lagenula*		8						8

Species	NBC 1	NBC 2	NBC 3	NBC 4	MNC 5	NBC 6	NBC 8	NBC 9
Gomphonema angustatum (Kützing) Rabenhorst	1	1						
Gomphonema exilissimum Lange-Bertalot & Reichardt					5			
Gomphonema gracile Ehrenberg		1	1		3	1		
Gomphonema insigne Gregory		1						
Gomphonema parvulum (Kützing) Kützing	3	23		7	1	1		5
Gomphonema parvulum var. *parvulius* Lange-Bertalot & Reichardt		8				4		78
Gomphonema species			5	4	8	5	16	11
Mayamaea atomus (Kützing) Lange-Bertalot	1							
Mayamaea atomus var. *permitis* (Hustedt) Lange-Bertalot	1							
Navicula cryptocephala Kützing		12	24		7			3
Navicula cryptotenella Lange-Bertalot								1
Navicula kotschyi Grunow								1
Navicula notha Wallace					10	1		8
Navicula radiosa Kützing		1	35		1			
Navicula rostellata Kützing		3						
Navicula species		1	3		1		1	3
Navicula tridentula Krasske			1					1
Navicula trivialis Lange-Bertalot		1						
Navicula veneta Kützing		1						
Nitzschia acicularis (Kützing) WM Smith			14					
Nitzschia acidoclinata Lange-Bertalot	13	2	19		32	9		
Nitzschia agnewii Cholnoky			11		1			
Nitzschia amphibia Grunow		2						
Nitzschia archibaldii Lange-Bertalot					8			
Nitzschia gracilis Hantzsch			8					
Nitzschia linearis (Agardh) W Smith		1	10		3			
Nitzschia linearis var. *subtilis* (Grunow)	3		2	1				
Nitzschia nana Grunow				7				1
Nitzschia palea (Kützing) W. Smith		3	11					
Nitzschia paleaeformis Hustedt					8	1	3	
Nitzschia perminuta (Grunow) M. Peragallo			5					
Nitzschia pura Hustedt			40		36			
Nitzschia recta Hantzsch			10					
Nitzschia species	6	15	31	10	70	28	18	9
Pinnularia borealis Ehrenberg						6		
Pinnularia divergens W Smith							3	
Pinnularia gibba Ehrenberg						48		
Pinnularia microstauron var. *rostrata* Krammer				2		10		
Pinnularia species		2	3	2		11	1	11
Pinnularia subcapitata Gregory		1						
Pinnularia viridis (Nitzsch) Ehrenberg						20		
Placoneis dicephala (W Smith) Mereschkowsky		1						
Planothidium frequentissima (Lange-Bertalot) Round & Bukhityarova		1						
Rhopalodia gibba (Ehrenberg) O Müller			2		4			
Rhopalodia gibberula (Ehrenberg) O Müller								1
Sellaphora pupula (Kützing) Mereschkowksy		2				1		
Sellaphora radiosa (Hustedt) Kobayasi in Mayama & al.			3					
Sellaphora seminulum (Grunow) DG Mann			1					
Stauroneis gracilior (Rabenhorst) Reichardt						5		
Stenopterobia delicatissima (Lewis) Brébisson						2		1

Species	NBC 1	NBC 2	NBC 3	NBC 4	MNC 5	NBC 6	NBC 8	NBC 9
Synedra rumpens Kützing	10	3			36			
Synedra tenera W. Smith			8		2			
Tabellaria flocculosa (Roth) Kützing		5						2
Ulnaria biceps (Kützing) Compére		9	2		2			
Ulnaria ulna Sippe *angustissima* (Grunow) Compére					2			
Total Count	**400**	**400**	**400**	**400**	**400**	**400**	**200**	**400**

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PGS HERITAGE

NBC COLLIERY GLISA AND PAARDEPLAATS MINING PROJECT

Phase 1 – Heritage Impact Assessment

Issue Date:	**19 May 2021**
Revision No.:	**2.0**
PGS Project No.:	**524HIA**
CIGroup project No:	**19.0001**

Declaration of Independence

PGS HERITAGE

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Directors: HS Steyn, PD Birkholtz, W Fourie

I, Polke Birkholtz, declare that –

- I act as the independent heritage practitioner 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 heritage impact assessments, 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 will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- 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;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected from a heritage practitioner in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

HERITAGE CONSULTANT: PGS Heritage (Pty) Ltd

CONTACT PERSON: Polke Birkholtz – Project Manager
Tel: +27 (0) 12 332 5305
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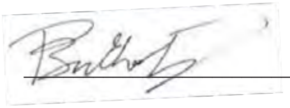
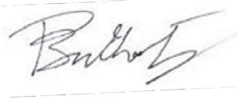
SIGNATURE: 

Report Title	NBC Colliery Glisa and Paardeplaats Mining Project		
Control	**Name**	**Signature**	**Designation**
Author	Cherene de Bruyn		Archaeologist – PGS Heritage
Co-Author & Internal Review	Polke Birkholtz		Archaeologist/Heritage Specialist/Project Manager – PGS Heritage

DETAILS OF CLIENT:

CLIENT: CIGroup Environmental (Pty) Ltd

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EXECUTIVE SUMMARY

Introduction

PGS Heritage (Pty) Ltd (PGS) was appointed by CIGroup Environmental (Pty) Ltd (CIGroup) to undertake a Heritage Impact Assessment (HIA) for the Glisa and Paardeplaats Sections of the NBC Colliery (NBC). The project area is located near (eMakhazeni) Belfast and is situated in the eMakhazeni Local Municipality, Nkangala District Municipality, Mpumalanga Province

Project Description

The following information was provided by CIGroup. NBC consists of three (3) mining sections namely the Eerstelingsfontein Section, the Glisa Section, and the Paardeplaats Section. The focus of this assessment will be on the Glisa and Paardeplaats Sections.

The Section 102 Consolidation and IEA application focus on the following:

- Consolidation of the Glisa Section Mining Right (MR) and Environmental Management Plan (EMP) into the Paardeplaats Section (MP 30/5/1/2/2/10090 MR);
- Inclusion of Portion 24 of the farm Paardeplaats 380 JT into the Paardeplaats Section MR; and
- IEA for listed activities triggered in terms of the NEMA and National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEMA:WA) within the MR areas and Portion 24 of the farm Paardeplaats 380 JT1.

NBC require the following changes to existing infrastructure:

- Expansion of the Crushing, Screening and Washing Plant (CSWP) on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Expansion of the existing Water Treatment Plant (WTP) pipeline network on all farm portions associated with the Integrated Paardeplaats Section; and
- Widening of haul roads between the mining sections and processing plants

Scope of Work

PGS's scope of work was to undertake intensive walkthroughs of the proposed Discard Management Facility (DMF) coupled with revisits to the heritage sites identified by PGS during a previous study undertaken in 2012. This report and its recommendations are based on only this scope of work.

General Desktop Study

An archaeological and historical desktop study was undertaken of the project area and surrounding landscape (refer to **Chapter 5**). An archaeological and historical overview was compiled, which was augmented by an assessment of previous archaeological and heritage studies completed for the study area and surrounding landscape. Furthermore, an assessment was made of the early editions of the relevant topographic maps.

Associated Reports and Processes

PGS completed a Heritage Impact Assessment for the proposed Exxaro Paardeplaats project in 2012. The current report represents an amendment as well as verification of the sites identified in 2012. During the fieldwork for the 2012 study, a total of 32 heritage sites, including 22 heritage structures, seven cemeteries and three areas with historical mining shafts were identified. Although additional walkthroughs were also undertaken for the proposed DMF area, this report is largely based on the original fieldwork findings.

Fieldwork

The fieldwork comprised a field assessment of the study area undertaken primarily by foot and vehicle over the course of three days by an experienced fieldwork team from PGS consisting of an archaeologist (Cherene de Bruyn) and two field assistants (Michelle Sacshe and Thomas Mulaudzi). The fieldwork was undertaken from Monday, 19 April 2021 to Wednesday 21 April 2021.

As almost the entire project area had been intensively assessed as part of a previous HIA study by PGS, the focus on the current fieldwork was on revisiting all the heritage sites that were identified in the previous report and also undertaking intensive walkthroughs of a small section that is now earmarked for the development of a Discard Management Facility (DMF).

As part of the current fieldwork, revisits and verification of the location and state of the 32 heritage sites that were identified in 2012 were conducted. These previously identified sites are numbered PP 01 to PP 32. As part of the current fieldwork, an additional 13 heritage sites (PP33 to PP45) were identified. The table below provides a summary of all the heritage sites.

Table 1 – Heritage Sites identified within the Study Area

Site Number	Coordinates	Site Type	Significance
PP 1	S 25.725820 E 30.002610	Demolished Historic Farmstead	Low (GP.C)
PP 2	S 25.729890 E 30.002260	Burial Ground	Medium to High (GP.A)

PP 3	S 25.719080 E 30.004140	Burial Ground	Medium to High (GP.A)
PP 4	S 25.744150 E 29.985790	Burial Ground	Medium to High (GP.A)
PP 5	S 25.725210 E 30.015120	Burial Ground	Medium to High (GP.A)
PP 6	S 25.728000 E 30.010130	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 7	S 25.743270 E 30.003010	Demolished Historic Structures	Low (GP.C)
PP 8	S 25.743800 E 30.002360	Demolished Historic Farmstead	Low (GP.C)
PP 9	S 25.742100 E 30.004780	Demolished Historic Structure	Low (GP.C)
PP 10	S 25.750780 E 29.989940	Single Grave	Medium to High (GP.A)
PP 11	S 25.751030 E 29.989600	Historic Farmstead and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 12	S 25.745950 E 29.974200	Historic Coal Mine Shaft	Medium to High (GP.A)
PP 13	S 25.748830 E 29.974700	Historic Coal Mine Shaft	Medium to High (GP.A)
PP 14	S 25.752210 E 29.978990	Possible Rock Art Site	Medium to High (GP.A)
PP 15	S 25.754350 E 29.983240	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 16	S 25.752990 E 29.982910	Historic Homestead with Graves and the Possible Risk for Unmarked Graves	Medium to High (GP.A)
PP 17	S 25.748830 E 29.974700	Historic Coal Mine Shaft	Medium to High (GP.A)
PP 18	S 25.760100 E 29.966720	Animal Drinking Trough	Low (GP.C)
PP 19	S 25.759800 E 29.966230	Demolished Historic Structure	Low (GP.C)
PP 20	S 25.761510 E 29.965360	Reservoir with Associated Structures	Low (GP.C)

PP 21	S 25.761660 E 29.964650	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 22	S 25.761690 E 29.963750	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 23	S 25.761660 E 29.964650	Demolished Historic Structure (before 2012)	Low (GP.C)
PP 24	S 25.762720 E 29.961770	Sunbury Railway Station	Low (GP.C)
PP 25	S 25.732420 E 29.993510	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 26	S 25.734280 E 29.993040	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 27	S 25.735080 E 29.993410	Historic Structure	Medium (GP.B)
PP 28	S 25.736050 E 29.993310	Burial Ground	Medium to High (GP.A)
PP 29	S 25.726980 E 29.989670	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 30	S 25.718530 E 30.017220	Historic Farmstead	Medium (GP.B)
PP 31	S 25.711330 E 30.016450	Burial Ground	Medium to High (GP.A)
PP 32	S 25.723070 E 30.015850	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 33	S 25.748624 E 29.974775	Historic Structure	Medium (GP.B)
PP 34	S 25.742500 E 30.002855	Demolished Structure	Low (GP.C)
PP 35	S 25.743408 E 30.001842	Contemporary Farmstead	Low (GP.C)
PP 36	S 25.754370 E 29.981422	Historic Coal Mine Shaft	Medium to High (GP.A)
PP 37	S 25.750654 E 29.989601	Single Grave	Medium to High (GP.A)
PP 38	S 25.729260 E 30.013751	Reservoir with Associated Structures	Low (GP.C)

PP 39	S 25.726835 E 30.010754	Reservoir with Associated Structures	Low (GP.C)
PP 40	S 25.735453 E 29.995204	Historic Homestead with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 41	S 25.716593 E 30.014553	Structure	Low (GP.C)
PP 42	S 25.726796 E 30.002923	Animal Drinking Trough	Low (GP.C)
PP 43	S 25.738228 E 30.000564	Demolished Structure	Low (GP.C)
PP 44	S 25.736880 E 30.003181	Reservoirs with Associated Structures	Low (GP.C)
PP 45	S 25.735982 E 30.001980	Demolished Structure	Low (GP.C)

Palaeontology

The palaeontological Desktop Assessment (PDA) was conducted by Banzai Environmental (Butler, 2021). The proposed development is primarily underlain by the Vryheid Formation of the Ecca Group (Karoo Supergroup). According to the South African Heritage Resources Information System the project area is located in an area with Very High sensitivity (red), as such the Palaeontological Sensitivity of project area is Very High.

As such, a full Environmental Impact Assessment (EIA) level Palaeontological Impact Assessment (PIA) report is recommended to assess the value and prominence of fossils in the development area and the effect of the proposed development on the palaeontological heritage.

Impact of Proposed Development and Mitigation

An overlay of the identified archaeological and heritage sites over the proposed development footprint area for the DMF was made. It was established that none of the identified heritage sites are located within 100m of the proposed development of the DMF. As a result, no impact is expected as a result of the proposed development of the DMF. Refer **Chapter 7**.
Please note the following regarding heritage mitigation:

- No mitigation is required for heritage sites assessed to have a low heritage significance. As a result, no mitigation is required for the following sites: PP 01, PP 07, PP 08, PP 09, PP 18, PP 19, PP 20, PP 23, PP 24, PP 34, PP 35, PP 38, PP 39, PP 41, PP 42, PP 43, PP 44 & PP 45;

- No heritage impact is expected as a result of the proposed development of the Discard Management Facility (DMF);

- Site mitigation measures are outlined in **Chapter 8**. These mitigation measures would be required should any development footprints be proposed within 100m of the identified burial grounds and graves or within 50m of the other identified heritage sites that are of Medium Significance and higher. Refer **Section 8.2**; and

- General site mitigation measures are also required for the Possible Rock Art Site and sites comprising Historic Coal Mine Shafts. These general mitigation measures must be implemented as soon as possible and are not dependant on the expansion of development footprint areas. Refer **Section 8.3.**

Conclusions

The unmitigated impact of the proposed development of the DMF is not expected to result in any heritage impacts. As a result, on the condition that the recommendations made in this report are adhered to, no heritage reasons can be given for the development of the DMF not to continue.

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TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;

- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Cultural Landscapes Terminology

"perceptual qualities" Aspects of a landscape which are perceived through the senses, specifically views and aesthetics.

"cultural landscape" A representation of the combined worlds of nature and of man illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal (World Heritage Committee, 1992). Includes and extends beyond the study site boundaries.

"cultural landscape area" These are single unique areas which are the discrete geographical areas of a particular landscape type. Each will have its own individual character and identity, even though it shares the same generic characteristics with other areas of the same type.

"study site" The study site is assumed to include the area within the boundaries of the proposed development

"characteristics" elements, or combination of elements, which make a particular contribution to distinctive character.

"elements" individual components which make up the landscape, such as trees and fences.

"landscape character" A distinct, and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse.

"landscape character assessment" This is the process of identifying and describing variation in the character of the landscape. It seeks to identify and explain the unique combination of elements and features (characteristics) that make landscapes distinctive. This process results in the production of a Landscape Character Assessment.

“sense of place” The unique quality or character of a place, whether natural, rural or urban. It relates to uniqueness, distinctiveness or strong identity.

“scenic route” A linear movement route, usually in the form of a scenic drive, but which could also be a railway, hiking trail, horse-riding trail or 4x4 trail.

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influences its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Earlier Stone Age

The archaeology of the Stone Age between ~300 000 and 3 300 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) the following (as stated under Section 3 of the NHRA):

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;

- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa

Holocene

The most recent geological time period which commenced 10 000 years ago.

Later Stone Age

The archaeology of the last 30 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800’s, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Site

Site in this context refers to an area place where a heritage resource is located and not a proclaimed heritage site as contemplated under s27 of the NHRA.

Table 2 – List of abbreviations used in this report

Abbreviations	Description
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists

CRM	Cultural Resource Management
CSWP	Crushing, Screening and Washing Plant
DEA	Department of Environmental Affairs
DMF	Discard Management Facility
DWS	Department of Water and Sanitation
ECO	Environmental Control Officer
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
HMP	Heritage Management Plan
IAP	Interested and Affected Party
IWUL	Integrated Water Use License
LSA	Late Stone Age
LIA	Late Iron Age
LoM	Life of Mine (
MSA	Middle Stone Age
MIA	Middle Iron Age
MR	Mining Right
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
NEMA	National Environmental Management Act
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NHRA	National Heritage Resources Act
PDA	Palaeontological Desktop Assesment
PHRA	Provincial Heritage Resources Authority

PIA	Palaeontological Impact Assesment
PSSA	Palaeontological Society of South Africa
RO	Reverse Osmosis
RoM	Run of Mine
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
UF	Ultrafiltration
WTP	Water Treatment Plant

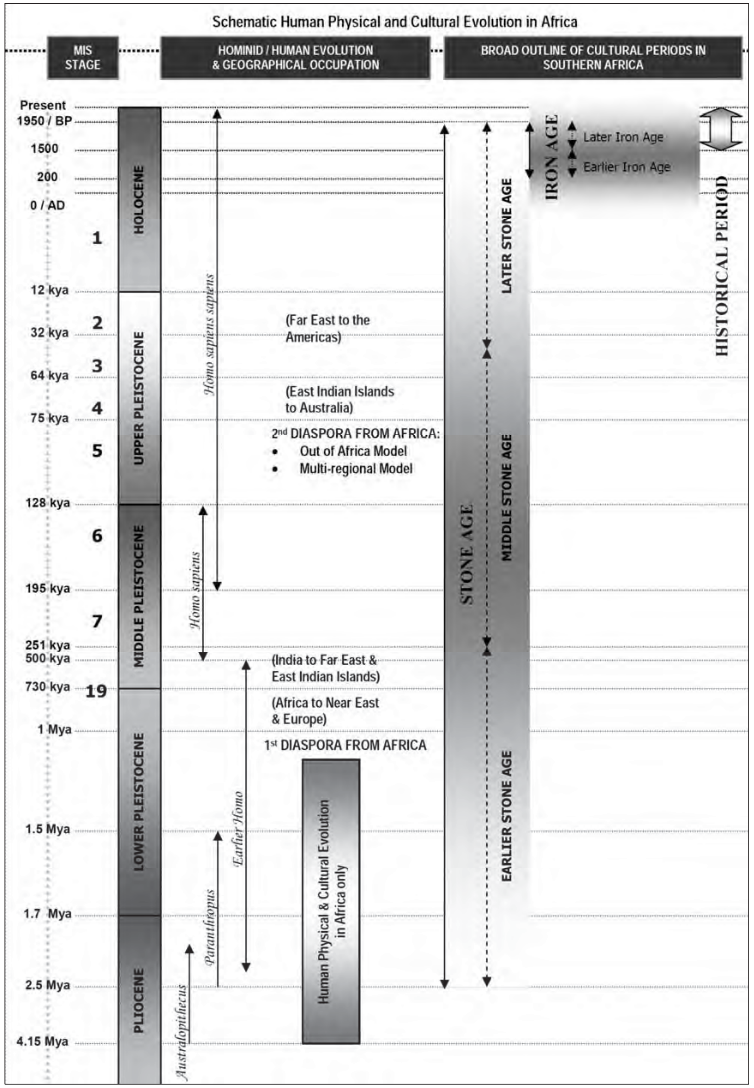

Figure 1 – Human and Cultural Timeline in Africa (Morris, 2008).

1 INTRODUCTION

PGS Heritage (Pty) Ltd was appointed by CIGroup (Pty) Ltd to undertake a Heritage Impact Assessment (HIA) for the Glisa and Paardeplaats Sections of the NBC Colliery (NBC). The project area is located near eMakhazeni (Belfast) and is situated in the eMakhazeni Local Municipality, Nkangala District Municipality, Mpumalanga Province.

The scope of work that PGS was appointed for was to undertake intensive walkthroughs of the DMF area coupled with revisits to the heritage sites identified during the previous hertage study undertaken by PGS in 2012.

1.1 Scope of the Study

This HIA aims to identify possible heritage sites and finds that may occur in the proposed development area and to assess the impact of the proposed development on these identified heritage sites. The study also aims to inform the developers to manage the identified heritage resources responsibly, to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This HIA was compiled by PGS. The staff at PGS has a combined experience of nearly 90 years in the heritage consulting industry and has extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where the staff has the relevant expertise and experience to undertake that work competently.

Polke Birkholtz, the project manager and co-author, is registered with the Association of Southern African Professional Archaeologists (ASAPA) as a Professional Archaeologist and is also accredited with its CRM Section. He has 20 years of experience in the heritage assessment and management field and holds a B.A. (cum laude) from the University of Pretoria specialising in Archaeology, Anthropology and History and a B.A. (Hons.) in Archaeology (cum laude) from the same institution.

Cherene de Bruyn, the author of this report is registered with ASAPA as a Professional Archaeologist and is accredited as a Principal Investigator and Field Director, she is further also a member of the International Association for Impact Assessment South Africa (IAIASA). She holds a MA in Archaeology from University College London, and a BSc (Hons) in Physical Anthropology and a BA (Hons) in Archaeology from the University of Pretoria.

1.3 Assumptions and Limitations

The following assumptions and limitations regarding this study and report exist:

- Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites, as well as the density of vegetation cover found in some areas. As such, should any heritage features and/or objects not included in the present study be located or observed, a heritage specialist must immediately be contacted. Such observed or located heritage features and/or objects may not be disturbed or removed in any way, until such time that the heritage specialist has been able to assess as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. If any graves or burial places are identified or exposed during the development, the procedures and requirements pertaining to graves and burials will apply as set out below (refer **Appendix A**).
- The scope of work that PGS was appointed for, was to undertake intensive walkthroughs of the DMF area coupled with revisits to the heritage sites identified during the previous heritage study by PGS in 2012. This report and its recommendations reflect this scope of work.
- Should any development footprint areas located outside the areas defined by the appointed scope of work by PGS be proposed, such additional footprint areas will have to be assessed in the field and included in a heritage impact assessment.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

1.4.1 Statutory Framework: The National Heritage Resources (Act 25 of 1999)

The NHRA has applicability, as the study forms part of an overall HIA in terms of the provisions of Section 34, 35, 36 and 38 of the NHRA and forms part of a heritage scoping study that serves to identify key heritage resources, informants, and issues relating to the palaeontological, archaeological, built environment and cultural landscape, as well as the need to address such issues during the impact assessment phase of the HIA process.

1.4.2 Section 34 – Structures

According to Section 34 of the NHRA, no person may alter, damage or destroy any structure that is older than 60 years, and which forms part of the sites built environment, without the necessary permits from the relevant provincial heritage authority.

1.4.3 Section 35 – Archaeology, Palaeontology and Meteorites

According to Section 35 (Archaeology, Palaeontology and Meteorites) and Section 38 (Heritage Resources Management) of the NHRA, PIAs and AIAs are required by law in the case of developments in areas underlain by potentially fossiliferous (fossil-bearing) rocks, especially where substantial bedrock excavations are envisaged, and where human settlement is known to have occurred during prehistory and the historic period.

1.4.4 Section 36 – Burial Grounds & Graves

A section 36 permit application is made to the SAHRA or the competent provincial heritage authority which protects burial grounds and graves that are older than 60 years and must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit. SAHRA must also identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with these graves and must maintain such memorials. A permit is required under the following conditions:

Permit applications for burial grounds and graves older than 60 years should be submitted to the South African Heritage Resources Agency:

a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of the conflict, or any burial ground or part thereof which contains such graves.
b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.
d) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant.

1.4.5 Section 38 - HIA as a Specialist Study within the EIA in Terms of Section 38(8)

A NHRA Section 38 (Heritage Impact Assessments) application to MP-PHRA is required when the proposed development triggers one or more of the following activities:

a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
b) the construction of a bridge or similar structure exceeding 50 m in length;
c) any development or other activity which will change the character of a site,
    i. exceeding 5 000 m2 in extent; or
    ii. involving three or more existing erven or subdivisions thereof; or
    iii. involving three or more erven or divisions thereof which have been consolidated within the past five years; or
    iv. the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
d) the re-zoning of a site exceeding 10 000 m2 in extent; or
e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority

In this instance, the heritage assessment for the property is to be undertaken as a component of the EIA for the project. Provision is made for this in terms of Section 38(8) of the NHRA, which states that:

- An HIA report is required to identify, and assess archaeological resources as defined by the NHR Act, assess the impact of the proposal on the said archaeological resources, review alternatives and recommend mitigation (see methodology above).

Section 38 (3) Impact Assessments are required, in terms of the statutory framework, to conform to basic requirements as laid out in Section 38(3) of the NHRA. These are:

- The identification and mapping of heritage resources in the area affected;
- The assessment of the significance of such resources;
- The assessment of the impact of the development on the heritage resources;
- An evaluation of the impact on the heritage resources relative to sustainable socio/economic benefits;
- Consideration of alternatives if heritage resources are adversely impacted by the proposed development;
- Consideration of alternatives; and
- Plans for mitigation.

1.4.6 Notice 648 of the Government Gazette 45421

Although minimum standards for archaeological (2007) and palaeontological (2012) assessments were published by SAHRA (2016), Government Notice (GN) 648 requires sensitivity verification for a site selected on the national web-based environmental screening tool for which no specific assessment protocol related to any theme has been identified. The requirements for this GN are listed in **Table 3** and the applicable section in this report noted.

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Table 3 - Reporting requirements for GN648.

GN 648	Relevant section in report	Where not applicable in this report
2.2 (a) a desktop analysis, using satellite imagery	Section 4 and 5	-
2.2 (b) a preliminary on-site inspection to identify if there are any discrepancies with the current use of land and environmental status quo versus the environmental sensitivity as identified on the national web-based environmental screening tool, such as new developments, infrastructure, indigenous/pristine vegetation, etc.	Section 4 and 5	-
2.3(a) confirms or disputes the current use of the land and environmental sensitivity as identified by the national web-based environmental screening tool	Section 1 and 5	-
2.3(b) contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity	Section 4 provides a description of the current use and confirms the status in the screening report	-

An assessment of the Environmental Screening tool provides the following sensitivity ratings for archaeological resources that fall within the proposed project area rated as Very High to Low (**Figure 2**), while palaeontological resources are rated as Very High (**Figure 3).**

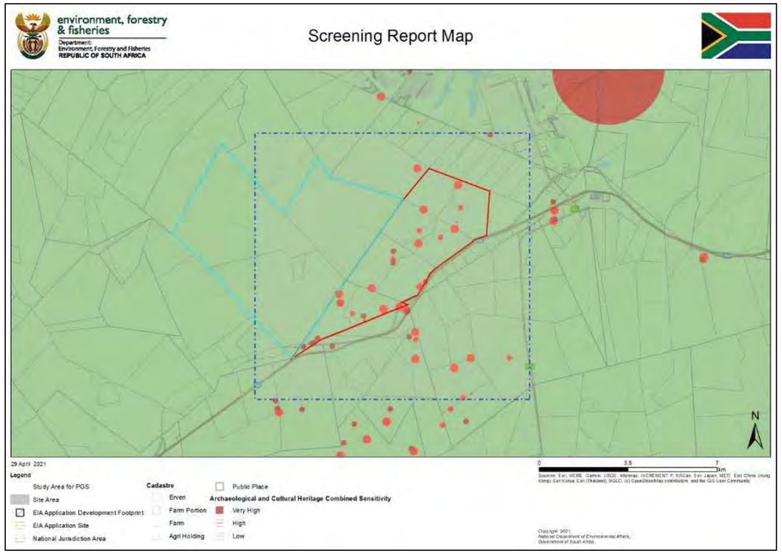


Figure 2 - Environmental screening tool's depiction of the archaeological and heritage sensitivity of the study area and surroundings.

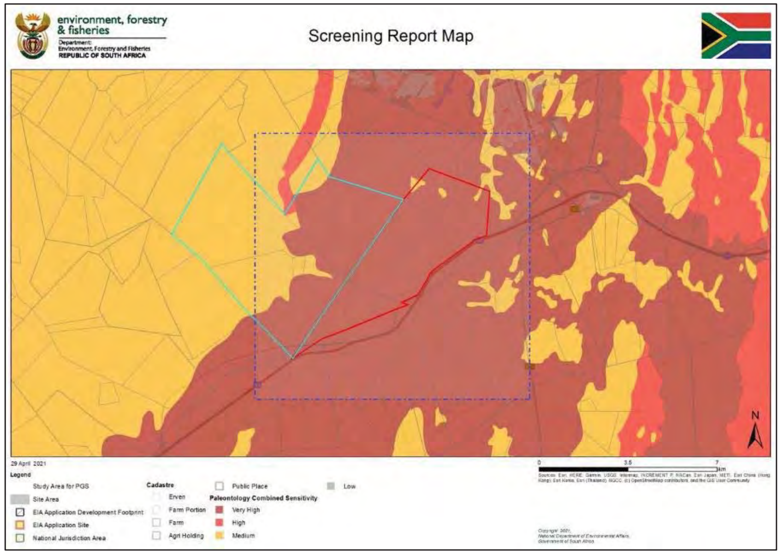


Figure 3 - Environmental screening tool's depiction of the palaeontological sensitivity of the study area and surroundings.

1.4.7 NEMA – Appendix 6 requirements

The HIA report has been compiled considering the National Environmental Management Act (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations (2014, and as amended in 2017). **Table 4** of this report sets out the relevant sections as listed in Appendix 6 of the EIA Regulations (2017), which describes the requirements for specialist reports. For ease of reference, **Table 4** provides cross-references to the report sections where these requirements have been addressed. It is important to note, that where something is not applicable to this HIA, this has been indicated in the table below.

Table 4 - Reporting requirements as per NEMA, as amended, Appendix 6 for specialist reports.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii of Report – Contact details and company	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 1 – refer to **Appendix B**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 1 and 2	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 3, 4 and 5	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6 and 7	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3 and 4	-
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3 and **Appendix A and B**	-
(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;	Sections 5 and 6	-
(g) An identification of any areas to be avoided, including buffers	Sections 6, 8 and 9	-
(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;	Figures 22 and 188	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1	-
(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	Section 7, 8 and 9	
(k) Any mitigation measures for inclusion in the EMPr	Sections 8 and 9	
(l) Any conditions for inclusion in the environmental authorisation	Sections 8 and 9	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Sections 8 and 9	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 9	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(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	Sections 8 and 9	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study		Not applicable. A public consultation process was handled as part of the BA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process		Not applicable. To date no comments regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.		Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	NEMA Appendix 6 and GN648 SAHRA guidelines on HIAs, PIAs and AIAs	

1.4.8 MPRDA 2002 (Act No. 28 OF 2002)

As per the NEMA no 107 of 1998, and the NEMA EIA Regulations, any activity requiring a prospecting right, mining right, mining permit, production right or exploration right, triggers the Mineral and Petroleum Resources Development Act, 28 of 2002 (MPRDA). The MPRDA Act 28 of 2002 intends to makes provision for sustainable development of South Africa's mineral and petroleum resources.

Furthermore, Chapter 8 of the MPRDA, as amended in 2015, states that the principles of the NEMA No. 107 of 1998 apply to all mining-related activities. It also serves as guidelines for the interpretation, administration and implementation of all the needed environmental requirements and authorizations of the MPRDA. In conjunction with the NEMA, the MPRDA makes provision that mining companies need to comply with other South African legislation regulating the impacts of mining-related projects on the natural and cultural environment, including the National Environmental Management Protected Areas Act (No. 57 of 2003) and the NHRA No. 25 of 1999.

Section 86 for EIA of the Regulations for Petroleum Exploration and Production (2015) of the MPRDA states that:

(1) The exploration and production activities related to petroleum are subject to the requirements of the NEMA and any relevant specific environmental management Act.
(2) Before exploration and production activities related to petroleum may commence, the holder must be in possession of an Environmental Authorisation (EA) issued in terms of the EIA Regulations, 2014.
(3) When submitting an application in terms of the EIA Regulations an applicant must comply with the minimum information requirement, guidance document or decision support tool as identified by the competent authority.
(4) The designated agency, the Council of Geosciences and the Council for Scientific Research must be identified as interested and affected parties for the purposes of the public participation to be undertaken as part of the EIA process.

2 PROJECT DESCRIPTION

2.1 Site Location

Study Area Coordinates	Northernmost point: S 25.705783 E 30.005728	Easternmost point: S 25.719525 E 30.026947
	Southernmost point: S 25.766746 E 29.957696	Westernmost point: S 25.731951 E 29.984605
Location	Near the town of eMakhazeni (Belfast) in the Emakhazeni Local Municipality and Nkangala District Municipality, Mpumalanga Province. The proposed project area is located approximately 3km south of eMakhazeni (Belfast), and 33km south-west of Dullstroom. The N4 is situated on the eastern boundary of the proposed project area.	
Property	Portion 1, Portion 2, Portion 3,Portion 4,Portion 5, Portion 13, Portion 24, Portion 28, Portion 29, Portion 30 and Portion 40 of the farm Paardeplaats 380 JT, as well as Remaining Extent and Portion 2 of the farm Paardeplaats 425 JS	
Topographic Map	2529DB, 2529DD, 2530CA and 2530CC	
Application Area	Approximately 2,463.78 hectares	

2.2 Project Description

The following information was provided by CIGroup.

NBC consists of three (3) mining sections namely the Eerstelingsfontein Section, the Glisa Section, and the Paardeplaats Section. The focus of this report will be on the Glisa and Paardeplaats Sections (**Figure 4 - Figure 6).**

A total of thirteen (13) farm portions relate to the Integrated Paardeplaats Section. Portion 1, 2, 3, 4, and 5 of the farm Paardeplaats 380 JT, apply to the Glisa Section MR, whilst the Remaining Extent of Portion 13, Portion 28, 29, 30 and 40 of the farm Paardeplaats 380 JT, and the Remaining Extent (RE) and Portion 2 of the farm Paardeplaats 425 JS, apply to the Paardeplaats Section. Portion 24 of the farm Paardeplaats 380 JT is the additional portion being requested through this process.

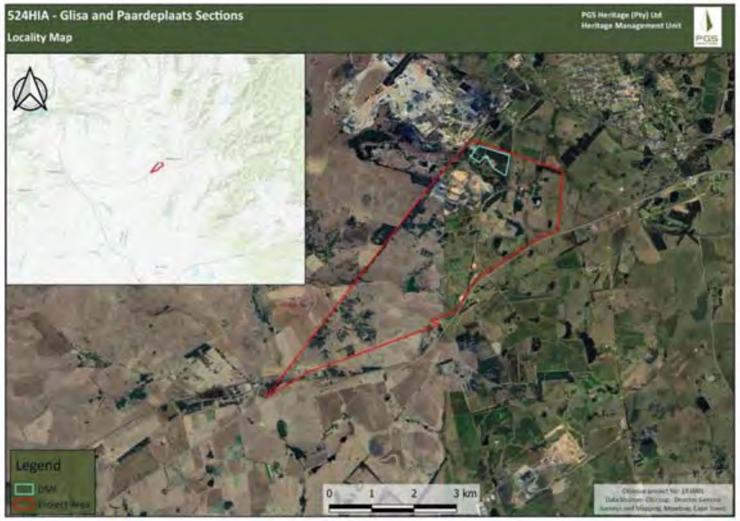


Figure 4 - Locality plan depicting the study area within its surroundings. The position of the proposed DMF area is shown in blue.

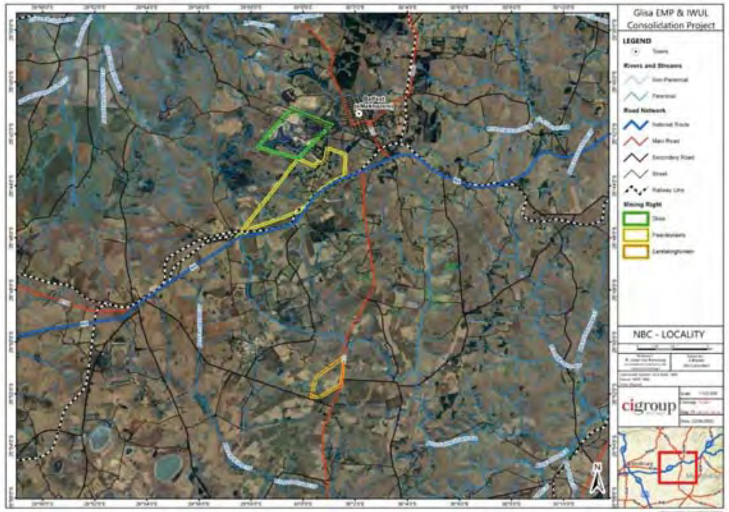


Figure 5 – Location and Farm Portions Applicable to the Glisa and Paardeplaats Sections. Map provided by CIGroup.

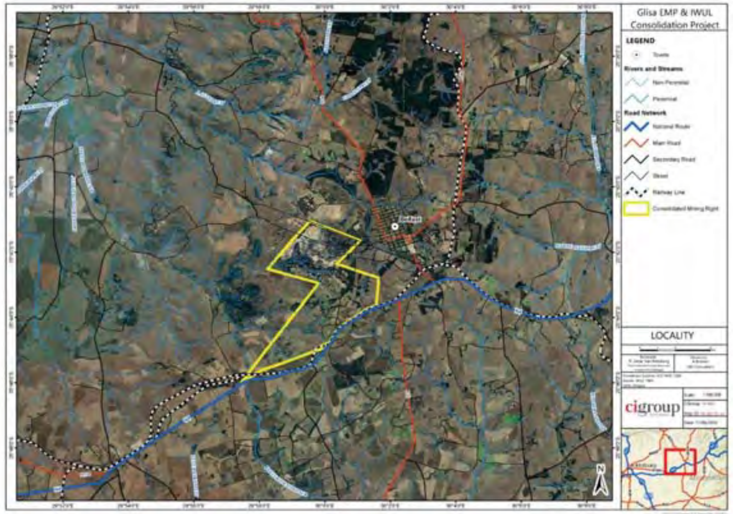


Figure 6 - Location of the Integrated Paardeplaats Section. Map provided by CIGroup.

2.3 Description of the Activities to be Undertaken

2.3.1 Current Activities

2.3.1.1 Glisa Section

Mining started at the Glisa Section in 1890 using underground mining methods. From 2006 mining was undertaken by opencast mining methods with underground pillars being reclaimed. This opencast mining method is still in force at the Glisa Section. Coal is crushed and screened at stationary plants whilst other coal products are processed at the main Crushing, Screening and Washing Plant (CSWP) located in the Glisa Section. In addition to mining and coal processing, the Glisa Section also consists of infrastructures such as roads, offices, workshops, stockpiles, pipelines, and a Water Treatment Plant (WTP).

NBC has an existing supply agreement with Eskom to supply steady and secure coal for selected Eskom coal-fired power stations. The Glisa Section has been the source of this coal for many years; however, the Glisa Section Life of Mine (LoM) is nearing its end and a resultant reduction in Run of Mine (RoM) coal is occurring. In order to meet its contractual obligations to Eskom, NBC intends to supply Eskom with coal from the adjoining Paardeplaats Section.

NBC, through the utilisation of the Glisa Section infrastructure, intends to limit the disturbance of additional natural areas in the Paardeplaats Section. In so doing, the utilisation of the existing infrastructure at the Glisa Section is paramount. Existing infrastructure at the Glisa Section is licensed in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) and the NEMA and all of the existing infrastructures at the Section will continue to be used in support of mining activities in the Integrated Paardeplaats Section. The infrastructure that will be continued to be used and which does not require licensing in terms of this application includes, the following:

- RoM stockpile areas at the crushing and screening plants, e.g. Gijima, and the main CSWP;
- Product stockpiles at the crushing and screening plants and main CSWP;
- Haul roads, including existing river diversions, culverts, and drains;
- Stormwater management infrastructure, including existing dams and channels;
- Magazine and explosives area;
- Workshops, administrative offices, mining contractor offices, and security offices, including ablution facilities, septic tanks, and French drains;
- Fuel bays, above and below ground diesel storage tanks, wash bays, and salvage areas; and
- Waste management areas.

2.3.1.1.1 Water Treatment Plant

The WTP for the Glisa Section spans an area of approximately 0.67 ha on Portion 24 of Paardeplaats 380JT and is fully operational. The design treatment capacity of the WTP is 1.5 megalitres per day (Ml/d) on average over a 30-day cycle, equating to an average of 62.5 cubic metres per hour (m^3/h). Proxa designed and constructed the WTP on behalf of the previous mine owner, Exxaro, and have been operating the WTP since 2017. The WTP processes entail chemical precipitation in combination with Ultrafiltration (UF) and Reverse Osmosis (RO) technologies. Additional brine treatment is designed to ensure a zero-brine discharge.

RO is a water treatment process whereby dissolved salts, such as sodium, chloride, calcium carbonate, and calcium sulphate may be separated from water by forcing the water through a semi-permeable membrane under high pressure. The water diffuses through the membrane and the dissolved salts remain behind as the liquid by-product. The liquid by-product generated by the WTP process is routed to a filter press which produces *Gypsum by-product* (25% moisture content) which is stored within a concrete based, bunded storage area on site.

The process water pipelines (dirty water collection and product water pipelines) traverse Portions 2, 3, 4, 5 and 24 of Paardeplaats 380JT. The purpose of the WTP is to treat water within the dams and voids at the Glisa and Paardeplaats Sections which have been impacted on by historical and current mining activities. The WTP is supported by a significant pipeline network to transfer feed water from the collection points to the WTP for treatment, as well as the pipeline routes from the plant to the discharge point and clean water storage locations.

The collection points are located within un-rehabilitated voids from historical opencast mining by previous owners of the mine. These voids contain poor quality water mainly from runoff. The voids are licensed in terms of the current Glisa Integrated Water Use License (IWUL) (License No.: 06/B41A/ABCFGIJ/1002; File No.: 27/2/2/B141/3/9) Water is collected from the collection points by means of sumps within which pumps are located

Existing infrastructure at the WTP in the Glisa Section is licensed in terms of the MPRDA and the NEMA and all of the existing infrastructure for the WTP will continue to be used in support of the Paardeplaats Section mining activities. The infrastructure that will continued to be used and which does not require licensing in terms of this application includes, the following:

- WTP and pipeline reticulation system, including discharge pipeline and electrical supply through a 500 Kilovolt Ampere (kVA) mini-substation;
- Gypsum storage areas at the WTP; and
- Waste management areas.

2.3.1.2 Paardeplaats Section

The Paardeplaats Section is an operational section that adjoins the Glisa Section. Mining is undertaken by opencast mining methods. Mining at the Paardeplaats Section will focus on Portion

30 of the farm Paardeplaats 380 JT for the first ten (10) years of the MR, before expanding to other farm portions.

As RoM reduces at the Glisa Section, the shortfall will be addressed through coal mined at the Paardeplaats Section. The Paardeplaats Section is an open cast mining operation where bench mining techniques are employed to access the coal seams. The 2 Seam Burden is removed with Dozers doing roll-over of the 2 seam burden into the previous 2 seam voids, and the upper burden seams are removed with the truck and shovel mining method. Coal seams 4, 3 and 2 will be mined for processing. Seam 1 appears in certain areas only and is highly weathered and contaminated with inseam shales and is not suitable to mine and will be left in situ in the pit. The Paardeplaats Section has an estimated RoM supply rate of 4.2 – 4.4 mtpa which relate to 2.4 – 2.6 mtpa of product, supplying Eskom's Komati and Arnot power stations, as well as an estimated RoM supply rate of 1.7 mtpa of export coal which equates to 1.0 mtpa of the export product.

2.3.1.2.1 Resource Details

The Integrated Paardeplaats Section falls within the Witbank Coal Field which is close to the north-eastern edge of the Karoo Basin. The Karoo sequence is represented by the Dwyka Formation consisting of diamictite and the overlaying Ecca Group. The coal seams of the Witbank Coal Field are found at the base of the Vryheid Formation of the Ecca Group and the strata in which coal seams occur consist predominantly of fine, medium and coarse-grained sandstone with subordinate mudstone, shale, siltstone, and carbonaceous shale.

All five coal seams of the Witbank Coal Field occur within the Integrated Paardeplaats Section. The number 2 and 4 seams are more extensively developed than seams 1, 3 and 5. In the far northeast portion of the Paardeplaats Section a dolerite sill, likely a post-depositional feature related to the Lesotho Basalts is believed to have completely displaced coal seams (EIMS, 2014). The coal seams are relatively flat-lying, and the average seam thickness is as follows:

- The Number (No.) 1 seam has an average thickness of 0.34 metres (m);
- The No. 2 seam has an average thickness of 5.37 m;
- The No. 3 seam has an average of 0.78 m;
- The No. 4 seam has an average thickness of 3.04 m; and
- The No. 5 seam has an average thickness of 0.62 m.

The No. 1, 2, 4 and 5 seams can be mined whilst the No. 3 seams, although persistent across the entire coal field, has been determined to be too thin to be considered an economically viable resource.

2.3.1.2.2 Mining Method

Mining at the Paardeplaats Section entails opencast mining. The open cast mining method was selected due to the shallowness of the target coal seams present within the MR area. The open cast mining will be undertaken as a hybrid of roll-over and bench/box cut mining techniques. The use of the two respective techniques is dependent on the number of seams present as well as the overburden thickness. The roll-over technique will be utilised where only a single seam is present and where the overburden has a corresponding thickness of less than 20 m. The bench/box-cut technique will be utilised where two or more seams are present, and the overburden has a thickness of greater than 20 m.

The creation of the opencast was initiated through a stripping operation which removes topsoil and exposes the overburden of the first proposed cut. Initial topsoil was hauled to a designated area and stored for use in rehabilitation. When a steady state is reached, topsoil will be replaced in a continuous operation. The overburden is then drilled and blasted. The removal of overburden is undertaken in two phases namely, the top portion will be loaded and hauled, and the lower portion dozed. This will ensure that backfilling is adequately addressed and that concurrent rehabilitation may take place.

Once the overburden has been removed and dozed, the coal seams are drilled and blasted and then transferred to the Glisa Section for mineral processing by means of standard load and haul operations. It is anticipated that after the first four (4) cuts, a steady-state will be reached. The schematics described the mining method in more detail, with the mining direction being from left to right, and depicts the following:

- A section through the general stratigraphic sequence;
- The box cut is excavated after removal of the topsoil and subsoil;
- Coal is removed from the box cut, subsoil from cut 2 and topsoil from cut 3;
- The overburden from cut 2 is drilled and blasted;
- The topmost part of the overburden is loaded and hauled to a stockpile due to insufficient pit room availability;
- The bottom part is dozed over;
- Coal is removed from cut 2 and subsoil from cut 3;
- Cut 3 overburden is blasted;
- The top part of the blasted overburden is hauled and placed at the beginning of the low wall;
- The bottom part of cut 3 is dozed over and the cleaned coal face;
- Coal is removed from cut 3 and subsoil from cut 4; and
- Overburden from cut 4 is blasted.

At this point the pit is now in a ready state and no more material is stockpiled as it can now be accommodated in the pit. Concurrent rehabilitation can now logically follow as soon as the subsoil gets stripped in the front and replaced in the back. The same is true for the topsoil which gets placed over the subsoil in a continuous process.

Due to the proximity of the Glisa and Paardeplaats Sections, all mineral processing and waste disposal for the Paardeplaats Section is being undertaken at the Glisa Section. For this reason, NBC requires the consolidation of the Sections into the Integrated Paardeplaats Section to align with the Paardeplaats Section LoM which currently extends until 25 September 2038. Coal will be crushed at stationary plants prior to processing being undertaken at the main CSWP located in the Glisa Section. Water treatment will also be undertaken at the WTP in the Glisa Section.

2.3.2 Proposed Activities

2.3.2.1 Existing Infrastructure Changes

NBC require the following changes to existing infrastructure:

- Expansion of the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Expansion of the existing WTP pipeline network on all farm portions associated with the Integrated Paardeplaats Section; and
- Widening of haul roads between the mining sections and processing plants.

2.3.2.2 New Infrastructure Required

To ensure the continuation of mineral processing and water treatment activities for the Integrated Paardeplaats Section in support of the mining activities taking place, NBC requires new infrastructure within the Integrated Paardeplaats Section in support operation activities in the Section. This new infrastructure includes the following:

- A RoM pad on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- A PCD at the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Additional stormwater management infrastructure including diversion channels around the CSWP, and diversion channels around the administrative, contractor, workshop, and security offices on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Rerouting of a powerline at the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT to ensure a clear footprint area for the PCD;
- A RoM pad on Portion 24 of the farm Paardeplaats 380 JT;
- An additional crushing and screening plant on Portion 24 of the farm Paardeplaats 380 JT;
- A mining contractors office, workshop, and conservancy tank on Portion 24 of the farm Paardeplaats 380 JT;
- A PCD on Portion 24 of the farm Paardeplaats 380 JT;

- Stormwater management infrastructure, including diversion channels, for the above-mentioned infrastructure on Portion 24 of the farm Paardeplaats 380 JT;
- A powerline extension from the existing network to supply power to the infrastructure on Portion 24 of the farm Paardeplaats 380 JT;
- Pipelines between the PCD, Plant and the WTP on Portion 24 of the farm Paardeplaats 380 JT;
- A conveyor between the RoM Pad on Portion 24 of the farm Paardeplaats 380 JT and the CSWP on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- An emulsion silo adjacent to the magazine yard on Portion 24 of the farm Paardeplaats 380 JT;
- Haul roads and a dewatering pipeline within the active mining area on Portion 30 of the farm Paardeplaats 380 JT and planned mining areas on Potion 13, 28, 29 and 40 of the the farm Paardeplaats 380 JT and Portion 2 and Remaining Extent of the farm Paardeplaats 425 JS;
- Backfill areas on Portion 1, 3, 4 and 5 of the farm Paardeplaats 380 JT; and
- Discard Management Facility (DMF) on Portion 24 of the farm Paardeplaats 380 JT.

2.4 Scope of Work

For the purposes of this report, only the proposed DMF is considered.

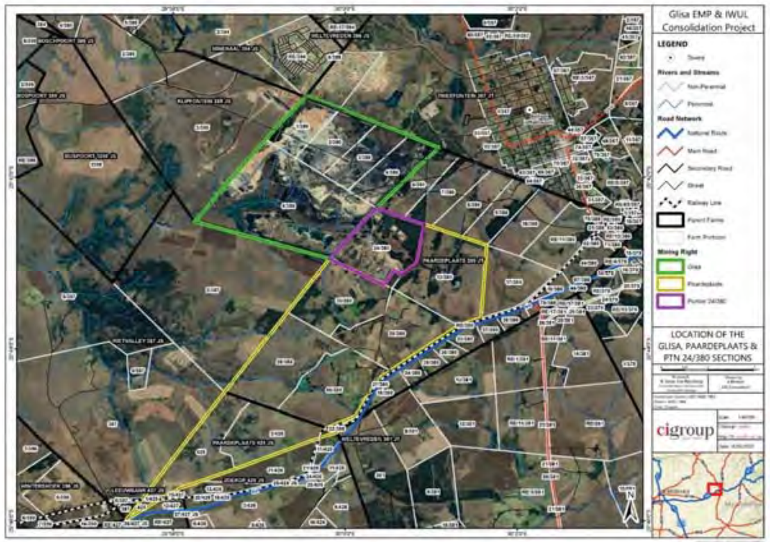


Figure 7 – Location of the Glisa and Paardeplaats Sections. Map provided by CIGroup.

3 METHODOLOGY

3.1 Methodology for Assessing Heritage Site Significance

The HIA process consisted of three steps:

Step I – Desktop Study: An archaeological and historical desktop study was undertaken of the project area and surrounding landscape (refer to **Chapter 5**). An archaeological and historical overview was compiled, which was augmented by an assessment of previous archaeological and heritage studies completed for the study area and surrounding landscape. Furthermore, an assessment was made of the early editions of the relevant topographic maps.

Step II – Physical Survey: The fieldwork comprised a field assessment of the study area undertaken primarily by foot and vehicle over the course of three days by an experienced fieldwork team from PGS consisting of an archaeologist (Cherene de Bruyn) and two field assistants (Michelle Sacshe and Thomas Mulaudzi). The fieldwork was undertaken from Monday, 19 April 2021 to Wednesday 21 April 2021.

As almost the entire project area had been intensively assessed as part of a previous HIA study by PGS, the focus on the current fieldwork was on revisiting all the heritage sites that were identified in the previous report and also undertaking intensive walkthroughs of a small section that is now earmarked for the development of a Discard Management Facility (DMF).

Step III – The final step involved the recording and documentation of relevant heritage resources, the assessment of resources in terms of the heritage impact assessment criteria and report writing as well as mapping and recommendations.

The significance of heritage sites was based on five main criteria:

- site integrity (i.e. primary vs. secondary context),
- amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
    - Low - <10/50m²
    - Medium - 10-50/50m²
    - High - >50/50m²
- uniqueness and
- the potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;
B - Mapping of the site and controlled sampling required;
C - No-go or relocate development position
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site

Site Significance

Site significance classification standards prescribed by the South African Heritage Resources Agency (2006) and approved by the Association for Southern African Professional Archaeologists (ASAPA) for the Southern African Development Community (SADC) region, were used for the purpose of this report (see table below).

Table 5 - Site significance classification standards as prescribed by SAHRA

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	-	High/Medium	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium	Recording before destruction
Generally Protected C (GP.C)	-	Low	Destruction

3.2 Methodology for Impact Assessment

To ensure uniformity, a standard impact assessment methodology has been utilised so that a wide range of impacts can be compared. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria.

A summary of each of the qualitative descriptors, along with the equivalent quantitative rating scale for each of the aforementioned criteria, is given in **Table 6** below.

Table 6 – Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	*Isolated corridor / proposed corridor*	Incidental
2	LOW	*Study area*	Short-term
3	MODERATE	*Local*	Medium-term
4	HIGH	*Regional / Provincial*	Long-term
5	VERY HIGH	*Global / National*	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

Significance Assessment

The significance rating (importance) of the associated impacts embraces the notion of extent and magnitude but does not always clearly define these since their importance in the rating scale is very relative. For example, 10 structures younger than 60 years might be affected by a proposed development, and if destroyed the impact can be considered as VERY LOW in that the structures are all of Low Heritage Significance. If two of the structures are older than 60 years and of historic significance, and as a result of High Heritage Significance, the impact will be considered to be HIGH to VERY HIGH. A more detailed description of the impact significance rating scale is given in **Table 7** below.

Table 7 – Description of the significance rating scale

RATING		DESCRIPTION
5	VERY HIGH	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	HIGH	The impact is of substantial order within the bounds of impacts which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	MODERATE	The impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the

		case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	LOW	The impact is of a low order and therefore likely to have a little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	VERY LOW	The impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity is needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or several ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	NO IMPACT	There is no impact at all - not even a very low impact on a party or system.

Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in **Table 8** below.

Table 8 – Description of the spatial significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of possible impacts and will be felt at a regional scale (District Municipality to Provincial Level). The impact will affect an area up to 50 km from the site.
3	Local	The impact will affect an area up to 5 km from the proposed site.
2	Study Area	The impact will affect an area not exceeding the study area boundary.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the site.

Temporal/Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact on the environment. The temporal or duration scale is rated according to criteria set out in **Table 9** below.

Table 9 – Description of the temporal rating scale

RATING		DESCRIPTION
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.

3	Medium-term	The environmental impact identified will operate for the duration of life of the project.
4	Long-term	The environmental impact identified will operate beyond the life of operation of the project.
5	Permanent	The environmental impact will be permanent.

Degree of Probability

The probability or likelihood of an impact occurring will be outlined in **Table 10** below.

Table 10 – Description of the degree of probability of an impact occurring

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely
3	Could happen
4	Very likely
5	It's going to happen/has occurred

Degree of Certainty

It is not possible to be 100% certain of all facts, and for this reason, a standard "degree of certainty" scale is used, as discussed in **Table 11**. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making.

Table 11 – Description of the degree of the certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact, or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.

Quantitative Description of Impacts

To allow for impacts to be described quantitatively, in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale, as described below:

$$\textbf{\textit{Impact Risk}} = \frac{(\text{Significance} + \text{Spatial} + \text{Temporal})}{3} \times \frac{\text{Probability}}{5}$$

An example of how this rating scale is applied is shown below:

Table 12 – Example of a rating scale

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	Low	Local	Medium Term	Could Happen	**Low**
Impact on heritage structures	2	3	3	3	**1.6**

Note: The significance, spatial and temporal scales are added to give a total of 8, which is divided by 3 to give a criterion rating of 2.67. The probability (3) is divided by 5 to give a probability rating of 0.6. The criteria rating of 2.67 is then multiplied by the probability rating (0,6) to give the final rating of 1,6. The impact risk is classified according to five classes as described in the table below.

Table 13 – Impact Risk Classes

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	1	Very Low
1.1 – 2.0	2	Low
2.1 – 3.0	3	Moderate
3.1 – 4.0	4	High
4.1 – 5.0	5	Very High

Therefore, with reference to the example used for heritage structures above, an impact rating of 1.6 will fall in Impact Class 2, which will be considered to be a low impact.

4 CURRENT STATUS QUO

The study area is located near the town of eMakhazeni (Belfast) in the eMakhazeni Local Municipality in the Nkangala District Municipality of the Mpumalanga Province. The proposed project area is located 3km south of Belfast, 55km east of Middelburg, approximately 40km northwest of Carolina and 33km south-east of Dullstroom. The N4 is located on the eastern boundary of the proposed project area.

According to the National Vegetation Map of South Africa, the study area is located within the vegetation type known as the Eastern Highveld Grassland. The Eastern Highveld Grassland is characterised by

"*Slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition (Aristida, Digitaria, Eragrostis, Themeda, Tristachya etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species" (*Sanbi, 2021).

In terms of geology and soils, the site characterised by *red to yellow sandy soils of the Ba and Bb land types found on shales and sandstones of the Madzaringwe Formation (Karoo Supergroup) "(*Sanbi, 2021).

During the fieldwork, the study area was found to be located in a landscape that consisted of primarily level sections, with some undulating sections also seen. The landscape is characterised by grassy vegetation. Several existing structures (including farmsteads, a substation, railway tracks and powerlines) were observed throughout the area.

Overall, the accessibility of the project footprint area was fairly good. The visibility of the site was limited due to the dense vegetation growth. Several photographs below provide general views of the study area and the landscape within which it is located **(Figure 8** to **Figure 13).**

Figure 8 – General view of the N4. This road provides access to the eastern section of the project area.

Figure 9 - Several sections of the project area can be characterised by grassy vegetation.

Figure 10 – Another general view of the study area showing some of the powerlines observed throughout the project area.

Figure 11 - The explosives magazine of the mine is located in the north-western section of the study area.

Figure 12 - The area surrounding the explosive magazine in the north-western corner of the project area is characterised by a plantation.

Figure 13 - Railway lines are found along the southern and south-eastern boundary of the project area.

5 DESKTOP STUDY FINDINGS

5.1 Archaeological and Historical Overview of the Study Area and Surroundings

DATE	DESCRIPTION
The Study Area and Surroundings during the Stone Age	
The archaeological literature does not contain much information on the Stone Age archaeology of this area, since this period has not been researched extensively in Mpumalanga (Esterhuysen & Smith, 2007). However, it is clear from the general archaeological record that the larger Mpumalanga region has been inhabited by humans since Earlier Stone Age (ESA) times. Although no Stone Age sites are known from the immediate vicinity of the study area, there are some sites recorded in the greater region (Esterhuysen & Smith, 2007). Examples of such sites are noted below.	
2.5 million to 250 000 years ago	The Earlier Stone Age (ESA) is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these technological phases is known as Oldowan which is associated with crude flakes and hammerstones and dates to approximately 2 million years ago. The second technological phase in the ESA of Southern Africa is known as the Acheulian and comprises more refined and better-made stone artefacts such as the cleaver and bifacial handaxe. The Acheulian phase dates back to approximately 1.5 million years ago. Concentrations of ESA stone tools were found in erosion gullies along the Rietspruit (Esterhuysen & Smith, 2007).

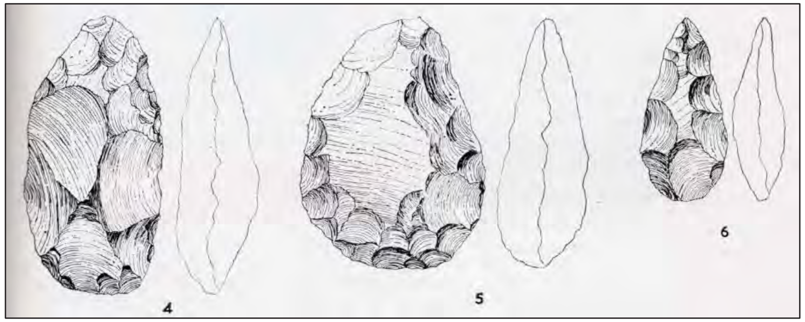


Figure 14 - Example of Early Stone Age Later Acheulian handaxes. These handaxes were identified at Blaaubank near Rooiberg. Cropped section of an illustration published in Mason (1962:199).

DATE	DESCRIPTION
>250 000 to 40 000 years ago	The Middle Stone Age (MSA) dates to between 250 000 to 40 000 years BP. MSA dates of around 250 000 BP originate from sites such as Leopards Kopje in Zambia, while the late Pleistocene (125 000 BP) yields several important dated sites associated with modern humans (Deacon & Deacon, 1999). The MSA is characterised by flake and blade industries, the first use of grindstones, wood and bone artefacts, personal ornaments, use of red ochre, circular hearths and hunting and gathering lifestyle. Evidence for the MSA period has been excavated from Bushman Rock Shelter, situated on the farm Klipfonteinhoek in the Ohrigstad District. The MSA layers indicated that the cave was visited repeatedly over a long period, between approximately 40 000 years ago and 27 000 years Before the Present (Esterhuysen & Smith, 2007). Low-density surface scatters of MSA material are known from areas closer to Ogies and Emalahleni (CRM Africa & Matakoma, 2001) (Birkholtz & De Bruyn, 2020).
40 000 years ago to c.AD200	The Later Stone Age (LSA) is the third phase identified in South Africa's archaeological history. It is associated with an abundance of very small stone artefacts known as microliths. Several surface occurrences of LSA materials are likely to be found around the general vicinity of the study area. Unfortunately, these are expected to be in the form of surface material that has been eroded out of dongas and riverbeds. The only possible LSA site known from within the study area is a possible rock art site (see site **PP 14**).
The Study Area and Surroundings during the Iron Age	
The arrival of early farming communities during the first Millenium heralded in the start of the Iron Age for South Africa. The Iron Age is that period in South Africa's archaeological history associated with pre-colonial farming communities who practised cultivation and pastoralist farming activities, metalworking, cultural customs such as lobola and whose settlement layouts show the tangible representation of the significance of cattle (known as the Central Cattle Pattern) (Huffman, 2007). The Southern African Iron Age can be divided into an Early Iron Age (AD 200 – AD 900), Middle Iron Age (AD 900 – AD 1300) and Late Iron Age (AD 1300 – AD 1840) (Huffman, 2007). Maggs (1976) opines that the Highveld areas of Mpumalanga were not occupied by the EIA due to the existing environment. The extensive grassland endemic to this area was of little value to their economy as they were dependent on slash-and-burn (swidden) agriculture. Radiocarbon dating from pottery places the EIA in the first millennium (Evers 1977); however, the land became valuable only when LIA populations had increased livestock numbers to the point that they formed a principal resource. It is during this time	

that the LIA populations would have migrated to the high grasslands of the Highveld to take advantage of the open grazing lands (Hall 1987). Delius (2007) mentions that from around the beginning of the sixteenth century, LIA communities would have migrated to Mpumalanga during times of climate shift and political instability. At around 1640, during a warmer phase within the Little Ice Age, the population growth showed a considerable increase. As the population increased, the frequency of interactions dealing with land and resources between various groups also intensified. A screening of the available Google Earth imagery was made. While no LIA stone walled settlements are evident from within the study area and its direct surroundings, large numbers of such settlements are for example evident in areas approximately 3km north-west of the present study area.	
AD 1700 – AD 1840	The Buispoort facies of the Moloko branch of the Urewe Tradition is the first association of the study area's surroundings with the Iron Age. It is most likely dated to between AD 1700 and AD 1840. The key features on the decorated ceramics of this facies include rim notching, broadly incised chevrons and white bands, all with red ochre (Huffman, 2007). Buispoort can be associated with the Western Sotho-Tswana, including the Hurutshe and Kwena, and the settlement layouts of Buispoort sites are known as Molokwane-type walling (Huffman, 2007). According to the map published by Huffman (2007:203), the present study area is located on the far eastern edge of the known distribution of Buispoort facies sites and settlements. The Heritage Impact Assessment undertaken for the proposed 400kV transmission line from Arnot to Gumeni (Pelser, 2012), mentions a number of Late Iron Age stonewalled sites located south, east and south-east of the present study area. It is expected that these sites can likely be associated with the Buispoort facies.
AD 1821 – AD 1823	After leaving present-day KwaZulu-Natal the Khumalo Ndebele (more commonly known as the Matabele) of Mzilikazi migrated through the general vicinity of the study area under discussion before reaching the central reaches of the Vaal River in the vicinity of Heidelberg in 1823 (www.mk.org.za). Two different settlement types have been associated with the Khumalo Ndebele. The first of these is known as Type B walling and was found at Nqabeni in the Babanango area of KwaZulu-Natal. These walls stood in the open without any military or defensive considerations and comprised an inner circle of linked cattle enclosures (Huffman, 2007). The second settlement type associated with the Khumalo Ndebele is known as Doornspruit, and comprises a layout which from the air has the appearance of a 'beaded necklace'. This layout comprises long scalloped walls (which mark the back of the residential area) which closely surround a complex core which in turn comprises a number of stone circles. The structures from the centre of the settlement can be interpreted as kitchen areas and enclosures for keeping small stock. It is important to note that the Doornspruit settlement type is associated with the later settlements of the Khumalo Ndebele in areas such as the Magaliesberg Mountains and Marico and represent a settlement under the influence of the Sotho with whom the Khumalo Ndebele intermarried. The Type B settlement is associated with the early Khumalo Ndebele settlements and conforms more to the typical Zulu form of settlement. As the Khumalo Ndebele passed through the general vicinity of the study areas shortly after leaving Kwazulu-Natal, one can assume that their settlements here would have conformed more to the Type B than the Doornspruit type of settlement. It must be stressed however that no published information could be found which indicates the presence of Type B sites in the general vicinity of the study area.

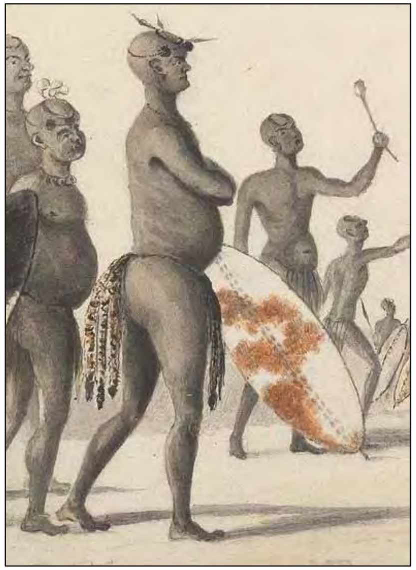


Figure 15 - King Mzilikazi of the Matabele. This depiction was made by Captain Cornwallis Harris in c. 1838 (www.sahistory.org.za).

The Study Area and Surroundings during the Historical Period

The Historical Period within the study area and surroundings commenced with the arrival of newcomers to this area. The first arrivals would almost certainly have been travellers, traders, missionaries, hunters and fortune seekers. However, with time, this initial trickle was replaced by a mass flood of white immigrants during the 1830s, when a mass migration of roughly 2 540 Afrikaner families (comprising approximately 12 000 individuals) from the frontier zone of the Cape Colony to the interior of Southern Africa took place. The people who took part in this Great Trek were later named Voortrekkers (Visagie, 2011).

As this period carried on, the general surroundings of the study area underwent significant changes during the Twentieth Century, including extensive infrastructural and mining development.

1836	The first Voortrekker parties crossed over the Vaal River (Bergh, 1999).
1845	Both the district and town of Lydenburg was established in this year (Bergh, 1999). The study area fell within the Lydenburg district at the time.
1860s	This period saw the early establishment of farms by white farmers in the general vicinity of the study area. Van der Merwe (1952) indicates that the farm Steynsplaats, located 4.5km north-east of the present study area, was awarded to its first owner CH Viljoen in 1862. Additionally, the farm Berg-en-Dal, located 3.5km east of the present study area, was also established in 1862. From these two dates it seems evident that many of the farms from the surroundings of the study area were established during the early 1860s. While these dates indicate when some of these farms were officially proclaimed, these dates do not necessarily mean that none of the farms

	from the surroundings of the study area were already settled and farmed before these dates. The permanent settlement of white farmers in the general vicinity of the study area would have resulted in the proclamation of individual farms and the establishment of permanent farmsteads. Features that can typically be associated with the early farming history of the area include farm dwellings, sheds, rectangular stone kraals and cemeteries. The other sites often associated with these early farms are graves and cemeteries for farmers and farm workers, and their respective families. These sites are often all that remains of the farmsteads of the mid to late nineteenth century. This may be due to their age as well as the destruction of farmsteads by the British forces during the South African War in accordance with the so-called 'scorched earth' policy.
1865	A Berlin Missionary Society station was established at Botshabelo (which means 'Place of Refuge') in 1865 by the Reverend Alexander Merensky (Erasmus, 2014). The mission station is located roughly 51km north-west of the present study area.
1866	Although a village had been established on the farms Klipfontein and Keerom in c. 1859, the site of this village was not popular with the local community. The village was subsequently moved to the adjoining farm Sterkfontein, where a town was formally laid out in 1866. Although the new town was named Nazareth, this name was changed to Middelburg in 1874. The name Middelburg was chosen as the new town was located between Pretoria and Lydenburg (Erasmus, 2014).
1872	The study area now fell within the district of Middelburg (Bergh, 1999). During the same year, the general surroundings of the study area were visited by a geologist from Eastern Europe, Woolf Harris. During his visit, Harris identified coal in the Van Dyksdrift area. He is also believed to have started the Maggie's Mine the following year (Falconer, 1990).

Figure 16 - This engraving by T. Wangeman depicts the mission station at Botshabelo during the early years of its existence (Delius & Hay, 2009:70).

30 June 1890	The town of Belfast (present-day Emakhazeni) was established on 30 June 1890 on the farm Tweefontein. This event followed on the late 1880s, when the numbers of farmers in the area began to increase and the need for a town was felt. During 1889, the community asked Richard Charles O'Neil to request the government of the Z.A.R. to establish a new town on his farm. When asked what the name of the new town should be, Richard Charles O'Neil proposed the name 'Belfast' in honour of his grandfather (also Richard Charles O'Neil) who was born in Belfast, Northern Ireland. According to Van der Merwe (1952), three main reasons can be given why it was decided that the farm Tweefontein would be best suited for a new town. These are: • On 16 December 1886 a monument was officially opened on the farm to commemorate the Battle of Blood River. The monument soon became the place where local farmers could gather during special events or festivals; • A strong need was felt for the establishment of a church roughly in the middle between the towns of Middelburg and Lydenburg. The farm Tweefontein fitted this requirement; and • The discovery of coal and the subsequent establishment of a number of coal mines all around the farm Tweefontein meant that a town on this farm would be centrally located within this wider mining area. The first survey work for the town was undertaken in 1889 by Peter Macdonald, and on the 30 July 1890 the town was officially proclaimed by President Paul Kruger. Of the original 888 surveyed stands, 575 were given to R.C. O'Neil as the owner of the farm (Van der Merwe, 1952).

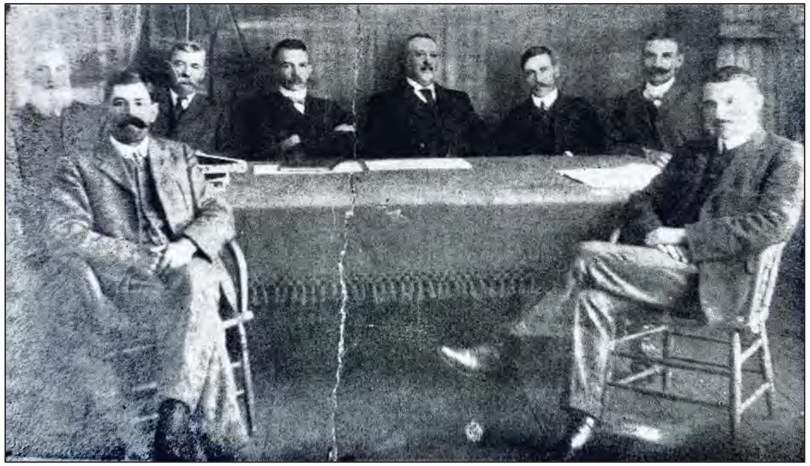


Figure 17

The top image depicts the only photograph of Richard Charles O'Neil that could be located. It was taken in 1911 and shows the Belfast Town Council in sitting. RC O'Neil is the fifth figure from the left. He is also shown in the cropped and enlarged image depicted on the left (Van der Merwe, 1952:55).

20 October 1894 - 2 November 1894	On this day the railway line between Pretoria and Delagoa Bay (present-day Maputo) was completed, with the last work on the line taking place near Balmoral. However, the symbolic completion of the line's construction took place at Brugspruit Station, where the last rail screw was fastened by President Paul Kruger on 2 November 1894 (De Jong, 1996). The completion of the NZASM Eastern Line, as it was known, was very significant for the study area and surroundings. This is due to the fact that the vast deposits of coal known to have existed in this area since the mid 19th century, could now be commercially mined (Bulpin, 1989) and easily transported to the Witwatersrand gold mines and the populated centres of Pretoria and Johannesburg where it was most required. As a result, the completion of the Eastern Line created a massive stimulus not only for the mining of coal but also for the establishment of coal mines. As will be seen below, a number of coal mines were established in the years following on the completion of the Eastern Line.
c. 1894 - 1895	Shortly after the completion of the main line in 1894 a branch line was built to connect it to a coal mine already in existence to the west of the town of

	Belfast (Van der Merwe, 1952). This branch line is depicted on the Middelburg Sheet of the Major Jackson Series depicted in **Figure 19** below. Van der Merwe (1952:31)) adds that this historic coal mine "…*belonged to Sammy Marks who had acquired all the coal rights parallel to the main line…At one stage a certain McLaughlin was the manager when there were about fifty families on the mine living mostly in tin shanties. These people who were mostly English speaking, characteristically had many and varied sporting activities and certainly had their influence on the development of the village.*"
The Study Area and Surroundings during the South African War	
The South African War (also known as the Anglo Boer War) between Great Britain and her allies and the Boer Republics of the Transvaal (known as the *Zuid-Afrikaansche Republiek*) and Free State took place between October 1899 and May 1902. The wider surroundings of the study area experienced skirmishes and battles associated with the war years. However, it is the Battle of Bergendal that is of highest significance for eMakhazeni and surroundings.	
27 August 1900	Pretoria, the capital city of the Transvaal Republic, was occupied by British forces on 5 June 1900. Many believed that the war, which had by now lasted for nearly eight months, was at an end, and that the Boer leaders would sue for peace. However, a couple of days before the occupation of Pretoria, President Paul Kruger and members of the Transvaal Government were rushed out of the capital city on a train and a temporary government was established at Machadodorp (present-day eNtokozweni). After the occupation of Pretoria, General Louis Botha, the Commandant-General of the Transvaal Republic, decided to delay the advance of the British from Pretoria by placing his forces along the far-eastern section of the Magaliesberg Mountain range, located 30km east of the centre of Pretoria. The subsequent battle, known as the Battle of Donkerhoek or Diamond Hill, took place over the course of a number of days, and only ended when the Boer forces slipped slipped unnoticed into the night on the evening of 12 June 1900. The route of retreat chosen by General Botha was to follow the old Eastern Line between Pretoria and Delagoa Bay in an eastern direction, and delay the British advance as much as tactically and logistically possible. On a number of occasions in the following weeks, General Botha used his Long Tom artillery to fire at significant range on advancing British units, thereby delaying the overall advance of the British Army. Eventually, General Botha positioned his 5,000 men north and south of the railway line in a defensive line more than 80km long. The centre of this defensive line was positioned on the farm Berg-en-Dal, a few kilometers south-east of the town of Belfast. This defensive line was placed here to protect the Transvaal Government from the expected British attack (Von der Heyde, 2013). Various British forces started advancing towards the Boer defensive line, with Lord Roberts advancing in an eastern direction along the railway line and General Sir Redvers Buller advancing in a northern direction from present-day Kwazulu-Natal. On 24 August 1900 the town of Belfast (present-day eMakhazeni) was occupied by a British force under General Reginald Pole-Carew (Von der Heyde, 2013). When Lord Roberts eventually decided to go on the offensive on the morning of 27 August 1900, he focused his attack on a rocky outcrop located south of the railway line on the farm Berg-en-Dal. This outcrop was held by the *Zuid Afrikaansche Republiek Politie (*ZARP), a special mounted police corps of the ZAR, under command of Commandant GMJ. van Dam. The offensive started at 11 am with a three-hour bombardment of the hill

	held by the ZARP. The hill was held until the British infantry managed to reach its foot before charging the Boer position with fixed bayonets. This resulted in the retreat of the ZARP. Of the original 74 men who held the hill, only 30 were able to escape the battle unharmed (Von der Heyde, 2013). When the remainder of the Boer front line heard of the breach near its centre, they started melting away. The towns of Machadodorp (eNtokozweni) and Waterval Boven were subsequently occupied by the British Army, which forced the Transvaal Government to continue moving eastwards along the railway line. The map depicted in **Figure 18** below shows the British and Boer positions at the Battle of Bergendal. It also shows the approximate position of the study area. From this map, it is clear that the events of the battle was located some distance east and south-east of the present study area. In fact, the rocky outcrop which represents the main component of the battle, is located approximately 7.7km east by south-east of the present study area.
7 – 8 January 1901	A Boer attack took place on the British positions in an around Belfast (present-day eMakhazeni) on the night of 7 - 8 January 1901. This attack was planned by Generals Louis Botha, Chris Botha and Tobias Smuts, and involved the simultaneous nightly attack on British positions at Pan Station, Wonderfontein Station, Belfast Camp and Station, the Coal Mine near Belfast, Monument Hill outside Belfast, Dalmanutha and Machadodorp (present-day eNtokozweni). Commandant Trichardt with the Middelburg and Germiston Commandos were to attack Pan Station and Wonderfontein Station. The State Artillery was ordered to attack the Coal Mine outside Belfast, whereas the Lydenburg Commando was to attack Dalmanutha and Machadodorp. General Muller with the Johannesburg and Boksburg Commandoes were to attack Monument Hill. If these attacks proved successful, General Viljoen was to attack the town of Belfast (Van der Westhuizen & Van der Westhuizen, 2013). Despite cold and misty conditions, the Boer forces north of the railway line were all in position at midnight when the attack commenced. The situation south of the railway line was less successful, and the attacks on Pan Station, Wonderfontein Station, Dalmanutha and Machadodorp failed. Meanwhile, the attack on Belfast was planned to comprise an initial simultaneous attack on the Coal Mine in the west and Monument Hill to the north-east of Belfast. Once these attacks were successful, the town itself could be attacked. The attack on the town was to be supported by General Chris Botha's attack on the railway station south of Belfast (Meijer, 2000). General Muller with the Johannesburg and Boksburg Commandos attacked Monument Hill and after an intense battle manage to occupy the position. Meanhwile, Major JF Wolmarans with the State Artillery attacked the forts guarding the coal mine west of town. When news of the two successful attacks reached General Viljoen, he proceeded to attack the town of Belfast. However, the British garrison under the command of General HL Smith-Dorrien fought off the Boer attack. When the planned supporting attack of General Chris Botha did not happen, or did not succeed, General Viljoen was forced to call off his attack (Meijer, 2000). The closest component of the events associated with the nightly attacks of 7 – 8 January 1901 to the present study area, appears to be Wolmarans's attack on a number of British forts defending the coal mine located west of Belfast. This coal mine appears to have been located in the north-western section of the farm Paardeplaats 380 JS. As a result, the coal mine and British forts were likely located more than 1.5km north-west of the study area.

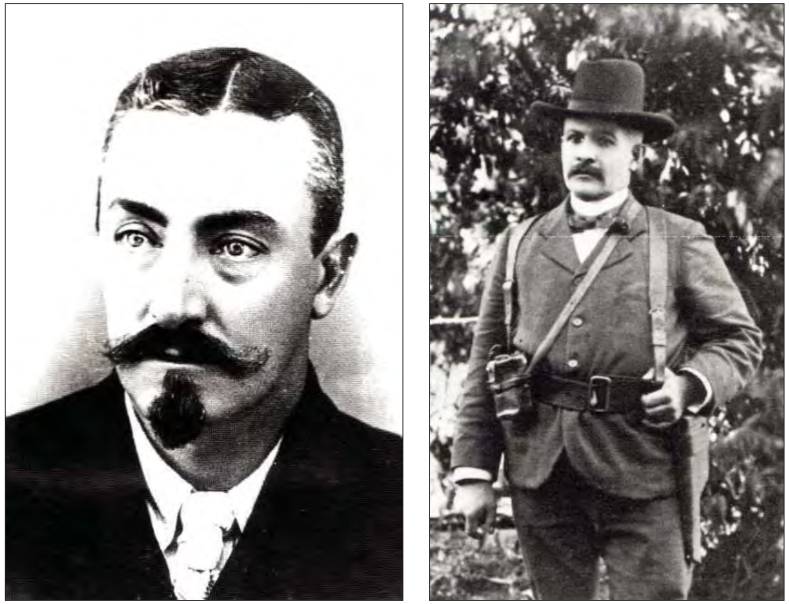


Figure 18 – The of the Boer officers who played crucial roles during the nightly attack of 7 and 8 January 1901 on Belfast (present-day eMakhazeni). From left to right: General Ben Viljoen, the Boer commander responsible for the attack on the town of Belfast itself and General Chris Muller, commandant of the Boksburg Commando, who was responsible for the attack on Monument Hill, north-east of Belfast (Meijer, 2000:149 & 215).

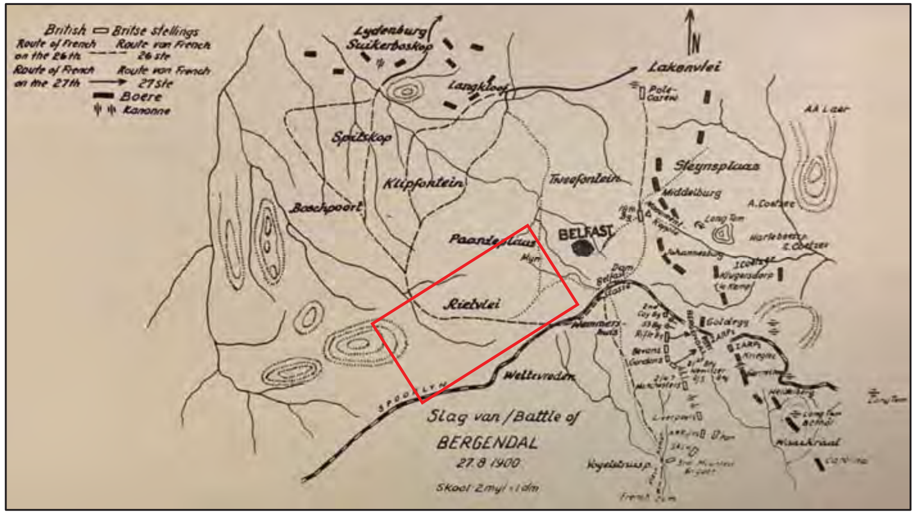


Figure 19 – Map of the Battle of Bergendal published in Van der Merwe (1952:106). The approximate position of the study area is indicated in red.

5.2 Archival and Historical Maps

An assessment of available archival and historical maps was undertaken as a way to establish a historic layering for the study area. These historic maps are also valuable resources in identifying possible heritage sites and features located within the study area. In terms of the topographic maps, overlays were compiled showing the study area boundaries on each of the maps. Any possible heritage sites depicted within the study area on these maps will be marked and discussed. Refer to **Figures 19** - **21**.

5.2.1 Middelburg Sheet of the Major Jackson Map Series dating to 1903

A section of the Middelburg Sheet of the Major Jackson Map Series is depicted below. This map series was compiled from farm surveys of the Transvaal. The sheet was drawn in the Surveyor-General's Office and printed at the Goevernment Printing Works in Pretoria on 1 August 1903.

The map depicts a colliery and explosives magazine in the north by north-western corner of the farm Paardeplaats. A mine-related railway siding can also be seen running across the northern and north-eastern sections of the study area.

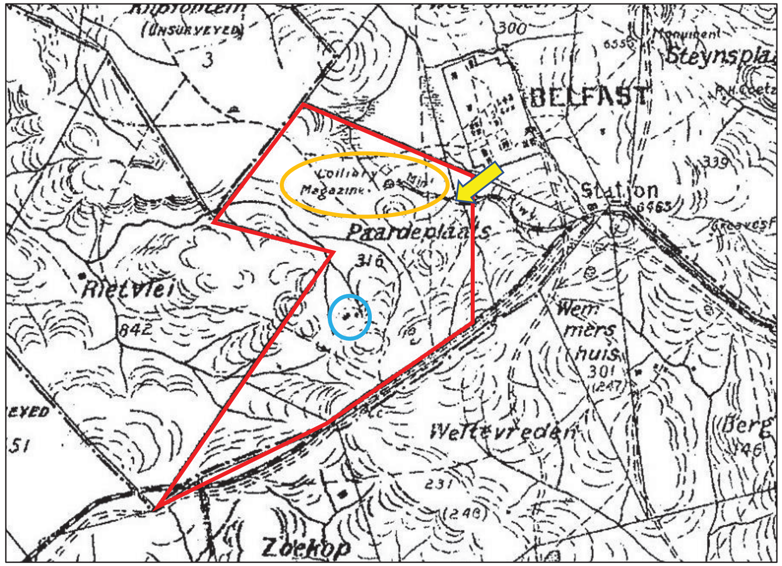


Figure 20 – Section of the Middelburg Sheet of the Major Jackson Map Series that was compiled in 1903. A colliery and magazine (orange oval) can be identified in the north-western corner of the farm. The yellow arrow indicates the position of the mining-related railway siding. Several buildings were identified in the central section of the farm (blue circle).

5.2.2 First Edition of the 2530CA Topographic Map

A section of the First Edition of the 2530CA (Belfast) Topographical Map is depicted below. This map was surveyed in 1969 and drawn by the Trigonometrical Survey Office in 1970. It was printed by the Government Printer in 1980**.** Seven possible heritage features were identified.

Table 14 – Possible Heritage Features depicted on the First Edition of the 2530CA Map

Feature	Coordinates	Description
Feature 1	S 25.712945 E 30.024450	Three huts are depicted here. As can be seen on the different map sections, the symbols used on these maps differed between a stylized image of a hut and a black circle. These symbols were used to indicate the position of homesteads and accommodation associated with black people. The huts shown here were most likely accommodation for farm labour.
Feature 2	S 25.717848 E 30.018611	Several buildings forming part of the Paardeplaats farmstead.
Feature 3	S 25.724216 E 30.013899	Three huts are depicted here. These huts were most likely accommodation for farm labour.
Feature 4	S 25.726005 E 30.003033	Several buildings forming part of the Westergloor farmstead.
Feature 5	S 25.727727 E 30.010433	A livestock enclosure (kraal) is depicted here.
Feature 6	S 25.722205 E 30.006246	A single hut. The hut was most likely accommodation for farm labour.
Feature 7	S 25.718135 E 30.003499	A single hut. The hut was most likely accommodation for farm labour.

5.2.3 First Edition of the 2529DB Topographic Map

A section of the First Edition of the 2529DB Languitsig Topographic Map is depicted below. This map was surveyed in 1967 and drawn by the Trigonometrical Survey Office in 1969. It was printed by the Government Printer in 1969.

One possible heritage feature was identified within the boundaries of the study area on this map section. This heritage feature is shown in **Table 15** below.

Table 15 – Possible Heritage Features depicted on the First Edition of the 2529DB Topographic Map

Feature	Coordinates	Description
Feature 8	S 25.734995 E 29.992645	A single hut. The hut was most likely accommodation for farm labour.

5.2.4 First Edition of the 2529DD Topographic Map

A section of the First Edition of the 2529DD (Wonderfontein) Topographic Map is depicted below. This map was surveyed in 1967 and drawn by the Trigonometrical Survey Office in 1968. It was printed by the Government Printer in 1969.

Five possible heritage features were identified within the boundaries of the study area on this map section. These heritage features are shown in **Table 16** below.

Table 16 – Possible Heritage Features depicted on the First Edition of the 2530DD Topographic Map

Feature	Coordinates	Description
Feature 9	S 25.762830 E 29.963107	Three structures forming part of the Sunbury Train Station are depicted here.
Feature 10	S 25.761615 E 29.964614	Three structures are depicted here.
Feature 11	S 25.753357 E 29.982477	A cluster of three huts is depicted here. The huts were most likely accommodation for farm labour.
Feature 12	S 25.755826 E 29.972066	A single hut is depicted here. The hut was most likely accommodation for farm labour.
Feature 13	S 25.758850 E 29.967931	A single hut is depicted here. The hut was most likely accommodation for farm labour.

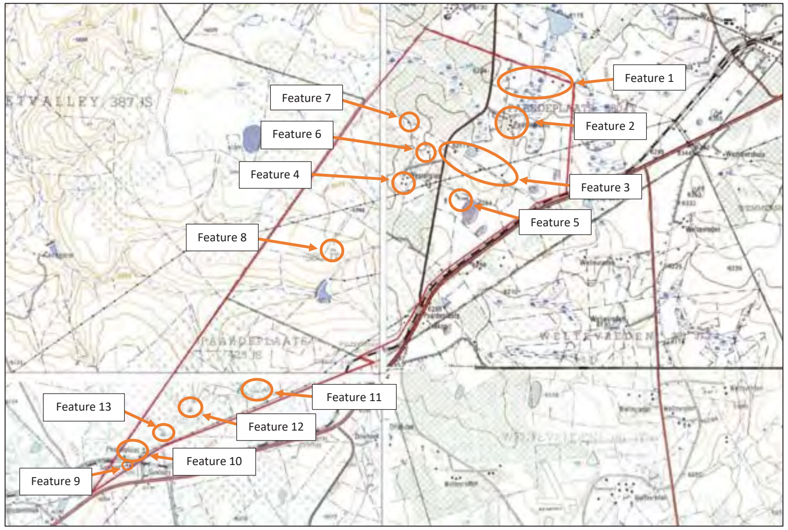


Figure 21 – Composite view of sections of the First Editions of the 2529DB, 2529DD, 2530CA and 2530CC Topographic Sheets. Please note that the study area does not extend into the 2530CC map. The possible heritage features depicted on these maps are indicated and numbered. The study area boundary is in red.

5.2.5 Second Edition of the 2530CA Topographic Map

A section of the Second Edition of the 2530CA (Belfast) Topographic Map is depicted below. The map was compiled by the Chief-Director Surveys and Mapping and printed by the Government Printer in 1989.

Thirteen possible heritage features are depicted within the study area on this map. These heritage features are shown in **Table 17** below.

Table 17 – Possible Heritage Features depicted on the Second Edition of the 2530CA Map

Feature	Coordinates	Description
Feature 1	S 25.712480 E 30.018195	A single hut is depicted here. The hut was most likely accommodation for farm labour.
Feature 2	S 25.712003 E 30.014748	Two structures are depicted here.
Feature 3	S 25.718392 E 30.002804	A single hut is depicted here. The hut was most likely accommodation for farm labour.
Feature 4	S 25.722085 E 30.009687	A single hut is depicted here. The hut was most likely accommodation for farm labour.
Feature 5	S 25.718791 E 30.017526	Several buildings forming part of the Paardeplaats farmstead are depicted here.
Feature 6	S 25.723998 E 30.012818	Several structures are depicted here.
Feature 7	S 25.724921 E 30.016495	A single hut is depicted here. The hut was most likely accommodation for farm labour.
Feature 8	S 25.728660 E 30.008688	Two structures are depicted here.
Feature 9	S 25.725698 E 30.004522	Several buildings forming part of the Westergloor farmstead are depicted.
Feature 10	S 25.737714 E 30.007839	Several structures are depicted here.
Feature 11	S 25.735505 E 30.001845	One structure is depicted here.
Feature 12	S 25.737550 E 30.000528	One structure is depicted here.
Feature 13	S 25.743072 E 30.002753	Several structures are depicted here.

5.2.6 Second Edition of the 2529DB Topographic Map

A section of the Second Edition of the 2529DB (Languitsig) Topographic Map is depicted below. This map was compiled by the Chief-Director Surveys and Mapping and printed by the Government Printer in 1987. No possible heritage features are depicted within the study area on this map.

5.2.7 Second Edition of the 2529DD Topographic Map

A section of the Second Edition of the 2529DD (Arnot) Topographic Map is depicted below. This map was compiled by the Chief-Director Surveys and Mapping and printed by the Government Printer in 1987. Three possible heritage features are depicted within the study area on this map.

Table 18 – Possible Heritage Features depicted on the Second Edition of the 2529DD Map

Feature	Coordinates	Description
Feature 14	S 25.747347 E 29.984125	One structure is depicted here.
Feature 15	S 25.752260 E 29.986820	Two structures are depicted here..
Feature 16	S 25.763457 E 29.962304	Three structures associated with the Sunbury Train Station are depicted here.

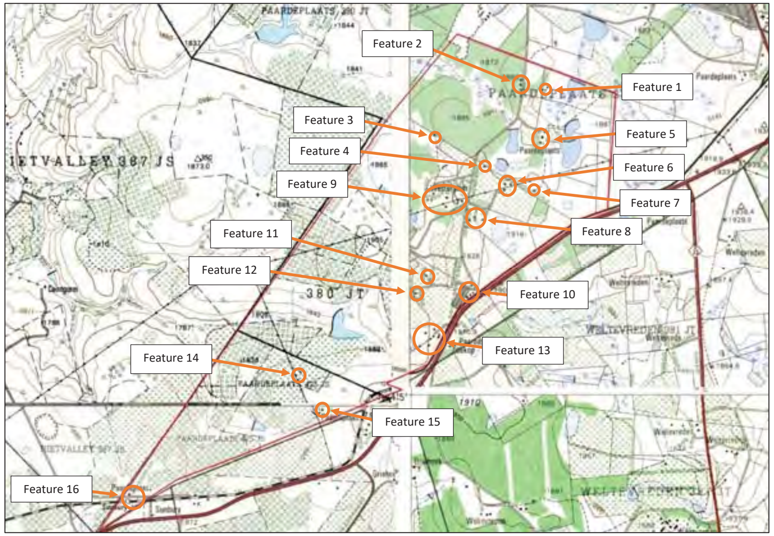


Figure 22 – Composite view of sections of the Second Editions of the 2529DB, 2529DD, 2530CA and 2530CC Sheets. Please note that the study area does not extend into the 2530CC map. The possible heritage features depicted on these map sheets are indicated and numbered. The study area boundary is in red.

5.3 Heritage Screening

5.3.1 Previous Heritage Impact Assessment Reports from the Study Area and Surroundings

An assessment of the South African Heritage Resources Information System (SAHRIS) of SAHRA was undertaken to establish whether any previous archaeological and heritage impact assessments had revealed archaeological and heritage sites within the present study area. This assessment has revealed that a number of previous studies had been undertaken in the surroundings of the study area. However, although a few sites were identified in proximity to the present study area, no sites from these studies were identified within the present study area. The only exception is the heritage impact assessment undertaken by PGS of almost the exact same area as the one assessed for the present study.

All previous studies that were located on the SAHRIS system and/or received from the client, will be briefly discussed in chronological order below. In each case, the results of each study are shown in bold.

- KUSEL, U. 2005. Cultural Heritage Resources Impact Assessment on the Farm De Suikerboschkop 361 JS, Belfast. **The sites identified include several graves and a farmhouse.**

- FOURIE, W. 2008. Archaeological Impact Assessment of Northern Coal's Portion 15 and 16 of the farm Weltevreden 381 JT, Belfast, Mpumalanga. **No sites of heritage significance were found during the survey.**

- COETZEE, F. 2008. Cultural Heritage Survey of the Proposed Eco-Tourism Development on the farm Paardeplaats 512 JT, near Dullstroom, Emakhazeni Municipality, Mpumalanga. **No Stone Age or Iron Age settlements, structures, features or artefacts were recorded during the survey.**

- KITTO, J. & FOURIE, W. 2012. Heritage Impact Assessment Report for the Exxaro Paardeplaats Project. **A total of 32 heritage sites, including 22 heritage structures, 7 cemeteries and 3 areas with historical mining shafts were identified.**

- PELSER, A. 2012. A Report on a Heritage Assessment for the Proposed Arnot-Gumeni 400 Kv Powerline Project, in the Middelburg/Belfast Area, Mpumalanga Province. **The sites identified during the fieldwork include stone-walled Iron Age sites, possible Stone Age sites, historical homesteads/farmsteads, historical Anglo-Boer War (1899-1902) battlefield sites as well as graveyards and cemeteries.**

- PISTORIUS, J. C. C. 2013. A Revised Phase I Heritage Impact Assessment study for the proposed Wonderfontein Colliery near Belfast in the Mpumalanga Province of South Africa**. The sites identified during the fieldwork include formal and informal graveyards, as well as historical houses.**

- HIGGIT, N. 2014. Heritage Impact Assessment for the Weltevreden Open Cast Coal Mine, Weltevreden 381JT, Belfast, Mpumalanga Province. **A total of five heritage resources were identified within the project area including histirical mine shafts, a historical werf, stonewalling and burial grounds.**

- ANGEL, J. 2017. Heritage Impact Assessment Umsimbithi eMakhazeni Mining Project. **The fieldwork for the HIA identified a total of 28 heritage resources consisting of 20 Burial sites (with approximately 200 burials in total), one archaeological site and seven historic structures.**

6 FIELDWORK FINDINGS

6.1 Introduction

PGS Heritage completed a HIA for the proposed Exxaro Paardeplaats project in 2012. During the fieldwork for this previous project a total of 32 heritage sites, including 21 heritage structures, seven cemeteries three areas with historical mining shafts and one possible rock art site.

As almost the entire project area had been intensively assessed as part of a previous HIA study by PGS, the focus on the current fieldwork was on revisiting all the heritage sites that were identified in the previous report and also undertaking intensive walkthroughs of a small section that is now earmarked for the development of a Discard Management Facility (DMF).

As a result, the fieldwork findings included in this report comprise the following:

- The 32 sites that were originally identified during the previous study and that were revisited during the present study (PP 01 – PP32); and
- An additional 13 heritage sites (PP33 – PP45) that were identified during the present fieldwork.

In terms of the heritage sites that were identified in 2012, the aim of the revisit was to establish what the current state and significance of these sites are. This is due to the fact that nearly nine years have passed since the original fieldwork undertaken in 2012.

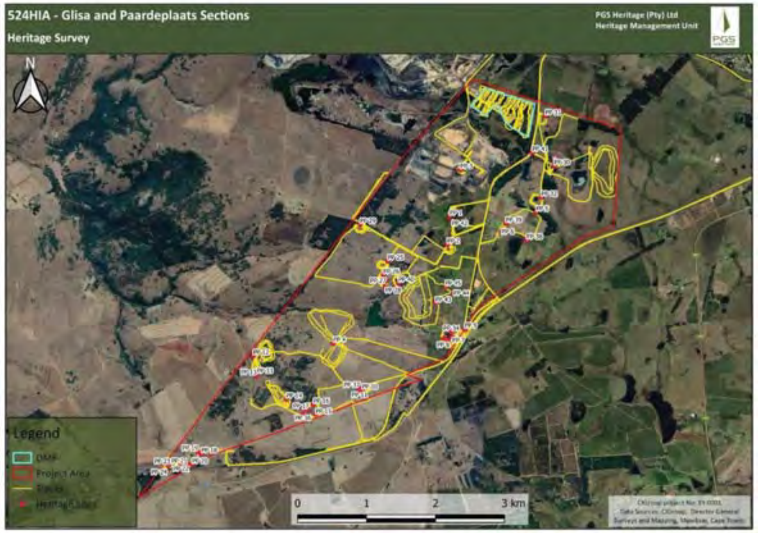


Figure 23 - Google Earth image depicting the study area in red with the recorded tracklogs in yellow. All the identified heritage sites are also depicted. As indicated in the text, the study area was intensively covered during the 2012 fieldwork.

6.2 Heritage Sites identified in 2012

6.2.1 PP 01

GPS Coordinates:

S 25.725820
E 30.002610

Type: Demolished Historic Farmstead

Description:

Description of Site from Kitto & Fourie (2012)

A farmstead with its associated buildings was identified at this location. The main house and other buildings were still intact and were occupied until recently before the property was sold to Exxaro (Pers.com). The main house measures approximately 20m x 20m and has a pitched corrugated iron roof. A kitchen and more rooms were added later to the back of the building. The original building has thick external walls which were plastered and painted. It also has a chimney for a coal stove. The house has wooden and metal door- and window frames. It also has external electricity and water systems on the older parts of the building and internal electricity and water systems on the later additional parts.

A carport combined with a storeroom is situated next to the main house. This structure is brick-built and is constructed in the same architectural style as the main house, but it was evident from the materials used that this structure is of a much more recent origin than the main house. This structure also has a pitched corrugated iron roof, metal window frames and wooden doors and door frames.

A storeroom or shed with farm implements was also identified. This storeroom measures approximately 12m x 8m and has a low pitched corrugated iron roof. The building is brick-built and has metal window frames and wooden door frames with homemade doors. It has an external electrical system.

Another storeroom or shed is situated next to the first shed. It measures approximately 10m x 5m and is brick-built with a low pitched corrugated iron roof. A 5m x 10m extension was added at the back of the original structure and this extension has a sloping corrugated iron roof. The building has metal window frames and wooden doors and door frames. It also has an external electrical system.

A cattle shed or stables for horses is situated next to the two storerooms. The building is also brick-built and measures approximately 15m x 18m. It has a low pitched corrugated iron roof with a sloping corrugated iron roof on the one side, which was a later extension. This extension served as a feed storeroom. The building also has external electrical and water systems. The external water pipes were

insulated to prevent the water from freezing in winter.

A pigsty was situated next to the cattle shed. The original structure is built with stone and mortar, but later extensions to raise the walls and additions are brick-built. The additions were most probably used as stables for horses. The building has a low pitched corrugated iron roof and external electrical and water systems. The building has no window or door frames and cement lintels were used for the window and door openings. The structure has a cement floor.

Figure 24 – The main farmhouse building as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 25 – The main house and storeroom/shed as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 26 - Pigsty and two sheds/storerooms as recorded in 2012 (Photo: Kitto & Fourie, 2012)

Description of Site from the 2021 Fieldwork

Currently, the structures that were identified at site PP 01 in 2012 have been demolished. Only the ruins of the foundations remain. The site is overgrown and abandoned.

Significance:

During the 2012 study, the site was assessed to be of **High Local Significance (Grade 3B).** Due to the fact that the site has now been completely demolished, the current significance of the site is deemed to be of **Low Significance** or **Generally Protected C (GP.C).**

Site Extent:

The site is approximately 200m x 150m in extent.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 27 - General view of site PP 01 as recorded during the 2021 fieldwork.

Figure 28 – Another view of site PP 01 as recorded during the 2021 fieldwork.

Figure 29 - View of building rubble from the demolished remains of structures from site PP 01.

6.2.2 PP 02

GPS Coordinates:

S 25.72989
E 30.00226

Type: Burial Ground

Description:

Description of Site from Kitto & Fourie (2012)

A cluster of four informal graves was identified at this location. The graves are situated in between a gravel road and a fence. The graves are placed next to each other along the fence and are orientated from west to east. One grave has a rectangular-shaped cement outline as a dressing, with an inscribed granite headstone. This seems to be a double child's grave, as the headstone has two inscriptions painted on. Another grave is a double adult grave with a square-shaped cement outline, which is filled with a layer of gravel. It also has an inscribed granite headstone. The fourth grave has an informal, elongated oval-shaped mound of packed rocks as a dressing. It does not have an inscribed headstone. The graves are overgrown with vegetation, but it was evident that the graves had been cleared regularly as the vegetation was not overwhelming. The headstone inscriptions date the graves from the late 1960's and the 1970's and all the names on the graves are of the Mtweni family.

Figure 30 – General view of the cemetery as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 31 - Inscription on the double child's grave as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The cemetery comprising four graves were identified during the current fieldwork. The site was found to be overgrown vegetation. Furthermore, the inscription appearing on the the double child's grave has faded significantly.

Significance:

All graves have high levels of emotional, religious and in some cases historical significance. As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 10m x 4m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures.

Figure 32 - General view of the cemetery at PP 02 as recorded during the 2021 fieldwork.

Figure 33 – Closer view of the headstone on the double grave.

6.2.3 PP 03

GPS Coordinates:

S 25.71908
E 30.00414

Type: Burial Ground

Description:

Description of Site from Kitto & Fourie (2012)

Two informal graves were identified at this location. The graves are crudely fenced and are placed next to each other and orientated from west to east. The graves have large oval-shaped outlines of packed rock as dressings. A flat rock serves as the head stone for one grave. A plastic bottle and ceramic cup were placed on the graves as grave goods. The graves are not maintained and are overgrown with grass and other vegetation. The graves belong to the Maseko family, but their age was not known (local informant - Lina). The Maseko family apparently lives on the farm in the farmworkers houses located behind the farmstead (PP 001). Such graves are treated as being of 60 years or older unless evidence is obtained to the contrary.

Figure 34 – The two Maseko graves as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site consists of three graves located near the pit of the mine. Two of the graves belong to the Maseko family, while the third grave belongs to an unknown individual. The mine has appointed a service provider to relocate these graves. This mitigation work is currently in the permit application phase.

Significance:

All graves have high levels of emotional, religious and in some cases historical significance. As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 5m x 5m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures.

Figure 35 - General view of site PP 03 as recorded during the 2021 fieldwork.

Figure 36 - The two Maseko family graves as recorded in 2021. The scale is in 10cm increments.

Figure 37 - The third grave belonging to an unknown individual. The scale is in 10cm increments.

6.2.4 PP 04

GPS Coordinates:

S 25.74415
E 29.98579

Type: Burial Ground

Description:

Description of Site from Kitto & Fourie (2012)

An informal cemetery with approximately 81 graves was identified at this location. The cemetery is not fenced and is located in the open veld. The graves are placed in 5 unequal lines next to each other. The graves are placed along the boundary fence of the property and they are orientated from west to east. Most of the graves have informal oval or rectangular shaped mounds or outlines of packed rocks as dressings. Some of the graves had been cleaned recently, but most of them are overgrown with grass and other vegetation. A number of graves have granite inscribed headstones and one grave has a formal granite dressing with an inscribed granite headstone.

Figure 38 – General view of the cemetery at PP 04 as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 39 - Close-up view of the headstone on one of the graves (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The cemetery was identified during the current fieldwork. Approximately 80 to 90 graves appear to be buried at the site. The cemetery is overgrown with vegetation and is not fenced.

Significance:

All graves have high levels of emotional, religious and in some cases historical significance. As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is approximately 50m x 40m in extent.

Impact Assessment and Mitigation:

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures.

Figure 40 - General view of some of the graves at PP 04 as recorded during the 2021 fieldwork.

Figure 41 - View of one of the graves with a cement headstone from site PP 04. This photograph was also taken during the 2021 fieldwork. The scale is in 10cm increments.

6.2.5 PP 05

GPS Coordinates:

S 25.72521
E 30.01512

Type: Burial Ground

Description:

Description of Site from Kitto & Fourie (2012)

Another informal cemetery with approximately 40 graves was identified at this location. The cemetery is not fenced and is located amongst a plantation of blue-gum trees. The graves are placed in 5 unequal lines next to each other. The graves are also placed along the boundary fence of the property and they are orientated from west to east. Most of the graves have informal oval or rectangular shaped mounds or outlines of packed rocks as dressings. Most of the graves are overgrown with grass and other vegetation. Some graves have inscribed granite headstones and some graves have painted metal markers as headstones. Most of the graves have grave goods placed on the dressings.

Figure 42 - View of some of the graves from PP 05 as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 43 - Grave with marker and grave goods as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was revisited during the present fieldwork. It seems possible for more graves to have been buried at the site in the nine years since the previous assessment took place. This is said as approximately 40 to 50 graves appear to be buried at the cemetery today. The site is located next to a bluegum plantation and is overgrown with vegetation.

Significance:

All graves have high levels of emotional, religious and in some cases historical significance. As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 20m x 50m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 44 - General view of the cemetery at site PP 05 as recorded during the 2021 fieldwork.

Figure 45 – Another general view of the cemetery at PP 05 as recorded during the 2021 fieldwork.

Figure 46 – Closer view of one of the graves from site PP 05. This is the same grave as the one shown on the photograph that was taken in 2012. The scale is in 10cm increments.

6.2.6 PP 06

GPS Coordinates:

S 25.72800
E 30.01013

Type: Historic Homesteads and Structures with the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

The remains of an old cattle kraal were identified at this location. The structure was built with stone and mortar and measures approximately 20m x 25m in size. The walls of the kraal are thick and measure approximately 0.75m thick and 2.2m high. The kraal has a storeroom attached to one side and feeding troughs are placed along another wall. The storeroom is a later addition and is brick-built with a sloping corrugated iron roof. Three families had used parts of the old kraal structure to build their own homesteads. These families were working on the farm. The age of the kraal is not known.

Figure 47 - View of the kraal with dwelling additions as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 48 - Close-up view of a dwelling addition as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

Although the cattle kraal was still identified during the current fieldwork, sections of its walls have collapsed. A number of dwellings are also still located at the site. The number of dwellings at the site appear to have increased in the nine years since the previous assessment of the site in 2012.

Significance:

The site was stated to be of **Low Significance** or **Generally Protected C (GP.C)** in the 2012 report. However, past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available. To address this potential risk, the site is deemed to be of **Medium Significance** or **Generally Protected B (GP.B).**

Site Extent:

The site is 40m x 40m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 49 - General view of site PP 06 as recorded during 2021 fieldwork.

Figure 50 – Closer view of a section of walling from the kraal. The scale is in 10cm incremets.

Figure 51 - View of some of the dwellings associated with the kraal.

6.2.7 PP 07

GPS Coordinates:

S 25.74327
E 30.00301

Type: Demolished Historic Structures

Description:

Description of Site from Kitto & Fourie (2012)

A large storeroom or shed was identified at this location. The storeroom measures approximately 20m x 12m in size and has a high pitched corrugated iron roof. It has large metal doors with metal door frames. These are most likely a later addition. The high windows have wooden frames and are open. The building also has an external electrical system. It has a cement floor and the building is still in use. A small, square sandstone-built structure is situated next to the larger storeroom. This structure measures approximately 5m x 5m in size and also has a pitched corrugated iron roof. It is built with sandstone blocks and mortar and is in a rather weathered state. It does not have a door or door frame and a wooden lintel is used in the door opening. It has wooden window frames. The building has a dirt floor and does not have any water or electrical systems. The age of these buildings is not known.

Figure 52 – General view of the large storeroom as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 53 – The dilapidated square structure as recorded in 2012. This building was constructed of sandstone (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

All the structures and buildings that were located at site PP 07 have been demolished. Only the remains of the foundations are visible on site.

Significance:

During the 2012 study, the site was assessed to be of **Medium Significance** or **Generally Protected B (GP.B).** Due to the fact that the site has now been completely demolished, the current significance of the site is deemed to be of **Low Significance** or **Generally Protected C (GP.C).**

Site Extent:

The site is 30m x 25m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 54 - General view of site PP 07 as recorded during the 2021 fieldwork.

Figure 55 - General view of the demolished remains observed at site PP 07.

Figure 56 – Another view of the state of site PP 07 as recorded during the 2021 fieldwork. The scale is in 10cm increments.

Figure 57 - Remains of the sandstone-built structure as recorded during the 2021 fieldwork at site PP 07. The scale is in 10cm increments.

6.2.8 PP 08

GPS Coordinates:

S 25.74380
E 30.00236

Type: Demolished Historic Farmstead

Description:

Description of Site from Kitto & Fourie (2012)

The remains of a farmhouse and its associated buildings were identified at this location. The remains of the multi-roomed farm house measure approximately 20m x 20m in size. The building was constructed with sandstone blocks and mortar and later additions are brick-built. The walls of the building are thick and are mostly constructed with sandstone blocks and mortar. Some other sections had been constructed or repaired with mud-bricks. Most of the building is plastered with cement and is painted over. A wrought iron fireplace with red tile surround was still in situ, which could date the building to approximately the 1910s to 1930s [Edwardian period, http://www.c20fireplaces.co.uk/information/history-twentieth-century-fireplaces-1905-1939].

The building has no roof and all windows, doors and window and door frames had been removed. It has a sandstone chimney and some of the floors are tiled. The house had an internal electrical system which was a later addition.

A water reservoir is situated approximately 30m from the main house. Another sandstone building is situated approximately 40m on the other side of the farmhouse. This building was constructed with sandstone blocks and mortar and has a pitched corrugated iron roof. This structure measures approximately 5m x 10m in size and is in a semi-dilapidated state. This structure probably served as a storeroom or garage for the main building.

The age of this farmstead and its associated buildings is not known, however, it is highly likely that they are 60 years or older and they could be the original buildings for the Hadeco company.

Figure 58 – General view of the farmhouse as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 59 – The sandstone storeroom as recorded during 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The structures that were identified in 2012 have all been demolished. Only the remains of the structures and foundations were found during the 2021 fieldwork.

Significance:

During the 2012 study, the site was assessed to be of **Medium Significance** or **Generally Protected B (GP. B)**. Due to the fact that the site has now been completely demolished, the current significance of the site is deemed to be of **Low Significance** or **Generally Protected C (GP.C).**

Site Extent:

The site is 30m x 25m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 60 - View of the foundation of a structure as seen during 2021. The scale is in 10cm increments.

Figure 61 – Building rubble from a demolished structure at site PP 08. The scale is in 10cm increments.

Figure 62 – More structural remains observed at site PP 08. The scale is in 10cm increments.

6.2.9 PP 09

GPS Coordinates:

S 25.74210
E 30.00478

Type: Demolished Historic Structure

Description:

Description of Site from Kitto & Fourie (2012)

The remains of a small, square structure were identified at this location. The structure is built with sandstone blocks and cement and measures approximately 4m x 4m in size. The structure has no roof and has only one entrance with no windows. It also has a gravel floor. The function and age of this structure is unknown.

Figure 63 - Square sandstone structure as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The remains of the same square structure were identified during the 2021 fieldwork. However, the condition of the structure has deteriorated significantly in the nine years since the previous assessment

was undertaken.

Significance:

During the 2012 study, the site was assessed to be of **Medium Significance** or **Generally Protected B (GP. B)**. Due to the fact that the site has now deteriorated significantly, the current significance of the site is deemed to be of **Low Significance** or **Generally Protected C (GP.C).**

Site Extent:

The site is 10m x 10m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 64 - View of the front of the structure as recorded in 2021. This view of the structure shows the same façade as the one that was taken in 2012 above. A comparison of the two photographs clearly show the level of deterioration at the site. The scale is in 10cm increments.

Figure 65 – Another view of the structure as recorded in 2021. The scale is in 10cm increments.

Figure 66 – Another view of the structure as recorded in 2021. The scale is in 10cm increments.

6.2.10 PP 10

GPS Coordinates:

S 25.75078
E 29.98994

Type: Grave

Description:

Description of Site from Kitto & Fourie (2012)

A single, informal grave was identified at this location. The grave is situated approximately 40m from a farmstead, which has been identified as site PP 011 (below). The grave has an oval-shaped outline of packed rocks as dressing and is orientated from west to east. A single rock is placed upright at the western end to serve as a headstone. The grave is not maintained and is overgrown with grass and other vegetation. The age of the grave is not known.

Figure 67 – General view of the grave at site PP 010 as recorded during the fieldwork undertaken in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The general area of where the grave was identified in 2012 was walked through by the fieldwork team from PGS. Despite the intensive walkthrough undertaken, no surface features as those observed during the 2012 fieldwork could be found. Several single stones, that could possibly be grave markers, were however found.

Significance:

All graves have high levels of emotional, religious and in some cases historical significance. As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 15m x 15m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 68 - General view of the area where the grave was recorded during the 2012 fieldwork. The scale is in 10cm increments.

6.2.11 PP 11

GPS Coordinates:

S 25.75103
E 29.98960

Type: Historic Farmstead and Structures with the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

A farmstead with its associated buildings was identified at this location. The farmstead consists of two brick-built houses, located next to each other inside a fenced area. Both houses have pitched corrugated iron roofs with metal window and door frames. Both houses also have internal electrical and plumbing systems. Both houses are still occupied.

A large brick-built storeroom or shed is situated approximately 70m from the two houses. It has a pitched corrugated iron roof and wooden door and window frames. Large metal doors are used to close the door openings.

Another brick-built house is situated on the other side of the storeroom. This house is occupied by the farm labourers and their families. It also has a pitched corrugated iron roof and metal door and window frames. Several brick-built extensions have been added to the original structure. It also has external electrical and plumbing systems.

Two cement and mud-brick silos are situated next to the storeroom. The silos measure approximately 4m in diameter and approximately 5m high. The silos are in a ruined state and are not in use.

The remains of a cattle kraal were also identified near the houses. The kraal was built with sandstone blocks and mortar and measures approximately 25m x 8m in size. The kraal is in a ruined state and the walls had been replaced by fencing.

The remains of a double-rondawel workers' dwelling was also identified near the houses. The two rondawels were built of cement bricks and plastered. A brick curtain wall was added to join the two rondawels at a later date. The rondawel may be associated with the single grave (PP010). The age of this farmstead and its associated buildings was not known.

Figure 69 – The farmstead at site PP 10 as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 70 - Brick shed as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 71 – Farm worker houses as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 72 – The two silos from site PP 10 as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 73 - Remains of the cattle kraal as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The farmstead was visited during the current fieldwork. The main farmhouse appears to be a bit dilapidated from the building that was recorded in 2012. However, all the other structures are still intact and appear to be in a similar condition as when they where identified in 2012. The site is currenlty occupied by the Joubert family.

Significance:

The site was stated to be of **Medium Significance** or **Generally Protected B (GP.B)** in the 2012 report. As the site has not significantly deteriorated over the last nine years, the same significance level can still be attributed to it. It is however important to note that past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves at the site is currently available.

Site Extent:

The site is 300m x 250m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 74 - View of the main farm house as recorded during the recent fieldwork.

Figure 75 - View of the silo, storeroom and farm labourer houses.

Figure 76 - General view of the stone kraal. The scale is in 10 cm increments.

6.2.12 PP 12

GPS Coordinates:

S 25.74595
E 29.97420

Type: Historic Coal Mine Shaft

Description:

Description of Site from Kitto & Fourie (2012)

An abandoned coal mine shaft was identified at this location. The shaft measures approximately 2m x 5m and extends approximately 25m into the side of the hill. A second tunnel/shaft extended from the main shaft and its roof had collapsed at the end of this shaft/tunnel. Most of the shaft is flooded with water. Wooden supports to keep the roof of the shaft from collapsing are still in place. A ventilation hole had been dug in the roof which is visible on the surface of the rock outcrop. The age of this abandoned mine is not known. However, it is likely that it dates to over 100 years. Van der Merwe's book on the town of Belfast states that coal mining occurred in this area in historical times and was associated with Sammy Marks (1952).

Figure 77 – The entrance to the old mine shaft as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 78 - Interior view of mine shaft as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The entrance to the shaft is currently covered by dense vegetation. As a result, it was not possible to access the shaft and assess its interior.

Significance:

The site is a relatively unique tangible reminder of the history of coal mining in the surroundings of eMakhazeni (Belfast). As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 5m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 79 – General view of the site and shaft entrance as recorded in 2012.

Figure 80 – Closer view of the entrance to the shaft as recorded during the recent fieldwork. As can be seen, the shaft entrance is completely overgrown. The scale is in 10cm increments.

6.2.13 PP 13

GPS Coordinates:

S 25.74883
E 29.97470

Type: Historic Coal Mine Shaft

Description:

Description of Site from Kitto & Fourie (2012)

Another abandoned mine shaft was identified at this location. The shaft also measures approximately 2m x 5m and extends approximately 25m into the side of the hill. Most of the shaft is flooded with water. Wooden supports to keep the roof of the shaft from collapsing are still in place. The age of this abandoned mine was not known. However, as noted above, it probably dates to the historical period. The coal spoil heap is also still present close to the entrance of the shaft

Figure 81 - General view of mine shaft at site PP 13 as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 82 - Close-up view oof the shaft entrance as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The shaft appears to be in the same condition as when it was identified in 2012.

Significance:

The site is a relatively unique tangible reminder of the history of coal mining in the surroundings of eMakhazeni (Belfast). As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 30m x 25m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 83 – General view of the shaft entrance at PP 13 as recorded during the recent fieldwork. The scale is in 10cm increments.

Figure 84 – Closer view of the shaft entrance at PP 13 as recorded during the recent fieldwork.

6.2.14 PP 14

GPS Coordinates:

S 25.75221
E 29.97899

Type: Possible Rock Art Site

Description:

Description of Site from Kitto & Fourie (2012)

A possible rock art site was identified at this location. The position of the panel is situated on the southern side of an exposed rock bank which formed a slight overhang. Two extremely faded figures were identified. These figures were red in colour, but could not be identified clearly. The figures measure approximately 20cm in size. The rock face is also deteriorating. No archaeological deposit was identified at the foot of the rock face.

Figure 85 – General view of the rock outcrop with possible rock art as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 86 – Closer view of the possible rock art as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. During the site visit, the southern panel was studied. No evidence for rock art can currently be seen with the naked eye at the site.

Significance:

During the 2012 study, the site was assessed to be of **Provincial Significance (Grade 2).** Due to the deterioration that has evidentl occurred over the last nine years, the the current significance of the site is deemed to be of **Medium** to **High Significance (GP. A).**

Site Extent:

The site is 10m x 3m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 87 - General view of the exposed rock at site PP 14 as recorded during the recent fieldwork.

Figure 88 - Closer view of the side of the boulder shows no distinctive or visible rock art

6.2.15 PP 15

GPS Coordinates:

S 25.75435
E 29.98324

Type: Historic Homestead and Structures with the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

The remains of a mud-brick homestead together with a stone-walled cattle kraal were identified at this location. The remains of the mud-brick homestead consist of the foundations of two rectangular structures, which each measure approximately 5m x 5m in size. Another circular structure measures approximately 4m in diameter. This structure was most probably the cooking hut. Rocks were used in the foundations to support the mud-brick walls. Two lower grinding stones were also identified with the remains of the structures.

The ruined stone walled cattle kraal was situated approximately 35m to the west of the homestead. The kraal measures approximately 10m x 10m in size and the walls measure approximately 0.5m wide and 0.75m high.

Figure 89 - Remains of the cattle kraal as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 90 – Close-up view along a section of the wall of the cattle kraal (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. Sections of the stone-packed kraal were identified. It would appear that sections of the kraal's walls have collapsed in the nine years since the 2012 site visit. The remains of the mudbrick homestead could not be seen.

Significance:

The site was stated to be of **Low Significance** or **Generally Protected C (GP.C)** in the 2012 report. However, past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available. To address this potential risk, the site is deemed to be of **Medium Significance** or **Generally Protected B (GP.B).**

Site Extent:

The site is 30m x 25m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 91 - View of the stone kraal as recorded during the 2021 fieldwork. The site is currently overgrown and it appears as if sections of its walls have collapsed since the 2012 fieldwork. The scale is in 10cm increments.

Figure 92 - Closer view of a section of walling from the kraal. The scale is in 10cm increments.

6.2.16 PP 16

GPS Coordinates:

S 25.75299
E 29.98291

Type: Historic Homestead with Graves and the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

The remains of a mud-brick homestead with a stone-walled cattle kraal were identified at this location. The remains of the mud-brick homestead consist of the foundations of one rectangular structure, which measures approximately 7m x 4m in size, and a multi-roomed rectangular structure, which measured 8m x 10m each. Another circular structure measures approximately 4m in diameter. This structure was most probably the cooking hut. Rocks were used in the foundations to support the mud-brick walls of the structures. A lower grinding stone was also identified with the remains of the structures. Several modern metal artefacts such as wire, corrugated iron and cans were found scattered around the site.

The ruin of a stone-walled cattle kraal is situated approximately 30m to the east of the homestead. The kraal measures approximately 10m x 12m in size but the walls had been robbed and the size of the walls could not be determined. Two informal graves were also identified next to the kraal. They are placed next to each other and are orientated from west to east. The graves have oval-shaped mounds of packed rocks as dressing. The graves have no headstones and their age could not be determined.

Figure 93 – The remains of kraal walling as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 94 – General view of the two graves as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. Sections of the stone-packed kraal were identified. It would appear that sections of the kraal's walls have collapsed in the nine years since the 2012 site visit. The remains of the mudbrick homestead could not be seen. The two stone packed graves were identified on-site.

Significance:

All graves have high levels of emotional, religious and in some cases historical significance. As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available.

To address this potential risk, the site, without the above-mentioned presence of two graves, is deemed to be of **Medium Significance** or **Generally Protected B (GP.B).**

Site Extent:

The site is 60m x 60m.

Impact Assessment and Mitigation:

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures.

Figure 95 - General view of the site as recorded in 2021. The scale is in 10cm increments.

Figure 96 - View of the stone wall observed at the site during the 2021 fieldwork. The scale is in 10cm increments.

Figure 97 - View of the two graves as recorded during the 2021 fieldwork. The scale is in 10cm increments.

6.2.17 PP 17

GPS Coordinates:

S 25.74883
E 29.97470

Type: Historic Coal Mine Shaft

Description:

Description of Site from Kitto & Fourie (2012)

An abandoned coal mine shaft was identified at this location. The shaft measures approximately 2m x 4m and extends approximately 15m into the side of the hill. Most of the shaft is flooded with water. The age of this abandoned mine is not known but it is likely to be of historical date (as discussed above).

Figure 98 – Entrance to the mine shaft at site PP17 as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. The mine shaft appears to be relatively intact and in a similar condition as when it was recorded in 2012. The shaft is still flooded with water.

Significance:

The site is a relatively unique tangible reminder of the history of coal mining in the surroundings of eMakhazeni (Belfast). As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 5m x 15m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 99 – General view of site PP 17 as recorded during the recent fieldwork. The entrance to the mine shaft can be seen below the weaver-nests hanging from the tree.

Figure 100 – General view of the entrance to the shaft at site PP 17 as recorded during the recent fieldwork. The scale is in 10cm increments.

Figure 101 - Interior view of the shaft as recorded during the recent fieldwork.

6.2.18 PP 18

GPS Coordinates:

S 25.76010
E 29.96672

Type: Animal Drinking Trough

Description:

Description of Site from Kitto & Fourie (2012)

An old animal drinking trough was identified at this location. The trough is constructed with sandstone blocks and cement and is plastered. The trough measures approximately 5m x 1m and is approximately 0.75m high. No other structures or features are associated with the trough. The age of the trough is not known.

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork.The trough appears to be in the same condition as when it was recorded in 2012. The site is overgrown with vegetation and it would appear that the trough is not currently used.

Significance:

The site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**. This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 1m x 5m.

Impact Assessment and Mitigation:

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 102 - General view of the animal drinking trough at site PP 18 as recorded during the recent fieldwork. The scale is in 10cm increments.

6.2.19 PP 19

GPS Coordinates:

S 25.75980
E 29.96623

Type: Demolished Historic Structure

Description:

Description of Site from Kitto & Fourie (2012)

A ruined stone-walled cattle kraal was identified at this location. The kraal measures approximately 20m x 10m in size and the walls measure approximately 0.5m wide and 1m high. Most of the sandstone blocks used in the walls of the kraal have been robbed (used somewhere else) and the original kraal is in a very dilapidated state.

Figure 103 - Remains of stone kraal as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 104 - Close-up view of a section of walling from the kraal (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

During the recent site visit undertaken in 2021, the kraal could not be identified. This was due to the fact that the site, and its surroundings, was used for the construction of the Phumulani village. The kraal was most likely demolished during the construction.

A sign placed near the site reads as follows: "PHUMULANI AGRI-VILLAGE BELFAST COAL MINE RELOCATED COMMUNITY"

Significance:

The site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**. This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 20m x 10m

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 105 - General view of PP 19 as recording during the recent fieldwork. The kraal is no longer located on-site, as the area has since been used for the site of the Phumulani Agri-Village.

Figure 106 - Information board at the entrance to the Phumulani Agri-Village.

6.2.20 PP 20

GPS Coordinates:

S 25.76151
E 29.96536

Type: Reservoir with Associated Structures

Description:

Description of Site from Kitto & Fourie (2012)

A brick and cement dam was identified at this location. The circular dam is brick-built and is plastered with cement. The dam measures approximately 10m in diameter and the dam wall is approximately 1.6m high.

A 6m x 6m square brick-built building is situated next to the cement dam. The building is plastered and has a wooden door frame. The building's roof, windows and doors had been removed.
The age of this building is not known.

Figure 107 – General view of the brick and cement dam as recorded during the fieldwork undertaken in 2012 (Photo: Kitto & Fourie, 2012).

Figure 108 - Brick structure as recorded during the fieldwork undertaken in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

During the recent fieldwork undertaken in 2021, the site was also visited. No evidence for the structures that were recorded in 2012 could be observed during the recent fieldwork. It would appear that the structures were most likely demolished during the construction of the Phumulani Agri-village. A newer steel reservoir is located close to the original position of the cement dam.

Significance:

The site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**. This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 109 - General view of the site as recorded in 2021. As can be seen from this image, no evidence for the dam or associated structure could be found. The scale is in 10cm increments

Figure 110 – The new steel reservoir that was built near site PP 20. This steel reservoir is associated with the Phumulani Agri-Village.

6.2.21 PP 21

GPS Coordinates:

S 25.76166
E 29.96465

Type: Historic Homesteads and Structures with the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

The remains of a mud-brick homestead were identified at this location. The remains of the mud-brick homestead consist of the foundations of one rectangular structure, which measure approximately 7m x 4m in size, and a multi-roomed l-shaped structure, which measures 8m x 12. A further circular structure measures approximately 4m in diameter. This structure was most probably the cooking hut. Rocks were used in the foundations to support the mud-brick walls of the structures. A lower grinding stone was also identified with the remains of the structures. Several modern metal artefacts such as wire, corrugated iron and cans were found scattered around the site.

Figure 111 - Foundations of rectangular structure as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 112 - Remains of circular structure as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 113 - Lower grinding stone as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

During the recent fieldwork undertaken in 2021, the site was also visited. No remains of a mud-brick homestead were identified at this location. The site is overgrown with grassy vegetation. No other cultural material including remains of foundations of a grinding stone was observed at the site. The site has been disturbed by illegal dumping activities.

Significance:

The site was stated to be of **Low Significance** or **Generally Protected C (GP. C)** in the 2012 report. However, past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available. To address this potential risk, the site is deemed to be of **Medium Significance** or **Generally Protected B (GP. B).**

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 114 - General view of the site as recorded during the recent site visit. Note the dense vegetation found across the surface of the site, which may explain why the remains of the structures could not be found.

Figure 115 – Evidence for illegal dumping activities was noticed around the site.

6.2.22 PP 22

GPS Coordinates:

S 25.76169
E 29.96375

Type: Historic Homesteads and Structures with the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

The remains of a mud-brick homestead were identified at this location. The remains of the mud-brick homestead consist of the foundations of one rectangular multi-roomed structure, which measures approximately 10m x 15m in size; two rectangular-shaped structures, which measure 4m x 6m each; and a square room, which measures 4m x 4m. There was also a circular structure, which measures approximately 4m in diameter. This structure was most probably the cooking hut. The structures are arranged in an open square which formed a central Lapa area. Rocks were used in the foundations to support the mud-brick walls of the structures. Several modern metal artefacts such as wire, corrugated iron and cans were found scattered around the site.

Figure 116 - Foundations of a multi-roomed structure recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. A small section of the remains of the foundation of the mud-brick homestead could be identified. The outlines of the structure were barely visible underneath the grassy vegetation. No other cultural material including remains were observed at the site.

Significance:

The site was stated to be of **Low Significance** or **Generally Protected C (GP. C)** in the 2012 report. However, past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available. To address this potential risk, the site is deemed to be of **Medium Significance** or **Generally Protected B (GP. B).**

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 117 - General view of site PP 22 as recorded during the recent site visit. The remains of the mudbrick homestead could barely be seen in the dense vegetation. The scale is in 10cm increments.

6.2.23 PP 23

GPS Coordinates:

S 25.76166
E 29.96465

Type: Demolished Historic Structure (before 2012)

Description:

Description of Site from Kitto & Fourie (2012)

The remains of an old sandstone building were identified at this location. Most of the remains of the building had been removed and only the sandstone blocks which formed the foundations of the building are left. Several bricks were also found scattered across the site. There were no other features such as windows, doors or any floors to identify the structure with. These remains are most probably parts of an old farmhouse, which were broken down and removed from this site in the past. The structure measures approximately 18m x 20m in size. The exact function and age of this structure are not known.

Figure 118 – General view of the site as recorded in 2012. The poorly preserved state of the structure can be seen (Photo: Kitto & Fourie, 2012).

Figure 119 – Another photograph of the site that was taken in 2012. A few of the sandstone blocks can be seen (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. The scattered remains of an old sandstone building were identified at this location. Most of the remains of the building had been removed and only the sandstone blocks which formed the foundations of the building were left. The site is overgrown.

Significance:

The site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**. This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation:

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures.

Figure 120 - General view of site PP 23 as recorded during the recent fieldwork. The dense vegetation covering the surface of the site can be seen.

Figure 121 - Only the scattered remains of the sandstone blocks of the structure were observed on site. The site is poorly preserved and overgrown. The scale is in 10cm increments.

6.2.24 PP 24

GPS Coordinates:

S 25.76272
E 29.96177

Type: Sunbury Railway Station

Description:

Description of Site from Kitto & Fourie (2012)

The ruined remains of the Sunbury Railway Station were identified at this location. The structure is constructed of red brick that was plastered and painted. The structure has been stripped of its roof, doors, windows and all other features. Only a few of its walls remain. The structure is in ruins and is overgrown with vegetation. The age of the station is not known.

Figure 122 - Remains of the building at the Sunbury Railway Station as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

During the site visit undertaken recently the collapsed remains of the building associated with the Sunbury Railway Station building were identified. A newer brick structure, the Sunbury Substation, was also identified at the site.

Significance:

The site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**. This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 30m x 25m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 123 - The collapsed remains of the building associated with the Sunbury Railway Station as recorded during the recent fieldwork.

6.2.25 PP 25

GPS Coordinates:

S 25.73242
E 29.99351

Type: Historic Homesteads and Structures with the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

The remains of farm labourer quarters were identified at this location. The structure is brick-built and plastered and measures approximately 10m x 5m in size. The roof, doors, windows and frames have been removed from the building. The building consisted of two rooms and a bathroom. A warm water system (donkey) is situated next to the bathroom of the building. A midden was also identified approximately 20m from the structure.

The remains of a cattle or pig shed were also identified approximately 50m to the west of the labourer quarters. A brick and cement drinking trough was identified near the remains of the cattle/pig shed.

Figure 124 - Ruins of farmworker dwelling and "donkey" structure as recorded during the fieldwork undertaken in 2012 (Photo: Kitto & Fourie, 2012).

Figure 125 - Remains of shed as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 126 - Close-up view of a section of walling from the shed. This photograph was also taken during the site visit of 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

During the site visit undertaken recently, the remains of collapsed dwellings were observed. A single animal drinking trough was also found near the houses.

The site is overgrown and no remains of the shed were identified.

Significance:

The site was stated to be of **Low Significance** or **Generally Protected C (GP. C)** in the 2012 report.

However, past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available.

To address this potential risk, the site is deemed to be of **Medium Significance** or **Generally Protected B (GP. B).**

Site Extent:

The site is 30m x 25m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 127 - General view of site PP 25 as recorded during the recent site visit.

Figure 128 - The drinking trough was also observed during the recent fieldwork.

6.2.26 PP 26

GPS Coordinates:

S 25.73428
E 29.99304

Type: Historic Homesteads and Structures with the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

The remains of a mud-brick homestead were identified at this location. The mud-brick homestead consists of the foundations of two square structures, which measure approximately 4m x 4m in size each, and a multi-roomed rectangular structure, which measures 8m x 15m. Another circular structure measures approximately 4m in diameter. This structure was most probably the cooking hut. Rocks were used in the foundations to support the mud-brick walls of the structures. Several modern metal artefacts such as wire, corrugated iron and cans were found scattered around the site.

Figure 129 - Foundation of the homestead as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 130 - Remains of a circular structure recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

During the site visit undertaken recently, the site was found to consist of the remains of a barely visible foundation of a mudbrick house. The site was found to be very overgrown.

Significance:

The site was stated to be of **Low Significance** or **Generally Protected C (GP. C)** in the 2012 report. However, past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available. To address this potential risk, the site is deemed to be of **Medium Significance** or **Generally Protected B (GP. B).**

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 131 - General view of the site as recorded during the recent fieldwork.

Figure 132 – Another view of the site that was recorded during the recent visit. This image depicts an elevated soil heap containing scattered bricks and stones. The scale is in 10cm increments.

6.2.27 PP 27

GPS Coordinates:

S 25.73508
E 29.99341

Type: Historic Structure

Description:

Description of Site from Kitto & Fourie (2012)

The remains of a sandstone building were identified at this location. The structure measures approximately 12m x 5m and is constructed with sandstone blocks without mortar or cement. The original entrance to the structure has been filled up with other sandstone blocks. The walls of this structure measure approximately 0.5m wide and approximately 2m high. The structure was most probably a shed or a storeroom.

The remains of a stone-walled kraal were identified next to the sandstone structure. Most of the walling for the kraal has been removed and only some sandstone blocks from the foundations are left. The kraal measures approximately 10m x 25m.

Figure 133 - Ruin of the sandstone building as recorded during the fieldwork undertaken in 2012 (Photo: Kitto & Fourie, 2012).

Figure 134 – Another view of the site as recorded in 2012. This image depicts the remains of walls associated with the building (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

During the site visit undertaken recently, the site was found to consist of a collapsed sandstone building and wall. The site is abandoned and poorly preserved. This said, the site appears to be in a similar condition as what was recorded in 2012.

Significance:

During the 2012 study, the site was assessed to be of **Medium Significance** or **Generally Protected B (GP. B)**. Due to the fact that the site has not deteriorated significantly, the current significance of the site would be the same.

Site Extent:

The site is 30m x 40m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 135 - General view of the site as recorded during the recent fieldwork. The sandstone building can clearly be seen.

Figure 136 – Closer view of the sandstone building as recorded during the recent fieldwork.

Figure 137 – Side view of a section of walling from the building. The scale is in 10cm increments.

Figure 138 – A section of the stone wall associated with the sandstone building (visible in the back) can be seen in the foreground.

6.2.28 PP 28

GPS Coordinates:

S 25.73605
E 29.99331

Type: Burial Ground

Description:

Description of Site from Kitto & Fourie (2012)

A small informal cemetery with eight graves was identified at this location. The cemetery is fenced and is situated in the open veld. The graves are placed in one line next to each other and all are orientated from west to east. Seven of the graves have informal, oval-shaped outlines of packed rocks which are filled with soil. Rocks are placed upright at the western ends to serve as headstones. One grave has a formal granite dressing and an inscribed granite headstone. This grave dates from the early 1960's and belongs to the Skhosana family. Most of the graves are overgrown with grass and other vegetation. No grave goods were found with these graves.

Figure 139 – General view of the cemetery as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 140 - Close-up view of one of the graves from site PP 28 as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

All eight graves were observed during the site visit undertaken recently. One of the graves contained a headstone, which is in a poor state of preservation and has fallen over. The graves are overgrown but clearly visible.

Significance:

All graves have high levels of emotional, religious and in some cases historical significance. As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 30m x 25m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 141 - General view of the site as recorded during the recent site visit. The dense vegetation can still be seen.

Figure 142 - View of the headstone on the grave of Magwegwe Skhosana, which has fallen over. The scale is in 10cm increments.

6.2.29 PP 29

GPS Coordinates:

S 25.72698
E 29.98967

Type: Historic Homesteads and Structures with the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

The remains of an extended mud-brick settlement were identified at this location. The remains of this mud-brick settlement cover an area of approximately 200m x 200 and consist of at least nine different homesteads or structures that formed part of the larger settlement. Most of the structures are ruined and were very difficult to identify. The numbers, sizes and shapes of these structures of this settlement are not clearly identifiable. Rocks were used in the foundations to support the mud-brick walls of the structures. Several modern metal artefacts such as wire, corrugated iron and cans were found scattered around the site.

Figure 143 - General view of some of the foundation remains as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. It was found to consist of the foundation remains of several mudbrick homesteads spread across the site. Only the raised foundations are visible on the surface. The site is overgrown. No other cultural remains were found.

Significance:

The site was stated to be of **Low Significance** or **Generally Protected C (GP. C)** in the 2012 report. However, past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available. To address this potential risk, the site is deemed to be of **Medium Significance** or **Generally Protected B (GP. B).**

Site Extent:

The site is 30m x 25m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 144 - General view of site PP 29 as recorded during the recent fieldwork.

Figure 145 - View of the remains of the foundations of two mudbrick homesteads. The scale is not visible due to the dense grass covering the surface of the site.

6.2.30 PP 30

GPS Coordinates:

S 25.71853
E 30.01722

Type: Historic Farmstead

Description:

Description of Site from Kitto & Fourie (2012)

A farmstead with its associated buildings was identified at this location. The main house and other buildings are still intact and are still being occupied. The main house has been extended over the years and several extensions are visible. These additions are all done in the same architectural style as the original building. The original house has a pitched thatched roof and wooden door and window frames. It has thick walls which are plastered and whitewashed or painted white According to the owner, Mr. Wilkie, the house is more than a hundred years old. The house has many different features and a detailed study by a heritage architect would be necessary to document them all.

A second, more modern, house is situated opposite the original old house . This house is brick-built and has a pitched corrugated iron roof. It measures approximately 25 m x 30m in size and actually consists of two separate buildings which have been joined. According to the owner, Mr.Wilkie, this house is more than 60 years old. The house has metal window frames and wooden door frames and doors. It also has internal electrical and plumbing systems.

A storeroom or shed with farm implements was also identified. This storeroom measures approximately 12m x 8m and has a low pitched corrugated iron roof. The building is built with sandstone blocks and mortar and has wooden window frames and wooden door frames with homemade doors. It has an external electrical system.

Another storeroom or shed is situated next to the first shed. It measures approximately 10m x 5m and is also constructed with sandstone blocks and mortar, with a low pitched corrugated iron roof. This building is in a rather poor state and more recent brick and cement supports had been placed there to extend the life of the building. The building has wooden window frames and wooden doors and door frames.

Figure 146 – General view of the farmhouse as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 147 – Another view of the farmhouse as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 148 - View of rear of the main farmhouse (Photo: Kitto & Fourie, 2012).

Figure 149 - Two sandstone sheds (Photo: Kitto & Fourie, 2012).

Figure 150 - Second farmhouse, the original building (Photo: Kitto & Fourie, 2012).

Figure 151 - Modern addition to the rear of the second farmhouse (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. It was found to consist of the remains of an abandoned farmstead with several buildings and a stone kraal. It appears as if the site has been abandoned for some period as the site is overgrown with vegetation.

The main house and other buildings are intact and are currently unoccupied. The main house has been extended over the years and several extensions are visible. Two storerooms or sheds were also identified. The buildings are built with sandstone blocks and mortar and are located next to each other. The roof of one of the sandstone buildings has collapsed. Since the farmstead appears to be unoccupied, access could not be gained through the locked gate and electric fence.

Significance:

During the 2012 study, the site was assessed to be of **Medium Significance** or **Generally Protected B (GP. B)**. Although the site has deteriorated, the current significance would remain the same.

Site Extent:

The site is 50m x 50m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures.

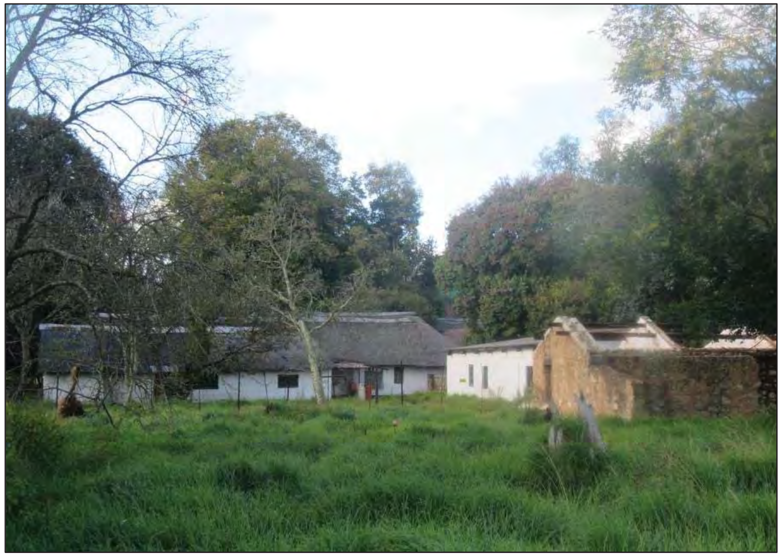


Figure 152 - General view of the farmstead at site PP 30 as recorded during the recent visit to the site. The thatched-roof farmhouse can be seen in the background on the left.

Figure 153 - View of the stone building with collapsed roof. The scale is in 10cm increments.

6.2.31 PP 31

GPS Coordinates:

S 25.71133
E 30.01645

Type: Burial Ground

Description:

Description of Site from Kitto & Fourie (2012)

An informal cemetery with approximately 39 graves was identified at this location. The cemetery is not fenced and is located in a ploughed and planted field. The graves are placed in 3 unequal lines next to each other aligned east-west. Most of the graves have informal oval or rectangular shaped mounds or outlines of packed rocks as dressings. One grave has a formal granite dressing and an inscribed granite headstone. Some of the graves had been cleaned recently, but most of them are overgrown with grass and other vegetation. Some graves have granite inscribed headstones. According to local residents, the graves are farmworker graves. Some families still live on the farm and others live in the settlement of Siyathuthuka.

Figure 154 - View of the cemetery at site PP 31 as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Figure 155 – Another view of the cemetery as recorded in 2012 (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. It was found to consist of a cemetery containing a total of approximately 40 graves located in an agricultural field. Many of the graves have stone-lined dressings whereas some graves have formal dressings and inscribed headstones. The graves are clearly visibly. The cemetery is not fenced.

Significance:

All graves have high levels of emotional, religious and in some cases historical significance. As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).** This is the same heritage significance rating that the site received in the 2012 report.

Site Extent:

The site is 50m x 50m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 156 - General view of the cemetery at site PP 31 as recorded during the recent site visit.

Figure 157 - View of some of the graves consisting of formal dressings, headstones and packed graves. Not the small fence surrounds three stone-lined graves.

6.2.32 PP 32

GPS Coordinates:

S 25.72307

E 30.01585

Type: Historic Homesteads and Structures with the Possible Risk for Unmarked Graves

Description:

Description of Site from Kitto & Fourie (2012)

The remains of another mud-brick homestead were identified at this location. The remains of the mud-brick homestead consist of the foundations of four square structures, which each measure approximately 4m x 4m in size, and a circular structure that measured approximately 4m in diameter. This structure was most probably the cooking hut. The structures are all placed around a central Lapa area. Rocks were used in the foundations to support the mud-brick walls of the structures. Several modern metal artefacts such as wire, corrugated iron and cans were found scattered around the site.

Figure 158 – General view of site PP 32 as recorded during the fieldwork undertaken in 2012. The foundation remains of the homestead can be seen on this photograph (Photo: Kitto & Fourie, 2012).

Figure 159 - Close-up view of one of the wall foundations. This photograph was also taken during the 2012 fieldwork (Photo: Kitto & Fourie, 2012).

Description of Site from the 2021 Fieldwork

The site was visited during the recent fieldwork. It was found to consist of the remains of a mudbrick homestead, with only some of the foundations visible on site. The site is overgrown with vegetation.

Significance:

The site was stated to be of **Low Significance** or **Generally Protected C (GP. C)** in the 2012 report. However, past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available. To address this potential risk, the site is deemed to be of **Medium Significance** or **Generally Protected B (GP. B).**

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 160 - General view of site PP 32 as recorded during the recent fieldwork. Note the dense vegetation found at the site.

Figure 161 - View of some of the stone foundations observed at the site.

6.3 Heritage Sites identified in 2021

6.3.1 PP 33

GPS Coordinates:

S 25.748624
E 29.974775

Type: Historic Structure associated with Historic Coal Mine Shaft

Description:

The site consists of the stone foundation of a structure located approximately 25m north of the old mine shaft at site PP 13. This suggests that the structure can in all likelihood be associated with the old mine shaft.

The structure is rectangular in shape and consists of low stone foundations. No other cultural material was identified on-site.

Significance:

The structure is possibly associated with PP 13, and most likely older than 60 years. As such the site is of **Medium Significance** and is rated as **Generally Protected B (GP.B)**.

Site Extent:

The site is 10m x 10m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 162 - General view of the stone foundations of a ming structure found at site PP 33. The scale is in 10cm increments.

6.2.34 PP 34

GPS Coordinates:

S 25.742500
E 30.002855

Type: Demolished Structure

Description:

The site consists of the demolished ruins of a multi-roomed brick house. The site is located approximately 100m north of PP 07.

A building is depicted in proximity to this site on the Second Edition of the 2530CA (Belfast) Topographical Map that was compiled in 1989. This building is not depicted on the First Edition of this sheet that was surveyed in 1969. From this information it seems evident that the building at site PP 34 was built between 1969 and 1989. The building at site PP 34 is therefore younger than 60 years.

Significance:

The building at the site is completely demolished. It is also younger than 60 years. As a result, the site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 163 - General view of the demolished structure at PP 34.

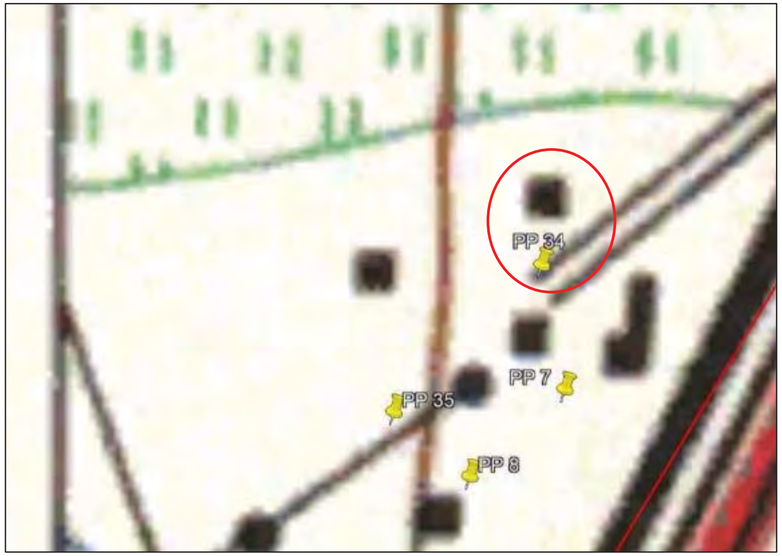


Figure 164 - View of the building (red polygon) depicted on the Second Edition of the 2530CA (Belfast) Topographical Map in proximity to the position of the demolished structure at site PP 34. This map was compiled in 1989.

6.2.35 PP 35

GPS Coordinates:

S 25.743408
E 30.001842

Type: Contemporary Farmstead

Description:

The site consists of two brick buildings with tiled roofs. structures, A third smaller brick building is located in the western corner of the property. A fourth building with a collapsed roof, most likely used as an outside storeroom, is located in the southern corner of the property. The property is surrounded by a fence and is currently occupied. The site is located approximately 90m north-west of PP 08.

A building is depicted in proximity to this site on the Second Edition of the 2530CA (Belfast) Topographical Map that was compiled in 1989. This building is not depicted on the First Edition of this sheet that was surveyed in 1969. From this information it seems evident that the buildings at site PP 35 were built between 1969 and 1989. These buildings are therefore younger than 60 years.

Significance:

The buildings at the site are all younger than 60 years. As a result, the site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 165 - General view of the two brick houses (visible in the background) with an associated smaller brick building in the foreground.

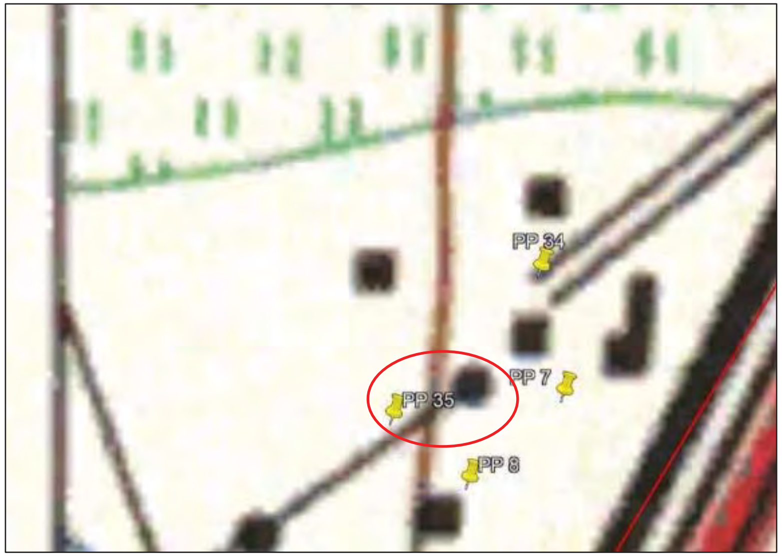


Figure 166 - View of the building (red polygon) depicted on the Second Edition of the 2530CA (Belfast) Topographical Map in proximity to the position of site PP 35. This map was compiled in 1989.

6.2.36 PP 36

GPS Coordinates:

S 25.754370
E 29.981422

Type: Historic Coal Mine Shaft

Description:

An abandoned coal mine shaft was identified here. The shaft measures approximately 2m x 2m. It is located approximately 90m south-west of the shaft at site PP 17. Because of the smaller shaft entrance, it was not possible to get a clear view of the interior of the shaft. The age of this abandoned mine is not known but it is likely quite old.

Significance:

The site is a relatively unique tangible reminder of the history of coal mining in the surroundings of eMakhazeni (Belfast). As such, the site is of **Medium** to **High Significance** or **Generally Protected A (GP. A).**

Site Extent:

The site is 10m x 10m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 167 - View of the entrance to the abandoned coal mine shaft at PP 36. The scale is in 10cm increments.

6.2.37 PP 37

GPS Coordinates:

S 25.750654
E 29.989601

Type: Single Grave

Description:

A single grave was identified near the recorded positions of the farmhouse at PP 11 and the grave identified at site PP 10. The grave is located approximately 35m northwest of PP 10.

The grave at site PP 37 was pointed out by the farmworkers. Its surface is marked with an iron rod that was placed at the head of the grave. No other cultural remains were identified at the grave site.

Significance:

All graves have high levels of emotional, religious and in some cases historical significance. As such, the site is of **Medium** to **High Significance** and is rated as **Generally Protected A (GP. A).**

Site Extent:

The site is 10m x 10m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures.

Figure 168 - General view of the single grave at site PP 37. The metal rod marking the position of the grave can be seen. The scale is in 10cm increments.

Figure 169 - Another view of the single grave at site PP 37. The metal rod marking the position of the grave can again be seen. The scale is in 10cm increments.

6.2.38 PP 38

GPS Coordinates:

S 25.729260
E 30.013751

Type: Reservoir with Associated Structures

Description:

The site consist of a collapsed reservoir associated with a single brick building. Both the reservoir and brick building are younger than 60 years.

Significance:

The buildings from the site are both younger than 60 years. As such, the site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation:

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures.

Figure 170 - General view of site PP 38.

Figure 171 – Another view of the site showing a section of the reservoir in the foreground with the brick building in the back.

6.2.39 PP 39

GPS Coordinates:

S 25.726835
E 30.010754

Type: Reservoir with Associated Structures

Description:

The site consists of a circular reservoir associated with two brick buildings. Both the reservoir and brick buildings are younger than 60 years.

Significance:

The buildings from the site are younger than 60 years. As such, the site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation:

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 172 - General view of the reservoir and buildings at site PP 39.

Figure 173 – A section of the reservoir is visible on the left, with the two associated brick structures located in the back.

6.2.40 PP 40

GPS Coordinates:

S 25.735453
E 29.995204

Type: Historic Homestead with the Possible Risk for Unmarked Graves

Description:

The site consists of the stone foundations of a rectangular structure. The structure is located approximately 252m north-west of the mudbrick homestead at site PP 26 and approximately 180m west of the stone structure at site PP27. It is most likely that the structure was a dwelling and can likely be associated with sites PP 26 and PP 27.

Significance:

The structure itself is deemed to be of **Low Significance** and is rated as **Generally Protected C (GP. C)**. However, past experience has shown that in some cases unmarked stillborn babies and infants were buried in close proximity to such homesteads. These babies and infants were frequently buried along the sides, or underneath, the parents' dwelling. No direct information with regards to the presence (or not) of such graves is currently available. To address this potential risk, the site is deemed to be of **Medium Significance** or **Generally Protected B (GP. B).**

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 174 – General view of the stone foundations of a rectangular structure. The scale is in 10cm increments.

Figure 175 - Closer view of a section of the foundations at site PP 40.

6.2.41 PP 41

GPS Coordinates:

S 25.716593
E 30.014553

Type: Structure

Description:

The remains of a small, square structure were identified at this location. The structure was built with stone and cement and measures approximately 4m x 4m in size. It has has no roof and has only one entrance with no windows. The function and age of this structure are unknown. A section of one wall has broken away.

Significance:

The site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 176 – General view of the stone structure at site PP 41.

6.2.42 PP 42

GPS Coordinates:

S 25.726796
E 30.002923

Type: Animal Drinking Trough

Description:

An old animal drinking trough was identified at this location. The trough is constructed with blocks and cement and is plastered. The trough measures approximately 5m x 1m and is approximately 0.75m high. No other structures or features are associated with the trough. The age of the trough is not known.

Significance:

The site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation:

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 177 - View of the animal drinking trough. The scale is in 10cm increments.

6.2.43 PP 43

GPS Coordinates:

S 25.738228
E 30.000564

Type: Demolished Structure

Description:

The site consists of the remains of a demolished brick and plaster structure. The collapsed walls and foundations of the structure were found on site.

A building is depicted in proximity to this site on the Second Edition of the 2530CA (Belfast) Topographical Map that was compiled in 1989. This building is not depicted on the First Edition of this sheet that was surveyed in 1969. From this information it seems evident that the building at site PP 43 was built between 1969 and 1989. The building at site PP 43 is therefore younger than 60 years.

Significance:

The building at the site is completely demolished. It is also younger than 60 years. As a result, the site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 178 - General view of the demolished structure at site PP 43.

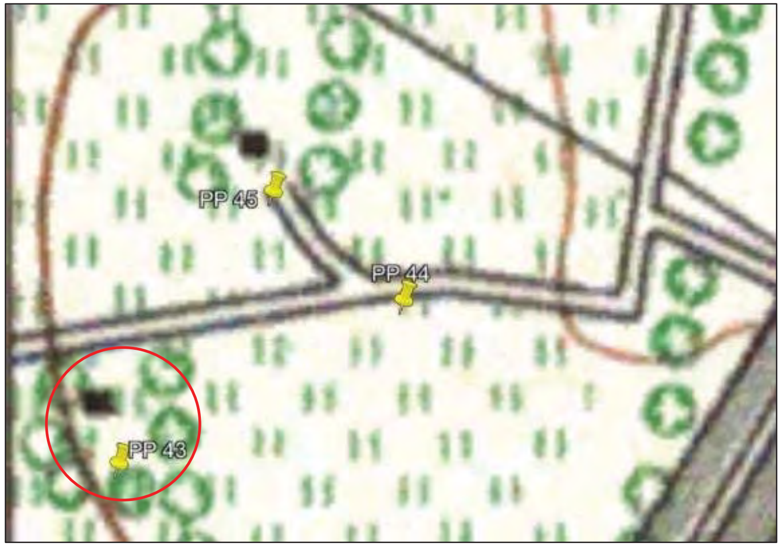


Figure 179 - View of the building (red polygon) depicted on the Second Edition of the 2530CA (Belfast) Topographical Map in proximity to the position of the demolished structure at site PP 43. This map was compiled in 1989.

6.2.44 PP 44

GPS Coordinates:

S 25.736880
E 30.003181

Type: Reservoirs with Associated Structures

Description:

The site consists of two circular cement reservoirs. Three delipidated brick buildings, with no roofs or windows, were also identified at the site. The site is believed to be younger than 60 years.

Significance:

The site is believed to be younger than 60 years. As a result, it is of **Low Significance** and is rated as **Generally Protected C (GP.C)**.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 180 - General view of the site showing sections of the two reservoirs in the back with one of the associated brick buildings visible in the foreground.

Figure 181 – Anohter view of the site showing a reservoir and its associated buildings and structures.

6.2.45 PP 45

GPS Coordinates:

S 25.735982
E 30.001980

Type: Demolished Structure

Description:

The site consists of the remains of a demolished multi-roomed structure.

A building is depicted in proximity to this site on the Second Edition of the 2530CA (Belfast) Topographical Map that was compiled in 1989. This building is not depicted on the First Edition of this sheet that was surveyed in 1969. From this information it seems evident that the building at site PP 45 was built between 1969 and 1989. The building at site PP 45 is therefore younger than 60 years.

Significance:

The building at the site is completely demolished. It is also younger than 60 years. As a result, the site is of **Low Significance** and is rated as **Generally Protected C (GP.C)**.

Site Extent:

The site is 30m x 30m.

Impact Assessment and Mitigation*:*

See Chapter 7 for impact assessment calculations and Chapter 8 for required mitigation measures

Figure 182 - General view of the demolished structure at site PP 45.

Figure 183 - View of the building (red polygon) depicted on the Second Edition of the 2530CA (Belfast) Topographical Map in proximity to the position of the demolished structure at site PP 45. This map was compiled in 1989.

6.4 Palaeontology

The palaeontological Desktop Assessment (PDA) was compiled by Banzai Environmental (Butler, 2021). The text and figures provided in this chapter are derived from this specialist report. Refer **Appendix C**.

The proposed development is primarily underlain by the Vryheid Formation of the Ecca Group (Karoo Supergroup). According to the South African Heritage, Resources Information System the project area is located in an area with Very High sensitivity (red), as such the Palaeontological Sensitivity of these rocks is Very High.

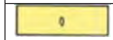
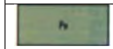
The geology of the proposed Glisa EMP and IWUL Consolidated Project is depicted on the 1: 250 000 2528 Pretoria (1978) and 2530 Baberton (1986) Geological Map (Council for Geosciences, Pretoria. The area is underlain by rocks of the Transvaal Supergroup (Rooiberg and Pretoria Groups) that is overlain by the Vryheid Formation (Ecca Group, Karoo Supergroup). Isolated areas are mantled by Quaternary alluvium.

Quaternary superficial deposits are the youngest geological deposits formed during the most recent period of geological time (approximately 2.6 million years ago to the present). Most of the superficial deposits are unconsolidated sediments and consist of gravel, sand, silt and clay, and they form relatively thin, often discontinuous patches of sediments or larger spreads onshore. These sediments may include stream, channel and floodplain deposits, beach sand, talus gravels and glacial drift sediments (Partridge et al, 2006). Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. In the past palaeontologists did not focus on Caenozoic superficial deposits although they sometimes comprise of significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known as Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

As such it is recommended that an EIA level palaeontology report be conducted to assess the value and prominence of fossils in the development area and the effect of the proposed development on the palaeontological heritage. The purpose of the EIA Report is to elaborate on the issues and potential impacts identified during the scoping phase. A Phase 1 field-based assessment would be conducted with research in the site-specific study area, as well as a comprehensive assessment of the impacts identified during the scoping phase.

Figure 184 - Extract of the 2528 (Pretoria) and 2530 (Baberton) Geological Map (Council of Geoscience) indicating the surface geology of the proposed development in white and orange (Butler, 2021:12).

Table 19 - Legend to Map and short explanation (Modified from the 1:250 000 2528 Pretoria (1978) and 2530 Baberton (1986) Geological Map (Council for Geosciences, Pretoria)

Symbol	Lithology	Stratigraphy	Age
	Surface deposit, alluvium		Quaternary
	Shale, Shaley sandstone, grit, sandstone, conglomerate, coal in places near top and bottom	Vryheid Formation, Ecca Group, Karoo Supergroup	Permian
	Diabase		Vaalian to post Mogolian Age
	Volcanic rocks, pyroxene hornfels	Dullstroom Formation, Pretoria Group, Transvaal Supergroup	Vaalian
	Quartzite, subordinate shale	Steenkampsberg Formation, Pretoria Group, Transvaal Supergroup	

Vryheid Formation

The coalfields of South African occur in the Main Karoo Basin or its associated sub-basins. The Main Karoo Basin forms part of a series of Gondwanan basins that was established along the southern boundary of Gondwana (Cole, 1992; De Wit and Ransome 1992; Veevers *et al*. 1994; Catuneanu *et al*. 1998). These basins include Beacon Basin in Antarctica, Bowen Basin in Australia as well as the Paraná Basin in South America. The Basins were formed between the Late Carboniferous and Middle Jurassic and their joint stratigraphies portray the best non-marine sedimentation record globally.

Most of the coal mined in South Africa originates in the Permian Vryheid Formation (refer **Figure 184** below).

The **Vryheid Formation** comprises mudrock, rhythmite, siltstone and fine- to coarse-grained sandstone (pebbly in places). The Formation contains up to five (mineable) coal seams. The different lithofacies are mainly arranged in upward-coarsening deltaic cycles (up to 80m thick in the southeast). Fining-upward fluvial cycles, of which up to six are present in the east, are typically sheet-like in geometry, although some form valley-fill deposits. They comprise coarse-grained to pebbly, immature sandstones - with an abrupt upward transition into fine-grained sediments and coal seams.

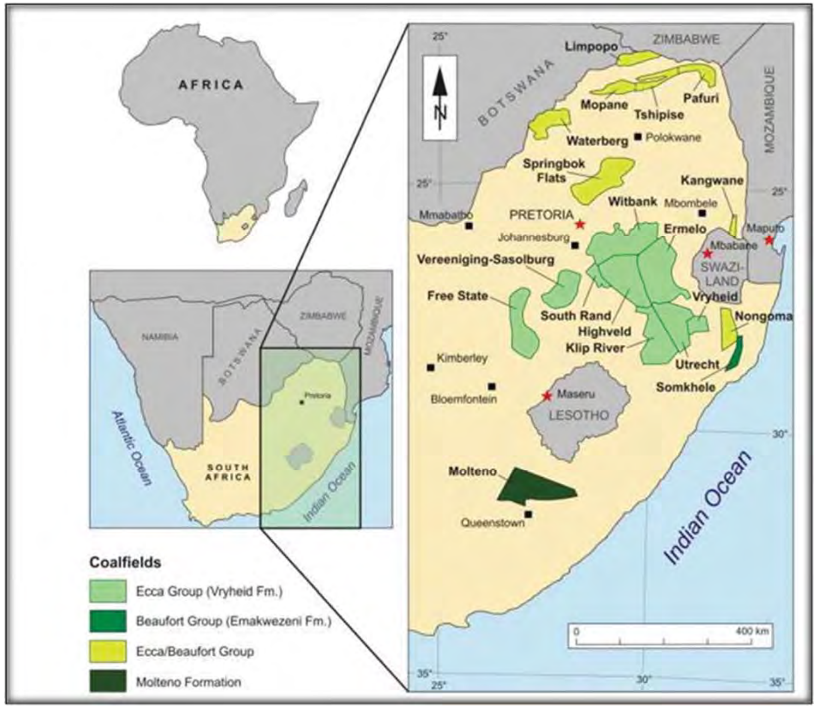


Figure 185 - Coalfields of Southern Africa, taken from Hancox and Götz (2014).

The Vryheid Formation comprise of a rich assemblage of Glossopteris flora. After continental deglaciation took place Gymnospermous glossopterids (Figure 6) dominated the peat and non-peat accumulating Permian wetlands (Falcon, 1986, Greb *et al*., 2006).

Recent paleobotanical studies in the Vryburg Formation include that of Bordy and Prevec (2008) and Prevec *et al.* (2008, 2009, 2010) and Prevec, (2011). Bamford (2011) described numerous plant fossils from this formation (e.g. *Azaniodendron fertile*, *Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Hirsutum* sp., *Scutum* sp., *Ottokaria* sp., *Estcourtia* sp., *Arberia* sp., *Lidgetonnia* sp., *Noeggerathiopsis* sp., *Podocarpidites* sp as well as more than 20 Glossopteris species.

In the past, palynological studies have focused on the coal-bearing successions of the Vryheid Formation and include articles by Aitken (1994, 1998), and Millsteed (1994, 1999), while recent studies focussed on the Witbank Coalfield were conducted by Götz and Ruckwied (2014).

Table 20 - Ecca Group and Formations. (Modified from Johnson et al, 2006).

Period	Supergroup	Group	Formation West of 24º E	Formation East of 24º E	Formation Free State / KwaZulu Natal
Permian	Karoo Supergroup	Ecca Group	Waterford Formation	Waterford Formation	Volksrust Formation
			Tierberg / Fort Brown Formation	Fort Brown Formation	
			Laingsburg / Rippon Formation	Rippon Formation	Vryheid Formation
			Collingham Formation	Collingham Formation	Pietermaritzburg Formation
			Whitehill Formation	Whitehill Formation	
			Prince Albert Formation	Prince Albert Formation	Mbizane Formation

Bamford (2011) is of the opinion that only a small amount of data has been published on these potentially fossiliferous deposits and that most likely good material is present around coal mines and in other areas the exposures are poor and of little interest. When plant fossils do occur, they are usually abundant. According to Bamford, it is not feasible to preserve all the sites but in the interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

To date no fossil vertebrates have been collected from the Vryheid formation. The occurrence of fossil insects is rare, while palynomorphs are diverse. Fish scales and non-marine bivalves have been reported. Trace fossils are found abundantly but the diversity is low. The mesosaurid reptile, *Mesosaurus* (Figure 7) has been found in the southern parts of the basin but may also be present in other areas of the Vryheid formation. Regardless of the rare and irregular occurrence of fossils in this biozone, a single fossil may be of scientific value as many fossil taxa are known from a single fossil.

Figure 186 - Glossopteris leaf.

Figure 187 - Mesosaurus sp. (National Museum, Bloemfontein specimen NMQR 3536)

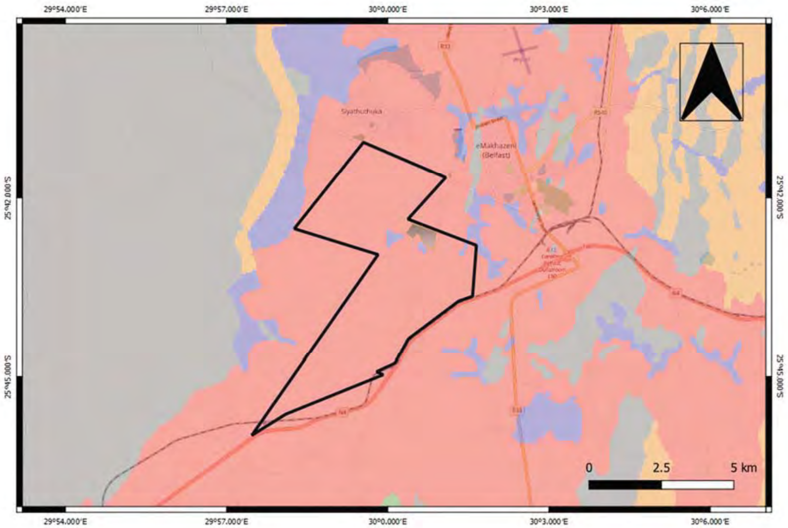


Figure 188 - Extract of the 1:250 000 SAHRIS PalaeoMap (Council of Geosciences) indicating the proposed development in graded colours (Butler, 2021:19).

Table 21 - SAHRIS Palaeosensitivity ratings table.

Colour	Sensitivity	Required Action
RED	**VERY HIGH**	**Field assessment and protocol for finds is required.**
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely.
GREEN	MODERATE	Desktop study is required.
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required.
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required.
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

7 ASSESSMENT OF IMPACT OF PROPOSED DEVELOPMENT

7.1 Introduction

In this section, an assessment will be made of the impact of the proposed development on the identified heritage sites. The following general observations will apply for the impact assessment undertaken in this report:

- Heritage sites assessed to have a low heritage significance are not included in these impact risk assessment calculations. The reason for this is that sites of low significance will not require mitigation. These sites are PP 01, PP 07, PP 08, PP 09, PP 18, PP 19, PP 20, PP 23, PP 24, PP 34, PP 35, PP 38, PP 39, PP 41, PP 42, PP 43, PP 44 & PP 45; and
- The only development footprint area that was assessed for the purposes of this study, is the proposed Discard Management Facility (DMF).

7.2 Assessment of Pre-Mitigation Impact of DMF on the Identified Heritage Sites

As indicated elsewhere, only the heritage impact of the proposed Discard Management Facility (DMF) is included in this assessment.

No heritage sites were identified within the proposed DMF area. Of the 45 heritage sites included in this report, only five are located within 1,000 meters of this proposed proposed development area. These five sites, with their respective distances from this proposed development area, are provided below.

- Site PP 31 (Burial Ground) – 158m east of the proposed development;
- Site PP 41 (Structure) – 199m south by south-east of the proposed development;
- Site PP 30 (Historic Farmstead) – 549m south-east of the proposed development;
- Site PP 3 (Burial Ground) – 930m south-west of the proposed development; and
- Site PP 32 (Historic Homestead with Possible Risk for Unmarked Graves) – 937m south-east of the proposed development.

From these distances it is evident that the construction of the proposed DMF will have no impact on any of the identified heritage sites.

Figure 189 – This image provides an overlay of the identified heritage sites over the proposed development footprint area of the DMF. As can be seen, none of the identified heritage sites are located within, or in close proximity to, this development footprint.

8 REQUIRED MITIGATION MEASURES

8.1 Introduction

In this chapter, required mitigation measures for each of the sites affected by the proposed development will be outlined. Please note the following:

- No mitigation is required for heritage sites assessed to have a low heritage significance. As a result, no mitigation is required for the following sites: PP 01, PP 07, PP 08, PP 09, PP 18, PP 19, PP 20, PP 23, PP 24, PP 34, PP 35, PP 38, PP 39, PP 41, PP 42, PP 43, PP 44 & PP 45;
- No heritage impact is expected as a result of the proposed development of the Discard Management Facility (DMF). As such, no mitigation is required for the construction of this DMF to continue;
- Site mitigation measures are outlined in this chapter. These mitigation measures would be required should any development footprints be proposed within 100m of the identified burial grounds and graves or within 50m of any other identified heritage sites that are of Medium Significance and higher. Refer **Section 8.2**; and
- General site mitigation measures are also required for the Possible Rock Art Site and sites comprising Historic Coal Mine Shafts. These general mitigation measures must be implemented as soon as possible and are not dependent on the expansion of development footprint areas. Refer **Section 8.3.**

8.2 Site Mitigation Measures

8.2.1 Graves and Burial Grounds

These sites are sites PP 2, PP 3, PP 4, PP 5, PP 10, PP 16, PP 28, PP 31 and PP 37.

As cemeteries and graves have Medium to High Heritage Significance, the best option is to change the development footprint to allow for the *in situ* preservation of these sites. However, should it not be possible to preserve these sites in situ, the required mitigation measures are outlined below.

- A grave relocation process must be undertaken.
- A detailed social consultation process, at least 60 days in length, comprising the attempted identification of the next-of-kin in order to obtain their consent for the relocation.
- Bilingual site and newspaper notices indicating the intent of the relocation.
- Permits from all the relevant and legally required authorities.
- An exhumation process that keeps the dignity of the remains and family intact.

- An exhumation process that safeguards the legal rights of the families as well as that of the mining company.
- The process must be done by a reputable company well versed in the mitigation of graves.

8.2.2 Historic Homesteads and Structures with the Possible Risk for Unmarked Graves

These sites are PP 6, PP 11, PP 15, PP 16, PP 21, PP 22, PP 25, PP 26, PP 29, PP 32 and PP 40.

The following initial mitigation measure is required:

- A social consultation process to assess whether any local residents or the wider public is aware of the presence of graves at these sites.

Depending on the outcome of the social consultation process, three different outcomes would be the result, namely:

- Outcome 1: The social consultation absolutely confirms that no graves are located here.
- Outcome 2: The social consultation absolutely confirms that graves are located here.
- Outcome 3: The social consultation does not yield any confident results.

The following mitigation measures would be required for sites falling under Outcome 1:

- No further grave-related mitigation would be required.

The following mitigation measures would be required for sites falling under Outcome 2:

- A grave relocation process must be undertaken.
- A detailed social consultation process, at least 60 days in length, comprising the attempted identification of the next-of-kin in order to obtain their consent for the relocation.
- Bilingual site and newspaper notices indicating the intent of the relocation.
- Permits from all the relevant and legally required authorities.
- An exhumation process that keeps the dignity of the remains and family intact.
- An exhumation process that safeguards the legal rights of the families as well as that of the mining company.
- The process must be done by a reputable company well versed in the mitigation of graves.

The following mitigation measures would be required for sites falling under Outcome 3:

- Test excavations to physically confirm the presence or absence graves.
- If no evidence for graves is found, the site will fall within Outcome 1 as outlined above. This

means that no further mitigation measures would be required.
- If evidence for graves is found, the site will fall within Outcome 2 as outlined above. This means that a full grave relocation process must be implemented.

Additionally, the following mitigation measures must be undertaken for all these sites:

- All structures and site layouts from each site must be recorded using standard survey methods. The end result would be site layout plans for all these sites.
- A mitigation report must be compiled for these sites within which all the mitigation measures and its findings will be outlined. The recorded drawings from the previous item must also be included in this mitigation report.
- The completed mitigation report must be submitted to the relevant heritage authorities.

8.2.3 Historic Farmsteads and Historic Structures

The sites are PP 27 and PP 30.

The following mitigation measure are required:

- An architectural historical specialist must be appointed to undertake a specialist assessment of these sites.
- The recommendations made by the specialist must be implemented.

8.3 General Mitigation Measures

8.3.1 Possible Rock Art Site

The site is PP 4.

The following mitigation measures are required:

- A suitably qualified rock art specialist must be appointed to undertake a specialist assessment of the site.
- The recommendations made by the specialist must be implemented.

8.3.2 Historic Coal Mine Shafts and Associated Structures

The sites are PP 12, PP 13, PP 17, PP 33 and PP 36.

The following mitigation measures are required for these sites:

- Due to the uniqueness of these historic coal mine shafts, every attempt must be made to preserve them *in situ*.

The following general mitigation measures, which forms part of the *in situ* management measures of these sites, must be undertaken:

- These mine shafts must be recorded by way of site plans and photographs.
- Archival and historical research must be undertaken on the history of these very old mine shafts.
- A mitigation report must be compiled for these sites within which the recorded drawings, photographs and history of these shafts must be compiled.
- The completed mitigation report must be submitted to the relevant heritage authorities (SAHRA).

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

PGS Heritage (Pty) Ltd (PGS) was appointed by CIGroup Environmental (Pty) Ltd (CIGroup) to undertake a Heritage Impact Assessment (HIA) for the Glisa and Paardeplaats Sections of the NBC Colliery (NBC). The project area is located near (eMakhazeni) Belfast and is situated in the eMakhazeni Local Municipality, Nkangala District Municipality, Mpumalanga Province

9.2 Project Description

The following information was provided by CIGroup. NBC consists of three (3) mining sections namely the Eerstelingsfontein Section, the Glisa Section, and the Paardeplaats Section. The focus of this assessment will be on the Glisa and Paardeplaats Sections.

The Section 102 Consolidation and IEA application focus on the following:

- Consolidation of the Glisa Section Mining Right (MR) and Environmental Management Plan (EMP) into the Paardeplaats Section (MP 30/5/1/2/2/10090 MR);
- Inclusion of Portion 24 of the farm Paardeplaats 380 JT into the Paardeplaats Section MR; and
- IEA for listed activities triggered in terms of the NEMA and National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEMA:WA) within the MR areas and Portion 24 of the farm Paardeplaats 380 JT1.

NBC require the following changes to existing infrastructure:

- Expansion of the Crushing, Screening and Washing Plant (CSWP) on Portion 3 and 4 of the farm Paardeplaats 380 JT;
- Expansion of the existing Water Treatment Plant (WTP) pipeline network on all farm portions associated with the Integrated Paardeplaats Section; and
- Widening of haul roads between the mining sections and processing plants

9.3 Scope of Work

PGS's scope of work was to undertake intensive walkthroughs of the proposed Discard Management Facility (DMF) coupled with revisits to the heritage sites identified by PGS during a previous study undertaken in 2012. This report and its recommendations are based on only this scope of work.

9.4 General Desktop Study

An archaeological and historical desktop study was undertaken of the project area and surrounding landscape (refer to **Chapter 5**). An archaeological and historical overview was compiled, which was augmented by an assessment of previous archaeological and heritage studies completed for the study area and surrounding landscape. Furthermore, an assessment was made of the early editions of the relevant topographic maps.

9.5 Associated Reports and Processes

PGS completed a Heritage Impact Assessment for the proposed Exxaro Paardeplaats project in 2012. The current report represents an amendment as well as verification of the sites identified in 2012. During the fieldwork for the 2012 study, a total of 32 heritage sites, including 22 heritage structures, seven cemeteries and three areas with historical mining shafts were identified. Although additional walkthroughs were also undertaken for the proposed DMF area, this report is largely based on the original fieldwork findings.

9.6 Fieldwork

The fieldwork comprised a field assessment of the study area undertaken primarily by foot and vehicle over the course of three days by an experienced fieldwork team from PGS consisting of an archaeologist (Cherene de Bruyn) and two field assistants (Michelle Sacshe and Thomas Mulaudzi). The fieldwork was undertaken from Monday, 19 April 2021 to Wednesday 21 April 2021.

As almost the entire project area had been intensively assessed as part of a previous HIA study by PGS, the focus on the current fieldwork was on revisiting all the heritage sites that were identified in the previous report and also undertaking intensive walkthroughs of a small section that is now earmarked for the development of a Discard Management Facility (DMF).

As part of the current fieldwork, revisits and verification of the location and state of the 32 heritage sites that were identified in 2012 were conducted. These previously identified sites are numbered PP 01 to PP 32. As part of the current fieldwork, an additional 13 heritage sites (PP33 to PP45) were identified. The table below provides a summary of all the heritage sites.

Table 22 – Heritage Sites identified within the Study Area

Site Number	Coordinates	Site Type	Significance
PP 1	S 25.725820 E 30.002610	Demolished Historic Farmstead	Low (GP.C)
PP 2	S 25.729890 E 30.002260	Burial Ground	Medium to High (GP.A)
PP 3	S 25.719080 E 30.004140	Burial Ground	Medium to High (GP.A)
PP 4	S 25.744150 E 29.985790	Burial Ground	Medium to High (GP.A)
PP 5	S 25.725210 E 30.015120	Burial Ground	Medium to High (GP.A)
PP 6	S 25.728000 E 30.010130	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 7	S 25.743270 E 30.003010	Demolished Historic Structures	Low (GP.C)
PP 8	S 25.743800 E 30.002360	Demolished Historic Farmstead	Low (GP.C)
PP 9	S 25.742100 E 30.004780	Demolished Historic Structure	Low (GP.C)
PP 10	S 25.750780 E 29.989940	Single Grave	Medium to High (GP.A)
PP 11	S 25.751030 E 29.989600	Historic Farmstead and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 12	S 25.745950 E 29.974200	Historic Coal Mine Shaft	Medium to High (GP.A)
PP 13	S 25.748830 E 29.974700	Historic Coal Mine Shaft	Medium to High (GP.A)
PP 14	S 25.752210 E 29.978990	Possible Rock Art Site	Medium to High (GP.A)
PP 15	S 25.754350 E 29.983240	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 16	S 25.752990 E 29.982910	Historic Homestead with Graves and the Possible Risk for Unmarked Graves	Medium to High (GP.A)
PP 17	S 25.748830 E 29.974700	Historic Coal Mine Shaft	Medium to High (GP.A)
PP 18	S 25.760100 E 29.966720	Animal Drinking Trough	Low (GP.C)
PP 19	S 25.759800 E 29.966230	Demolished Historic Structure	Low (GP.C)
PP 20	S 25.761510 E 29.965360	Reservoir with Associated Structures	Low (GP.C)

PP 21	S 25.761660 E 29.964650	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 22	S 25.761690 E 29.963750	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 23	S 25.761660 E 29.964650	Demolished Historic Structure (before 2012)	Low (GP.C)
PP 24	S 25.762720 E 29.961770	Sunbury Railway Station	Low (GP.C)
PP 25	S 25.732420 E 29.993510	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 26	S 25.734280 E 29.993040	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 27	S 25.735080 E 29.993410	Historic Structure	Medium (GP.B)
PP 28	S 25.736050 E 29.993310	Burial Ground	Medium to High (GP.A)
PP 29	S 25.726980 E 29.989670	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 30	S 25.718530 E 30.017220	Historic Farmstead	Medium (GP.B)
PP 31	S 25.711330 E 30.016450	Burial Ground	Medium to High (GP.A)
PP 32	S 25.723070 E 30.015850	Historic Homesteads and Structures with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 33	S 25.748624 E 29.974775	Historic Structure	Medium (GP.B)
PP 34	S 25.742500 E 30.002855	Demolished Structure	Low (GP.C)
PP 35	S 25.743408 E 30.001842	Contemporary Farmstead	Low (GP.C)
PP 36	S 25.754370 E 29.981422	Historic Coal Mine Shaft	Medium to High (GP.A)
PP 37	S 25.750654 E 29.989601	Single Grave	Medium to High (GP.A)
PP 38	S 25.729260 E 30.013751	Reservoir with Associated Structures	Low (GP.C)

PP 39	S 25.726835 E 30.010754	Reservoir with Associated Structures	Low (GP.C)
PP 40	S 25.735453 E 29.995204	Historic Homestead with the Possible Risk for Unmarked Graves	Medium (GP.B)
PP 41	S 25.716593 E 30.014553	Structure	Low (GP.C)
PP 42	S 25.726796 E 30.002923	Animal Drinking Trough	Low (GP.C)
PP 43	S 25.738228 E 30.000564	Demolished Structure	Low (GP.C)
PP 44	S 25.736880 E 30.003181	Reservoirs with Associated Structures	Low (GP.C)
PP 45	S 25.735982 E 30.001980	Demolished Structure	Low (GP.C)

9.7 Palaeontology

The palaeontological Desktop Assessment (PDA) was conducted by Banzai Environmental (Butler, 2021). The proposed development is primarily underlain by the Vryheid Formation of the Ecca Group (Karoo Supergroup). According to the South African Heritage Resources Information System the project area is located in an area with Very High sensitivity (red), as such the Palaeontological Sensitivity of project area is Very High.

As such, a full Environmental Impact Assessment (EIA) level Palaeontological Impact Assessment (PIA) report is recommended to assess the value and prominence of fossils in the development area and the effect of the proposed development on the palaeontological heritage.

9.8 Impact of Proposed Development and Mitigation

An overlay of the identified archaeological and heritage sites over the proposed development footprint area for the DMF was made. It was established that none of the identified heritage sites are located within 100m of the proposed development of the DMF. As a result, no impact is expected as a result of the proposed development of the DMF. Refer **Chapter 7**.

Please note the following regarding heritage mitigation:

- No mitigation is required for heritage sites assessed to have a low heritage significance. As a result, no mitigation is required for the following sites: PP 01, PP 07, PP 08, PP 09,

PP 18, PP 19, PP 20, PP 23, PP 24, PP 34, PP 35, PP 38, PP 39, PP 41, PP 42, PP 43, PP 44 & PP 45;

- No heritage impact is expected as a result of the proposed development of the Discard Management Facility (DMF);

- Site mitigation measures are outlined in **Chapter 8**. These mitigation measures would be required should any development footprints be proposed within 100m of the identified burial grounds and graves or within 50m of the other identified heritage sites that are of Medium Significance and higher. Refer **Section 8.2**; and

- General site mitigation measures are also required for the Possible Rock Art Site and sites comprising Historic Coal Mine Shafts. These general mitigation measures must be implemented as soon as possible and are not dependant on the expansion of development footprint areas. Refer **Section 8.3.**

9.9 Conclusions

The unmitigated impact of the proposed development of the DMF is not expected to result in any heritage impacts. As a result, on the condition that the recommendations made in this report are adhered to, no heritage reasons can be given for the development of the DMF not to continue.

10 PREPARERS

This Heritage Impact Assessment was written by the following preparers:

- Polke Birkholtz – Project Manager / Archaeologist - Co-Author
- Cherene de Bruyn – Archaeologist – Author

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VAN SCHALKWYK, J 2007. Heritage Impact Scoping Report for the Planned Hendrina-Marathon Power line, Mpumalanga Province.

11.3 Old Topographic Maps

All the historic topographical maps used in this report were obtained from the Directorate: National Geo-spatial Information of the Department of Rural Development and Land Reform in Cape Town.

11.4 Internet

www.sanbi.org
https://screening.environment.gov.za/screeningtool/#/pages/welcome
http://www.c20fireplaces.co.uk/information/history-twentieth-century-fireplaces-1905-1939
www.sahistory.org.za

11.5 Google Earth

At least some of the aerial depictions of the study área were obtained using Google Earth.

Appendix A

HERITAGE MANAGEMENT GUIDELINES

1. **General Management Guidelines**

1. The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-

   (a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
   (b) the construction of a bridge or similar structure exceeding 50m in length;
   (c) any development or other activity which will change the character of a site-

      (i) exceeding 5 000 m^2 in extent; or
      (ii) involving three or more existing erven or subdivisions thereof; or
      (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
      (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

   (d) the re-zoning of a site exceeding 10 000 m^2 in extent; or
   (e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In the event that an area previously not included in an archaeological or cultural resources survey is to be disturbed, the SAHRA needs to be contacted. An enquiry must be lodged with them into the necessity for a Heritage Impact Assessment.

2. In the event that an additional heritage assessment is required, it is advisable to utilise a qualified heritage practitioner, preferably registered with the Cultural Resources Management Section (CRM) of the Association of Southern African Professional Archaeologists (ASAPA). This survey and evaluation must include:

   (a) The identification and mapping of all heritage resources in the area affected;
   (b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7 of the National Heritage Resources Act;
   (c) An assessment of the impact of the development on such heritage resources;
   (d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
   (e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

   (f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
   (g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

1. In the event that a possible find is discovered during construction, the following steps must be taken:

   (a) All activities must be halted in the area of the discovery and a qualified archaeologist contacted;
   (b) The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures;
   (c) If mitigation is necessary, an application for a rescue permit must be lodged with SAHRA; and
   (d) After mitigation, an application must be lodged with SAHRA for a destruction permit. This application must be supported by the mitigation report generated during the rescue excavation. Only after the permit is issued may such a site be destroyed.

2. In the case where a grave is identified during construction, the following measures must be taken:

   (a) Upon the accidental discovery of graves, a buffer of at least 20 meters should be implemented;
   (b) If graves are accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find;
   (c) To remove the remains, a permit must be applied for from SAHRA and other relevant authorities. The local South African Police Services must immediately be notified of the find; and
   (d) Where it is recommended that the graves be relocated, a full grave relocation process that includes a comprehensive social consultation must be followed. Such a grave relocation process must include the following:

      (i) A detailed social consultation process that aims to trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
      (ii) Site notices indicating the intent of the relocation;
      (iii) Newspaper notices indicating the intent of the relocation;
      (iv) Permits from the relevant permitting authorities, including the local authority; the Provincial Department of Health; the South African Heritage Resources Agency (SAHRA) (if the graves are older than 60 years or unidentified and thus presumed older than 60 years) etc.

(vii) An exhumation process that keeps the dignity of the remains intact;

(viii) The whole process must be done by a reputable company that is well versed in relocations; and

(ix) The exhumation process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the mining company.

PGS Heritage can be contacted on the way forward in this regard.

Table 23: Roles and responsibilities of archaeological and heritage management

ROLE	RESPONSIBILITY	IMPLEMENTATION
A responsible specialist needs to be allocated and should attend all relevant meetings, especially when changes in design are discussed, and liaise with SAHRA.	The client	Archaeologist and a competent archaeological support team
If chance finds and/or graves or burial grounds are identified during construction or operational phases, a specialist must be contacted for evaluation.	The client	Archaeologist and a competent archaeological support team
Comply with defined national and local cultural heritage regulations on management plans for identified sites.	The client	Environmental Consultancy and the Archaeologist
Consult the managers, local communities and other key stakeholders on mitigation of archaeological sites.	The client	Environmental Consultancy and the Archaeologist
Implement additional programs, as appropriate, to promote the safeguarding of our cultural heritage.	The client	Environmental Consultancy and the Archaeologist
If required, conservation or relocation of burial grounds and/or graves according to the applicable regulations and legislation.	The client	Archaeologist, and/or competent authority for relocation services
Ensure that recommendations made in the Heritage Report are adhered to.	The client	The client
Provision of services and activities related to the management and monitoring of significant archaeological sites.	The client	Environmental Consultancy and the Archaeologist
After the specialist/archaeologist has been appointed, comprehensive feedback reports should be submitted to relevant authorities during each phase of development.	Client and Archaeologist	Archaeologist

CURRICULUM VITAE

PROFESSIONAL CURRICULUM
FOR POLKE DOUSSY BIRKHOLTZ

Name: *Polke Doussy Birkholtz*

Date & Place of Birth: *9 February 1975 – Klerksdorp, North West Province, South Africa*

Place of Tertiary Education & Dates Associated:

Institution: University of Pretoria
Qualification: BA (Cum Laude) - Bachelor of Arts Specializing in Archaeology, History & Anthropology
Date: 1996

Institution: University of Pretoria
Qualification: BA Hons (Cum Laude) - Bachelor of Arts with Honours Degree Specializing in Archaeology
Date: 1997

Qualifications:

BA	-	Degree specialising in Archaeology, History and Anthropology
BA Hons	-	Professional Archaeologist

Memberships:

Association of Southern African Professional Archaeologists (ASAPA)
Professional Member of the CRM Section of ASAPA

Overview of Post Graduate Experience:

1997 – 2000 – Member/Archaeologist – Archaeo-Info
2001 – 2003 – Archaeologist/Heritage Specialist – Helio Alliance
2000 – 2008 – Member/Archaeologist/Heritage Specialist – Archaeology Africa
2003 - Present – Director / Archaeologist / Heritage Specialist – PGS Heritage

Languages: English: Speak, Read & Write & Afrikaans: Speak, Read & Write

Total Years' Experience: 19 Years

Experience Related to the Scope of Work:

- Polke has worked as a **HERITAGE SPECIALIST / ARCHAEOLOGIST / HISTORIAN** on more than 300 projects and acted as **PROJECT MANAGER** on almost all of these projects. His experience includes the following:

    - Development of New Sedimentation and Flocculation Tanks at Rand Water's Vereeniging Pumping Station, Vereeniging, Gauteng Province. Heritage Impact Assessment for *Greenline*.
    - EThekwini Northern Aqueduct Project, Durban, KwaZulu-Natal. Heritage Impact Assessment for *Strategic Environmental Focus*.
    - Johannesburg Union Observatory, Johannesburg, Gauteng Province. Heritage Inventory for *Holm Jordaan*.
    - Development at Rand Water's Vereeniging Pumping Station, Vereeniging, Gauteng Province. Heritage Impact Assessment for *Aurecon*.
    - Comet Ext. 8 Development, Boksburg, Gauteng Province. Phase 2 Heritage Impact Assessment for *Urban Dynamics*.
    - Randjesfontein Homestead, Midrand, Gauteng Province. Baseline Heritage Assessment with Nkosinathi Tomose for Johannesburg City Parks.
    - Rand Leases Ext. 13 Development, Roodepoort, Gauteng Province. Heritage Impact Assessment for *Marsh*.
    - Proposed Relocation of the Hillendale Heavy Minerals Plant (HHMP) from Hillendale to Fairbreeze, KwaZulu-Natal. Heritage Impact Assessment for *Goslar Environmental*.
    - Portion 80 of the farm Eikenhof 323 IQ, Johannesburg, Gauteng Province. Heritage Inventory for *Khare Incorporated*.
    - Comet Ext. 14 Development, Boksburg, Gauteng Province. Heritage Impact Assessment for *Marsh*.
    - Rand Steam Laundries, Johannesburg, Gauteng Province. Archival and Historical Study for *Impendulo* and *Imperial Properties*.
    - Mine Waste Solutions, near Klerksdorp, North West Province. Heritage Inventory for *AngloGold Ashanti*.
    - Consolidated EIA and EMP for the Kroondal and Marikana Mining Right Areas, North West Province. Heritage Impact Assessment for *Aquarius Platinum*.
    - Wilkoppies Shopping Mall, Klerksdorp, North West Province. Heritage Impact Assessment for the *Center for Environmental Management*.
    - Proposed Vosloorus Ext. 24, Vosloorus Ext. 41 and Vosloorus Ext. 43 Developments, Ekurhuleni District Municipality, Gauteng Province. Heritage Impact Assessment for *Enkanyini Projects*.
    - Proposed Development of Portions 3, 6, 7 and 9 of the farm Olievenhoutbosch 389 JR, City of Tshwane Metropolitan Municipality, Gauteng Province. Heritage Impact Assessment for *Marsh*.

    - Proposed Development of Lotus Gardens Ext. 18 to 27, City of Tshwane Metropolitan Municipality, Gauteng Province. Heritage Impact Assessment for *Pierre Joubert*.
    - Proposed Development of the site of the old Vereeniging Hospital, Vereeniging, Gauteng Province. Heritage Scoping Assessment for *Lekwa*.
    - Proposed Demolition of an Old Building, Kroonstad, Free State Province. Phase 2 Heritage Impact Assessment for *De Beers Consolidated Mines*.
    - Proposed Development at Westdene Dam, Johannesburg, Gauteng Province. Heritage Impact Assessment for *Newtown*.
    - West End, Central Johannesburg, Gauteng Province. Phase 1 Heritage Impact Assessment for the *Johannesburg Land Company*.
    - Kathu Supplier Park, Kathu, Northern Cape Province. Heritage Impact Assessment for *Synergistics*.
    - Matlosana 132 kV Line and Substation, Stilfontein, North West Province. Heritage Impact Assessment for *Anglo Saxon Group* and *Eskom*.
    - Marakele National Park, Thabazimbi, Limpopo Province. Cultural Resources Management Plan for *SANParks*.
    - Cullinan Diamond Mine, Cullinan, Gauteng Province. Heritage Inventory for *Petra Diamonds*.
    - Highveld Mushrooms Project, Pretoria, Gauteng Province. Heritage Impact Assessment for *Mills & Otten*.
    - Development at the Reserve Bank Governor's Residence, Pretoria, Gauteng Province. Archaeological Excavations and Mitigation for the *South African Reserve Bank*.
    - Proposed Stones & Stones Recycling Plant, Johannesburg, Gauteng Province. Heritage Scoping Report for *KV3*.
    - South East Vertical Shaft Section of ERPM, Boksburg, Gauteng Province. Heritage Scoping Report for *East Rand Proprietary Mines*.
    - Proposed Development of the Top Star Mine Dump, Johannesburg, Gauteng Province. Detailed Archival and Historical Study for *Matakoma.*
    - Soshanguve Bulk Water Replacement Project, Soshanguve, Gauteng Province. Heritage Impact Assessment for *KWP*.
    - Biodiversity, Conservation and Participatory Development Project, Swaziland. Archaeological Component for *Africon*.
    - Camdeboo National Park, Graaff-Reinet, Eastern Cape Province. Cultural Resources Management Plan for *SANParks*.
    - Main Place, Central Johannesburg, Gauteng Province. Phase 1 Heritage Impact Assessment for the *Johannesburg Land Company*.
    - Modderfontein Mine, Springs, Gauteng Province. Detailed Archival and Historical Study for *Consolidated Modderfontein Mines.*
    - Proposed New Head Office for the Department of Foreign Affairs, Pretoria, Gauteng Province. Heritage Impact Assessment for *Holm Jordaan Group*.

- Proposed Modification of the Lukasrand Tower, Pretoria, Gauteng Province. Heritage Assessment for IEPM.
- Proposed Road between the Noupoort CBD and Kwazamukolo, Northern Cape Province. Heritage Impact Assessment for *Gill & Associates*.
- Proposed Development at the Johannesburg Zoological Gardens, Johannesburg, Gauteng Province. Detailed Archival and Historical Study for *Matakoma.*

- Polke's **KEY QUALIFICATIONS:**
  - Project Management
  - Archaeological and Heritage Management
  - Archaeological and Heritage Impact Assessment
  - Archaeological and Heritage Fieldwork
  - Archival and Historical Research
  - Report Writing

- Polke's **INFORMATION TECHNOLOGY EXPERIENCE:**
  - *MS Office – Word, Excel, & Powerpoint*
  - *Google Earth*
  - *Garmin Mapsource*
  - *Adobe Photoshop*
  - *Corel Draw*

PROFESSIONAL CURRICULUM FOR CHERENE DE BRUYN

Professional Archaeologist for PGS Heritage

2016-2017	MA in Archaeology University College London, United Kingdom
2015	BSC Honours in Physical Anthropology, University of Pretoria, South Africa
2013	BA Honours in Archaeology University of Pretoria, South Africa
2010-2012	BA (General) University of Pretoria, South Africa Major subjects: Archaeology and Anthropology

PROFESSIONAL QUALIFICATIONS:
- Association of Southern African Professional Archaeologists - Professional Member (#432)
- International Association for Impact Assessment South Africa - Member (#6082)
- Association of Southern African Professional Archaeologists - CRM Accreditation
  - Principal Investigator: Grave relocation
  - Field Director: Colonial period archaeology, Iron Age archaeology
  - Field Supervisor: Rock art, Stone Age archaeology
  - Laboratory Specialist: Human Skeletal Remains
- KZN Amafa and Research Institute - Accredited Professional Heritage Practitioner

Languages:
Afrikaans & English

SUMMARY OF EXPERIENCE
Expertise in Heritage Impact Assessment Management, Historical and Archival Research, Archaeology, Physical Anthropology, Grave Relocations, Fieldwork, Geographic Information Systems and Project Management including *inter alia* -

Involvement in various grave relocation projects
- Grave exhumation, test excavations and grave "rescue" excavations in the various provinces of South Africa.
- Permit applications with SAHRA BGG and AMAFA, including relevant Munciplaities and Authorities for grave relocation projects.

Involvement with various Heritage Impact Assessments,
- Heritage Impact Assessments and Management for various projects within Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West and Western Cape Province.
- Archaeological Walkdowns for various projects.
- Instrument Survey and recording for various projects.
- Desktop, archival and heritage screening for projects.

INFORMATION TECHNOLOGY EXPERIENCE:
- MS Office – Word, Excel, Publisher & Powerpoint
- Google Earth
- QGIS, ArcGIS Online, ArcGIS Collector
- Inkscape

Heritage Assessment Projects
Below a selected list of Heritage Impact Assessments (HIA) Projects involvement:

- Heritage Management Plan for the proposed development of the 305MW Oya solar photovoltaic (PV) facility and associated infrastructure near Matjiesfontein, Western Cape.
- Heritage Impact Assessment for the Proposed Township Establishment on the Remainder of Portion 8 of the Farm Boschoek 103 JQ, near Boschoek, North West Province.
- The Proposed Irenedale Water Pipeline Between Bosjesspruit Colliery And A Local Reservoir, Located In The Lekwa Local Municipality And The Govan Mbeki Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.
- Heritage Impact Assessment for the proposed development of the Msobo Coal Tselentis Colliery: Albion Opencast project, Near Breyten, Mpumalanga Province.
- Heritage Impact Assessment for the proposed development of an Airport For Kolomela Mine In Postmasburg, Northern Cape.
- Heritage Impact Assessment for the Proposed South African Coal Estates (SACE) Clydesdale Pit Project, near Emalahleni, Mpumalanga Province.
- Heritage Impact Assessment for the Amendment of the Mogalakwena Mine Expansion Project, near Mokopane, Limpopo Province.
- Heritage Impact Assessment for the Mogalakwena Mine Integrated Permitting Project near Mokopane, Limpopo Province.
- Heritage Impact Assessment for the Proposed Solar PV Plant at Armoede, near Mokopane, Limpopo Province.
- Heritage Impact Assessment for the Proposed New Cargo Precinct For The O.R. Tambo International Airport On The Farm Witkoppie 64, Gauteng Province.
- Heritage Impact Assessment for the upgrade of road d4407 between Hluvukani and Timbavati, road d4409 at Welverdiend and road d4416/2 between Welverdiend and road P194/1 in the Bohlabela region of the Mpumalanga Province.
- Heritage Impact Assessment for the proposed Piggery on Portion 46 of the farm Brakkefontien 416, within the Nelson Mandela Bay Municipality, Eastern Cape.
- Heritage Impact Assessment for proposed development On Erf 30, Letamo Town, Farm Honingklip 178 Iq, Mogale Local Municipality, Gauteng Province.
- Heritage Impact Assessment for the proposed Prospecting Right Application on the Farm Reserve No 4 15823 And 7638/1, near St Lucia, within the jurisdiction of the Mfolozi Local Municipality in the King Cetshwayo District Municipality, KwaZulu-Natal Province.

Grave Relocation Projects

Below, a selection of grave relocation projects involvement:

- Report On Test Excavations. Ivn_078 Maruma Graves, Farm Turfspruit 241 Kr, Mokopane, Limpopo Province. Test Excavation Of Possible Burial Ground As Identified By The Maruma Family.
- Relocation Of Two Infant Graves From The Farm Wonderfontein 428 Js, Belfast, Mpumalanga Province.
- Relocation Of Approximately 4 Stillborn Graves From Farm Wonderfontein 428 Js, Umsimbithi Mining (Pty) Ltd, Belfast, Chief Albert Luthuli Local Municipality, Mpumalanga Province.

EMPLOYMENT SUMMARY:

Positions Held

- 2020 – to date: Archaeologist - PGS Heritage (Pty) Ltd
- 2018 – 2019: Manager of the NGT ESHS Heritage Department – NGT Holdings (Pty) Ltd
Archaeologist and Heritage Consultant – NGT Holdings (Pty) Ltd
- 2015-2016: Archaeological Contractor - BA3G, University of Pretoria
- 2014 – 2015: DST-NRF Archaeological Intern, Forensic Anthropological Research Centre

Appendix C

PALAEONTOLOGICAL REPORT

banzai environmental

PGS HERITAGE

PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED GLISA EMP AND IWUL CONSOLIDATED PROJECT NEAR EMAKHAZENI (BELFAST), IN MPUMALANGA

Issue Date:	**30 April 2021**
Revision No.:	v0.1
Client:	
PGS Project No:	524HIA - Paardeplaats

PGS HERITAGE
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Head Office:
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Waverley, Pretoria,
South Africa

Offices in South Africa, Kingdom of Lesotho and Mozambique

Directors: HS Steyn, PD Birkholtz, W Fourie

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological 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 favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, 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 will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- 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;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: elizebutler002@gmail.com

SIGNATURE: ______________________________

ACKNOWLEDGEMENT OF RECEIPT

Report Title	Palaeontological Desktop Assessment for the proposed Glisa EMP and IWUL Consolidated Project near Emakhazeni (Belfast), in Mpumalanga		
Control	**Name**	**Signature**	**Designation**
Author	**Elize Butler**		**Palaeontologist**
Reviewed			**Principal Heritage Specialist**

CLIENT:

CONTACT PERSON:

SIGNATURE: ______________________________

This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 9	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1 and 10	
(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 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated	Section 1 and 10	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
structures and infrastructure, inclusive of a site plan identifying site alternatives;		
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(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 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(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	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Desktop	
(l) Any conditions for inclusion in the environmental authorisation	Desktop	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Desktop	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should	Section 1 and 10	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
be included in the EMPr, and where applicable, the closure plan		
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Desktop Assessment for the proposed Glisa EMP and IWUL Consolidated Project near Emakhazeni (Belfast), in Mpumalanga. This Palaeontological Assessment forms part of a Heritage Assessment and complies with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), stating that a Palaeontological Impact Assessment is required to determine the presence of fossil material within the planned development. This study is thus necessary to evaluate the effect of the construction on the palaeontological resources.

The proposed development is primarily underlain by the Vryheid Formation of the Ecca Group (Karoo Supergroup). According to the South African Heritage Resources Information System, the Palaeontological Sensitivity of these rocks are Very High.

It is recommended that an EIA level palaeontology report be conducted to assess the value and prominence of fossils in the development area and the effect of the proposed development on the palaeontological heritage. The purpose of the EIA Report is to elaborate on the issues and potential impacts identified during the scoping phase. A Phase 1 field-based assessment would be conducted with research in the site-specific study area, as well as a comprehensive assessment of the impacts identified during the scoping phase.

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Appendix A: CV

TERMINOLOGY AND ABBREVIATIONS

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influences its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place.
- carrying out any works on or over or under a place.
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place.
- constructing or putting up for display signs or boards.
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Fossil

Mineralized bones of animals, shellfish, plants, and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures, and equipment of cultural significance.
- places to which oral traditions are attached or which are associated with living heritage.
- historical settlements and townscapes.
- landscapes and natural features of cultural significance.
- geological sites of scientific or cultural importance.
- archaeological and palaeontological sites.
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Table 2: Abbreviations

Abbreviations	Description
ASAP	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEFF	Department of Environmental Department of Environment, Forestry and Fisheries
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
IWUL	Integrated Water Use License
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
MPRDA	Mineral and Petroleum Resources Development Act
MR	Mining Right
NEMA	National Environmental Management Act
NEM: WA	National Environmental Management: Waste Act
NWA	National Water Act
NHRA	National Heritage Resources Act
PDA	Palaeontological Desktop Assessment
PIA	Palaeontological Impact Assessment
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

1 INTRODUCTION

PGS Heritage (Pty) Ltd to was commissioned to conduct the Heritage Assessment for the proposed Glisa EMP and IWUL Consolidated Project near Emakhazeni (Belfast), in Mpumalanga. Banzai Environmental was in turn appointed to conduct the Palaeontological Desktop Assessment.

NBC consists of three (3) mining sections namely the Eerstelingsfontein Section, the Glisa Section, and the Paardeplaats Section (Figure 1). The focus of this process will be on the Glisa and Paardeplaats Sections. **Error! Reference source not found.** presents the Glisa and Paardeplaats Sections Mining Right (MR), Environmental Authorisation (EA), and Integrated Water Use License (IWUL) reference numbers as issued in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), the National Environmental Management Act, 1998 (Act No. 107 of 1998), and where applicable, the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA), and the National Water Act, 1998 (Act No. 36 of 1998) (NWA) respectively[1].

Table 3: Glisa and Paardeplaats Mining Sections.

REFERENCE	GLISA SECTION	PAARDEPLAATS SECTION
MR:	MP 30/5/1/2/1/236 MR	MP 30/5/1/2/2/10090 MR
EA:	17/2/3N-4, 17/2/3N-235, & 17/2/3GNK13	-
IWUL:	License No.: 06/B41A/ABCFGIJ/1002 File No.: 27/2/2/B141/3/9	06/B41A/CGIJ/8880

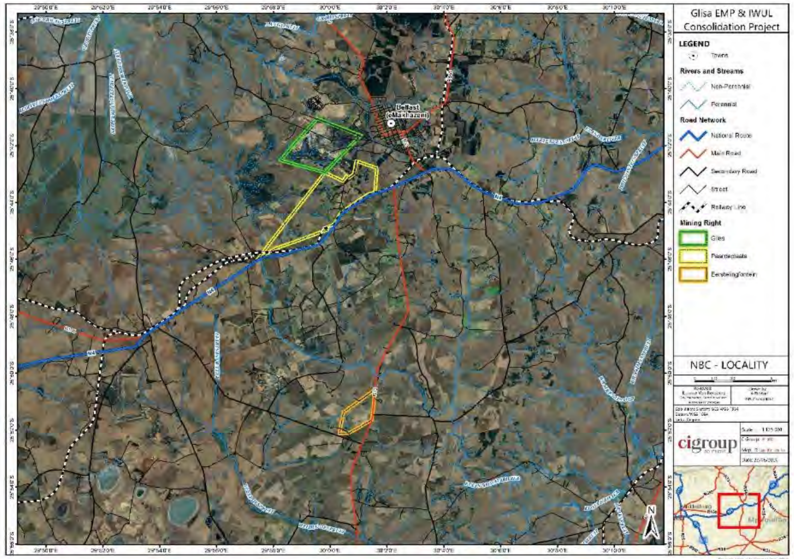

Figure 1: Location of the NBC Glisa, Paardeplaats and Eerstelingsfontein Sections.

The Section 102 Consolidation and IEA application focus on the following:

1. **Consolidation of the Glisa Section MR and Environmental Management Plan (EMP) into the Paardeplaats Section (MP 30/5/1/2/2/10090 MR);**
2. **Inclusion of Portion 24 of the farm Paardeplaats 380 JT into the Paardeplaats Section MR; and**
3. **IEA for listed activities triggered in terms of the NEMA and NEM: WA within the MR areas and Portion 24 of the farm Paardeplaats 380 JT[1].**

Figure 2 presents the individual areas associated with the consolidation and IEA application process, namely the Glisa Section MR area, the Paardeplaats Section MR area and Portion 24 of the farm Paardeplaats 380 JT. For the purposes of distinction, the current mining Sections will be referred to in this report as the Glisa Section and Paardeplaats Section, Portion 24 of the farm Paardeplaats 380 JT will be referred to in this report as Portion 24, and the area applicable to the Section 102 Consolidation and IEA application (i.e. both Sections and Portion 24) will be referred to as the **Integrated Paardeplaats Section (MP 30/5/1/2/2/10090 MR)** (Figure 3).

[1]Information provided by cigroup

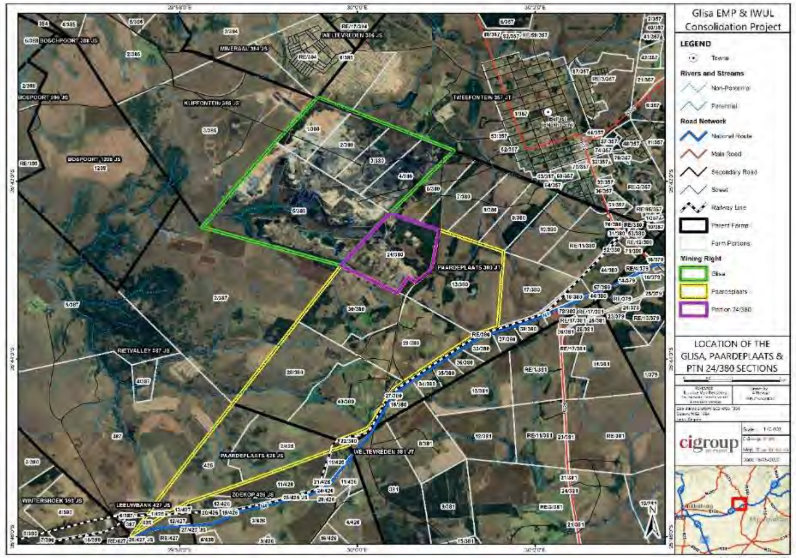

Figure 2: Location of the Glisa Section, Paardeplaats Section and Portion 24.

[1]Information provided by cigroup

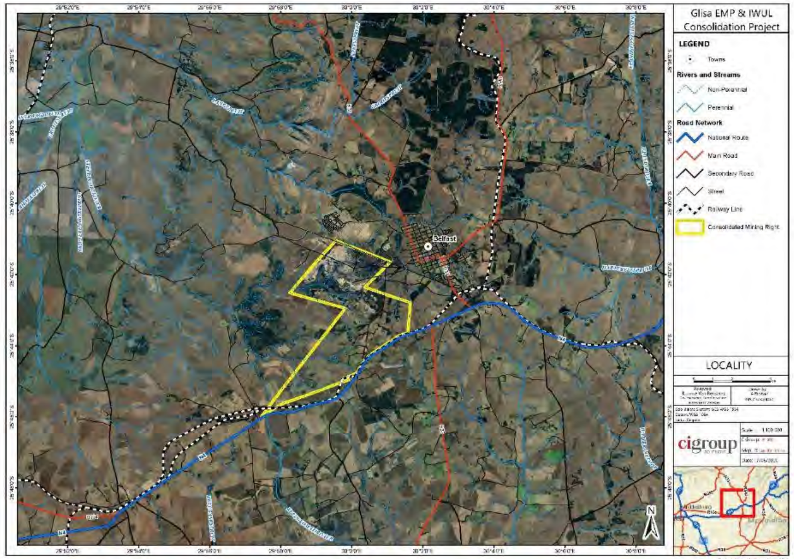

Figure 3:Location of the Integrated Paardeplaats Section.

[1]Information provided by NBS Colliery (Universal Coal)

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—
- (exceeding 5 000 m^2 in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or

- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The aim of a Palaeontological Impact Assessment (PIA) is to decrease the effect of the development on potential fossils at the development site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the purpose of the PIA are: 1) to **identify** the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to determine the **impact** on fossil heritage; and 4) to **recommend** how the property developer should guard against and lessen damage to fossil heritage.

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.

    b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
    c. **Cumulative impacts** result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and

Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Glisa EMP and IWUL Consolidated Project near Emakhazeni, in Mpumalanga is depicted on the 1: 250 000 2528 Pretoria (1978) and 2530 Baberton (1986) Geological Map (Council for Geosciences, Pretoria) (Figure 4). The area is underlain by rocks of the Transvaal Supergroup (Rooiberg and Pretoria Groups) that is overlain by the Vryheid Formation (Ecca Group, Karoo Supergroup). Isolated areas are mantled by Quaternary alluvium (Figure 4).

The proposed development is close to the north-eastern margin of the main Karoo basin and located in the Witbank Coalfield. This Coalfield supplies more than 50% of South Africa's saleable coal. The Witbank Coalfield extends 190 km west-east between Brakpan and Belfast an approximately 60km north-south between Middelburg and Ermelo. In the Witbank Coalfield the coal-bearing Vryheid Formation reaches a thickness of between 70m to 200m.

Quaternary superficial deposits are the youngest geological deposits formed during the most recent period of geological time (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of gravel, sand, silt and clay, and they form relatively thin, often discontinuous patches of sediments or larger spreads onshore. These sediments may include stream, channel and floodplain deposits, beach sand, talus gravels and glacial drift sediments (Partridge *et al*, 2006). Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. In the past palaeontologists did not focus on Caenozoic superficial deposits although they sometimes comprise of significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

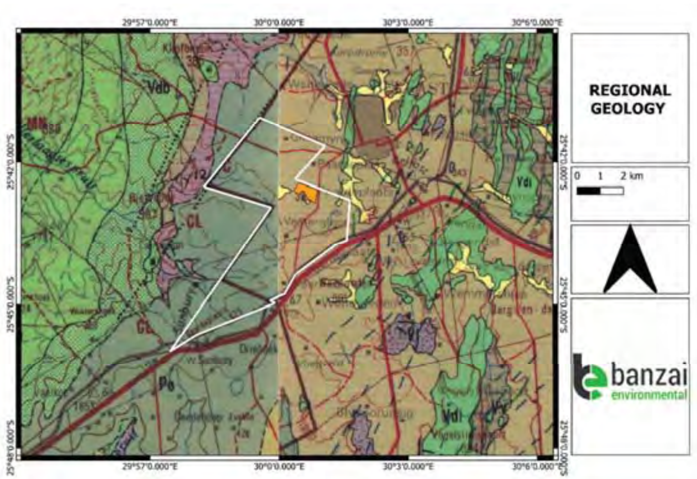

Figure 4: Extract of the 2528 (Pretoria) and 2530 (Baberton) Geological Map (Council of Geoscience) indicating the surface geology of the proposed development in white and orange.

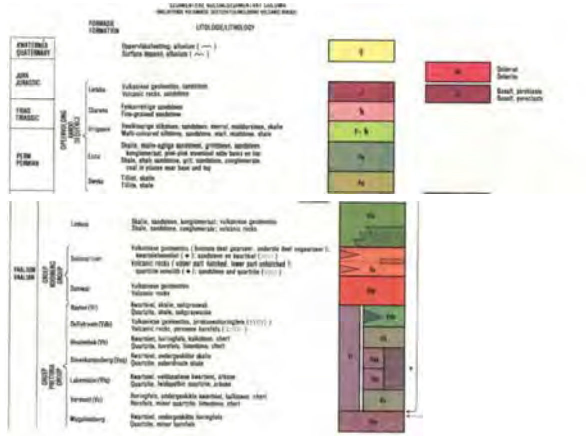

Table 4: Legend to Map and short explanation (Modified from the *1:250 000 2528 Pretoria (1978) and 2530 Baberton (1986) Geological Map (Council for Geosciences, Pretoria))*.

Symbol	Lithology	Stratigraphy	Age
Q	Surface deposit, alluvium		Quaternary
Pe	Shale, Shaley sandstone, grit, sandstone, conglomerate, coal in places near top and bottom	Vryheid Formation, Ecca Group, Karoo Supergroup	Permian
di	Diabase		Vaalian to post Mogolian Age
Vdb	Volcanic rocks, pyroxene hornfels	Dullstroom Formation, Pretoria Group, Transvaal Supergroup	Vaalian
Vsq	Quartzite, subordinate shale	Steenkampsberg Formation, Pretoria Group, Transvaal Supergroup	

Vryheid Formation

The coalfields of South African occur in the Main Karoo Basin or its associated sub-basins. The Main Karoo Basin forms part of a series of Gondwanan basins that was established along the southern boundary of Gondwana (Cole, 1992; De Wit and Ransome 1992; Veevers *et al*. 1994; Catuneanu *et al*. 1998). These basins include Beacon Basin in Antarctica, Bowen Basin in Australia as well as the Paraná Basin in South America. The Basins were formed between the Late Carboniferous and Middle Jurassic and their joint stratigraphies portray the best non-marine sedimentation record globally.

Most of the coal mined in South Africa originates in the Permian Vryheid Formation (Figure 5). The **Vryheid Formation** comprises mudrock, rhythmite, siltstone and fine- to coarse-grained sandstone (pebbly in places). The Formation contains up to five (mineable) coal seams. The different lithofacies are mainly arranged in upward-coarsening deltaic cycles (up to 80m thick in the southeast). Fining-upward fluvial cycles, of which up to six are present in the east, are typically sheet-like in geometry, although some form valley-fill deposits. They comprise coarse-grained to pebbly, immature sandstones - with an abrupt upward transition into fine-grained sediments and coal seams.

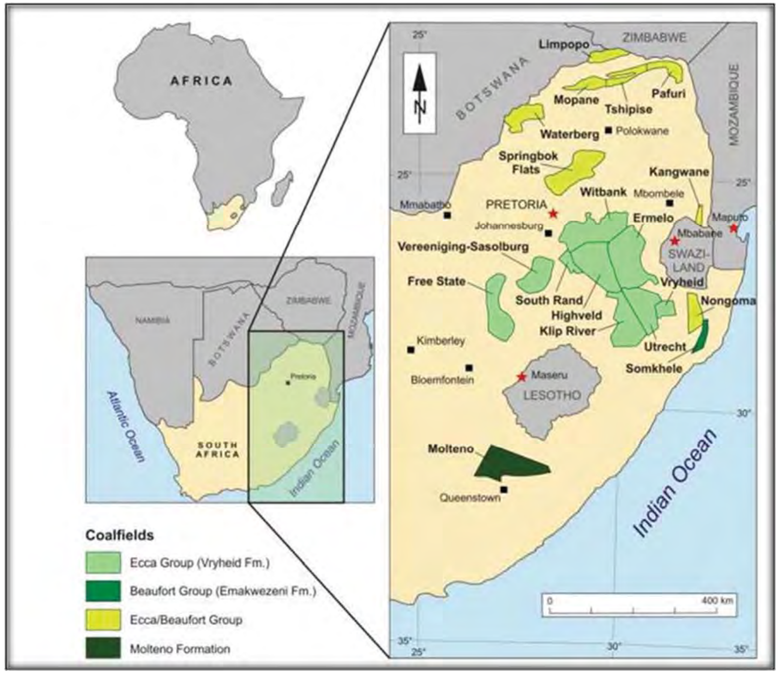

Figure 5: Coalfields of Southern Africa, taken from Hancox and Götz (2014).

The Vryheid Formation comprise of a rich assemblage of Glossopteris flora. After continental deglaciation took place Gymnospermous glossopterids (Figure 6) dominated the peat and non-peat accumulating Permian wetlands (Falcon, 1986, Greb *et al*., 2006).

Table 5: Ecca Group and Formations. (Modified from Johnson et al, 2006).

Period	Supergroup	Group	Formation West of 24º E	Formation East of 24º E	Formation Free State / KwaZulu Natal
Permian	Karoo Supergroup	Ecca Group	Waterford Formation	Waterford Formation	Volksrust Formation
			Tierberg / Fort Brown Formation	Fort Brown Formation	
			Laingsburg / Rippon Formation	Rippon Formation	Vryheid Formation
			Collingham Formation	Collingham Formation	Pietermaritzburg Formation
			Whitehill Formation	Whitehill Formation	
			Prince Albert Formation	Prince Albert Formation	Mbizane Formation

Recent paleobotanical studies in the Vryburg Formation include that of Bordy and Prevec (2008) and Prevec *et al.* (2008, 2009, 2010) and Prevec, (2011). Bamford (2011) described numerous plant fossils from this formation (e.g. *Azaniodendron fertile*, *Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Hirsutum* sp., *Scutum* sp., *Ottokaria* sp., *Estcourtia* sp., *Arberia* sp., *Lidgetonnia* sp., *Noeggerathiopsis* sp., *Podocarpidites* sp as well as more than 20 Glossopteris species.

In the past, palynological studies have focused on the coal-bearing successions of the Vryheid Formation and include articles by Aitken (1994, 1998), and Millsteed (1994, 1999), while recent studies focussed on the Witbank Coalfield were conducted by Götz and Ruckwied (2014).

Bamford (2011) is of the opinion that only a small amount of data has been published on these potentially fossiliferous deposits and that most likely good material is present around coal mines and in other areas the exposures are poor and of little interest. When plant fossils do occur, they are usually abundant. According to Bamford, it is not feasible to preserve all the sites but in the

interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

To date no fossil vertebrates have been collected from the Vryheid formation. The occurrence of fossil insects is rare, while palynomorphs are diverse. Fish scales and non-marine bivalves have been reported. Trace fossils are found abundantly but the diversity is low. The mesosaurid reptile, *Mesosaurus* (Figure 7) has been found in the southern parts of the basin but may also be present in other areas of the Vryheid formation. Regardless of the rare and irregular occurrence of fossils in this biozone, a single fossil may be of scientific value as many fossil taxa are known from a single fossil.

Figure 6: Glossopteris leaf.

Figure 7: Mesosaurus sp. (National Museum, Bloemfontein specimen NMQR 3536)

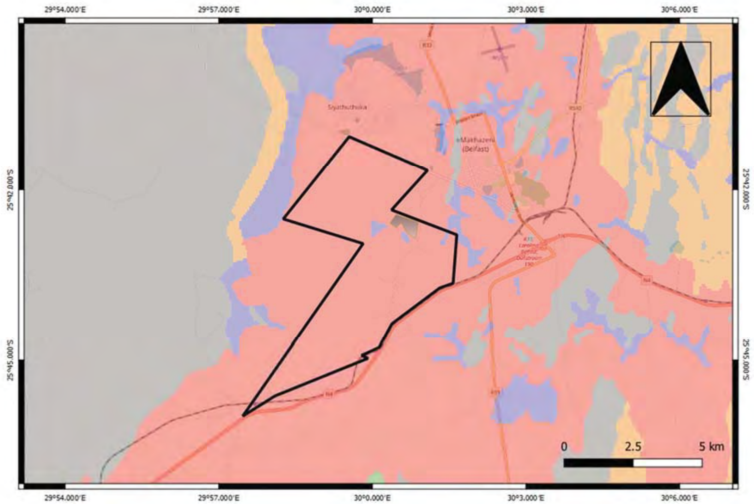

Figure 8: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in graded colours.

Colour	Sensitivity	Required Action
RED	**VERY HIGH**	**field assessment and protocol for finds is required**
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

According to the SAHRIS Palaeo Sensitivity map (Figure 88) there is a very high chance of finding fossils in the red area.

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is located approximately 5 kilometres South of the town of eMakhazeni (Belfast) and about 1 km South of the Siyathuthuka Township (closest formal settlement).

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes: Palaeontological impact assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1: 250 000 2530 Baberton Geological Map (1986) (Council of Geoscience)
- 1: 250 000 2528 Pretoria Geological Map (1978) (Council of Geoscience)
- A Google Earth map with polygons of the proposed development was obtained from PGS Consultants.
- Information provided by NBS Colliery (Universal Coal).

9 IMPACT ASSESSMENT METHODOLOGY

9.1 Introduction

PLEASE NOTE:

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in **Table 6**.

Table 6: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	Proposed site	Incidental
2	LOW	Study area	Short-term
3	MODERATE	Local	Medium/High-term
4	HIGH	Regional / Provincial	Long-term
5	VERY HIGH	Global / National	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

9.2 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1 000 km2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given below.

Table 7: Description of the significance rating scale

RATING		DESCRIPTION
5	Very high	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	High	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	Moderate	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	Very low	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	No impact	There is no impact at all - not even a very low impact on a party or system.

9.3 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail below**.**

Table 8: Description of the significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 10 km from the proposed site.
2	Study Site	The impact will affect an area not exceeding the Eskom property.
1	Proposed site	The impact will affect an area no bigger than the ash disposal site.

9.4 Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in **Table 9**.

Table 9: Description of the temporal rating scale

RATING		DESCRIPTION
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium/High term	The environmental impact identified will operate for the duration of life of facility.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

9.5 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in **Table 10** below.

Table 10: Description of the degree of probability of an impact occurring.

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It's going to happen / has occurred

9.6 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in **Table 11**. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 11: Description of the degree of certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

9.7 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus, the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

Impact Risk = (SIGNIFICANCE (5)**+** *Spatial* (2)**+** Temporal(5)) X Probability4)
3 **5**

An example of how this rating scale is applied is shown in **Table 12**.

Table 12: Rating Ratings of the proposed development

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
	Very High	Study site	Permanent	Very Likely	
Impact	5	2	5	4	3.2

Note: The significance, spatial and temporal scales are added to give a total of 12, that is divided by 3 to give a criteria rating of 4. The probability (4) is divided by 5 to give a probability rating of 0,8. The criteria rating of 4 is then multiplied by the probability rating (0,8) to give the final rating of 3.2.

The impact risk is classified according to five classes as described in the **Table 13** below.

Table 13: Impact Risk Classes

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	1	**Very Low**
1.1 – 2.0	2	**Low**
2.1 – 3.0	3	**Moderate**
3.1 – 4.0	4	**High**
4.1 – 5.0	5	**Very High**

Therefore, with reference to the example above, an impact rating of 3.2 will fall in the **Impact Class 4,** which will be considered to be a **High impact**.

9.8 SUMMARY OF IMPACT TABLES

Only the site will be affected by the proposed development. The proposed development will have a negative impact on Fossil Heritage. The expected duration of the impact is assessed as potentially permanent to long term. It is Very Likely that the impact could occur. The significance of the impact occurring will be High.

10 FINDINGS AND RECOMMENDATIONS

The proposed development is primarily underlain by the Vryheid Formation of the Ecca Group (Karoo Supergroup). According to the South African Heritage Resources Information System, the Palaeontological Sensitivity of these rocks are Very High.

It is thus recommended that an EIA level palaeontology report be conducted to assess the value and prominence of fossils in the development area and the effect of the proposed development on the palaeontological heritage. The purpose of the EIA Report is to elaborate on the issues and potential impacts identified during the scoping phase. A Phase 1 field-based assessment would be conducted with research in the site-specific study area, as well as a comprehensive assessment of the impacts identified during the scoping phase.

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APPENDIX A – ELIZE BUTLER CV

ELIZE BUTLER

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	26 years in Palaeontology
EDUCATION:	B.Sc Botany and Zoology, 1988 University of the Orange Free State
	B.Sc (Hons) Zoology, 1991 University of the Orange Free State
	Management Course, 1991 University of the Orange Free State
	M. Sc. *Cum laude* (Zoology), 2009 University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

MEMBERSHIP

Palaeontological Society of South Africa (PSSA)	2006-currently

EMPLOYMENT HISTORY

Part time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

TECHNICAL REPORTS

Butler, E. 2014. Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.

Butler, E. 2014. Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoort, Northern Cape Province. 2014. Bloemfontein.

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Butler, E. 2015. Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.

Butler, E. 2015. Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.

Butler, E. 2015. Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.

Butler, E. 2015. Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.

Butler, E. 2015. Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.

Butler, E. 2015. Palaeontological Heritage Impact Assessment report on the establishment of the 65 mw Majuba Solar Photovoltaic facility and associated infrastructure on portion 1, 2 and 6 of the farm Witkoppies 81 HS, Mpumalanga Province. Bloemfontein.

Butler, E. 2015. Palaeontological Impact Assessment of the proposed township establishment on the remainder of portion 6 and 7 of the farm Sunnyside 2620, Bloemfontein, Mangaung metropolitan municipality, Free State, Bloemfontein.

Butler, E. 2015. Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse729, near Vryburg, North West Province. Bloemfontein.

Butler, E. 2015. Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

Butler, E. 2015. Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.

Butler, E. 2015. Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed Woodhouse 1 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

Butler, E. 2016. Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.

Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City Of Johannesburg, Gauteng Province. Bloemfontein.

Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.

Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.

Butler, E. 2016. Recommended Exemption from further Palaeontological studies: Proposed Construction of the Gunstfontein Switching Station, 132kv Overhead Power Line (Single Or Double Circuit) and ancillary infrastructure for the Gunstfontein Wind Farm Near Sutherland, Northern Cape Province. Savannaha South Africa. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

Butler, E. 2016. Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Savannaha South Africa. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from the Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's river valley Local Municipality, Eastern Cape Province. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannaha South Africa. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment for the proposed construction of up to a 132kv power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces. PGS Heritage. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed development of two burrow pits (DR02625 and DR02614) in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.

Butler, E. 2016. Ezibeleni waste Buy-Back Centre (near Queenstown), Enoch Mgijima Local Municipality, Eastern Cape. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment for the proposed construction of two 5 Mw Solar Photovoltaic Power Plants on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment for the proposed development of four Leeuwberg Wind farms and basic assessments for the associated grid connection near Loeriesfontein, Northern Cape Province. Bloemfontein.

Butler, E. 2016. Palaeontological impact assessment for the proposed Aggeneys south prospecting right project, Northern Cape Province. Bloemfontein.

Butler, E. 2016. Palaeontological impact assessment of the proposed Motuoane Ladysmith Exploration right application, Kwazulu Natal. Bloemfontein.

Butler, E. 2016. Palaeontological impact assessment for the proposed construction of two 5 MW solar photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.

Butler, E. 2016: Palaeontological desktop assessment of the establishment of the proposed residential and mixed use development on the remainder of portion 7 and portion 898 of the farm Knopjeslaagte 385 Ir, located near Centurion within the Tshwane Metropolitan Municipality of Gauteng Province. Bloemfontein.

Butler, E. 2017. Palaeontological impact assessment for the proposed development of a new cemetery, near Kathu, Gamagara local municipality and John Taolo Gaetsewe district municipality, Northern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment Of The Proposed Development Of The New Open Cast Mining Operations On The Remaining Portions Of 6, 7, 8 And 10 Of The Farm Kwaggafontein 8 In The Carolina Magisterial District, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Development of a Wastewater Treatment Works at Lanseria, Gauteng Province. Bloemfontein.

Butler, E. 2017. Palaeontological Scoping Report for the Proposed Construction of a Warehouse and Associated Infrastructure at Perseverance in Port Elizabeth, Eastern Cape Province.

Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Establishment of a Diesel Farm and a Haul Road for the Tshipi Borwa mine Near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Changes to Operations at the UMK Mine near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment for the Development of the Proposed Ventersburg Project-An Underground Mining Operation near Ventersburg and Henneman, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological desktop assessment of the proposed development of a 3000 MW combined cycle gas turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment for the Development of the Proposed Revalidation of the lapsed General Plans for Elliotdale, Mbhashe Local Municipality. Bloemfontein.

Butler, E. 2017. Palaeontological assessment of the proposed development of a 3000 MW Combined Cycle Gas Turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the new open cast mining operations on the remaining portions of 6, 7, 8 and 10 of the farm Kwaggafontein 8 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed mining of the farm Zandvoort 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Lanseria outfall sewer pipeline in Johannesburg, Gauteng Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of open pit mining at Pit 36W (New Pit) and 62E (Dishaba) Amandelbult Mine Complex, Thabazimbi, Limpopo Province. Bloemfontein.

Butler, E. 2017. Palaeontological impact assessment of the proposed development of the sport precinct and associated infrastructure at Merrifield Preparatory school and college, Amathole Municipality, East London. PGS Heritage. Bloemfontein.

Butler, E. 2017. Palaeontological impact assessment of the proposed construction of the Lehae training and fire station, Lenasia, Gauteng Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new open cast mining operations of the Impunzi mine in the Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the construction of the proposed Viljoenskroon Munic 132 KV line, Vierfontein substation and related projects. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed rehabilitation of 5 ownerless asbestos mines. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the Lephalale coal and power project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a 132KV powerline from the Tweespruit distribution substation (in the Mantsopa local municipality) to the Driedorp rural substation (within the Naledi local municipality), Free State province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a Photovoltaic Solar Power station near Collett substation, Middelburg, Eastern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment for the proposed township establishment of 2000 residential sites with supporting amenities on a portion of farm 826 in Botshabelo West, Mangaung Metro, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed prospecting right project without bulk sampling, in the Koa Valley, Northern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Aroams prospecting right project, without bulk sampling, near Aggeneys, Northern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvior aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

Butler, E. 2017. PIA site visit and report of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of Tina Falls Hydropower and associated power lines near Cumbu, Mthlontlo Local Municipality, Eastern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of the Mangaung Gariep Water Augmentation Project. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvoir aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of the Melkspruit-Rouxville 132KV Power line. Bloemfontein.

Butler, E. 2017 Palaeontological Desktop Assessment of the proposed development of a railway siding on a portion of portion 41 of the farm Rustfontein 109 is, Govan Mbeki local municipality, Gert Sibande district municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed extension of the Kareerand Tailings Storage Facility, associated borrow pits as well as a storm water drainage channel in the Vaal River near Stilfontein, North West Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed of the Lephalale Coal and Power Project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Overvaal Trust PV Facility, Buffelspoort, North West Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the H2 Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HO, North West Province. Bloemfontein.

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Biodiversity Impact Assessment for the North Block Complex (Pty) Ltd NBC Colliery

Biodiversity Impact Assessment

Prepared for:	**Project Number:**
Universal Coal	UCD6860
	March 2021

Digby Wells and Associates (South Africa) (Pty) Ltd
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This document has been prepared by Digby Wells Environmental.

Report Type:	Biodiversity Impact Assessment
Project Name:	Biodiversity Impact Assessment for the North Block Complex (Pty) Ltd NBC Colliery
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Name	Responsibility	Signature	Date
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Danie Otto	Technical Review		26/03/2021
Stephen Burton	Technical Review		26/03/2021

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I, _______Lisa Hester___________________________, 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 48 and is punishable in terms of section 24F of the Act.

16/04/2021

Signature of the Specialist *Date*

Findings, recommendations and conclusions provided in this report are based on the best available scientific methods and the author's professional knowledge and information at the time of compilation. Digby Wells employees involved in the compilation of this report, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

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EXECUTIVE SUMMARY

Digby Wells Environmental (Digby Wells) was appointed by Universal Coal to undertake a Biodiversity Assessment within the Universal Coal's North Block Complex (Pty) Ltd (NBC). The coal mine is situated west of the town of Belfast in the Mpumalanga Province. The mining sections are situated in various portions of the farms Paardeplaats 380 JS and the portion Eerstelingsfontein 406.

Based on Mucina & Rutherford (2006) classification of South Africa's vegetation, the proposed Project is located in an area dominated by the vegetation type Eastern Highveld Grassland and Steenkampsberg Montane Grassland, which according to those authors, is regarded as Endangered. The Project area falls within a Important Bird Area (IBA), the Steenkampsberg IBA. This area lies in the central South African plateau, and is characterised primarily of rolling high-altitude grasslands, interspersed with rocky outcrops. Key trigger species within this IBA include: the Striped Flufftail (LC), Wattled Crane (VU), Southern Bald Ibis (VU), Ground Woodpecker (NT) and Rudd's Lark (EN). According to the Mpumalanga Biodiversity Sector Plan, the southern section of the NBC Project Area supports Irreplaceable CBA as well as scattered portions of CBA Optimal throughout the Project area.

A single season site visit was conducted in December 2020. The following details were onsereed

Much of the study area has been either transformed or degraded largely through historical crop production and other agricultural activities, and current mining activities.

SCC recorded during the 2020 survey included 12 floral species, namely *Boophone disticha, Eucomis autumnalis*, *Eulophia welwitschia, Kniphogia typhoides, Gladiolus dalenii, Gladiolus crassifolius, Crinum bulbispermum, Aloe ecklonis, Agapanthus inapertus, Haemanthus humilis* and *Watsonia lepida.* Moreover, a number of other Red Data/protected species could potentially occur in the area. Faunal SCC recorded included the Marsh Sylph recorded within the unchanneled valley bottom wetland in portion 5 and a Serval captured by camera in portion 28.

The mining activities in the identified vegetation communities have had direct negative ecological impacts, most notably vegetation clearing, habitat loss and fragmentation as well as AIP proliferation. Areas to be mined should be screened for the identified floral SCC and any other Red Data/protected species prior to construction. If found these species should be relocated to a nearby site of similar habitat and permits applied for the removal.

The Project area represents high faunal and floral diversity with numerous SCC identified throughout. The vegetation communities associated with the highest species richness were the Rocky outcrops and Wetland communities. However, in the context of the Project area all of the remaining natural vegetation provides habitat for numerous faunal and floral species and therefore is of conservation significance. The remaining vegetation not previously impacted from historical land use practices and is under severe pressure from grazing and AIP proliferation. Large extents of the Project area have dense stands of AIPs (*Eucalyptus, Acacia and Populus* sp.) established. Faunal SCC recorded included the Marsh Sylph recorded within he unchanneled valley bottom wetland in portion 5 and a Serval captured by camera in portion 28. Most recorded SCC reside in portions 13, 40 and 2, therefore a high conservation value is associated with these portions.

Recommendations and mitigation measures are provided in the Impact Assessment. The assessment provides mitigation measures, continuous monitoring measures, encourages concurrent rehabilitation and monitoring plan. An addendum to this report is the Land Management Plan with tailored recommendations and management measures for each of the portions in the farm Paardeplaats 380 JS and Eerstelingfontein 406 JT.

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ACRONYMS, ABBREVIATIONS AND DEFINITION

AIP	Alien Invasive Plant
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EAP	Environmental Assessment Practitioner
EMPr	Environmental Management Programme Report
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MRA	Mining Right Area
MBSP	Mpumalanga Biodiversity Sector Plan
MNCA	Mpumalanga Natura Conservation Act (Act No. 10 of 1998)
LoM	Life of Mine
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM:BA	National Environmental Management Act: Biodiversity Act, 1998 (Act No. 107 of 1998)
S&EIR	Scoping and Environmental Impact Reporting
SCC	Species of Conservation Concern
Project area	Paardeplaats 380 JS and Eerstelingsfontein 406 JT
EFN	Eerstelingsfontein 406 JT
Paardeplaats	Paardeplaats 380 JS

1. Introduction

Digby Wells Environmental (Digby Wells) was appointed by Universal Coal to undertake a Biodiversity Assessment within the Universal Coal's North Block Complex (Pty) Ltd (NBC). The coal mine is situated west of the town of Belfast in the Mpumalanga Province. The mining sections are situated in various portions of the farms Paardeplaats 380 JS and the portion Eerstelingsfontein 406 JT (hereby Project area) (Figure 1-1 & Figure 1-3). The mine makes use of an open-pit strip mining method with continuous rehabilitation. The mining operation consists of 2,849.14 hectares (ha).

The proposed Paardeplaats Coal Mine is located in Portions 13, 28, 29, 30 and 40 of the Farm Paardeplaats 380 JT and Remaining Extent and Portion 2 of the Farm Paardeplaats 425 JS (Figure 1-2). The area under the application is approximately 1,415 ha and falls within the jurisdiction of the eMakhazeni Local Municipality in the Nkangala District Municipality. The application area lies approximately 2 km west of eMakhanzeni (formerly Belfast) in the Mpumalanga Province and is linked to Mhluzi via the N4 highway.

1.1. Project Description

The Paardeplaats Coal Mine is best viewed as an extension of the bordering NBC Glisa. Paardeplaats is proposed as an open cast mining development where a hybrid of roll-over and bench/box cut mining techniques will be employed to access and mine coal from both shallow and deeper target seams. The project is aimed at supplying Run of Mine (RoM) to NBC Glisa for minerals processing at a rate of 4.2 – 4.4 million tonnes per annum (mtpa) and supply Eskom's power stations at a rate of 2.4 mtpa.

All mineral processing and waste disposal will be undertaken at NBC Glisa and as such the Paardeplaats Coal Mine requires limited infrastructure. Infrastructure that is required, and that has been applied for includes haul roads, dewatering pipelines, pollution control dams, a pit dewatering dam, diesel storage and a temporary general waste storage facility. A detailed project description can be viewed in the Environmental Management Programme Report of 2014 (Environmental Impact Management Services, 2014).

1.2. Terms of Reference

The Biodiversity Assessment is required to develop a Biodiversity Land Management Plan (BLMP) for the existing NBC. The BLMP is a consolidation of the following proposed scope of work:

- Undertake a desktop assessment and site assessment;
- Provide a description of the baseline receiving environment, including a general description of the ecology and biodiversity of the Project area;
- Provide biodiversity sensitivity mapping covering vegetation units, sensitive receptors, based on the site inspection findings and desktop assessment;

- Provide mitigation and management measures to address relevant impacts identified in a Biodiversity Impact Assessment; and
- Provide an action plan for implementation.

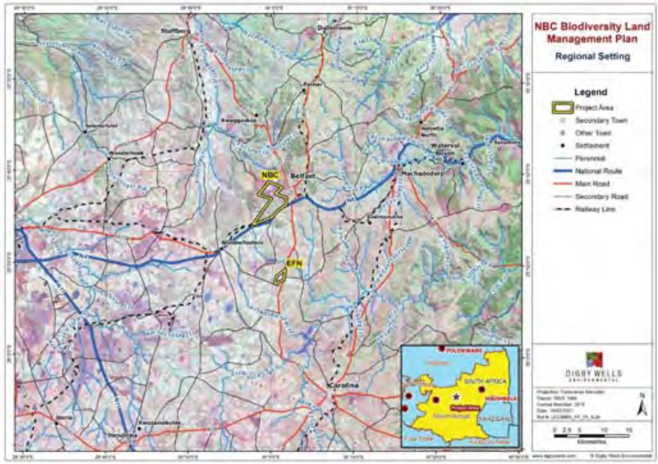

Figure 1-1: Regional Setting of the NBC

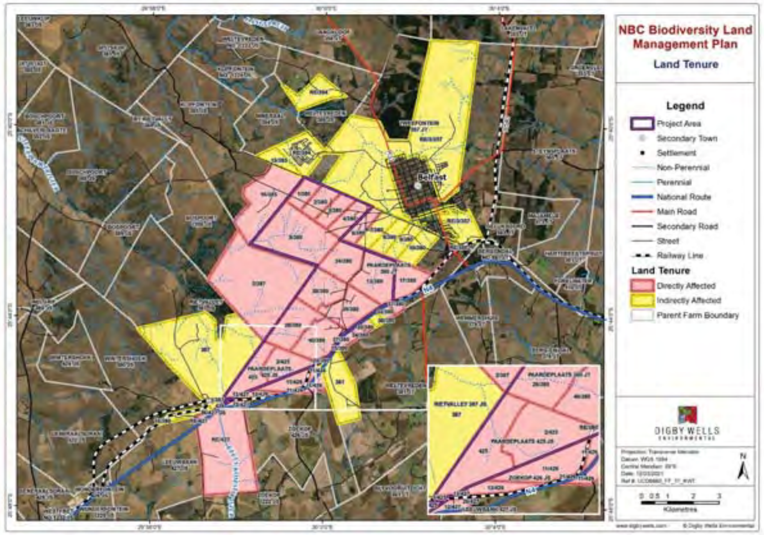

Figure 1-2: Land Tenure Map of the Paardeplaats Farm Portions

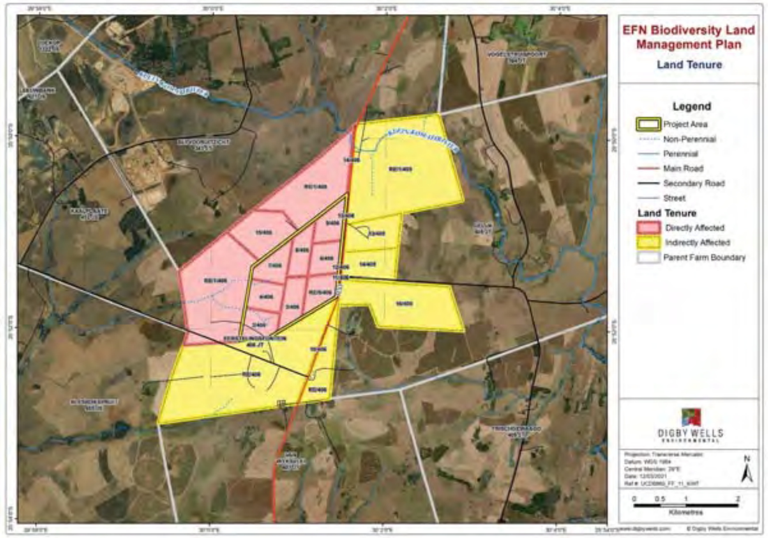

Figure 1-3: Land Tenure Map of the EFN Farm Portions

2. Relevant Legislation, Standards and Guidelines

2.1.1.1. Mpumalanga Nature Conservation Act (Act No. 10 of 1998)

The Mpumalanga Nature Conservation Act (Act No. 10 of 1998) (MNCA) is responsible for making provisions with respect to nature conservation in the Mpumalanga province. It provides for, among other things, protection of wildlife, hunting fisheries, protection of endangered fauna and flora as listed in the Convention of International Trade in Endangered Species (CITES) of wild flora and fauna, the control of harmful animals, freshwater pollution and enforcement. The objectives of the MNCA are to consolidate the laws relating to nature conservation applicable in the Mpumalanga province and to provide for matters connected therewith. The MNCA focuses on the protection of critically endangered to vulnerable fauna, and flora within the province.

2.1.1.2. National Environmental Management Biodiversity Act (Act No. 10 of 2004)

The purpose of the National Environmental Management Biodiversity Act (Act No. 10 of 2004) (NEM:BA) is to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA and the protection of species and ecosystems that warrant national protection. As part of its implementation strategy, the National Spatial Biodiversity Assessment was developed. In terms of the NEM:BA, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA Regulations);
- Application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all developments within the area are in line with ecological sustainable development and protection of biodiversity; and
- Limit further loss of biodiversity and conserve endangered ecosystems.

NEM: BA restricts activities on protected species via its associated Threatened or Protected Species (TOPS) regulations and provides protection for any activity (which must be identified in terms of this Act) which may impact these species.

Additionally, the Alien and Invasive Species Regulations (GNR 506 of 2013), promulgated in terms of Section 97(1) of NEM: BA apply as well as Alien Invasive Regulations (2014) and the Invasive Species List (2018).

2.1.1.3. Red Data

Red Data Books or RDBs, are lists of threatened plants and animals specific to a certain region. They are a vital source of information in guiding conservation decisions and have guided the literature review of this study. South Africa has produced 5 RDBs dealing with each of the following: birds, land mammals, fish (freshwater and estuarine only), reptiles and amphibians, and butterflies.

The conservation status of a plant or animal species is described by the following terms:

- EXTINCT: a species for which there is a historical record, but which no longer exists in the area under review.
- ENDANGERED a species in danger of extinction, and whose survival is unlikely if the factors causing its decline to continue.
- VULNERABLE a species which it is believed will move into the endangered category if the factors causing its decline to continue.
- RARE a species with small populations, which are not yet vulnerable or endangered, but which are at risk.

The term **THREATENED** is commonly used as a collective description for species which are endangered vulnerable or rare.

Some species are **ENDEMIC,** i.e. they are restricted to one region and occur nowhere else. A threatened endemic is a conservation priority.

Of special concern were protected plant and animal species. Listed species of flora and fauna are regarded as species whose representation in the wild has declined to such an extent that drastic action is needed to ensure their survival. Under anthropogenic pressure, the number of these species has reached levels where preservation management is needed, and conservation management will no longer be effective. The listing of these species under either International Union for the Conservation of Nature (IUCN) or CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora), is regarded as a valuable starting point to initiate legally sanctioned management practices to bring the numbers of these species back to within acceptable numbers.

2.1.1.4. IUCN

The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those plants and animals that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered, and Vulnerable). The IUCN Red List also includes information on plants and animals that are categorized as Extinct or Extinct in the Wild; on taxa that cannot be evaluated because of insufficient information (i.e., are Data Deficient); and on plants and animals that are either close to meeting the threatened thresholds or that would be threatened were it not for an ongoing taxon-specific conservation programme (i.e., are Near Threatened). Abbreviations and descriptions of each IUCN category are summarized in Table 2-1 below.

Plants and animals that have been evaluated to have a low risk of extinction are classified as Least Concern (IUCN.org) (Figure 2-1)

Figure 2-1: IUCN categories

The figure above shows the Current IUCN Red List categories. These categories include Critically Endangered (CR), Endangered (EN), and Vulnerable (VU), which are collectively known as the Threatened category, Conservation Dependent (CD), Near Threatened (NT), and Least Concern (LC) which are collectively known as Lower Risk.

Table 2-1: Description of IUCN Categories

IUCN Category	Abbreviation	Description
Extinct	EX	No surviving individuals of the species
Extinct In The Wild	EW	Known only to survive in captivity, or as a naturalized population outside its historic range.
Critically Endangered	CR	At a very high risk of extinction.
Endangered	EN	High risk of extinction in the wild.
Vulnerable	VU	High risk of endangerment in the wild.
Near Threatened	NT	Likely to become endangered in the near future.
Least Concern	LC	Lowest risk. Does not qualify for a more at-risk category
Data Deficient	DD	Not enough data to make an assessment of its risk of extinction.
Not evaluated	NE	Has not yet been evaluated against the criteria.

2.1.1.5. CITES

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival (CITES.org).

CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the

Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species (CITES.org). Specimens are divided into the following appendices according to the restriction on trade.

Appendices I, II and III

- Appendix I includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.
- Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.
- Appendix III contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party is entitled to make unilateral amendments to it.

2.1.1.6. TOPS Regulations

The Threatened or Protected Species Regulations 152 of 2007 ("TOPS Regulations") and the Lists of Critically Endangered, Endangered, Vulnerable and Protected Species (TOPS Lists) were published in 2007, in terms of the NEM:BA (South Africa, 2007(a) and (b)) and have been amended since then. These regulations through NEM:BA Chapter 4 provides for the protection and sustainable use of listed Threatened or Protected Species (TOPS) species. NEM:BA restricts activities that may be carried out in respect of Threatened or Protected Species (TOPS).

3. Assumptions, Limitations and Exclusions

Whilst every effort is made to cover as much of the site as possible, representative sampling was completed as per the nature of this type of investigation. The major limitation associated with the sampling approach is the narrow temporal window of sampling. Ideally, a site should be visited several times during the different seasons to ensure a comprehensive fauna and flora species list. However, due to time and cost restraints, this is not always possible. It is therefore possible that some plant and animal species that are present on site were not recorded during the field investigations. In order to overcome this limitation, the list of species observed during the site visit is supplemented with species of conservation concern that are known to occur in the area.

In the absence of a detailed soil map (1:10 000 scale), it is difficult to (with high confidence) map the extent of the natural grassland communities as vegetation reflects the soil conditions.

In order to obtain a comprehensive understanding of the dynamics of terrestrial communities, as well as the status the status of endemic, rare or threatened species in my area, faunal assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints such long-term studies are not feasible and more often based on instantaneous sampling bouts.

SARCA and SAFAP provide distribution data and the Quarter Degree Squares (QDS) resolution. Expected species list may therefore represent an overestimation of the diversity expected as very specific habitat types may be required by a species which may be present in a QDS but not necessarily on the study site within the QDS. Conversely, many large areas in South Africa are poorly sampled for herpetofauna and expected species lists may therefore underestimate the species diversity. All possible attempts were made to refine the expected species list based on species-specific habitat requirements and a deeper understanding of the habitat types and quality of the study area which was obtained during the summer survey.

The scope of work for this biodiversity assessment did not cover wetland delineation and assessments. Previous assessments by De Castro & Brits c.c. and Wetland Consulting Services (Pty) Ltd were used as reference guides in the development of this study.

4. Expertise of the Specialist

Lisa Hester (Pri.Sci.Cand) currently holds the position of Ecologist at Digby Wells Environmental in South Africa. She obtained her BSc Honour's degree in Ecology and Conservation from the University of Witwatersrand in South Africa. Her dissertation topic involved an in-depth ecological survey of the Croc River Mountain Conservancy in Nelspruit.

Since completion of her studies, Lisa has worked on numerous fauna and flora biomonitoring reports both locally and internationally (including Australia). Working on a multitude of surveys in various locations has allowed Lisa to engage upon a multi-faceted professional forum. Various scopes of work involving, ecological baseline assessments, ecological rehabilitation, wetland assessments, nest-box installations, scoping reports, bat surveys, species relocation and vegetation reports consists of her repertoire of work.

Danie Otto is a Director and manages the Southern African Operations at Digby Wells. He holds an M.Sc in Environmental Management with B.Sc Hons (Limnology & Geomorphology, and GIS & Environmental Management) and B.Sc (Botany and Geography & Environmental Management). He is a biogeomorphologist that specialises in ecology of wetlands and rehabilitation. He has been a registered Professional Natural Scientist since 2002.

Danie has more than 20 years of experience in the mining industry in environmental and specialist assessments, management plans, audits, rehabilitation, and research.

He has experience in eight countries and his experience is in the environmental sector of coal, gold, platinum (PGMs), diamonds, asbestos, rock, clay & sand quarries, copper, phosphate, andalusite, base metals, heavy minerals (titanium), uranium, pyrophyllite, chrome, nickel etc.

He has wetland and geomorphology working experience across Africa including specialist environmental input into various water resource related studies. These vary from studies of the wetlands of the Kruger National Park to swamp forests in central Africa to alpine systems in Lesotho.

Stephen Burton is the Ecology and Atmospheric Sciences Divisional Manager at Digby Wells. He has a B.Sc. (Zoology and Entomology) and a B.Sc. Honours (Zoology) from the University of Natal. He also holds an M.Sc. (Zoology) from the University of KwaZulu-Natal.

Stephen has over 14 years of experience in the ecology field, with a varied background in faunal, floral and wetland ecology. He has been involved in large scale floral and faunal assessments, as well as wetland delineations, functional assessments, rehabilitation planning and implementation, and biodiversity offset planning. His faunal experience involves most terrestrial animal groups, including a strong focus on invertebrates (insects, molluscs, millipedes etc.), but also extensive experience in bird and mammal assessments.

He is currently registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions.

5. Methodology

This section presents the detailed methodology undertaken during the infield assessment and during the assessment of all impacts related to the project in terms of fauna and flora (Terrestrial Biodiversity)

5.1. Desktop Gap Analysis

The desktop review involved compiling relevant information for the greater study area from reliable and recognised resources, including historical studies and assessments. The aim of the desktop study is to identify the current biodiversity and ecosystem status through various databases including the following:

- Mucina and Rutherford (2012), expected vegetation type and community structure:
- South African National Botanical Institute (SANBI), Pretoria Computerised Information System) PRECIS List's, potential species in the proposed development area/site area according to the QDS;
- Potentially occurring avifaunal species through South African Bird Atlas Project (SABAP2), BirdLife South Africa Area (IBA) Directory (Barnes, 1998) and The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al*., 2015);
- Potentially occurring mammal species through The Mammals of the Southern African Subregion (Skinner & Chimimba , 2005), the Animal Demography Unit Virtual Museum (http://vmus.adu.org.za/), and The 2016 Red List of Mammals of South Africa, Lesotho and Swaziland (ww.ewt.org.za) (Child, M. F., *et al*.,2017);
- Potentially occurring herpetofauna species list through the SARCA (sarca.adu.org); A Guide to the Reptiles of Southern Africa (Graham, 2013); Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland (Bates et al., 2014), A Complete Guide to the Frogs of Southern Africa (Du Preez & Carruthers, 2009); Atlas and Red Data Book of Frogs of South Africa, Lesotho and Swaziland (Minter, 2004); and
  - Mpumalanga Provincial legislation, potential Red Data Listed species and their current status.

5.2. Field Investigations

Wet season infield fauna assessments took place during December 2020. Camera traps and Sherman traps were set out in locations where high faunal activity was observed and expected. During the field survey, the area was surveyed for the various fauna assemblages and floral species. The methodology of the fauna and flora assessment is described below.

5.2.1. Flora

A walkthrough of the site was undertaken to assess the vegetation. The survey searched for protected and listed plant species and declared Alien Invasive Plants (AIPs), with the overall aim to produce a full species list of all plant species present.

5.2.2. Mammals

A walkthrough of the site was done during the site survey whereby mammal species were identified by visual sightings as well as using spoor, droppings and roosting sights and available habitat. Camera traps and Sherman traps were set up in various locations where high faunal activity was observed and expected. Mammals were identified using the Smithers' Mammals of the Southern African field guide (Smithers, 2000).

5.2.3. Birds (Avifauna)

Data regarding the distribution of bird species was obtained from the Quarter Degree Square (QDS) using the information available from the South African Bird Atlas Project 2 (SABAP2). Concurrently with the mammal survey, the principal ornithological field survey technique was used to record bird species present. Opportunistic sightings were taken during the site survey.

Because the primary purpose of this work was to establish the presence of species, no distance or time limit was set, and hence any species seen or heard anywhere within the general vicinity of the proposed project site was recorded. Visual identification was used to confirm calls of the less common species. Bird species were confirmed using the Sasol photographic field guide (Ryan, 2009)

Assessment of the conservation status of species recorded focused on the various categories of Globally Threatened Species (IUCN 2019), birds listed by NEMBA and the Eskom Red Data Book of Birds (Taylor MR, 2015).

5.2.4. Reptiles and Frogs

Comprehensive amphibian surveys can only be undertaken by nocturnal surveys throughout the wet season. This was beyond the current scope of the assessment and the area was surveyed diurnally for possible habitat for amphibian species. Direct / opportunistic observations were completed along trails or paths within the Project Area. Any herpetofauna species seen or heard along such paths or trails within the Project Area were identified and recorded. Another method used was to examine refuges using visual scanning of terrains to record smaller herpetofauna species which often conceal themselves under rocks and in fallen logs, rotten tree stumps, in leaf litter, rodent burrows, ponds, old termite mounds, etc. Du

Preez, *et al*. (2009) was used to confirm identification where necessary. Assessment of the conservation status of species recorded focused on the various categories of Globally Threatened Species (IUCN 2019) and listed by NEMBA.

5.2.5. Invertebrates (Spiders, Scorpions, Beetles and Butterflies)

A list of visually identified and observed invertebrate species was compiled during the field survey. However, due to their cryptic nature and habits, varied stages of life cycles, seasonal and temporal fluctuations within the environment, it is unlikely that all invertebrate species will have been recorded during the site assessment period. Nevertheless, the data gathered during the general invertebrate assessment along with the habitat analysis provided an accurate indication of which invertebrate species are likely to occur in the study area. A sweep net was used to capture and identify invertebrates. The focus of this assessment was on protected species as this would narrow the field considerably. Assessment of the conservation status of species recorded focused on the various categories of Globally Threatened Species (IUCN 2019) and inverts listed by the NEMBA.

5.2.6. Species of Conservational Concern Assessment

The term Species of Conservation Concern (SCC) in the context of this report refers to all RD (Red Data) and IUCN (International Union for the Conservation of Nature) listed fauna and flora species, as well as protected species of relevance to the project.:

- Critically Endangered (CR): A taxon is Critically Endangered when it is considered to be facing an extremely high risk of extinction in the wild (IUCN, 2019).
- Endangered (EN): A taxon is Endangered when it is considered to be facing a very high risk of extinction in the wild (IUCN, 2019).
- Vulnerable (VU): A taxon is Vulnerable when the best available evidence indicates it to be facing a high risk of extinction in the wild (IUCN, 2019).
- Near Threatened (NT): A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future (IUCN, 2010).

6. Findings and Discussion

The baseline and desktop findings for the Project area are elaborated and discussed in Table 6-1 below. The correlating maps per each database succeed the baseline table.

Table 6-1: Baseline Environment for the Project area

DETAILS OF THE PROJECT AREA IN TERMS OF MUCINA & RUTHERFORD (2006)	
Biome	According to Mucina and Rutherford (2012), the study area falls within a **Grassland** Biome**.**
Bioregion	The study area is located within the **Mesic Highveld Grassland Bioregion.**
Vegetation Type	The study area falls within the **Eastern Highveld Grassland and Steenkamp Montane Grassland** Vegetation type (Figure 6-1)**.**
CONSERVATION DETAILS PERTAINING TO THE PROJECT AREA (VARIOUS DATABASES)	
Mining and Biodiversity Guideline Category, DEA (2013) (FIGURE 6-3)	Areas within the Paardeplaats/Glisa and EFN portions have various areas demarcated and classified as **High Biodiversity Importance – High Risk for Mining** and **Moderate Biodiversity Importance – Moderate Risk for Mining.**
National Threatened Ecosystems (2011)	According to the National List of threatened terrestrial ecosystems, the proposed extension area falls does not fall within any original or remaining extents of a threatened ecosystem.

DESCRIPTION OF THE VEGETATION TYPE(S) RELEVANT TO THE PROJECT AREA ACCORDING TO MUCINA & RUTHERFORD (2006)					
Vegetation Type	**Eastern Highveld Grassland (Gm12) and Steenkampsberg Montane Grassland (Gm30)**				
Altitude (m)	1,520-1,780 m for Gm12 and up to 2,330 m for Gm30				
Climate (Gm12)	Strongly seasonal summer-rainfall region, with very dry winters				
	MAP* (mm)	**MAT* (°C)**	**MFD* (Days)**	**MAPE* (mm)**	**MASMS* (%)**
	400-1000	16	14	2234	77
Climate (Gm30)	Seasonally arid temperate region with hot summers and cool and dry winters. Winter frost is common and summer mist is infrequent				
	MAP* (mm)	**MAT* (°C)**	**MFD* (Days)**	**MAPE* (mm)**	**MASMS* (%)**
	400-1000	17	14	2243	74
Distribution	Mpumalanga Province				
Geology & Soils	Gm30 forms part of the Pretoria Group (intersected by Transvaal Diabase), with the several hill formations running from west to east. Rocks are quartzite, shale, dolerite, diabase and basalt. Soils are shallow to deep,				

			well drained; either dystrophic and/or mesotrophic depending on geology. Soil derived from quartzite results in sandy, white dystrophic soils with high humus content.
SAPAD & SACAD (Q4, 2018); and NPAES (2009) (FIGURE 6-6)	According to SACAD (Q4, 2018), the nearest and most apparent is the Nooitgedacht Dam Nature Reserve located approximately 22 km south of the Project Area. The Nooitgedacht reserve is 3000 ha and holds host to a numerous number of game species such as Blesbuck, Spingbok, Zebra, Red Hartebeest, Reedbuck, Oribi and recently introduced Buffalo. The Reserve surrounds the Nooitgedacht Dam where the Komati River originates. Other important tributaries are the Boesmansspruit, Witkloofspruit, and the Vaalwaterspruit. This Reserve is within the Gert Sibande District Municipality and is a custodian of the Mpumalanga Tourism and Parks Agency (MTPA).		Gm12 has red to yellow sandy soils of the Ba and Bb land types found on shales and sandstones of the Madzaringwe formation (Karoo Supergroup). Land types Bb (65%) and Ba (30%).
		Conservation	Gm 12 is Endangered with a 24% Conservation Target and Gm30 is poorly protected
IBA (2015) (FIGURE 6-4)	According to the Important Bird and Biodiversity Areas (IBA) database, the NBC falls within the Steenkampsberg IBA. This area lies in the central South African plateau, and is characterised primarily of rolling high-altitude grasslands, interspersed with rocky outcrops. Key trigger species within this IBA include: the Striped Flufftail (LC), Wattled Crane (VU), Southern Bald Ibis (VU), Ground Woodpecker (NT) and Rudd's Lark (EN). A very important wetland in the northern portion of this IBA, known as Middlepunt Vlei, provides habitat for the Critically Endangered White-winged Flufftail (*Sarothrura ayresi*). The species has been regularly recorded in the *Carex*-dominated marshes and nests have been recently recorded in the area.	**Vegetation & landscape features**	The dominant floral taxa are listed in Table 6-2 and Table 6-3. Gm30 is characterised by Mountainous with plateau grasslands, mountain slopes and shallow valleys. Grasslands are short with high forb diversity. Gm12 has modeartly undulating plains. The vegetation is short dense grassland dominated by the usual highveld grassland composition (*Aristida, Digitaria, Eragrostis, Themeda)* with small scattered rocky outcrops with wiry sour grasses and some woody species.
MPUMALANGA BIODIVERSITY SECTOR PLAN CATEGORY (MTPA, 2014)			
CBA & ESA (FIGURE 6-2)	The southern section of the NBC Project Area supports **Irreplaceable CBA** as well as scattered portions of **CBA Optimal** throughout the Project area (not within the EFN portion).		
NFEPA WETLAND CLASSIFICATION (NEL, ET AL., 2011) (FIGURE 6-7)			

NFEPA WETLANDS	The Project Area comprises of **Slope Seep** and **Depression NFEPA Wetlands.**

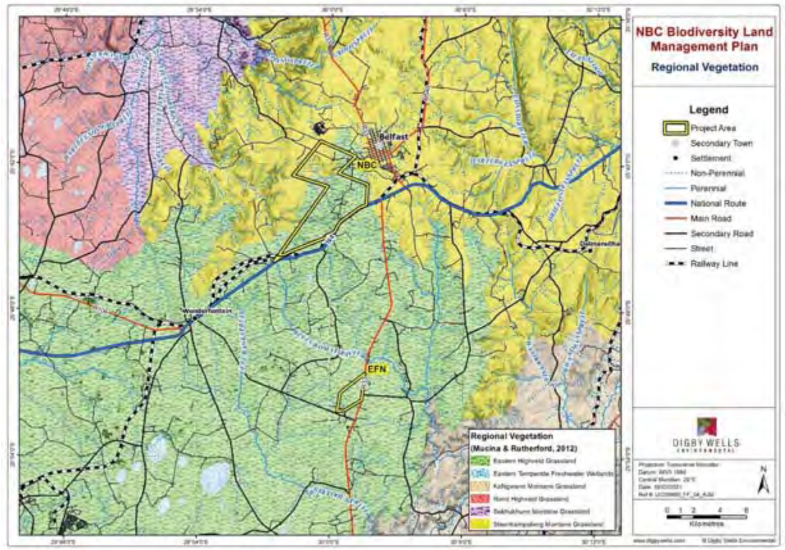

Figure 6-1: Regional Vegetation for the NBC Complex

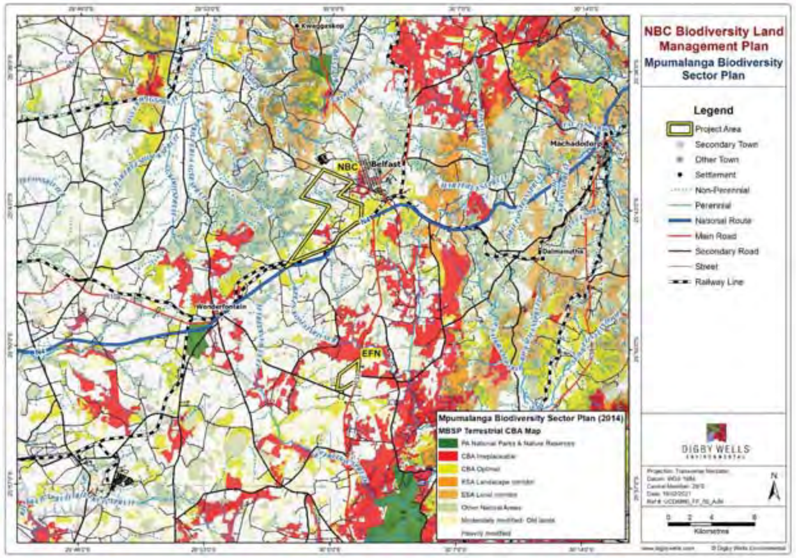

Figure 6-2: MBSP of the NBC Complex

Biodiversity Impact Assessment
Biodiversity Impact Assessment for the North Block Complex (Pty) Ltd NBC Colliery
UCD6860

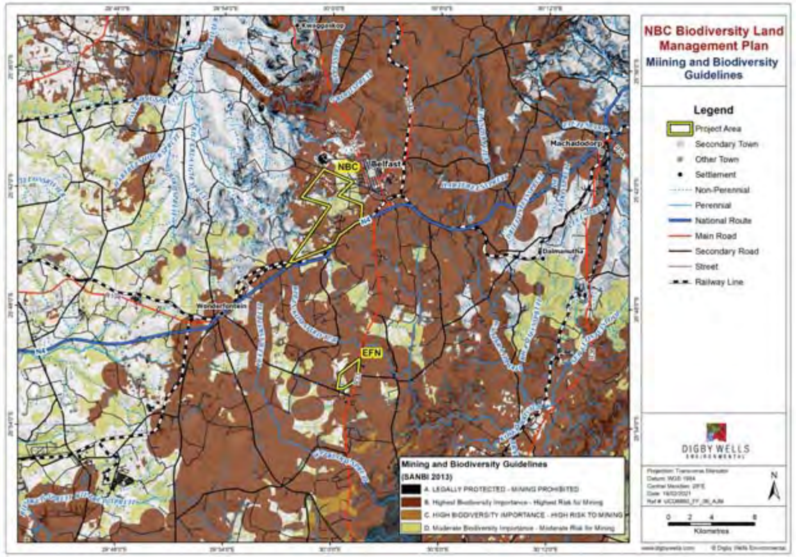

Figure 6-3: Mining and Biodiversity Guidelines of the Project area

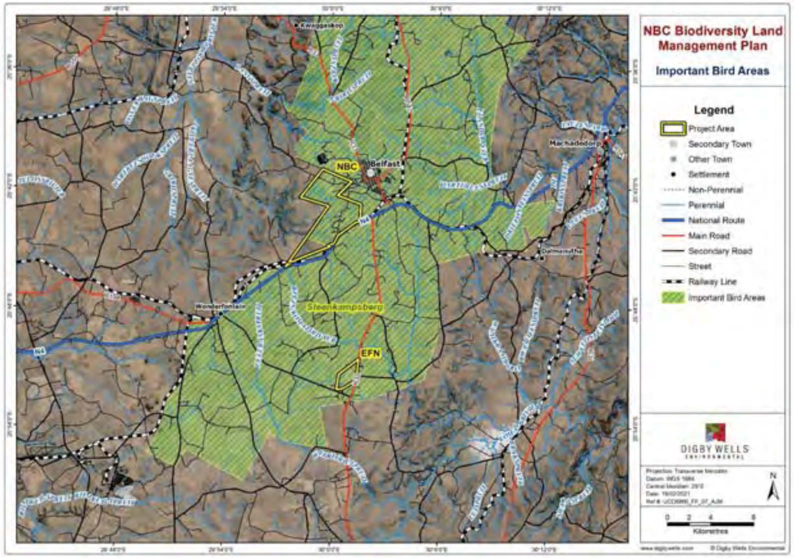

Figure 6-4: Important Bird Area within the NBC

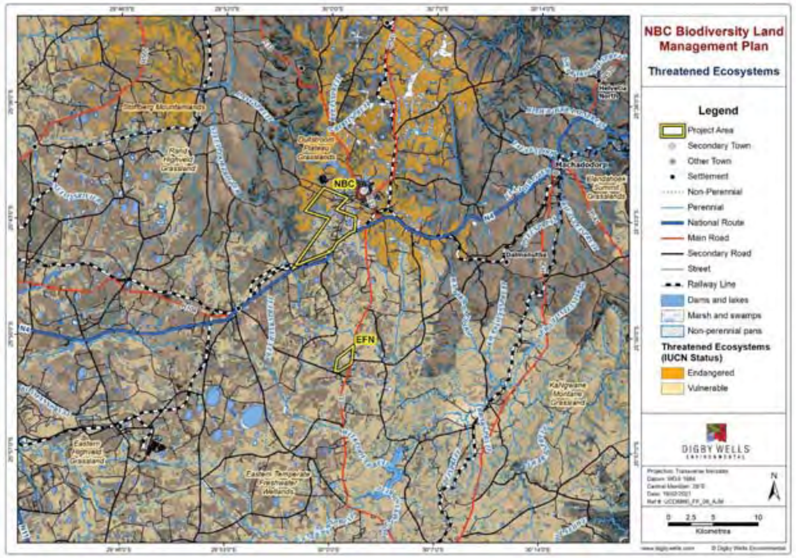

Figure 6-5: Threatened Ecosystems within the NBC

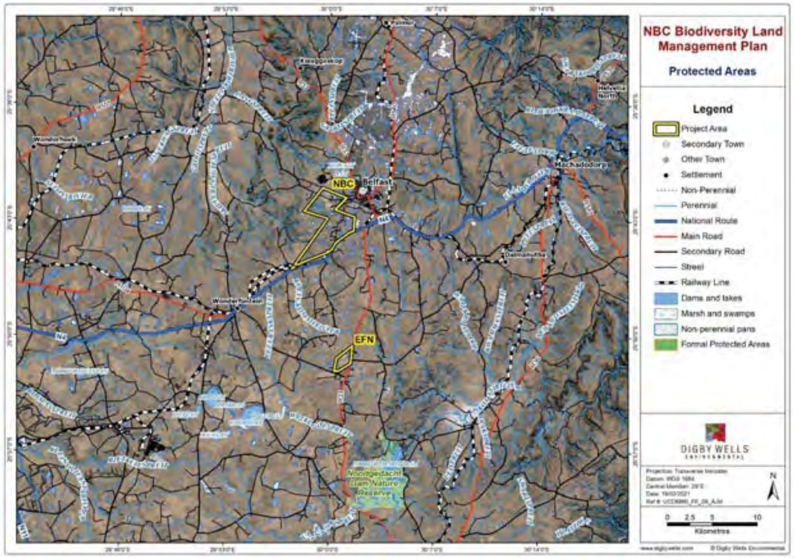

Figure 6-6: Protected Areas within vicinity to the NBC

Biodiversity Impact Assessment
Biodiversity Impact Assessment for the North Block Complex (Pty) Ltd NBC Colliery
UCD6860

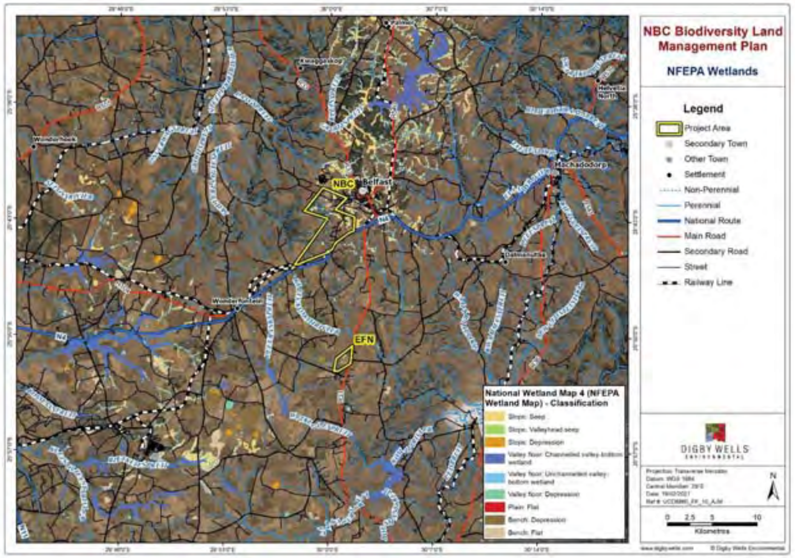

Figure 6-7: NFEPA Wetlands of the NBC

6.1. Regional Vegetation

Two regional vegetation types are identified within the NBC and EFN Project Area, namely the Eastern Highveld Grassland and the Steenkampsberg Montane Grassland. The various vegetation types are discussed below.

6.1.1. Eastern Highveld Grassland

The Project area falls within the Eastern Highveld Grassland (Gm12) vegetation type as described by Mucina & Rutherford, 2006, as seen in Figure 6-1. The Grassland Biome is one of the nine South African plant Biomes and the second most diverse biome in South Africa. The Grassland Biome is situated primarily on the central plateau of South Africa, and the inland areas of Kwa-Zulu Natal and the Eastern Cape provinces. The biome is rich in flora and fauna diversity but is under threat due to agricultural activities, expansion of mining and industrial activities.

The Eastern Highveld Grassland is characterised by slightly to moderately undulating plains, including some low hills and pan depressions. This vegetation type is considered to be "**Endangered**" on the National List of Threatened Terrestrial Ecosystems and is considered approximately 55% altered. It is considered to be "poorly protected" with only 13 % of its' target percentage protected (Lötter, 2015). The primary factor responsible for this status is due to on-going cultivation activities within the area. The vegetation of the landscape is short dense grassland dominated by the usual highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya* etc) (Mucina & Rutherford, 2012). Table 6-2Table 6-2 lists the species expected to occur within this region

Table 6-2: Flora Species Characteristics of the Eastern Highveld Grassland

Plant Form	Species
Graminoid[1]s	*Aristida aequiglumis, A. congesta, A. junciformis* subsp. *galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. capensis, E. curvula, E. gummiflua, E. patentissima, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata* subsp. *eckloniana, Andropogon appendiculatus, A. schirensis, Bewsia biflora, Ctenium concinnum, Diheteropogon amplectens, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyrium sanguineum, Setaria nigrirostris, Urelytrum agropyroides.*
Herbs	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis* subsp. *setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides* subsp. *latifolia, Selago densiflora, Senecio coronatus, Hilliardiella oligocephala, Wahlenbergia undulata.*
Geophytic[2] Herbs	*Gladiolus crassifolius, Haemanthus humilis* subsp. *hirsutus, Hypoxis rigidula* var. *pilosissima, Ledebouria ovatifolia.*
Succulent Herbs	*Aloe ecklonis.*
Low Shrubs	*Anthospermum rigidum* subsp. *pumilum, Seriphium plumosum.*

[1] **Graminoids** means grasses and grass like plants, such as sedges.

6.1.2. Steenkampsberg Montane Grassland

This vegetation type occurs along the Steenkampsberg escarpment that extends from the headwaters of the Waterval River in mountains north-west of Lydenburg, extending southwards through Dullstroom towards Belfast, then eastwards through Machadodorp to Bambi and Elandshoogte. It is poorly protected yet over 70 % is still considered natural. It was previously mapped as Gm18 Lydenburg Montane Grassland (100 %) (Mucina & Rutherford, 2012), which was split into Gm30 and Gm31 (Dayaram, 2017). A floristic analysis along the Mpumalanga escarpment supports the recognition proposal of two subcentres of plant endemism, namely the Long Tom Pass subcentre and the Steenkampsberg subcentre. Dominant, biogeographically important taxa and endemic taxa are listed in Table 6-3 below.

Table 6-3: Flora Species Characteristics of the Steenkampsberg Montane Grassland (Dayaram, 2017)

Plant Form	Species
Dominant	*Hilliardiella aristata, Searsia discolour, Rubus ludwigii., Lopholaena coriifolia, Otholobium wilmsii, Tristachya leucothrix, Harpochloa falx, Andropogon schirensis Hochst., Monocymbium ceresiiforme, Acalypha wilmsii, Argyrolobium tuberosum, Helichrysum adenocarpum subsp. adenocarpum* and *Lobelia flaccida*
Biogeographically Important Taxa	*Aloe modesta, Watsonia watsonioides, Disa klugei, Khadia alticola, Brachystelma stellatum,* and *Indigofera longibarbarta*
Endemic Taxa	*Searsia tumulicola var. meeuseana, Crotalaria monophylla, Indigofera hedyantha var. steenkampianus. Kniphofia rigidifolia, Riocreuxia aberrans, Streptocarpus latens, Gladiolus cataractarum, Gladiolus malvinus, Graderia linearifolia, Xysmalobium pedifoetidum, Eucomis vandermerwei, Drimiopsis purpurea,* and *Aloe challisii.*

[2] **Geophytic** means a land plant that survives an unfavourable period by means of underground food-storage organs (e.g. rhizomes, tubers, and bulbs).

6.2. Species of Conservation Concern

The Project area is situated within the Quarter Degree Square (QDS) 2529CB, 2530CA, 2530CC and 2529DD. Based on the results of a search of historical records for the QDS on the Botanical Research and Herbarium Management Software (BRAHMS) New Plants of southern Africa website (NEWPOSA), a total of 362 species are indicated to potentially occur in the Project area. Of these potentially occurring species, 34 are Red Data listed and may potentially occur within the Project area (see Table 6-4). The succeeding headings discuss the Species of Conservation Concern (SCC) (fauna and flora) that occur and are likely to occur within the Project area.

Table 6-4: Red Data flora species occurring in the designated QDS

Species Name	Red List	South African Endemic
Aloe challisii	VU (D2)	Yes
Aloe cooperi subsp. cooperi	LC	No
Aloe modesta	**VU (B1ab(iii)+2ab(iii))**	Yes
Aloe reitzii var. reitzii	NT	Yes
Anemone transvaalensis	VU (D2)	Yes
Brachystelma minor	VU	Yes
Brachystelma stellatum	Rare	Yes
Crassula setulosa var. deminuta	NE	Yes
Crassula setulosa. var. setulosa	NE	Yes
Cymbopappus piliferus	VU	Yes
Dactylis glomerata	NE	No
Dianthus zeyheri subsp. natalensis	NE	Yes
Disa alticola	VU	Yes
Disa klugei	VU (D2)	Yes
Disa zuluensis	EN	Yes
Eucomis vandermerwei	VU	Yes
Gladiolus cataractarum	EN (B1ab(iii)+2ab(iii); C2a(i))	Yes
Gladiolus malvinus	VU (B1ab(i,ii,iii,iv,v))	Yes
Graderia linearifolia	VU (D2)	Yes
Habenaria barbertoni	NT	Yes
Helichrysum aureum. var. argenteum	NE	Yes
Jamesbrittenia macrantha	NT	Yes
Khadia alticola	Rare	Yes
Khadia carolinensis	VU (A3)	Yes
Kniphofia rigidifolia	LC	Yes
Lydenburgia cassinoides	NT	Yes
Merwilla natalensis	NT	No
Protea parvula	NT	No
Streptocarpus latens	Rare	Yes
Zantedeschia pentlandii	VU	Yes

NE=Not Evaluated, NT=Near Threatened, VU=Vulnerable, LC=Least Concern,

6.2.1. Protected Flora

Thirteen (13) floral SCC were encountered within the Project area during the recent survey in December 2020. These species and their respective statutory protection status are listed in Table 6-5 below. Eleven (11) species are listed under Schedule 11 Protected Plants (Section 69 (1) (a)) of the Mpumalanga Nature Conservation Act (No. 10 of 1998) (MNCA, 1998) and two are Red Listed species under the South African National Biodiversity Institute (SANBI). Images captured during the site survey are depicted in Figure 6-8. Location of the floral SCC are listed under the Farm Portions column in Table 6-5. Portion 40 (of Paardeplaats) had the highest count of floral SCC within its' portion. Most floral SCC were encountered along and surrounding the Rocky outcrop located in the centre of the farm portion. GPS locations of all recorded floral SCC are listed in Appendix G.

Table 6-5: Floral SCC identified with the Project area

Family	Species	Conservation Status	Farm Portion
Asphodelaceae	*Aloe ecklonis*	MNCA 1998	2, 40
Asphodelaceae	*Aloe davyanni*	MNCA 1998	29
Amaryllidaceae	*Boophone disticha*	MNCA 1998	2, 13
Amaryllidaceae	*Brunsvigia radulosa*	MNCA 1998	EFN
Amaryllidaceae	*Crinum bulbispermum*	MNCA 1998	13, 30
Asparagaceae	*Eucomis autumnalis*	MNCA 1998	40
Orchidaceae	*Eulophia welwitschii*	MNCA 1998	30
Iridaceae	*Gladiolus crassifolius*	MNCA 1998	40
Iridaceae	*Gladiolus dalenii*	MNCA 1998	13, 30
Amaryllidaceae	*Haemanthus humilis*	MNCA 1998	13
Asphodelaceae	*Kniphofia typhoides*	NT (SANBI)	2 (homestead)
Iridaceae	*Watsonia lepida*	MNCA 1998	5, EFN
Araceae	*Zantedeschia pentlandii*	VU (SANBI)	29, 40

Figure 6-8:Top row from left to right: ***Watsonia lepida, Boophane disticah, Eucomis autumnalis, Brunsvigia radulosa, Crinum bullbispermum.***
Bottom row left to right: ***Haemanthus humulis, Gladioulus dalenii, Aloe ecklonis, Kniphofia typhoides.***

6.2.2. Protected Fauna

The field work searched for various animal groups including small mammals, large mammals, birds, reptiles, amphibians and invertebrates (specifically butterflies).

6.2.2.1. Mammals

The diverse regional vegetation presents an opportunity to support a variety of mammal species, namely the grassland and wetland habitats. The Virtual Museum of the Animal Demography Unit (ADU) (http://www.adu.org.za) was consulted to investigate the recent recordings of mammal SCC. According to this database, the following SCC have been previously recorded within the designated QDS. Expected mammal species are listed in Appendix A. Potential mammal SCC that may be encountered in the Project area are listed in Table 6-6 below. Numerous mammal SCC were previously recorded in the ecological assessment conducted in 2012 (EkoInfo CC, 2012), only one mammal SCC, namely a Serval, was recorded during the survey in 2020 (discussed further is Section 6.4.1 below).

Table 6-6: Mammal SCC likely to occur within Project area

Family	Species	Common Name	Conservation Status	Recorded in 2012 (EkoInfo CC, 2012)
Bovidae	*Hippotragus equinus*	Roan Antelope	EN	-
Bovidae	*Ourebia ourebi*	Oribi	EN	-
Erinaceidae	*Atelerix frontalis*	Southern African Hedgehog	NT	X
Felidae	*Leptailurus serval*	Serval	NT	X
Felidae	*Panthera pardus*	Leopard	VU	
Hyaenidae	*Hyaena brunnea*	Brown Hyena	NT	X
Orycteropodidae	*Orycteropus afer*	Aardvark	NT	X
Muridae	*Otomys auratus*	Southern African Vlei Rat (Grassland type)	NT	X
Mustelidae	*Aonyx capensis*	African Clawless Otter	NT	X
Rhinolophidae	*Rhinolophus swinnyi*	Swinny's Horseshoe Bat	VU	-
Soricidae	*Crocidura maquassiensis*	Makwassie Musk Shrew	VU	X
Soricidae	*Crocidura mariquensis*	Swamp Musk Shrew	NT	-
Vespertilionidae	*Miniopterus schreibersii*	Schreibers's Long-fingered Bat	NT	-

NE=Not Evaluated, NT=Near Threatened, VU=Vulnerable, LC=Least Concern, X=Recorded in 2012

6.2.2.2. Birds

Birds have been viewed as good ecological indicators, since their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007). Land cover is directly linked to habitats within the area of interest. The diversity of these habitats should give rise to many different species. According to the South African Bird Atlas Project (SABAP2) database, 239 species of birds have been identified in the area (see Appendix E); the majority of these birds are comprised of grassland and waterbird species. Of these species, five have been assigned a Red Data status (Taylor MR, 2015). These species are listed in the table below (Table 6-7).

Table 6-7: Potential Bird SCC that may occur in the Project area

Family	Species Name	Common Name	Conservation Status
Gruidae	*Anthropoides paradiseus*	Blue Crane	VU
Gruidae	*Bugeranus carunculatus*	Wattled Crane	VU
Gruidae	*Balearica regulorum*	Grey Crowned Crane	EN
Otididae	*Eupodotis caerulescens*	Blue Korhaan	NT
Phoenicopteridae	*Phoeniconaias minor*	Lesser Flamingo	NT
Threskiornithidae	*Geronticus calvus*	Southern Bald Ibis	VU

NE=Not Evaluated, NT=Near Threatened, VU=Vulnerable, LC=Least Concern,

6.2.2.3. Amphibians

Amphibians are viewed to be good indicators of changes to the whole ecosystem as they are sensitive to changes in the aquatic and terrestrial environments (Waddle, 2006). Most species of amphibians are dependent on the aquatic environment for reproduction. Additionally, amphibians are sensitive to water quality and ultraviolet radiation because of their permeable skin (Gerlanc, 2005).

Wetland clusters are groups of wetlands (within a 1 km buffer) that are considered to function as a unit in the landscape, allowing for important ecological processes such as migration of frogs and insects between wetlands to take place. Numerous pans and wetlands have been identified within the Project area and thus provide ideal habitat (among others) for the SCC Giant African Bullfrog (*Pyxicephalus adspersus*), thus this species is therefore likely to occur. This is an SCC due to the loss of habitat from negative anthropogenic activities, the Giant African Bullfrog is listed as Near Threatened (NT) in South Africa according to the IUCN. A list of potentially occurring amphibians is listed in Appendix C.

6.2.2.4. Reptiles

Reptiles are ectothermic (cold-blooded) meaning their internal basal temperature is influenced by their surrounding external environment, as a result, reptiles are dependent on environmental heat sources. Thus, many reptiles regulate their body temperatures by basking in the sun, or warmer surfaces (or substrates). Substrates are an important determining factor for identifying which habitats are suitable for which species of reptile. Rocky outcrops and

suitable woody vegetation would increase habitat and intern diversity of reptiles within the Project area. Species richness for reptiles in South Africa is higher the north-eastern parts, and is declining in a south-westerly direction (Alexander, 2007). Areas with highest species richness correspond with the Savanna Biome, while the grassland biome has moderately low reptile species richness. A large component of the grassland biome has been transformed (around 80%), and as a result several reptile species are of conservation importance (Alexander, 2007).

Reptiles expected to occur on site are listed in Appendix B. Of these species one has been assigned Red Data status and presented in Table 6-8 below.

Table 6-8: Potential Reptile SCC that may occur in the Project area

Family	Species Name	Common Name	Conservation Status
Cordylidae	Chamaesaura aenea	Coppery Grass Lizard	Near Threatened (SARCA 2014)

SARCA=South Africa Reptile Conservation Assessment

6.2.2.5. Invertebrates

Butterflies are a good indication of the habitats available in a specific area (Woodhall, 2005). Butterflies are very sensitive to habitat degradation. Although many species are eurytropes (able to use a wide range of habitats) and are widespread and common, South Africa has many stenotrope (specific habitat requirements with populations concentrated in a small area) species which may be very specialised (Woodhall, 2005). Butterflies are useful indicators as they are relatively easy to locate and catch, and to identify. One SCC that is likely to occur is the Marsh Sylph (*Metisella meninx*) (Vulnerable according to Henning, G. A. (2009) South African Red Data Book: Butterflies). This is a marsh species that requires thick clumps of grass, particularly *Leersia hexandra* (Poacea), and unpolluted environments. A marsh habitat is one of the most easily disrupted habitats and the apparent plight of this species brings it sharply into focus (Henning, 2009). Expected butterfly species are listed in Appendix D.

6.3. Flora

The Project area's floral composition and distribution has been significantly altered due to the historical and current land practises. Upon site inspection, it was apparent that areas are currently utilised for grazing, homestead settlements and mining activities. As a result of these land use practises, large portions of the Project area have been subjected to alterations and have transformed the natural habitat. As a result of the land uses, secondary grasslands have developed and constitute as part of a vegetation community. Patches of secondary grassland were found in conjunction with and adjacent to areas of transformed landscapes and wetlands. Majority of the transformed habitats were encountered within the Glisa Coal Mine (Portion 1-5). Current and historical mining activities and related infrastructure has resulted in vast proliferation of Alien Invasive Plants (AIPs) and complete transformation of the landscape. There are numerous wetlands within the Project area and are distinguishable via their composition of wetland indicating species such as Red Cotton Wool Grass (*Imperata* *cylindrica*), *Cyperus* sp, *Juncus* sp. and *Schoenoplectus* sp (Sedges). A total of 203 species of flora were identified and presented in Appendix E. For the purpose of this report the Project area has been classified into vegetation units and are discussed in detail below.

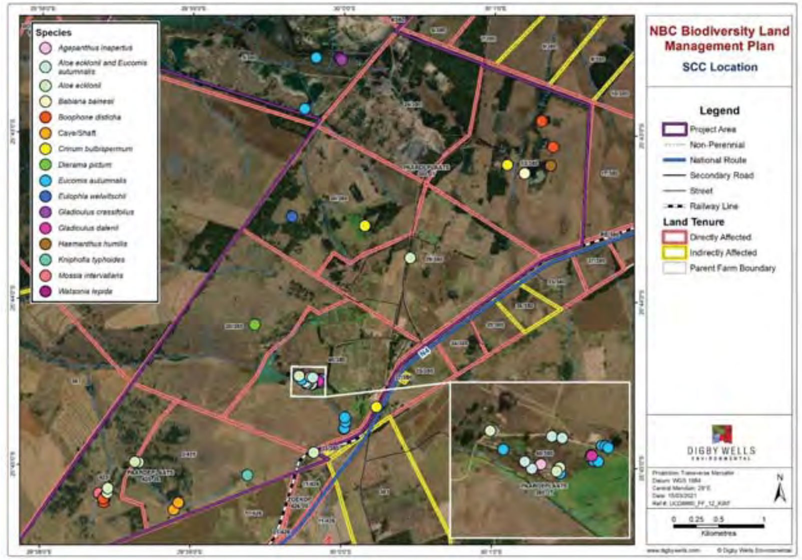

Figure 6-9: Location of Species of Conservation Concern (SCC) in the Paardeplats 380 JS

Figure 6-10: Location of Species of Conservation Concern (SCC) in the Eerstelingsfontein 406

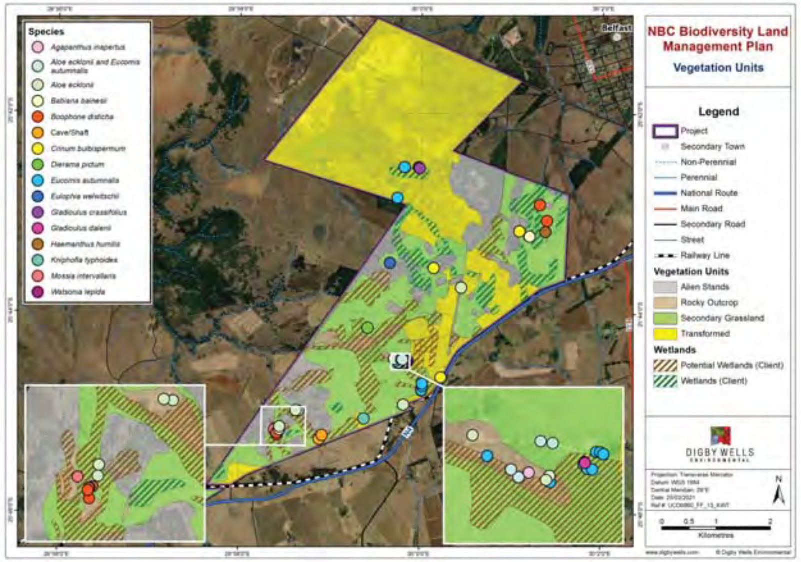

Figure 6-11: Vegetation Units associated with the Paardeplaats 380 JS of the NBC Complex

Figure 6-12: Vegetation Units associated with the Eerstelingfontein 406 JS of the NBC Complex

6.3.1. Vegetation Habitats

The site assessment in December 2020 concluded that the vegetation habitats delineated within the Project area include natural and secondary grasslands, outcrops of rocky sheets, wetlands and areas which have been largely and completely transformed from their original state. Four broadly defined vegetation habitats have been identified and discussed in further detail below (see Figure 6-11). The Project area comprises of Secondary Grassland, Wetland, Rocky Outcrop and Transformed Habitats. This biodiversity assessment did not delineate or assess wetlands. Wetlands within the NBC Complex have been previously confirmed, assessed, and delineated by De Castro and Brits c.c. (Tony de Castro, 2020) and Wetland Consulting Services (Pty) Ltd (Wetland Consulting Services (Pty) Ltd, 2020). For the purpose of the vegetation unit mapping, wetland delineations provided by Universal Coal (Pty) Ltd were included to conceptualise the habitat units. The findings from the aforementioned studies aided in the discussion of the wetland habitats encountered on site.

6.3.1.1. Transformed Habitat

For the purpose of this report, transformed land refers to areas that have been changed or disturbed to such an extent that all-natural habitats, biota and ecosystem functions have been fragmented or lost. The transformed areas are a direct result from the mining activities and previous land-use practises. Most notable transformation areas reside within the Glisa Mine Area. Past and current mining activities have completely changed the landscape and permitted AIP proliferation. Most distinguishable negative anthropogenic impacts can be observed in the watercourses within Glisa. Potential sedimentation from the surrounding mining activities has inundated the surfaces in the immediate surrounding environment, retarding vegetation growth (see Figure 6-13) (GPS Coordinates: 25°42'45.46"S, 29°59'51.04"E). Sediments observed appeared black and white (respectively) in colour. The black sediments appeared compacted and desiccated, with no vegetative growth. The white sediment could be a result of potential salt residue and it appeared to have a “spongy” texture when traversed upon. The sedimentations observed within this area, could potentially be a result from the upstream pollutants from surrounding anthropogenic activities. No vegetation was encountered within the compacted sediments surfaces. The only plant life observed within this area was *Arundo donax* (Category 1b) growing within the fresh waterbody (see Figure 6-13). It is recommended that soil sampling be conducted within these sedimented areas to identify the possible pollutants and sources of such. It should be noted that the Wetland Vegetation Monitoring Report in 2020 (Tony de Castro, 2020) recorded two floral SCC within the grounds of the transformed area. *Khadia carolinensis* was recorded on the rocky outcrops within Portion 24 and *Gunnera perpensa* was recorded on the western border of Portion 5. Due to access limitations and time constraints, the Digby Wells team was not able to revisit the proposed locations of the previously identified SCC.

The EFN portion has ceased with mining activities and has been previously rehabilitated. Upon site inspection various AIPs were noted within the area. Species such as *Acacia mearnsii,* *Datura ferox, Solanum nigrim, S. sisymbrifolium, Cirsium vulgare, Cortaderia selloana*, and *Verbena brasiliensis* were noted in and throughout the entire EFN portion. Soil erosion was apparent throughout the area with numerous gullies along the boundaries and central portions. Along the boundary adjacent to the R33, several floral SCC were marked (see Figure 6-10) and included *Brunsvigia sp, Aloe sp, and Gladiolus sp.*

6.3.1.1.1. Exotics

Previous natural grasslands have been altered and/or transformed and have been replaced by carpets of *Pennisetum clandestinum* and pioneering AIP shrubs, trees and forbs such as *Cotoneaster franchetii, Acacia mearnsii, Datura stramonium, Hypericum forrestii, Cirsium vulgare, Solanum mauritanum, Eucalyptus* sp., and *Verbena brasiliensis, V. officianalis* can be observed throughout the transformed areas (Figure 6-14). Remains of old rubble and/or building ruins and previous land practices are observed as unrehabilitated landscapes providing ideal hosting for pioneering AIP species. Cattle grazing was observed throughout the entire Project area. Vegetation considered in a "natural" state (where no evidence of transformation was observed) were identified within the margins of the wetland areas and rocky outcrops. Dense stands of *Populus x canescens* were observed along the margins of portion 13 with *Eucalyptus* sp. and *Acacia* sp. stands observed in the riparian slopes of portions 24, 30 and 2. These dense stands of AIPs accelerate due to the favourable growing conditions, they consume large amounts of water, thereby lowing the water table and thereby threatening the water supplies in the ecology of the region (Bromilow, 2010). A list of recorded AIPs is presented in Table 6-9 below.

Table 6-9: AIPs recorded in the Project area

Species	Category[3]
*Acacia dealbata**	2
*Acacia mearnsii**	2
*Amaranthus viridus**	Invasive
*Arundo donax**	1b
*Bidens pilosa**	Invasive
*Callistemon verminallis**	1b
*Centella asiatica**	Invasive
*Cirsium vulgare**	1b
*Conyza bonariensis**	Invasive
*Cortaderia selloana**	1b
*Cotoneaster franchetii**	1b
*Datura stramonium**	1b
*Eucalyptus camaldulensis**	1b
*Eucalyptus diversicolor**	2
*Eucalyptus viminalis**	Invasive
*Gladioulus grandiflora**	Invasive
*Gomphrena celosioides**	Invasive
*Hemerocallis sp.**	Invasive
*Hypericum forrestii**	Invasive
*Lolium perenne**	Invasive
*Nymphoides thunbergiana**	Invasive
*Oenothera rosea**	Invasive
*Oenothera stricta**	Invasive
*Paspalum notatum**	Invasive
*Pennisetum clandestinum**	1b
*Persicaria longiseta**	Invasive
*Phytolacca octanda**	1b
*Pinus patula**	2
*Populus x canescens**	2
*Pyracantha angustifolia**	1b
*Raphanus raphanistrum**	Invasive
*Richardia brasiliensis**	Invasive
*Salix babylonica**	Invasive
*Solanum mauritianum**	1b
*Solanum nigrum**	Invasive
*Solanum sisymbrifolium**	1b
*Tagetes minuta**	Invasive
*Verbena brasiliensis**	1b
*Verbena officianalis**	Invasive

[3] In accordance with the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Alien and Invasive Species List, 2020

Figure 6-13: Possible sedimentation observed within the Transformed areas

Figure 6-14: AIPs observed in the Transformed areas

6.3.1.2. Secondary Grassland

Secondary grasslands differ from primary grasslands, based on the extent of modification they have undergone. Secondary grasslands have undergone extensive modification and a fundamental shift from their original state, such as cultivated fields and unmonitored grazing, yet they have been allowed to return to their 'grassland' state (SANBI, Grasslands Ecosytems Guidleines: landscape interpretation for planners and managers., 2013). Although secondary grasslands appear as a counterfeit primary grassland, they differ with respect to species composition, vegetation structure, ecological functioning, and the ecosystem services they deliver (SANBI, Grasslands Ecosytems Guidleines: landscape interpretation for planners and managers., 2013). The established secondary grassland in the Project area presented a well-developed graminoid and herbaceous component. The highest diversity of forbs and graminoids were observed along the rocky slopes transitioning into the rocky outcrops. Fewer disturbances were observed within these slopes and consequently resulted in a high floral diversity. Species encountered along these slopes included *Acalypha angustata, Alloteropsis semialata subsp. eckloniana, Asclepias aurea, Aristida sp, Babiana bainesii, Eragrostis sp., Digitaria sp., Dierama pictum* numerous *Helichrysum sp., Hermannia lancifolia, Hilliardiella olgocephala, H. aristate*, *Indigofera hilaris, Lasiosiphon caffer, Ledebouria revoluta, L. ovatifolia,* and *Xysmalobium* sp.. Floral SCC, *Boophone disticha,* were encountered in varying locations throughout the slopes of the grassland and one *Eulophia welwitschia* was observed in the open grassland adjacent to the Glisa Mine (in Portion 30) (See Figure 6-9). The grasslands with easier accessibility to the cattle grazing presented a very low species diversity. The unmonitored grazing (cattle) is placing the remaining extent of the grasslands under pressure and altering the species composition, encouraging pioneer (increaser) species to flourish. This was observed within the southern portion of the Paardeplaats farms portions, namely portion 2 and the southern regions of 28 & 40.

In conjunction with wetlands, grasslands support hydrological processes by acting as sponges, collecting rainwater, and assisting in flood attenuation through reduction of runoff and erosion. They act as critical life supporting systems for an array of biodiversity and endemic and threatened species. Grasslands in south Africa is one the most threatened biomes, with 30% of the biome transformed beyond repair and only 2% formally conserved.

6.3.1.3. Rocky Outcrop

Rocky Outcrops are geological features that encompass a wide variety of physical environments such as escarpments, overhangs, and cliffs (Fitzsimons, 2017). They support high levels of species diversity and endemism, and provide stable micro-climates. They provide ecological refuges for colonial species such as seabirds, bats and swifts for ancient lineages. Rocky outcrops provide steppingstone habitats across landscapes and facilitate the movement of migratory bird species and other wide ranging fauna. As rocky environments are less fertile, steep-sided and less accessible than the surrounding landscapes, they are typically less prone to human disturbances. Nonetheless, rocky outcrops are susceptible to a

variety of threats including soil compaction, erosion from livestock and nutrient enrichment and weed invasion.

Numerous rocky outcrops were observed within the NBC Project area. The Rocky Outcrops within the Project area provided refuge for a variety of floral SCC, such as *Boophane disticha, Haemanthus humilis, Gladiolus dalenii, Mossia intervallaris* and *Aloe ecklonis* (see Figure 6-16 and Figure 6-9). The rocky outcrops within the Project area are slightly elevated above the grasslands and host not only forbs but also abundant woody species. The species were not present in the grassland community. Species included *Erica cerinthoides var. cerinthoides, Chlorophytum trichophlebium, Clutia pulchella, Cheilanthes multifida lacerate, Drypopteris athamantica, Eriospermum abyssinicum, Zaluzianskya katharinae, Pearsonia grandiflora, Pallaea calomelanos, Searsia magalismontana* and *Diospyrus lycoides*. Many of the species encountered within this vegetation unit are representative of the Eastern Highveld Grassland. Fifty-five (55) of the 207 species recorded reside or occurred within the rocky outcrops of the Project area. Plant species recorded are listed in Appendix E.

It should be noted that a potential cave with a manmade tunnel was encountered within the rocky outcrop habitats. This potential cave may have cultural or heritage significance and may require further investigation for clarification. The location of the tunnel is represented in Figure 6-9 and an image of the cave can be seen in Figure 6-15 below. The potential cave may support cave dwelling dependent species and have significant ecological importance. Cave-formations are also protected under the MNCA (1998) and any alterations will require permit applications. Therefore, further investigations are required in the instance of mining.

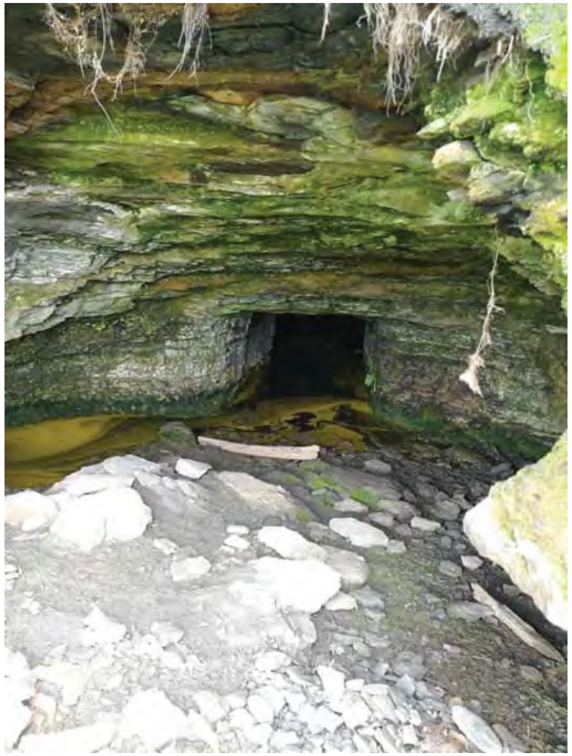

Figure 6-15: Cave with tunnel

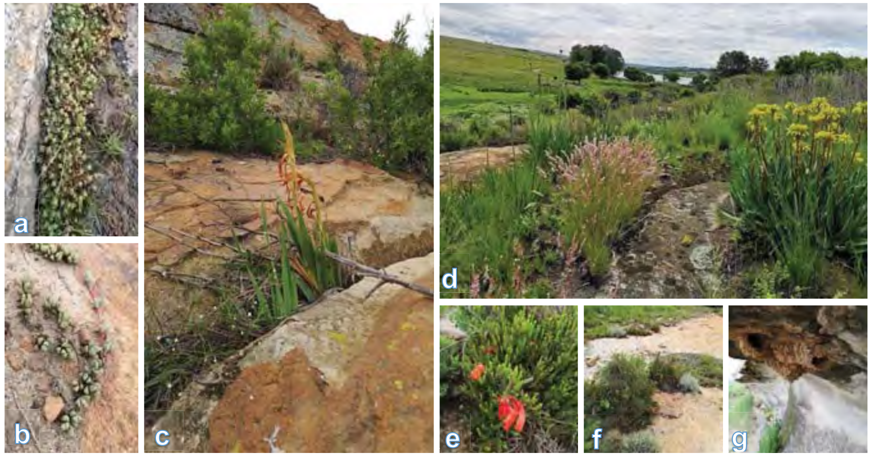

Figure 6-16: a) *Crassula setulose* b) *Mossia intervallaris* c) *Gladiolus dalenii* d) *Aloe ecklonis* & *Agapanthus inapertus* e) *Erica cerinthoides var. cerinthoides* f) *E. cerinthoides* on the rocky sheeth g) Swallow's nest under the sheeth of the outcrop

6.3.1.4. Wetlands

Numerous wetlands have been previously recorded, delineated and monitored within the Project area (Paardeplaats and EFN) (Tony de Castro, 2020) (Wetland Consulting Services (Pty) Ltd, 2020). The monitoring results claimed some deterioration of the wetlands since the studies commenced in 2017. The decline in condition was caused by factors such as limited vegetation clearing, soil disturbances along temporary access roads, increased mining in the catchments and an increase in AIP proliferation. The slow sprawl of alien invasive species, such as *Eucalyptus* sp., and *Acacia* sp., threatens both the vegetation integrity of the wetlands, and the hydrology due to their high-water uptakes. Other AIP observed within most of the wetlands included, *Verbena brasiliensis, Centella asiatica, Amaranthus viridus, Salix babylonica, Populus x canescens* and *Cirsium vulgare*. The AIP NEM:BA Category for listed species is presented in Section 6.3.1.1. Ongoing sedimentation (viewed and discussed in Section 6.3.1.1) is having negative effects on the wetland functioning by burying the wetland and decelerating vegetation growth. Within a number of wetlands, the presence of large pollution control dams were observed. No measures for low flows were accounted for and thus are having a negative impact of the wetland integrity. The dams alter the wetness regime and reduce flow to the downstream reaches. As recorded by the previous wetland studies, most of the wetland habitats have been seriously impacted within the Glisa mining operation area. Nonetheless, various floral SCC were encountered and recorded at varying wetland locations within the Project area. *Brunsvigia radulosa, Gladiolus crassifolius, Eucomis autumnalis* and *Watsonia lepida* were located along the southern border adjacent to the R33 within the EFN farm portion. Numerous wetland indicating species and sedges were recorded, such as *Chironia krebsii, Berkheya setifera,* numerous *Cyperus* sp., *Eleocharis dregeana, Fimbristylis ferruginea, Leersia hexandra, Isolepsis sepulcralis, Juncus* sp., *Oropetium capense, Xyris capensis* and *Gomphostigma virgatum*. Figure 6-17 depicts some of the wetlands encountered during the field assessment. Most of the wetlands are negatively impacted by artificial dams, AIP sprawl, agricultural disturbances and the current mining activities.

The wetland areas within the Project area are highly ecologically important for faunal assemblages and habitat for floral SCC. The wetland systems and associated drainage lines provide basis for the trophic chain as well as essential ecological corridors for faunal movement. Continuous biomonitoring of the wetlands is recommended to identify the deterioration factors and provide mitigation measures to prevent further degradation of the systems.

Figure 6-17: Various wetlands encountered within the Project area

6.4. Fauna

The section represents the results from the single field survey conducted in December 2020.

6.4.1. Mammals

A total of thirteen (13) mammal species were recorded during the infield assessments. High faunal activity was observed within the Rocky outcrops, and along the banks of the artificial dams. Various mammals of the Herpestidae (Mongoose) family were observed throughout the numerous wetlands. Tracks of a Water Mongoose were observed in the marshes of the unchanneled valley bottom wetlands. Meerkats were encountered within the rocky outcrops. Numerous sightings of Black-backed Jackal and Scrub Hare were recorded throughout the Project area. The Rocky outcrops in the Project area appeared less transformed, possibly due to its inability to traverse or cultivate and showcased most of the fauna activity. It has now provided habitat, as a microclimate refugia, for numerous faunal species and acts as an ecological corridor for the movement of various animals. Numerous burrows were observed throughout the Paardeplaats portions but particularly in Portion 425. According to the EkoInfo CC (2012) Report, numerous burrowing and crepuscular mammals were recorded, namely Bushpig, Porcupine, Aardvark, South African Hedgehog (NT) and Side-striped Jackal (NT). Natural Scientific Services (NSS, 2011) and the EkoInfo study in 2012 recorded an additional seventeen (17) species in conjunction with the 2020 study. Additional species are listed in Table 6-10 below.

Table 6-10: Previous recordings of Mammalian Species (EkoInfo and NSS)

Family	Species	Common Name	Conservation Status	EkoInfo (2012)	NSS (2010/2011)
Rumenentia	*Raphicerus campestrus*	Steenbok	LC	x	x (EFN)
Suiformes	*Potamochoerus porcus*	Bush Pig	LC	x	-
Rodentia	*Otomys irroratus*	Vlei Rat	NT	x	-
Bathyergidae	*Cryptomys hottentotus*	Common Mole Rat	LC	x	x (EFN)
Soricidea	*Myosorex varius*	Forest Shrew	LC	x	-
Soricidea	Crocidura mariquensis	Swamp Shrew	LC	x	-
Soricidea	Crocidura cyanea	Red-grey musk Shrew	LC	x	-
Felidae	*Caracal caracal*	Caracal	LC	x	-
Canidae	*Canis adustus*	Side-striped Jackal	NT	x	-
Canidae	*Vulpes chama*	Cape Fox	LC (IUCN)/ TOPS	x	-
Viverridae	*Genetta tigrina*	Large Spotted Genet	LC	x	-
Hyaenidae	*Hyaena brunnea*	Brown Hyena	NT	x	-
Mustillidae	*Aonyx capensis*	African Otter	NT	x	-
Eulipotyphla	*Atelerix frontalis*	South African Hedgehog	NT	x	-
Orycteropodidae	*Orycteropus afer*	Aardvark	LC	x	-
Muridae	*Rhabdomys pumilio*	Four-striped Grass Mouse	LC	-	x (EFN)
Vespertilionidae	*Neoromicia capensis*	Cape Serotine Bat	LC	-	x (EFN)

LC=Least Concern; NT=Near Threatened;TOPS=Threatened or Protected Species

Camera and Sherman traps were set up in this location and observations of Meerkats and Namaqua Rock Mice were captured on the cameras (see Figure 6-18). Ground Squirrels, Scrub Hares and Yellow, Slender and Water Mongoose were observed throughout the Project area. These species are highly synanthropic meaning they thrive in the presence of human disturbance. No larger mammals were observed apart from cattle throughout the Project area. Numerous Black-backed Jackals were encountered throughout the Paardeplaats and EFN portions. All encountered and recorded mammals in the 2020 survey are listed the table below (Table 6-11), one mammal SCC was recorded, a Serval, captured by the camera traps within the central region of Portion 30 (Figure 6-18). A strong presence of Serval was recorded in the EkoInfo (2012) Report. Evidence of high numbers of the IUCN Near Threatened species were recorded, indicating a viable extant population in the area which may require further invesitgations.

Servals are found in many protected areas within South Africa and are included on CITES Appendix II and protected under national legislation (TOPS regulations) (SANBI, 2018). It is listed as Least Concern (LC) globally and Near Threatened (NT) nationally on the IUCN Red List. Effective conservation of serval depends on the conservation of wetlands, particularly wetlands in fragmented landscapes. Wetlands form a micro habitat in a mosaic of farmland for several wetland-dependent species; they are reservoirs of small mammal populations that are major dietary components of servals. Consequently, if wetlands are protected in a mosaic of farmland use, the landscape may support the persistence of serval populations.

The Paardeplaats and EFN portions have historically and are currently subjected to land transformations (mining activities) and heavy subsistence utilisation. This directly and indirectly alters the in-situ species composition. Taking into consideration the previous ecological assessments conducted for the NBC complex (EkoInfo CC, 2012) (NSS, 2011), a considerable decline in mammal species composition has been noted from the results of the 2020 field investigations. This suggests poor land management practices and anthropogenic encroachment. Implementation of a sound Environmental Management Plan (EMP) during the construction and operational phases of the mining activities.

Table 6-11: Mammal species encountered in Project area

Family	Species Name	Common Name	Conservation Status	Farm Portions	GPS Coordinates
Canidae	*Lupulella(Canis) mesomelas*	Black-backed Jackal	LC	13	25°43'14.49"S; 30° 1'21.79"E
Mustelidae	*Ictonyx striatus*	Striped polecat	LC	Near EFN	25°50'24.79"S; 30° 1'34.49"E
Rodentia	*Aethomys namaquensis*	Namaqua Rock Mouse	LC	13	25°43'11.11"S; 30° 1'22.14"E
Rodentia	*Hystrix africaeaustralis*	Porcupine	LC	425	25°45'14.32"S; 29°58'27.69"E
Rodentia	*Tater asp.*	Gerbil	LC	29	25°43'51.28"S; 30° 0'30.21"E
Felidae	*Leptailurus serval*	Serval	NT (SANBI) TOPS & CITES	28	25°44'2.52"S; 29°59'47.60"E
Bovidae	*Sylvicapra grimmia*	Common Duiker	LC	40	25°44'30.90"S; 29°59'44.12"E
Herpestidae	*Cynictis penicillata*	Yellow Mongoose	LC	30	25°43'27.70"S; 30° 0'28.90"E
Herpestidae	*Atilax paludinosus*	Water Mongoose	LC	28	25°44'21.10"S; 29°59'27.79"E
Herpestidae	*Galerella sanguinea*	Slender Mongoose	LC	29	25°43'39.68"S; 30° 0'34.11"E
Herpestidae	*Suricata suricatta*	Meerkat	LC	28	25°44'16.56"S; 29°59'22.67"E
Leporidae	*Lepus saxatilis*	Scrub Hare	LC	13, 28, 40, & 2/425	25°43'22.11"S; 30° 1'22.74"E
Sciuridae	*Xerus inauris*	Southern African Ground Squirrel	LC	2/425	25°45'0.97"S; 29°59'17.03"E

Figure 6-18: From top left to bottom right: Serval, Field Mouse, Black-backed Jackal and Meerkat

6.4.2. Birds

Birds are viewed as good ecological indicators, as their presence or absence tends to represent conditions of a functioning ecosystem. The direct link between bird diversity and land cover portrays a direct indication of the habitats in the area of interest.

According to the South African Bird Atlas Project (SABAP2) database, 239 species of birds have been identified in the area (see Appendix E); the majority of these birds are comprised of grassland and waterbird species. Eighty eight (88) birds were recorded during the field assessment in December 2020. The identified birds are listed in Table 6-13 below. The numerous dams scattered across the region provided ideal habitat for a number of waterbirds including; Little Grebes, Grey Herons, Southern Pochards, Whiskered Terns, White-breasted Comorant, Yellow-billed Ducks, Red Knobbed Coots and Red-billed Teals.

Although not directly confirmed during the field assessment, a pair of Grey Crowned Cranes (*Balearica regulorum*), were previously sighted by the landowners in Portion 13. The landowner (Mr Milky) also reported that the pair would regularly visit/reside on the site (*pers. comm.* Mr Milky 15 December 2020). These Cranes are a Red Listed species and are listed as Endangered (BirdLife International, 2021). This species is not a migratory species although has been known to make use of variable local and seasonal movements depending on food availability. They nest in solitary pairs and are generally found in wetlands such as marshes, pans and dams with tall emergent vegetation. Its' diet primarily consists of insects, frogs, lizards, crabs and is known to feed on the seed heads of sedges. The species population has been threatened by the loss and degradation of wetland breeding areas through drought-related changes in land-use. Impacts include cultivation, overgrazing, heavy use of agricultural pesticide, declines in fallowing practices, high sedimentation rates, uncontrolled fires, and changes in the hydrological regimes (BirdLife International, 2021). Unsolicited harvesting (egg-collecting and hunting) and indirect disturbances from the hunting of larger animals and ducks in wetlands has prompted the decline in their numbers. The numerous pans and wetlands within the Project area provide ideal habitat for this species.

Majority of the avifaunal SCC are dependent on intact grassland vegetation. Anecdotal evidence suggests that long-term effects of unmonitored grazing regimes will have detrimental impacts on the conservation-dependent bird species on site. It is strongly recommended that a grazing regime be stipulated to counteract any further degradation and enhance the avifaunal diversity. The desktop assessment revealed that five bird SCC may occur within the Paardeplaats and EFN portions. The previous ecological assessments (EkoInfo and NSS) recorded several bird SCC and are listed in Table 6-12 below. Majority of the bird SCC are associated with wetland habitats and moist grasslands. The wetland systems are earmarked with high ecological functioning and act as important dispersal corridors for many of the terrestrial bird species. Areas with facultative wetland flora (*Imperata cylindrica, Helicotrichon turgidulum* and *Arundinella nepalensis*) provide potential breeding and foraging habitats for SCC, in particular the African Grass Owl (VU) and African Marsh Harrier (EN) (EkoInfo CC, 2012). These areas are confined to wetland communities and structurally reminiscent of open grasslands. The artificial dams conform to an interconnected system of dams and water bodies with high seasonal variability among each other in terms of water levels. Therefore, it is anticipated that these systems experience an influx of species at the varying water levels and changes in season. They also provide refuge for large congregations of waterfowl.

Table 6-12: Previously recorded bird SCC (EkoInfo and NSS)

Family	Species	Common Name	Conservation Status	EkoInfo (2012)	NSS (2010/2011)
Threskiornithidae	*Geronticus calvus*	Southern Bald Ibis	VU	-	x (EFN)
Accipitridae	*Polemaetus bellicosus*	Martial Eagle	EN	-	x (EFN)
Gruidae	*Balearica regulorum*	Grey Crowned-crane	NT	-	x (EFN)
Gruidae	*Anthropoides paradiseus*	Blue Crane	NT	-	x (EFN)
Tytonidae	*Tyto capensis*	African Grass Owl	VU	x	-
Saigittariidae	*Sagittarius serpentarius*	Secretarybird	VU	x	-
Accipitridae	*Circus ranivorus*	African Marsh Harrier	EN	x	-

LC=Least Concern; VU=Vulnerable; EN= Endangered; NT=Near Threatened;TOPS=Threatened or Protected Species

Table 6-13: Recorded birds in the Project area

Family	Species Name	Common Name	Conservation Status
Accipitridae	*Buteo buteo vulpinus*	Steppe Buzzard	LC
Accipitridae	*Elanus caeruleus*	Black-winged Kite	LC
Accipitridae	*Haliaeetus vocifer*	African Fish Eagle	LC
Acrocephalidae	*Acrocephalus baeticatus*	African Reed-warbler	LC
Acrocephalidae	*Iduna natalensis*	Dark-capped Yellow Warbler	LC
Alaudidae	*Calandrella cinerea*	Red-capped Lark	LC
Alaudidae	*Mirafra fasciolata*	Eastern Clapper Lark	LC
Anatidae	*Alopochen aegyptiacus*	Egyptian Goose	LC
Anatidae	*Anas erythrorhyncha*	Red-billed Teal	LC
Anatidae	*Anas undulata*	Yellow-billed Duck	LC
Anatidae	*Dendrocygna viduata*	White-faced Duck	LC
Anatidae	*Netta erythrophthalma*	Southern Pochard	LC
Anatidae	*Plectropterus gambensis*	Spur-winged Goose	LC
Anhingidae	*Anhinga rufa*	African Darter	LC
Apodidae	*Apus barbatus*	African Black Swift	LC
Apodidae	*Apus caffer*	White-rumped Swift	LC
Apodidae	*Tachymarptis melba*	Alpine Swift	LC
Ardeidae	*Ardea cinerea*	Grey Heron	LC
Ardeidae	*Ardea melanocephala*	Black-headed Heron	LC
Ardeidae	*Bubulcus ibis*	Cattle Egret	LC
Ardeidae	*Egretta intermedia*	Yellow-billed Egret	LC
Charadriidae	*Charadrius tricollaris*	Three-banded Plover	LC
Charadriidae	*Vanellus armatus*	Blacksmith Lapwing	LC
Charadriidae	*Vanellus coronatus*	Crowned Lapwing	LC
Charadriidae	*Vanellus senegallus*	African Wattled Lapwing	LC
Cisticolidae	*Cisticola ayresii*	Wing-snapping Cisticola	LC
Cisticolidae	*Cisticola fulvicapilla*	Neddicky	LC
Cisticolidae	*Cisticola juncidis*	Zitting Cisticola	LC
Cisticolidae	*Prinia flavicans*	Black-chested Prinia	LC
Coliidae	*Colius striatus*	Speckled Mousebird	LC
Columbidae	*Columba arquatrix*	African Olive-pigeon	LC
Columbidae	*Columba guinea*	Speckled Pigeon	LC
Columbidae	*Streptopelia capicola*	Cape Turtle-dove	LC
Columbidae	*Streptopelia semitorquata*	Red-eyed Dove	LC
Columbidae	*Streptopelia senegalensis*	Laughing Dove	LC
Corvidae	*Corvus capensis*	Cape Crow	LC
Cuculidae	*Chrysococcyx caprius*	Diderick Cuckoo	LC
Cuculidae	*Cuculus solitarius*	Red-chested Cuckoo	LC
Falconidae	*Falco amurensis*	Amur Falcon	LC
Fringillidae	*Crithagra gualris*	Streaky-headed Seedeater	LC
Fringillidae	*Crithagra mozambicus*	Yellow-fronted Canary	LC
Hirundinidae	*Cecropis cucullata*	Greater Striped Swallow	LC

Hirundinidae	*Hirundo albigularis*	White-throated Swallow	LC
Hirundinidae	*Hirundo fuligula*	Rock Martin	LC
Hirundinidae	*Hirundo rustica*	Barn Swallow	LC
Hirundinidae	*Hirundo spilodera*	South African Cliff-swallow	LC
Hirundinidae	*Riparia cincta*	Banded Martin	LC
Hirundinidae	*Riparia paludicola*	Brown-throated Martin	LC
Laniidae	*Lanius collaris*	Common (Southern) Fiscal	LC
Laniidae	*Telophorus zeylonus*	Bokmakierie	LC
Laridae	*Chlidonias hybrida*	Whiskered Tern	LC
Locustellidae	*Bradypterus baboecala*	Little Rush-warbler	LC
Motacillidae	*Anthus cinnamomeus*	African Pipit	LC
Motacillidae	*Macronyx capensis*	Cape Longclaw	LC
Motacillidae	*Motacilla capensis*	Cape Wagtail	LC
Muscicapidae	*Cossypha caffra*	Cape Robin-chat	LC
Muscicapidae	*Saxicola torquatus*	African Stonechat	LC
Nectariniidae	*Chalcomitra amethystina*	Amethyst Sunbird	LC
Nectariniidae	*Nectarinia famosa*	Malachite Sunbird	LC
Numididae	*Numida meleagris*	Helmeted Guineafowl	LC
Passeridae	*Passer melanurus*	Cape Sparrow	LC
Phalacrocoracidae	*Phalacrocorax africanus*	Reed Cormorant	LC
Phalacrocoracidae	*Phalacrocorax carbo*	White-breasted Cormorant	LC
Phasianidae	*Pternistis natalensis*	Natal Spurfowl	LC
Phasianidae	*Pternistis swainsonii*	Swainson's Spurfowl	LC
Ploceidae	*Euplectes afer*	Yellow-crowned Bishop	LC
Ploceidae	*Euplectes orix*	Southern Red Bishop	LC
Ploceidae	*Euplectes progne*	Long-tailed Widowbird	LC
Ploceidae	*Ploceus capensis*	Cape Weaver	LC
Ploceidae	*Ploceus velatus*	Southern Masked Weaver	LC
Ploceidae	*Quelea quelea*	Red-billed Quelea	LC
Podicipedidae	*Tachybaptus ruficollis*	Little Grebe	LC
Pycnonotidae	*Pycnonotus tricolor*	Dark-capped Bulbul	LC
Rallidae	*Fulica cristata*	Red-knobbed Coot	LC
Rallidae	*Gallinula chloropus*	Common Moorhen	LC
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	LC
Scolopacidae	*Gallinago nigripennis*	African Snipe	LC
Scolopacidae	*Tringa nebularis*	Common Greenshank	LC
Scopidae	*Scopus umbretta*	Hamerkop	LC
Sturnidae	*Lamprotornis bicolor*	Pied Starling	LC
Threskiornithidae	*Bostrychia hagedash*	Hadeda Ibis	LC
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	LC
Threskiornithidae	*Threskiornis aethiopicus*	African Sacred Ibis	LC
Turdidae	*Turdus litsitsirupa*	Groundscraper Thrush	LC
Viduidae	*Vidua macroura*	Pin-tailed Whydah	LC
Zosteropidae	*Zosterops capensis*	Cape White-eye	LC

6.4.3. Herpetofauna

Herpertofauna is defined as reptiles and amphibians inhabiting a given area. Reptiles are ectothermic (cold-blooded) meaning they are organisms that control body temperature through external means. As a result, reptiles are dependent on environmental heat sources. Due to this, many reptiles regulate their body temperature by basking in the sun, or in warmer areas. Substrate is an important factor determining which habitats are suitable for which species of reptile.

According to Carruthers (2001), a number of factors influence the distribution of amphibians, but because amphibians have porous skin they generally prosper in warm and damp habitats. The presence of suitable habitat within the Project area (wetland and grassland areas) provides a number of different species of amphibians.

The brevity of the survey meant that relatively few reptiles were observed compared to that of mammals and birds. During the field assessment, three amphibian species were identified within the wetland, pan and dams, via its call and by direct sightings. The Delalande's River Frog (*Amietia delalandii*), Sand Frog (*Tomopterna* sp.) and the Boettger's Caco (*Cacosternum boettgeri*) (all Least Concern). The Boettger's Caco is abundant in grassy areas and it can breed in almost any small, temporary water body such as pools in inundated grasslands, culverts and other rain-filled depressions. Its predominant prey is mosquitos, and it is prey to the Yellow-billed Egret (*Ardea intermedia*) and the Giant African Bullfrog (*Pyxicephalus adspersus*) (Scott, 2021).

Reptiles are notoriously difficult to comprehensively detect during short field surveys, due to many species in this group naturally occurring at low densities and being inherently illusive.Two species of reptile was identified, namely a African Striped Skink (*Trachylepis striata*) and the Common Brown Water Snake (*Lycodonomorphus rufulus*) (both Least Concern). The Skink was encountered in the transformed habitat in and amongst old building rubble and the Water Snake was encountered near the dam in Portion 28 (see Table 6-14). The Rocky Outcrops identified within the Project area provide crucial refugia for numerous herpetofauna species. The EkoInfo (2012) Report recorded numerous *Psammophylax rhombeatus* (Rhombic Skaapstekers) incubating eggs within the rocky ridges or under rocks that had been previously stacked by humans. The remaining grassland and wetland habitats provide both hunting sites and shelter for herpetofauna, primarily amphibians colonizing the wetlands which in turn attracts reptile predators.

The observed species diversity for both reptiles and amphibians was considerably low. The weather during the field survey was wet and overcast, this may have hindered the presence of herpetofauna (specifically reptile) species within the Project area. Nevertheless, the large alien plantation stands and large areas of previously disturbed grasslands contribute to the decreasing reptile diversity. There is no current explanation for the low species composition of amphibians as numerous water bodies and systems were found throughout the Paardeplaats and EFN portions. Table 6-15 lists the previously recorded herpetofauna within the Project area, no SCC were encountered during the previous surveys.

Figure 6-19: Common Brown Water Snake

Figure 6-20: Sand Frog and Delalande's River Frog

Table 6-14: Coordinates and locations of Herpetofauna recorded

Species	Farm Portion	GPS Coordinates
Common Brown Water Snake	28	25°44'21.55"S; 29°59'27.07"E
African Striped Skink	40	25°44'50.92"S;29°59'53.08"E
Sand Frog	13	25°43'9.53"S;30° 1'15.91"E
Boettger's Caco	13	25°43'13.84"S;30° 1'20.02"E
Delalande's River Frog	2/425	25°45'16.09"S;29°58'53.27"E

Table 6-15: Previously Recorded Herpetofauna (EkoInfo 2012 and NSS 2011)

Amphibians				
Species	**Common Name**	**Conservation Status**	**EkoInfo (2012)**	**NSS (2010/2011)**
Amietia angloensis	Angola River Frog	LC	x	-
Ametia fuscigula	Cape River Frog	LC	x	-
Amietophrynus garmani	Eastern Olive Toad	LC	x	-
Breviceps adspersus	Common Rain Frog	LC	x	-
Cacosternum boettgeri	Boettger's Dainty Frog	LC	x	-
Kassina senegalensis	Bubbling Kassina	LC	x	-
Semnodactylus wealii	Rattling Frog	LC	x	-
Strongylopus fasciatus	Striped Stream Frog	LC	x	-
Strongylopus grayii	Gray's Stream Frog	LC	x	-
Xenopus laevis	African Clawed Frog	LC	x	-
Reptiles				
Species	**Common Name**	**Conservation Status**	**EkoInfo (2012)**	**NSS (2010/2011)**
Afrotyphlops bibronii	Bibon's Blind Snake	LC	x	-
Hemachatus haemachatus	Rinkhals	LC	x	-
Leptotyphlops scutifrons	Peter's Threadsnake	LC	x	-
Psammophis crucifer	Cross Marked Grass Snake	LC	x	-
Psammophylax rhombeatus	Rhombic Skaapsteker	LC	x	-
Trachylepis capensis	Cape Skink	LC	x	-
Trachylepis punctatissima	Speckled Rock Skink	LC	x	-
Trachylepis varia	Variable Skink	DD	x	-
Varanus niloticus	Nile Monitor	LC	x	-

6.4.4. Invertebrates

Invertebrates are the main components of faunal diversity in grasslands, playing substantial roles in ecosystem processes including nutrient cycling and pollination. Grassland invertebrate communities are heavily dependent on plant diversity and production within a given system (Barnett and Facey, 2016). During the field survey in December, a total of 34 invertebrates were observed and are listed in Table 6-16 below. Various images of invertebrates were captured during the field assessment and are presented in Table 6-16 below. The SCC, Marsh Sylph (*Metisella meninx*), was recorded during the 2020 survey in the Transformed Habitat within the Unchanneled Valley Bottom Wetland of portion 5 (Wetland Consulting Services (Pty) Ltd, 2020) (see Figure 7-1). This species was previously recorded by NSS (2011) within the wetland habitats of the EFN farm portion. *M.* meninx is an obligate wetland species and depends on the occurrence of *Leersia hexandra* (Rice Grass), of which has been recorded in majority of the wetland habitats. Henning (2009) states that this species requires unpolluted marsh habitats. The adults tend to roost low down in the wetland vegetation, above the water level – which makes the susceptible to unexpected flooding. Adults rely on nectar to replenish their energy demands, of which has been noted to be obtained from *Verbena bonariensis, V. brasililiensis,* and *Persicaria spp* (all of which were recorded within the wetland habitats). Various images and their locations of observed invertebrates is represented in Figure 6-21 and Table 6-17: Coordinates and location of Invertebrates presented in Figure 6-21Table 6-17 below.

Table 6-16: Invertebrates recorded in the Project area

Common name	Species name	Conservation status
Freshwater crab	*Potamonautes flavusjo*	LC
Red pumpkin beetle	*Aulacophora foveicollis*	LC
Garden fruit chafer	*Pachnoda sinuata*	NE
Hook-winged net-winged beetle	*Lycus melanurus*	NE
Spotted cucumber beetle	*Diabrotica undecimpunctata*	LC
Gaudy commodore	*Precis octavia sesamus*	LC
Marsh Sylph	***Metisella meninx***	**VU**
European Beewolf	*Philanthus triangulum*	LC
African honey bee	*Apis mellifera scutellata*	LC
Orange plume moth	*Stenodacma wahlbergi*	LC
Garden acraea butterfly caterpillar	*Acraea horta*	LC
Two-spotted ground beetle	*Anthia thoracica*	LC
Mountain white spot moth caterpillar	*Mesocelis montana*	LC
Cherry spot moth caterpillar	*Diaphone eumela*	LC
Paper wasp	*Polistes marginalis*	LC
Cleg fly	*Haematopota spp*	LC
Brown Veined White Butterfly	*Belenois aurota*	LC
Navy dropwing (female)	*Trithemis furva*	LC
Tussock Moth Caterpillar	*Laelia sp.*	LC
Black vine weevil	*Otiorhynchus sulcatus*	LC
Red legged tick	*Rhipicephalus evertsi evertsi*	LC
Grass stick insect	*Maransis rufolineatus*	LC
Blue emperor	*Anax imperator*	LC
Snouted harvester termites	*Trinervitermes*	LC
Grasshopper (with striped hind leg)	*Vitticatantops humeralis*	LC
Grasshopper (with yellow spots)	*Ochrophlebia cafra*	LC
Velvet spider	*Dresserus spp*	LC
Spider wasp	*Hemipepsis*	LC
Robber fly	*Gonioscelis ventralis*	LC
Grass moth	*Ancylolomia spp*	NE
Short-tailed Ichneumon Wasp	*Enicospilus*	LC
Geranium Bronze	*Cacyreus marshalli*	LC
Black miliipede	*Doratogonus*	LC
Twig wilter	*Anoplocnemis spp.*	LC

Table 6-17: Coordinates and location of Invertebrates presented in Figure 6-21

Species	Farm Portion	GPS Coordinate
Grass Stick Insect	2/425	25°45'14.48"S; 29°58'54.54"E
Short-tailed Ichneumon Wasp	425	25°45'11.75"S; 29°58'25.03"E
Geranium Bronze	5	25°42'34.25"S; 29°59'56.09"E
Mountain White Spot Moth caterpillar	13	25°43'9.42"S; 30° 1'16.07"E
Navy Dropwing	13	25°43'7.15"S; 30° 1'18.89"E
Blue Emperor	EFN	25°51'44.69"S; 30° 0'40.13"E
Brown-veined White Butterfly	29	25°43'52.68"S; 30° 0'13.38"E
Gaudy Commodore	425	25°45'14.44"S; 29°58'24.66"E
Marsh Sylph (Vulnerable)	**5**	**25°42'34.88"S; 29°59'49.73"E**

Figure 6-21: Top row left to right**: Grass Stick Insect, Mountain White Spot Moth caterpillar, Geranium Bronze, Short-tailed Ichneumon Wasp**
Bottom row left to right**: Navy Dropwing, Blue Emperor, Brown-veined White Butterfly, Gaudy Commodore, Marsh Sylph**

7. Sensitivity Analysis

The sensitivity analysis takes into account all of the desktop data (Mpumalanga C-Plan, Threatened Ecosystems, IBAs and the NPAES), as well as the field data gathered during the site visits. The outcome of this assessment depicts sensitivity ranging from low to high in the Project area. High sensitivity was assigned to the Rocky Outcrops and Wetland habitats as they provide habitat for SCC and their irreplaceability as unique biodiversity features. Various habitats within the Paardeplaats portion sustain a high diversity of faunal and floral SCC. The drainage and wetland systems are associated with a high ecological sensitivity as they provide refugia and habitat for numerous faunal SCC, promote movement of faunal species and act as corridors and also provide vital ecosystem services. Areas with moderate sensitivity included those that were considered in a natural state with minor anthropogenic disturbances and presence of SCC such as the intact grasslands and moderate rocky slopes. Low sensitivity was assigned to the transformed areas as they have been previously heavily degraded and are proliferated with AIPs. The map below illustrates the areas of concern confined to the Paardeplaats portions in Figure 7-1.

As EFN has previously been subjected to mining activities, several areas have consequently succumbed to habitat modifications and have resulted in low sensitivities. Areas of high sensitivity within the portion were based on the remaining intactness of the natural areas and presence of SCC. The remining natural systems in the Project area provide habitat for faunal SCC, particularly the Grey Crowned Crane (see Section 6.4.2). These sensitive areas can be observed in Figure 7-2 below.

It is recommended that areas of high sensitivity be actively conserved throughout the life of the proposed Project, as well as after decommissioning and closure. These areas should not be cleared or impacted in any way by construction activities. Areas of moderate sensitivity should be avoided as far as possible, and ideally conserved along with areas of high sensitivity. Mining activities and associated infrastructure should proceed with caution in these areas. Areas of low sensitivity are recommended for construction activities, however, should any SCC occur, the area is to be avoided or removal of the species from the area. If this cannot be done, the appropriate permits should be obtained for their removal.

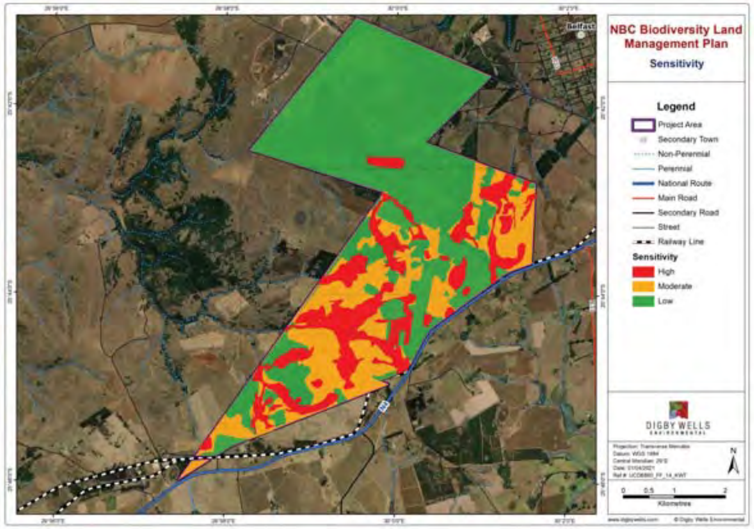

Figure 7-1: Sensitive areas associated with Paardeplaats 308 JS

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Figure 7-2: Sensitive areas associated with Eerstelingfontein 406 JT

8. Impact Assessment

It is assumed that the open cast mining activities are proposed throughout the Paardeplaats farm portions and as such, the fauna and flora impacts are assessed for the three phases of the project life, which include the construction, operational and decommissioning phases. The impacts were based on the impact's magnitude as well as the receiver's sensitivity, concluding an impact significance rating which identifies the most important impacts that require management.

The impacts that possibly will affect the fauna and flora of the Project area are:

- Clearing of the vegetation within the development footprint of the Project area. Clearing the vegetation will result in loss of the vegetation communities, biodiversity, SCC identified (faunal and floral). Loss of these components will degrade the overall habitat and ecosystem services;
- Sensitive areas such as wetlands and rock outcrops will be impacted. There is a risk of water contamination, loss of water quality and quantity, and loss of niche habitats for fauna and flora SCC. Contaminated water will affect the surrounding areas and decrease the overall functioning of the ecosystem;
- The current land use (mainly cattle grazing, wildlife, natural grassland and fallow land) will be negatively impacted due to the mining and infrastructure. This will result in a loss of grazing, wildlife (game farming) which in turn will negatively impact the local economy; and
- Vegetation clearance and removal of topsoil will deplete the soil fertility and encourage AIP proliferation, further degrading the land.

Methodology used to for the impact assessment is represented in Appendix F.

8.1. Construction Phase

Activities during the Construction Phase that may have potential impacts on the vegetation communities, biodiversity and ecosystem function are listed in Table 8-1.

Table 8-1: Construction Phase Interactions and Impacts of Activity

Interaction	Impact
Vegetation clearing	• Removal of all vegetation within the development footprint, permits the loss of vegetation communities (including floral SCC), biodiversity and ecosystem services; and • Soil compaction, increased runoff and soil erosion.
Diesel storage	• Potential spillage of hydrocarbons (diesel/fuel) thus contaminating the soil and ground water.
Access and road constructions	• Removal of vegetation, AIP proliferation and faunal casualties; • Increased vehicle movement; and • Increased dust, compaction and sedimentation.
Rock blasting	• Increased dust dispersal, faunal casualties and vegetation removal; and • Changes to the landscape, causing ponding and undulating topographies.
Stockpiles and dumping	• Vegetation removal, dust pollution, soil erosion, compaction, sedimentation and AIP proliferation.

8.1.1. Impact Description

It is assumed that large portions of the Paardeplaats' 380 JT habitat will be excavated and destroyed as a result of an Open Cast Pit. The destruction of identified vegetation types within this area will result in permanent reduction of the natural habitat of all faunal species that reside there. Furthermore, the confirmed presence of protected flora (see Section 6.2.1) and fauna (see Section 6.4.1**Error! Reference source not found.**), which supports the nature of t he vegetation types, will need to be taken into account.

The habitats within the proposed area of development will be directly impacted on, as the existing vegetation, which is considered the rocky outcrops, secondary grasslands and wetland vegetations (discussed in Section 6.3.1), will be removed to facilitate the construction of the mine and related infrastructure. The placement of the infrastructure will include the complete removal of vegetation present within the footprints of the mine infrastructure.

8.1.1.1. Management Objectives

Management objective for the site clearance activity will include informing the mine where the location of the vegetation communities is, including the location the protected fauna and flora, and how to limit impacts to these.

The management objectives are to prevent the loss of important landscapes, species of plants and animals (Red Data and Nationally or Provincially listed species). This is achieved by avoiding destruction of areas where these species occur. In the case of plants, if this is not possible, relocation permits are required for the relocation of all protected species. A thorough screening must take place to quantify and locate all protected species. If relocation is not possible than replacing all removed protected species must occur after operation of the mine and during the commencement of the rehabilitation. In the instance of Paardeplaats, protected flora have been identified in the proposed development footprint and will be removed for the construction of the mine. To permit the removal of the protected species, a protected species permit assessment is required and is discussed further in Management Actions below.

8.1.1.2. Management Actions

To avoid or minimise the potential impacts, the management actions and targets discussed below should be implemented:

- An alien plant management strategy to preserve remaining natural habitat and avoid alien plant infestations. Such a strategy will entail the identification of areas where easy propagation of invasive species may occur. Thereafter specific eradication measures can be prescribed for the species present.
- Destruction of natural vegetation should be limited to the areas essential for the development. Once site clearing and construction are complete, the environmental officer must ensure the non-mine construction areas are rehabilitated to an acceptable standard to accomplish the aim of the rehabilitated area. Open and steep areas are prone to erosion; these must be marked and attended to before the following wet season starts.
- Rehabilitation of disturbed areas should take place within a month of construction ending, all bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed areas relatively quickly and prevent erosion and alien vegetation establishing.
- A protected species permit assessment is needed as protected floral species have been identified within the development footprint area. This survey will identify and quantify all the protected plant species that will be impacted by the development and will ensure accordance with all necessary legislative requirements for the removal or relocation of the protected species.

8.1.1.3. Impact Ratings

Impacts associated with the construction phase are presented below in Table 8-2.

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Table 8-2: Construction Phase Interactions, and Impacts of Activity Rating

1. Activity, and Interaction: Site/vegetation clearance			
Impact Description: • Loss of plant communities including floral SCC; • Loss of biodiversity; • Increased erosion; • Potential for AIP proliferation; • Loss of faunal habitat including faunal SCC; and • Loss of vegetation types including Grassland, Rocky Outcrop and Wetland vegetation units.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact of the vegetation clearance will occur during the life of the project, although reduced during the decommissioning phase	Moderate (negative) - 105
Extent	3	Vegetation removal will occur within the Project Area and infrastructure layout	
Severity	6	Serious loss of the vegetation communities limiting ecosystem functioning	
Probability	7	Definite probability of vegetation clearing	
Nature	Negative		
Mitigation measures			
• Keep site clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans); • Keep site clearing and impacts to the Mining Right Application; • Alien plant management strategy should be implemented; • Make use of existing roads to encourage minimal impacts/footprint; • Adhere to 100 m protective buffers around pans. • Replacement of removed protected species during rehabilitation.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will occur beyond project life, specifically during the construction, and operational phases.	Moderate (negative) - 84
Extent	3	Vegetation removal is limited only to the Open Cast Area and infrastructure layout.	

Intensity	3	Moderate loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	7	There is a definite probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
2. Activity, and Interaction: Access and haul roads construction			
Impact Description: • Removal of vegetation and basal layer; • Increased proliferation of AIPs • Increased faunal casualties; and • Increased dust pollution.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact of haul roads will extend beyond the life of the project.	Moderate (negative) - 78
Extent	3	Loss of fauna and flora will only occur within the impacted area and its near surroundings.	
Intensity	4	If not mitigated serious loss will occur to the moderately sensitive environment.	
Probability	6	Site clearance has to take place for construction of the access and haul roads, so vegetation removal is inevitable.	
Nature	Negative		
Mitigation measures			
• Keep site clearing to a minimum; • If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place at regular intervals or after high rainfall events; • Staff of the mine must adhere to policies within the operation of the mine, such as adhering to designated speed limits; • Restoration and rehabilitation of removed vegetation and SCC during rehab phase; • Construction must be kept within the infrastructure footprint area, to reduce as much fragmentation as possible; and • AIPs should be continuously monitored and controlled throughout the life of the mine and thereafter.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**

Duration	5	The impacts will occur during the life of the project.	Minor (negative) - 72
Extent	3	Loss of fauna and flora is limited only to the footprint of the access and haul roads, exposed areas due to mitigation measures being implemented, such as limit vehicle movement, and restrict movement to specific sites.	
Intensity	3	Moderate loss, and/or effects to biological or physical resources or moderately sensitive environments, limiting ecosystem functioning.	
Probability	6	High probability that the impact will continue to occur.	
Nature	Negative		
3. Activity, and Interaction: Rock blasting and operation of Open Pits workings			
Impact Description: • Heavy machinery utilised increasing vehicle movement in the area, increasing soil compaction, habitat disturbances and vegetation removal; • Blasting will increase loss of habitat, faunal casualties, loss of ecosystem functioning and encourage habitat fragmentation; • Natural vegetation will be removed for the Open Pits working promoting edge effects and AIP proliferation; and • Increased dust pollution and erosion.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact of habitat fragmentation and loss of fauna and flora will occur during and after the life of the project.	Moderate (negative) - 105
Extent	4	This fragmentation will only occur within the impacted area and its near surroundings.	
Intensity	5	If not mitigated, once the resources have been lost from the landscape it can be difficult to recover and restore.	
Probability	7	Site clearance has to take place for construction of the various infrastructures which will encourage the fragmentation and loss of fauna and flora.	
Nature	Negative		
Mitigation measures			

- Restoration and rehabilitation of removed vegetation and SCC during rehab phase;
- Construction must be kept within the infrastructure footprint area, to reduce as much fragmentation as possible;
- Alien invasive plants should be continuously monitored and controlled throughout the life of the mine and thereafter; and
- Corridors (infrastructure and ecological) set aside within the mine area would mitigate fragmentation substantially, especially if this could be managed with the community over an extended period of time.

<table>
<tr><th colspan="4">Post-Mitigation</th></tr>
<tr><th>Dimension</th><th>Rating</th><th>Motivation</th><th>Significance</th></tr>
<tr><td>Duration</td><td>4</td><td>The impact will occur during the life of the project.</td><td rowspan="5">Minor (negative)
- 60</td></tr>
<tr><td>Extent</td><td>3</td><td>Loss of fauna and flora and habitat degradation is extending only as far as the development area.</td></tr>
<tr><td>Intensity</td><td>3</td><td>Moderate loss, and/or effects to biological or physical resources or moderate sensitive environments, affecting ecosystem functioning.</td></tr>
<tr><td>Probability</td><td>6</td><td>High probability that the impact will continue to occur.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
</table>

8.2. Operational Phase

Activities during the Operational Phase that may have potential impacts on the vegetation communities, biodiversity and ecosystem function are listed in Table 8-3.

Table 8-3: Operational Phases Interactions and Impacts

Interaction	Impact
Diesel storage and fuelling of diesel on site	• Potential spillage of hydrocarbon thus contaminating the soil, ground water and surrounding areas.
Coal Transportation: vehicle, and heavy machinery movement	• Removal of soil and vegetation, increased faunal casualties (road kill); and • Increased erosion and sedimentation decreasing vegetation cover.
Open-pit establishment	• Removal of vegetation, habitats and increased soil erosion and compaction.
Stockpiles, rock blasting and dumping	• Destruction of vegetation and habitat, dust pollution, soil erosion and AIP proliferation. • Increased vehicle movement in the area, increasing soil compaction, and runoff potential; and • Unexpected changes in the topography and overall habitats.

8.2.1. Impact Description

Site clearance will take place in areas where the infrastructure will expand, this could be the expansion of waste rock dumps and stockpiles, open cast pits and structural set-ups of the mine such as housing or storage of building material.

The establishment and operation of the open pit blasting of rock, diesel storage and coal transportation impact the current habitat. Removal of vegetation will cause a secondary impact on the faunal life due to the habitat destruction. There may be a direct impact on animal life, as haul roads will be utilised and expanded during this phase and there will be an increase in road kill. Continuous project activities during the operative phase will increase dust production and if not mitigated will have negative impacts on the surrounding vegetation and habitats

8.2.1.1. Management Objectives

Management objectives during the operational phase will concentrate on preventing the loss of vegetation and/or habitat and species that surround the operations. This can be accomplished by not allowing the condition of the vegetation and surrounds to deteriorate after the project activities have begun. Establishing the amount of protected floral species that will be removed for the construction of the mine will give an indication of how many will need to be replanted as an offset to the loss.

8.2.1.2. Management Actions

- Monitoring of alien invasive sprawl during the operation is recommended as the surrounding vegetation is relatively intact and free from alien invasive plants.

- Ensure no loss of faunal SCC by activating anti-poaching units that will be incorporated during the mine life cycle.
- Monitor dust pollution discussed in Section 10.
- Keep sight clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans).

8.2.1.3. Impact Ratings

The operational phase impacts are rated in Table 8-4.

Table 8-4: Operational Phase Interactions, and Impacts of Activity Rating

1. Activity, and Interaction: Coal transportation, vehicle and heavy machinery movement			
Impacts: • Habitat destruction by removal of vegetation; • Increase in dust production; • AIP spread; • Increased compaction, erosion, and consequently sedimentation potential; • Increased faunal casualties.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact of habitat destruction will occur during the life of the project, although reduced during the decommissioning phase.	Minor (negative) - 72
Extent	3	Majority of the impacts will occur within the Open Cast Areas and access roads.	
Intensity	4	Soil compaction and erosion further degrading the habitat, increased vehicular activity and loss of vegetation due to increased runoff from compacted areas.	
Probability	6	Movement of vehicles and heavy mine machinery will result in habitat degradation.	
Nature	Negative		
Mitigation measures			
• The footprint of the mine should be kept as small as possible with only necessary areas being cleared; • Existing roads should be used with no new roads constructed, if new roads need to be constructed, these should be done outside of the identified vegetation communities and as close as possible to the existing roads; • Access should be restricted to already impacted areas (haul roads, open pits and dumps) by rehabilitating these areas as soon as possible by removal of infrastructure and planting; • To minimise loss of Faunal SCC, awareness campaigns with activated anti-poaching units incorporated during the mine life cycle. Security patrols to prevent snaring. Create a sanctuary for faunal species identified within the Project area during the operational phase (See measures for Grey Crowned Crane conservation in Land Management Plan); • Alien invasive plants should be continuously monitored and controlled throughout the life of the mine and thereafter. It is recommended that AIP programme be established to control the spread; and • Monitoring of the vegetation communities present must be completed every 2 years to document to impacts of the edge effect and fragmentation.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will occur on a long-term basis, specifically during the construction, and operational phases.	Minor (negative) - 40
Extent	3	Habitat degradation is confined only to limited areas, provided that soil management measures are implemented	
Intensity	2	Minor loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
2. Activity, and Interaction: Open-pit establishment, stockpiles, rock blasting and dumping			
Impacts: • Removal of vegetation, habitats and increased soil erosion and compaction; • Loss of faunal SCC; • Destruction of and changes to the habitats; • Increased dust pollution due to erosion and vehicular activity; and • Risk of AIP proliferation.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**

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Duration	6	The impact will occur during the life of the project and result in permanent changes to the landscape and habitats.	Moderate negative (-91)
Extent	3	Impacts will extend as far as the development site area.	
Intensity	4	Serious environmental effects. These activities will result in modification of the landscape and loss of fauna and flora.	
Probability	7	The probability is very high	
Nature	Negative		
Mitigation measures			
• Monitoring of alien invasive sprawl during the operation is recommended as the surrounding vegetation is relatively intact and free from alien invasive plants. • Ensure no loss of faunal SCC by activating anti-poaching units that will be incorporated during the mine life cycle. • Monitor dust pollution discussed in Section 10. • Keep sight clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans). • Vegetate stockpiles to prevent soil loss, organic material loss, erosion, and sedimentation.			
Post-Mitigation			
Duration	4	The impact will occur on a long-term basis, specifically during the construction, and operational phases.	Minor negative (-40)
Extent	3	Removal of vegetation, soil stripping and stockpiling is limited only to current mine areas, provided that mitigation measures are implemented.	
Intensity	3	Moderate loss and damage to fauna and flora and habitats if mitigation measures are not adhered to.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
3. Activity, and Interaction: Diesel storage, and fuelling of diesel on site			
Impacts: • Contamination of soil, water and surrounding areas / habitats (pan vegetation) from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels).			
Prior Mitigation			

Dimension	Rating	Motivation	Significance
Duration	5	The impact will occur during the life of the project, although reduced during the decommissioning phase	Moderate Negative (- 78)
Extent	3	Most contamination will occur within the Open Cast Area.	
Intensity	5	Serious medium-term environmental effects and limiting ecosystem functioning. Damage can be irreparable if not mitigated.	
Probability	6	The probability is very high.	
Nature	Negative		
Mitigation measures			
• All spills should be immediately cleaned up, and treated accordingly; and • Re-fuelling must take place on a sealed surface area away from sensitive habitats such as the pan vegetation to prevent the ingress of hydrocarbons into the topsoil.			
Post-Mitigation			
Duration	5	The impact will occur on a long-term basis, specifically during the construction, and operational phases.	Negligible Negative (- 30)
Extent	3	Spillage and contamination is limited only to storage areas, provided that management measures are implemented	
Intensity	2	Minor - term environmental effects due to prevention measures and rehabilitation.	
Probability	3	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		

8.3. Decommissioning Phase

Activities during the decommissioning phase that may have potential impacts on the vegetation communities, biodiversity and ecosystem function are listed in Table 8-5.

Table 8-5: Decommissioning Phase Interactions and Impacts

Interaction	Impact
Demolition, and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation for the final land rehabilitation	• Disturbance of soils, and subsequent erosion by wind, and water; • Increased vehicle movement in the area, increasing soil erosion and habitat destruction; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the surrounding grounds; • AIP proliferation; and • Unexpected changes in topography and landscape.
Movement of vehicles, and heavy machinery	• Compaction of soil; • Increased runoff potential; and • Increased erosion, and consequently sedimentation potential.
Rehabilitation – re-vegetation and profiling of the land.	• Exposure of soils, and subsequent compaction, erosion, and sedimentation; • Soil compaction, and increased runoff potential due to vehicle movement during rehabilitation programs; • Loss of organic material, and vegetation cover; and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of soil.
Post-closure monitoring and rehabilitation	• Minimal negative impacts on the environment; and • Environmental Management Plan.

8.3.1. Impact Description

The decommissioning phase will enable the rehabilitation of the removed indigenous vegetation and protected trees. Trees that were propagated in a nursery will be used in the appropriate vegetation types for rehabilitation.

The demolition of the ancillary infrastructure may also take place, whereby these will be dismantled and trucked away.

8.3.1.1. Management Objectives

The objective for this phase will be to maximise the success of the rehabilitation that will take place after infrastructure is removed, and to furthermore reduce any impacts that may occur during this phase.

8.3.1.2. Management Actions

Decommissioning of the infrastructure will be predominantly a rehabilitation activity of footprint areas. These areas will be sloped and revegetated with indigenous plant species that represent the vegetation types and communities identified.

Thereafter the removal of the infrastructure (ancillary infrastructure) will be completed and the footprints of these areas also rehabilitated. This will be completed so as to not harm or negatively impact surrounding vegetation. The protected floral species that are to be removed will require permits for removal and it is recommended that the removed individuals be replanted in a suitable/similar habitat..

Furthermore, the rehabilitation (of all infrastructure footprints discussed) must be conducted in such a manner to achieve aims for the process. These aims will be to ensure the footprint areas are vegetated and that potential erosion through runoff and wind does not occur. Efforts will be maximised if rehabilitation is completed before the first rains fall so as to make use of the rainfall to assist in plant recruitment.

8.3.1.3. Impact Ratings

Impacts associated with the rehabilitation of the open cast pits and stockpiles together with the demolition and removal of the infrastructure area are presented in Table 8-6.

Table 8-6: Decommissioning Phase Interactions, and Impacts of Activity Rating

1. **Activity and Interaction:** Movement of vehicles and heavy machinery			
Impact Description: • Compaction of soil; • Potential faunal casualties; • Increased runoff potential; and • Increased erosion and decline in revegetation potential.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	3	Impacts can be managed during the decommissioning phase.	Minor (negative) - 50
Extent	3	Impacts will be localised within the Open Cast Area.	
Intensity	4	Erosion and decline in vegetation due to increased runoff from compacted areas.	
Probability	5	Movement of vehicles and heavy mine machinery will result in soil compaction and possible faunal casualties.	
Nature	Negative		

Mitigation measures			
• Rehabilitate the compacted, eroded areas by deep ripping to loosen the soil and revegetate the area as soon as possible; • Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs; • Adhere to health and safety protocols within the operations of the mine and adhere to speed limits to minimise faunal casualties; and • Only designated access routes are to be used to reduce any unnecessary compaction.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact will occur on a small scale, specifically during rehabilitation and monitoring.	Negligible (negative) - 32
Extent	2	The impact is limited only to specific areas, provided that mitigation measures are implemented.	
Intensity	2	Minor loss, and/or effects to biological or physical resources not affecting ecosystem functioning.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
2. Activity, and Interaction: Demolition of infrastructure and preparation for rehabilitation of affected areas			
Impact Description: • Disturbance of soils, and subsequent erosion by wind, and water; • Increased vehicle movement in the area, increasing soil erosion and habitat destruction; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the surrounding grounds; • AIP proliferation; and • Unexpected changes in topography and landscape.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impacts will remain for some time after the life of a Project.	Modearte (negative) - 78
Extent	3	Extending across the Open Cast Area and mine infrastructure and to neighbouring environments.	

Intensity	4	Serious medium-term environmental effects.	
Probability	5	The impact may likely occur.	
Nature	Negative		
Mitigation measures			
• Continue with Concurrent Rehabilitation, begin with stockpiles, open pits and dumps, implement rehabilitation measures; • Address eroded and compacted areas by deep ripping to loosen the soil, and revegetate the area as soon as possible to prevent AIP sprawl; • Inventory of hazardous waste materials stored on-site should be compiled and complete removal arranged; • Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs; and • Only designated access routes are to be used to reduce any unnecessary compaction.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	2	The impact will be less than a year if rehabilitation measures are implemented correctly.	Negligible (negative) - 24
Extent	2	The impact will be limited to the site due to the implementation of mitigation measures.	
Intensity	2	Minor effects on the biological or physical environment. Environmental damage can be rehabilitated internally with/ without the help of external consultants.	
Probability	4	The impact can occur.	
Nature	Negative		
3. Activity, and Interaction: Rehabilitation – re-vegetation and profiling of the land.			
Impact Description: • Exposure of soils, and subsequent compaction, erosion, and sedimentation; • Soil compaction, and increased runoff potential due to vehicle movement during rehabilitation programs; • AIP proliferation; • Loss of organic material, basal layer and vegetation cover; and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of soil.			
Prior Mitigation			

Dimension	Rating	Motivation	Significance
Duration	4	The impacts caused during the rehabilitation activities will have a long-lasting effect if not managed.	Minor negative (-65)
Extent	4	The impact could spread beyond the local development boundaries due to the ability of degraded landscape or alien invasive species impacting the area.	
Intensity	5	These impacts have serious implications to the revival of the disturbed areas.	
Probability	5	These are commonly observed impacts for the rehabilitation phase.	
Nature	Negative		
Mitigation measures			
• During the decommissioning phase, rehabilitation must start as soon as possible and preferably in the growing season to ensure adequate plant recruitment; • Address eroded and compacted areas by deep ripping to loosen the soil, and revegetate the area as soon as possible; • Inventory of hazardous waste materials stored on-site should be compiled and complete removal arranged; • Only designated access routes are to be used to reduce any unnecessary compaction.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will be less than a year if rehabilitation measures are implemented correctly	Positive Impact 66
Extent	3	The impact will be limited to the site due to the implementation of mitigation measures	
Intensity	2	Minor effects on the biological or physical environment. Environmental damage can be rehabilitated internally with/ without the help of external consultants.	
Probability	6	The impact can occur	
Nature	Positive		
4. Activity, and Interaction: Post-closure monitoring and rehabilitation			
Impact Description: • Minimal negative impacts on the environment; and • Environmental Monitoring Plan.			

Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will be permanent.	Minor (negative) 65
Extent	1	Limited to isolated sections of the Project area.	
Intensity	4	Moderate loss, and/or effects to biological or physical resources or low sensitive environments, limiting ecosystem functioning.	
Probability	5	Likely: The impact may occur. <65% probability	
Nature	Negative		
Mitigation measures			
• During the decommissioning phase, rehabilitation must start as soon as possible and preferably in the growing season to ensure adequate plant recruitment; • Stockpiles, open pits and dumps are to be rehabilitated; • Ensure sufficient irrigation (can use water cart) and fertilizing of newly planted vegetation to facilitate a rapid establishment; and • Replant with species identified within each vegetation community.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Positive Impact 66
Extent	3	Local area will be affected.	
Intensity	2	Low positive impact.	
Probability	6	Almost certain with a high probability that the impact will occur.	
Nature	Positive		

8.4. Cumulative Impacts

It is necessary to consider the impacts that the future development will have from a wide-ranging perspective, by considering land-use and transformation of the natural habitat in surrounding areas. Cumulative impacts are assessed by considering past, present and anticipated changes to the biodiversity.

Albeit the Eastern Highveld Grassland vegetation type is assigned an Endangered conservation status, large portions of this vegetation type are under threat due to expanding mining operations. The cumulative loss of the vegetation type as well as the SCC within it should be considered proactively.

The further removal of habitat/vegetation types to allow construction/mining will bring about a reduction of natural areas, and the increase of the edge effect. The impacts on the ecology of the area will be significant. It is expected that there will be great losses of vegetation and flora along with associated faunal habitat. The primary impacts will be fragmentation and edge effects with a reduction in movement of remaining naturally occurring wildlife and isolation of pockets of vegetation.

Secondary cumulative impacts will include increased accessibility to the site and the resulting increase in development and resource dependence. Ideally, a strategic environmental plan for the area should be developed and adhered to. This should include the conservation of important areas as well as the provision of corridors for faunal movement.

8.5. Unplanned and Low Risk Events

Major unplanned risks are associated with infrastructure malfunctioning and contamination of surrounding ground and ground water. Potentially hazardous substances can contaminate the area via accidental spillage or leakage. It is imperative that the requirements of South African legislation are met for minimisation of pollution. Table 8-7 goes into detail of unplanned risks and mitigation measures.

Table 8-7: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
Leaking or spillage of hazardous substances from pipelines and waste storage	• If a spill occurs, it is to be cleaned up immediately (Drizit/Zupazorbtype spill kits) and consequently reported to the authorities; • All infrastructure carrying or transporting such substances is to be checked frequently and maintained; and • Ensure all staff are adequately informed and safety measures are in place for such instances.
Hydrocarbon spillage from vehicles	• If leak occurs from vehicle, place drip trays below the leak; • All vehicles are to be serviced on concrete areas and off site; and • Machines must be parked upon hard parking surfaces and checked daily for leaks.
Infrastructure malfunction leading towards dirty water spillage or spontaneous combustion	• All infrastructure, machinery and associated setups are to be serviced and checked throughout the project life cycle; • All staff are to be informed about potential hazards and consequently prepared for malfunctioning; • Protocols are to be induced at every phase of the project life cycle; and • If such hazards were to incur, the appropriate authorities are to be notified and the incident recorded.
Excess dust pollution	• Excess dust in construction sites is mitigated via various methods and are site specific. The recommended methods for this site would be spraying of water, tackifiers and soil stabilisers that don't harden the soils.

9. Environmental Management Plan

The objective of an Environmental Management Plan (EMP) is to present mitigations (a) to manage undue or reasonably avoidable adverse impacts associated with the development of the project and (b) to enhance potential positives.

Mitigation measures will sometimes be built into the base of a project and should be considered as part of the "pre-mitigation" scenario; additional mitigation must be recommended if the impact assessment indicates it is necessary.

The key objectives are EMPs are to give mitigation measures to:

- Identify the actual environmental, socio-economic and public health impacts of the project and check if the observed impacts are within the levels predicted in the EIA;
- Determine that mitigation measures or other conditions attached to project approval (e.g. by legislation) are properly implemented and work effectively;

- Adapt the measures and conditions attached to project approval in the light of new information or take action to manage unanticipated impacts if necessary;
- Gauge if predicted benefits of the project are being achieved and maximized; and gain information for improving similar projects and ESIA practice in the future.

The EMP is described in Table 9-1 below.

Table 9-1: Environmental Management Plan

Activities		Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
Construction Phase	• Site clearing, and preparation by the removal of vegetation and associated habitats and removal of soils; • Movement of vehicles, and heavy machinery; • Construction of infrastructure, including access and haul roads, diesel storage, and explosive magazine and Open Cast Pits; and • Waste management activities, including handling of hydrocarbon chemicals, transportation of waste material, transportation of product coal, and disposal of waste material.	• Removal of vegetation, basal cover, and thus increasing the potential of loss of topsoil, organic material, and increased erosion potential. • Removal of flora and fauna SCC and faunal habitat; • Removal of vegetation communities such as grassland, rocky outcrops and pans (wetlands); • AIP proliferation; • Increased runoff potential and consequently sedimentation and compaction of the soil; • Potential spillage of hydrocarbons such as oils, fuels (diesel), and grease, thus contamination of the soils and surrounding grounds; • Risk of fire during the dry season; and • Increased dust pollution.	• Keep site clearing to an absolute minimum by adhering to the Project layout only, and restrict vehicle movement outside of dedicated sensitive areas (see sensitivity map), specifically close to wetlands adhere to recommened protective buffers stipulated in previous wetland reports (Wetland Consulting Services (Pty) Ltd, 2020) (Tony de Castro, 2020); • Make use of existing roads to encourage minimal impacts/footprint to the Project area; • Removal of vegetation is unavoidable in some areas of the Project area, the same species that have been removed should be replaced and purchased via local nurseries during the rehabilitation phase. It is suggested that a pre-screening assessment for the location and quantity of the *in situ* protected flora within the NBC Complex. Key focus areas will comprise of future Open Cast Areas and haul roads. Following a pre-screening assessment, it is then recommended that permits for the removal and / or destruction of the protected flora identified within the NBC Complex be applied for with the relevant local authorities; • Whilst the removal of vegetation and topsoil is underway, key monitoring methods should be focussed on the prevention of AIP proliferation during the construction and operational phase; • Erosion prevention is key thus runoff must be controlled, and managed by use of proper stormwater management measures; • Management of dust may involve the spraying of water and / or covering various stockpiles with chemical dust suppressants; • Vehicles should regularly be surveyed and checked that oils spill and other contaminants are not exposed to the soils; • Storage and re-fuelling of vehicles must take place on bunded impervious surfaces to prevent seepage of hydrocarbons into the soil; • Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits. However, for major spills (>5L), if soils are contaminated, they must be stripped, and disposed of at a licensed waste disposal site; and • Fire management plan is recommended in case of uncontrolled fires during the dry season.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of mine	Life of Construction Phase

Activities		Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
Operational Phase	• Vehicle, and heavy machinery movement • Open-pit establishment • Removal of rock (blasting) • Stockpiling (rock dumps, soils, ROM, discard dump) establishment, and operation • Waste management activities • Diesel storage, explosives magazine, and handling, and treatment of hazardous products (including fuel, explosives, and oil) • Operating crush, and screen, and coal washing plant.	• Increased vehicle movement in the area, increasing the risk of faunal casualties due to road kill; • Increased risk of AIP proliferation without adequate control measures; • Increased dust pollution; • Increase risk of fire during dry season; • Increased erosion, runoff and compaction of soil and consequently sedimentation potential; • Changes to the landscape with subsequent removal of faunal habitats and a decrease in biodiversity and loss of SCC (faunal and floral); and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils and surrounding grounds.	• Make use of existing roads to encourage minimal impacts/footprint to the Project Area; • Monitor AIPs and ensure measures are in place to prevent spread and proliferation; • Adhere to a protective 100 m buffer around the delineated wetlands as per the recommendations by the De Castro and Brits Ecological Consultants Wetland Vegetation Monitoring Report (Tony de Castro, 2020). • Where areas of high sedimentation It is recommended that a soil sampling be conducted along the areas with severe sedimentation within the Glisa portion of the NBC to determine the origin and provide mitigation measures to assist in rehabilitation (see Land Management Plan). • It is recommended that a Soil Land-Use and Land Capability study be conducted within the NBC Complex. To mitigate the negative impacts of stockpiling, a Topsoil Management Plan (TMP) may be prepared to demonstrate how topsoil will be preserved in a condition as near as possible to its pre-mining condition to allow successful mine rehabilitation (Statham, 2014). In addition, a Storm Water Management Plan (SWMP) should already be implemented. This should consider all high land capability area, high potential erosion areas, wetlands, and other watercourses associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure, and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Long term stockpiles should be revegetated to minimise loss of soil quality and minimise AIPs; • Management of dust may involve the spraying of water and / or covering exposed pits with chemical dust suppressants; • Monitoring must be carried out during the operational phase to ensure no unnecessary impact to the remaining vegetation and associated habitats, and if so that a remediation plan is put in place as soon as possible; • Fire management plan is recommended in case of uncontrolled fires during the dry season; • Hydrocarbons should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; and • Re-fuelling of vehicles and machinery must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons in the surrounding area.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of mine	Life of Operational Phase

Activities		Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
Decommissioning Phase	• Movement of vehicles, and heavy machinery removing infrastructure; • Demolition, and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation for the final land rehabilitation. • Rehabilitation – rehabilitation mainly consists of reprofiling the landscape via re-vegetation, and landscaping of the preserved subsoil and topsoil;. • Post-closure monitoring, and rehabilitation	• Increased vehicle movement in the area, increasing the risk of faunal casualties due to road kill; • Increased risk of AIP proliferation without adequate control measures; • Increased dust pollution; • Increase risk of fire during dry season; • Increased erosion, runoff and compaction of soil and consequently sedimentation potential; • Changes to the landscape with subsequent removal of faunal habitats and a decrease in biodiversity and loss of SCC (faunal and floral); and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils and surrounding grounds..	• Address areas that have been impacted by erosion, compaction, sedimentation by loosening the soil, and revegetate the area as soon as possible; • Begin with the rehabilitation of the vegetation and replant with indigenous flora identified in vegetation communities. Ensure the landscape has been reprofiled with the preserved topsoils and subsoils. • Ensure removal of all AIPs. This can be done manually and if necessary, with a systemic solution; • Ensure designated access routes and roads are used to reduce any unnecessary compaction and degradation; • Inventory of hazardous waste materials stored on-site should be compiled, and complete removal must be arranged; and • Rehabilitation and a Monitoring Plan should be implemented. In terms of biodiversity, a key component of the rehabilitation is the re-establishment of natural vegetation. The overall objectives for the establishment of natural vegetation are to: o Create a sustainable cover that prevents erosion and promotes ecological succession; o Avoid soil loss and reduce sedimentation into freshwater and aquatic ecosystems; o Re-establish ecosystem processes to ensure sustainable land use; and o Restore the biodiversity of the area as far as possible. • Rehabilitation of the vegetation cover will require varying species that complement the soil moisture content of the landscape. Rehabilitation of the dryland areas and rocky slopes will require good soil stabilising, easily establishing and nurse cropping grass species such as *Chloris gayana, Cynodon dactylon, Eragrostis curvula and E. tef.* Drainage areas, seepage zones and permanent wet areas will require species that stabilize the soils and are able to grow in permanent wet areas such as *C. gayana* and *Typha capensis*.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of mine	Life of Decommissioning Phase

10. Monitoring Programme

A monitoring programme is essential as a management tool to detect negative impacts and variations as they arise and ensure that the necessary mitigation measures are implemented together with the effectiveness of the management measures in place. Table 10-1 describes the monitoring plan that is to be implemented from the construction phase through to monitoring after decommissioning. The program includes each element, frequency of monitoring and the person responsible thereof.

Monitoring should be done in terms of:

- Appendix 6 of the NEMA EIA Regulations, 2014, (as amended);
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA);
- National Forest Act, 1998 (Act No. 84 of 1998) (NFA); and
- Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA).

Table 10-1: Monitoring Plan

Monitoring Element	Comment	Frequency	Responsibility
Alien Invasive Management	During the operational phase the presence if AIPs should be detected and monitored. An active programme of weed management, to control the presence and spread of invasive weeds, will need to be instituted so that encroaching weeds (from edge effects and fragmentation) are controlled by means appropriate to the species. This should run for the life of the mine and five years after rehabilitation.	Annually during the wet season for the first five years after rehabilitation.	Environmental Officer
Vegetation Cover Monitoring	The natural vegetation cover established on the disturbed areas needs to be monitored annually for the first five years after rehabilitation has been carried out, to ensure that the rehabilitation work has been successful in terms of stabilising the newly formed surfaces (preventing air and water erosion from affecting those surfaces), and that the newly established vegetation cover is trending towards convergence with the original vegetation cover found on the areas prior to disturbance (and on adjacent undisturbed areas). Parameters to be followed during monitoring: • Plant species present/absent; • Weed species composition; • Species density (number of individuals); • Species frequency (number of times species is recorded); • Basal cover; and • Biomass for ground cover.	Annually during the wet season for the first five years after rehabilitation.	Botanist / Flora Specialist
Red Data listed fauna and flora	All protected and Red Data plant and animal species must be marked prior to any construction taking place.	Monitored every 6 months from rehabilitation	Field Specialist
Fauna monitoring	This will be closely linked to the flora monitoring to enable scientific conclusions and comparisons. To successfully monitor faunal and floral biodiversity with a Savannah biome, a solid baseline (pre-construction) will be established through the first round of monitoring. This needs to be supplemented with regular repeats to compile a reasonable comparison between the pre-construction faunal communities present and faunal communities found in the same areas during various stages of construction and operation of the proposed project. It is recommended that this monitoring be carried out through the life of the mine and concurrently during rehabilitation.	Monitored every 6 months from rehabilitation	Field Specialist

11. Recommendations

The following actions are recommended to reduce adverse effects on the fauna and flora of the Project Area (Table 11-1).

Table 11-1: Possible Impacts and Recommendations

Possible Impacts	Recommendations	Person Responsible
Loss of Fauna SCC	• All identified faunal SCC identified must be located and relocated, if possible, before the construction phase	Field specialist, and PM

Possible Impacts	Recommendations	Person Responsible
Loss of Vegetation cover and Flora SCC	• All floral SCC must be identified and located in a pre-screening assessment prior to construction. Permits will be required to relocate and / or destroy the identified protected floral species within the Project area. As recommended in Section 9, replanting of suitable and indigenous flora during the rehabilitation phase as a means to re-vegetate the area after decommissioning the mine.	Field Specialist, and PM
Habitat and landscape fragmentation	• Restriction of vehicle movement over sensitive areas to reduce degradation of untouched areas. • Minimise unnecessary removal of the natural vegetation cover outside the development footprint. • After rehabilitation the area must be fenced, and animals should be kept off the area until the vegetation is self-sustaining and established.	Field Specialist, Communal Nursery and PM

12. Reasoned Opinion Whether Project Should Proceed

Based on the baseline information, and impact assessment significance ratings, it is the opinion of the specialist that this Project is feasible and should be considered. However, it is highly recommended that concurrent rehabilitation, management and mitigation measures are correctly implemented to minimise all potential impacts (identified in Section 7) on the fauna and flora of the site.

Managing measures to minimise potential negative impacts as set out in Section 9 should form part of the conditions throughout the development of the Project. Protected species permit applications will be required for the removal of identified protected species within the development footprint, so it is strictly advised to keep development and removal within the footprint. It is also highly recommended that water courses (wetlands and pans) be avoided and not impacted with at least 100 m zones of regulation buffers to any infrastructure and construction activities.

Fauna and flora management measures and monitoring requirements as set out in this report should form part of the conditions of the ongoing activities of the mine.

13. Conclusion

Based on Mucina & Rutherford (2006) classification of South Africa's vegetation, the proposed Project is located in an area dominated by the vegetation type Eastern Highveld Grassland and Steenkampsberg Montane Grassland, which according to those authors, is regarded as Endangered.

Much of the study area has been either transformed or degraded largely through historical crop production and other agricultural activities, and current mining activities.

Areas of semi-natural or natural vegetation occur in small, often fragmented patches. These areas have generally been subjected to disturbances such as varying degrees of grazing and therefore cannot be considered pristine habitats. As always, within the surrounding landscape matrix, these areas are important ecologically and serve to provide refuge and habitat for a variety of fauna and flora species.

SCC recorded during the 2020 survey included 12 floral species, namely *Boophone disticha, Eucomis autumnalis*, *Eulophia welwitschia, Kniphofia typhoides, Gladiolus dalenii, Gladiolus crassifolius, Crinum bulbispermum, Aloe ecklonis, Agapanthus inapertus, Haemanthus humilis* and *Watsonia lepida.* Moreover, a number of other Red Data/protected species could potentially occur in the area. Faunal SCC recorded included the Marsh Sylph recorded within the unchanneled valley bottom wetland in portion 5 and a Serval captured by camera in portion 28. Previous studies conducted in 2011 and 2012 recorded additional mammalian SCC including South African Hedgehog, African Otter and Brown Hyena (EkoInfo CC, 2012). Previous recordings of avifaunal SCC are presented in Table 6-12, an additional seven (7) avifaunal SCC have previously been recorded within the EFN and Pardeplaats portions.

The mining activities in the identified vegetation communities have had direct negative ecological impacts, most notably vegetation clearing, habitat loss and fragmentation as well as AIP proliferation. Areas to be mined should be screened for the identified floral SCC and any other Red Data/protected species prior to construction. If found these species should be relocated to a nearby site of similar habitat.

The Project area represents high faunal and floral diversity with numerous SCC identified throughout. The vegetation communities associated with the highest species richness were the Rocky outcrops and Wetland communities. However, in the context of the Project area all of the remaining natural vegetation provides habitat for numerous faunal and floral species and therefore is of conservation significance. The remaining vegetation not previously impacted from historical land use practices is under severe pressure from grazing and AIP proliferation. Large extents of the Project area have dense stands of AIPs (*Eucalyptus, Acacia and Populus* sp.) established. Continuous maintenance and control of the AIP infestation, particularly in the undisturbed areas, will result in an overall positive impact for the NBC. Faunal SCC recorded included the Marsh Sylph recorded within the unchanneled valley bottom wetland in portion 5 and a Serval captured by camera in portion 28. Most recorded SCC reside in portions 13, 40 and 2, therefore a high conservation value is associated with these portions. Loss of these components will result in significant loss of biodiversity for the area. The opportunity exists however, for the proposed project to contribute significantly to conservation of biodiversity within the Rocky Outcrop regions and the previously delineated wetlands.

The recommendations that have been constructed through the results of the impact assessment ensure that the rehabilitation plan, mitigation measures and continuous monitoring measures are in place, and encourage a concurrent rehabilitation and monitoring plan.

Recommendations and mitigation measures will be provided in the upcoming Impact Assessment to ensure a rehabilitation plan, mitigation measures and continuous monitoring measures are in place, and encourage concurrent rehabilitation and monitoring plan.

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Appendix A: Potential Mammal Species

Family	Species Name	Common Name	Conservation Status
Bathyergidae	*Cryptomys hottentotus*	Southern African Mole-rat	Least Concern (2016)
Bathyergidae	*Georychus capensis*	Cape Mole-rat	Least Concern (2016)
Bovidae	*Alcelaphus buselaphus caama*	Red Hartebeest	Least Concern (2008)
Bovidae	*Antidorcas marsupialis*	Springbok	Least Concern (2016)
Bovidae	*Connochaetes gnou*	Black Wildebeest	Least Concern (2016)
Bovidae	*Damaliscus pygargus phillipsi*	Blesbok	Least Concern (2016)
Bovidae	***Hippotragus equinus***	**Roan Antelope**	**Endangered (2016)**
Bovidae	*Oryx gazella*	Gemsbok	Least Concern (2016)
Bovidae	***Ourebia ourebi***	**Oribi**	**Endangered**
Bovidae	***Pelea capreolus***	**Vaal Rhebok**	**Near Threatened (2016)**
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern (2016)
Bovidae	*Redunca arundinum*	Southern Reedbuck	Least Concern (2016)
Bovidae	*Sylvicapra grimmia*	Bush Duiker	Least Concern (2016)
Bovidae	*Syncerus caffer*	African Buffalo	Least Concern (2008)
Bovidae	*Taurotragus oryx*	Common Eland	Least Concern (2016)
Canidae	*Canis adustus*	Side-striped Jackal	Least Concern (2016)
Canidae	*Canis mesomelas*	Black-backed Jackal	Least Concern (2016)
Canidae	*Vulpes chama*	Cape Fox	Least Concern (2016)
Cercopithecidae	*Chlorocebus pygerythrus pygerythrus*	Vervet Monkey (subspecies pygerythrus)	Least Concern (2008)
Chrysochloridae	***Amblysomus robustus***	**Robust Golden Mole**	**Vulnerable (2016)**
Chrysochloridae	***Chrysospalax villosus***	**Rough-haired Golden Mole**	**Vulnerable (2016)**
Equidae	*Equus quagga*	Plains Zebra	Least Concern (2016)
Erinaceidae	***Atelerix frontalis***	**Southern African Hedgehog**	**Near Threatened (2016)**
Felidae	*Caracal caracal*	Caracal	Least Concern (2016)
Felidae	***Leptailurus serval***	**Serval**	**Near Threatened (2016)**
Felidae	***Panthera pardus***	**Leopard**	**Vulnerable (2016)**
Herpestidae	*Atilax paludinosus*	Marsh Mongoose	Least Concern (2016)

Herpestidae	*Cynictis penicillata*	Yellow Mongoose	Least Concern (2016)
Herpestidae	*Herpestes sanguineus*	Slender Mongoose	Least Concern (2016)
Herpestidae	*Ichneumia albicauda*	White-tailed Mongoose	Least Concern (2016)
Herpestidae	*Suricata suricatta*	Meerkat	Least Concern (2016)
Hyaenidae	***Hyaena brunnea***	**Brown Hyena**	**Near Threatened (2015)**
Hyaenidae	*Proteles cristata*	Aardwolf	Least Concern (2016)
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern
Leporidae	*Lepus saxatilis*	Scrub Hare	Least Concern
Macroscelididae	*Elephantulus myurus*	Eastern Rock Elephant Shrew	Least Concern (2016)
Muridae	*Aethomys ineptus*	Tete Veld Aethomys	Least Concern (2016)
Muridae	*Aethomys namaquensis*	Namaqua Rock Mouse	Least Concern
Muridae	*Lemniscomys rosalia*	Single-Striped Lemniscomys	Least Concern (2016)
Muridae	*Mastomys coucha*	Southern African Mastomys	Least Concern (2016)
Muridae	*Mastomys natalensis*	Natal Mastomys	Least Concern (2016)
Muridae	*Mus (Nannomys) minutoides*	Southern African Pygmy Mouse	Least Concern
Muridae	*Mus musculus musculus*		Least concern
Muridae	***Otomys auratus***	**Southern African Vlei Rat (Grassland type)**	**Near Threatened (2016)**
Muridae	*Parotomys brantsii*	Brants's Whistling Rat	Least Concern (2016)
Muridae	*Rhabdomys pumilio*	Xeric Four-striped Grass Rat	Least Concern (2016)
Muridae	*Thallomys paedulcus*	Acacia Thallomys	Least Concern (2016)
Mustelidae	*Aonyx capensis*	African Clawless Otter	Near Threatened (2016)
Mustelidae	*Ictonyx striatus*	Striped Polecat	Least Concern (2016)
Mustelidae	*Mellivora capensis*	Honey Badger	Least Concern (2016)
Orycteropodidae	*Orycteropus afer*	Aardvark	Least Concern (2016)
Procaviidae	*Procavia capensis*	Cape Rock Hyrax	Least Concern (2016)
Rhinolophidae	***Rhinolophus blasii***	**Blasius's Horseshoe Bat**	**Near Threatened (2016)**
Rhinolophidae	*Rhinolophus clivosus*	Geoffroy's Horseshoe Bat	Least Concern (2016)
Rhinolophidae	*Rhinolophus simulator*	Bushveld Horseshoe Bat	Least Concern (2016)
Rhinolophidae	***Rhinolophus swinnyi***	**Swinny's Horseshoe Bat**	**Vulnerable (2016)**
Soricidae	***Crocidura maquassiensis***	**Makwassie Musk Shrew**	**Vulnerable (2016)**
Soricidae	*Crocidura mariquensis*	Swamp Musk Shrew	Near Threatened (2016)
Soricidae	*Myosorex varius*	Forest Shrew	Least Concern (2016)

Suidae	*Phacochoerus africanus*	Common Warthog	Least Concern (2016)
Suidae	*Potamochoerus larvatus koiropotamus*	Bush-pig (subspecies koiropotamus)	Least Concern (2016)
Vespertilionidae	*Kerivoula lanosa*	Lesser Woolly Bat	Least Concern (2016)
Vespertilionidae	*Miniopterus natalensis*	Natal Long-fingered Bat	Least Concern (2016)
Vespertilionidae	***Miniopterus schreibersii***	**Schreibers's Long-fingered Bat**	**Near Threatened**
Vespertilionidae	*Neoromicia capensis*	Cape Serotine	Least Concern (2016)
Viverridae	*Civettictis civetta*	African Civet	Least Concern (2016)
Viverridae	*Genetta maculata*	Rusty-spotted Genet (Common Large-spotted Genet)	Least Concern (2016)

Appendix B: Potential Reptile Species

Family	Species Name	Common Name	Conservation Status
Agamidae	Agama aculeata distanti	Distant's Ground Agama	Least Concern (SARCA 2014)
Agamidae	Agama atra	Southern Rock Agama	Least Concern (SARCA 2014)
Chamaeleonidae	Chamaeleo dilepis	Common Flap-neck Chameleon	Least Concern (SARCA 2014)
Colubridae	Crotaphopeltis hotamboeia	Red-lipped Snake	Least Concern (SARCA 2014)
Colubridae	Dasypeltis scabra	Rhombic Egg-eater	Least Concern (SARCA 2014)
Colubridae	Philothamnus hoplogaster	South Eastern Green Snake	Least Concern (SARCA 2014)
Colubridae	Philothamnus occidentalis	Western Natal Green Snake	Least Concern (SARCA 2014)
Colubridae	Philothamnus semivariegatus	Spotted Bush Snake	Least Concern (SARCA 2014)
Colubridae	Telescopus semiannulatus semiannulatus	Eastern Tiger Snake	Least Concern (SARCA 2014)
Cordylidae	**Chamaesaura aenea**	**Coppery Grass Lizard**	**Near Threatened (SARCA 2014)**
Cordylidae	Cordylus vittifer	Common Girdled Lizard	Least Concern (SARCA 2014)
Cordylidae	Pseudocordylus melanotus melanotus	Common Crag Lizard	Least Concern (SARCA 2014)
Cordylidae	Smaug vandami	Van Dam's Girdled Lizard	Least Concern (SARCA 2014)
Crocodylidae	**Crocodylus niloticus**	**Nile Crocodile**	**VU (SARCA 2014); LC (global, IUCN 2019)**
Elapidae	Elapsoidea sundevallii media	Highveld Garter Snake	
Elapidae	Hemachatus haemachatus	Rinkhals	Least Concern (SARCA 2014)
Elapidae	Naja annulifera	Snouted Cobra	Least Concern (SARCA 2014)
Gekkonidae	Lygodactylus capensis	Common Dwarf Gecko	Least Concern (SARCA 2014)
Gekkonidae	Lygodactylus nigropunctatus	Black-spotted Dwarf Gecko	Least Concern (SARCA 2014)
Gekkonidae	Lygodactylus ocellatus	Spotted Dwarf Gecko	Least Concern (SARCA 2014)
Gekkonidae	Pachydactylus affinis	Transvaal Gecko	Least Concern (SARCA 2014)
Gekkonidae	Pachydactylus capensis	Cape Gecko	Least Concern (SARCA 2014)
Gekkonidae	Pachydactylus vansoni	Van Son's Gecko	Least Concern (SARCA 2014)
Gerrhosauridae	Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	Least Concern (SARCA 2014)
Lacertidae	Nucras ornata	Ornate Sandveld Lizard	Least Concern (SARCA 2014)
Lacertidae	Pedioplanis lineoocellata lineoocellata	Spotted Sand Lizard	Least Concern (SARCA 2014)
Lamprophiidae	Amplorhinus multimaculatus	Many-spotted Snake	Least Concern (SARCA 2014)
Lamprophiidae	Aparallactus capensis	Black-headed Centipede-eater	Least Concern (SARCA 2014)
Lamprophiidae	Atractaspis bibronii	Bibron's Stiletto Snake	Least Concern (SARCA 2014)
Lamprophiidae	Boaedon capensis	Brown House Snake	Least Concern (SARCA 2014)
Lamprophiidae	Duberria lutrix lutrix	South African Slug-eater	Least Concern (SARCA 2014)
Lamprophiidae	Homoroselaps lacteus	Spotted Harlequin Snake	Least Concern (SARCA 2014)
Lamprophiidae	Lycodonomorphus inornatus	Olive House Snake	Least Concern (SARCA 2014)
Lamprophiidae	Lycodonomorphus rufulus	Brown Water Snake	Least Concern (SARCA 2014)
Lamprophiidae	Lycophidion capense capense	Cape Wolf Snake	Least Concern (SARCA 2014)
Lamprophiidae	Psammophis brevirostris	Short-snouted Grass Snake	Least Concern (SARCA 2014)
Lamprophiidae	Psammophis crucifer	Cross-marked Grass Snake	Least Concern (SARCA 2014)
Lamprophiidae	Psammophis subtaeniatus	Western Yellow-bellied Sand Snake	Least Concern (SARCA 2014)
Lamprophiidae	Psammophis trinasalis	Fork-marked Sand Snake	Least Concern (SARCA 2014)
Lamprophiidae	Psammophylax rhombeatus	Spotted Grass Snake	Least Concern (SARCA 2014)
Lamprophiidae	Pseudaspis cana	Mole Snake	Least Concern (SARCA 2014)
Leptotyphlopidae	Leptotyphlops sp.		
Leptotyphlopidae	Leptotyphlops incognitus	Incognito Thread Snake	Least Concern (SARCA 2014)
Pythonidae	Python natalensis	Southern African Python	Least Concern (SARCA 2014)
Scincidae	Acontias gracilicauda	Thin-tailed Legless Skink	Least Concern (SARCA 2014)
Scincidae	Acontias plumbeus	Giant Legless Skink	Least Concern (SARCA 2014)
Scincidae	Mochlus sundevallii	Sundevall's Writhing Skink	Least Concern (SARCA 2014)
Scincidae	Panaspis wahlbergii	Wahlberg's Snake-eyed Skink	Least Concern (SARCA 2014)
Scincidae	Scelotes mirus	Montane Dwarf Burrowing Skink	Least Concern (SARCA 2014)
Scincidae	Trachylepis damarana	Damara Variable Skink	
Scincidae	Trachylepis punctatissima	Speckled Rock Skink	Least Concern (SARCA 2014)
Scincidae	Trachylepis sp. (Transvaal varia)	Skink sp. 1	
Scincidae	Trachylepis varia sensu lato	Common Variable Skink Complex	Least Concern (SARCA 2014)
Testudinidae	Kinixys lobatsiana	Lobatse Hinged Tortoise	Least Concern (SARCA 2014)

Testudinidae	Kinixys spekii	Speke's Hinged Tortoise	Least Concern (SARCA 2014)
Testudinidae	Stigmochelys pardalis	Leopard Tortoise	Least Concern (SARCA 2014)
Typhlopidae	Afrotyphlops bibronii	Bibron's Blind Snake	Least Concern (SARCA 2014)
Typhlopidae	Afrotyphlops schlegelii	Schlegel's Beaked Blind Snake	Least Concern (SARCA 2014)
Varanidae	Varanus niloticus	Water Monitor	Least Concern (SARCA 2014)
Viperidae	Bitis arietans arietans	Puff Adder	Least Concern (SARCA 2014)
Viperidae	Causus rhombeatus	Rhombic Night Adder	Least Concern (SARCA 2014)

Appendix C: Amphibians

Family	Species Name	Common Name	Conservation Status
Brevicepitidae	Breviceps sp.		
Brevicepitidae	Breviceps adspersus	Bushveld Rain Frog	Least Concern
Brevicepitidae	Breviceps mossambicus	Mozambique Rain Frog	Least Concern
Bufonidae	Poyntonophrynus fenoulheti	Northern Pygmy Toad	Least Concern
Bufonidae	Schismaderma carens	Red Toad	Least Concern
Bufonidae	Sclerophrys capensis	Raucous Toad	Least Concern
Bufonidae	Sclerophrys gutturalis	Guttural Toad	Least Concern (IUCN, 2016)
Bufonidae	Sclerophrys pusilla	Flatbacked Toad	Least Concern (IUCN, 2016)
Bufonidae	Vandijkophrynus gariepensis gariepensis	Karoo Toad (subsp. gariepensis)	
Hyperoliidae	Kassina senegalensis	Bubbling Kassina	Least Concern
Hyperoliidae	Semnodactylus wealii	Rattling Frog	Least Concern
Phrynobatrachidae	Phrynobatrachus natalensis	Snoring Puddle Frog	Least Concern (IUCN, 2013)
Pipidae	Xenopus laevis	Common Platanna	Least Concern
Ptychadenidae	Ptychadena anchietae	Plain Grass Frog	Least Concern
Ptychadenidae	Ptychadena porosissima	Striped Grass Frog	Least Concern
Pyxicephalidae	Amietia delalandii	Delalande's River Frog	Least Concern (2017)
Pyxicephalidae	Amietia fuscigula	Cape River Frog	Least Concern (2017)
Pyxicephalidae	Cacosternum boettgeri	Common Caco	Least Concern (2013)
Pyxicephalidae	Cacosternum nanum	Bronze Caco	Least Concern (2013)
Pyxicephalidae	Strongylopus fasciatus	Striped Stream Frog	Least Concern
Pyxicephalidae	Strongylopus grayii	Clicking Stream Frog	Least Concern
Pyxicephalidae	Tomopterna cryptotis	Tremelo Sand Frog	Least Concern
Pyxicephalidae	Tomopterna natalensis	Natal Sand Frog	Least Concern
Pyxicephalidae	Tomopterna tandyi	Tandy's Sand Frog	Least Concern

Appendix D: Lepidoptera (Moths and Butterflies)

Family	Species Name	Common Name	Conservation Status
Alucitidae	Alucita sp.		
CRAMBIDAE	Loxostege venustalis		Not listed
EREBIDAE	Cyligramma latona		Not listed
EREBIDAE	Estigmene lemniscata		Not listed
EREBIDAE	Estigmene trivitta		Not listed
EREBIDAE	Grammodes sp.		
EREBIDAE	Grammodes stolida		Not listed
EREBIDAE	Metarctia lateritia		
EREBIDAE	Rhodogastria similis		Not listed
EREBIDAE	Spilosoma lineatum		Not listed
EREBIDAE	Tumicla sagenaria		Not listed
EUPTEROTIDAE	Phyllalia patens		Not listed
GEOMETRIDAE	Mimoclystia pudicata pudicata		Not Threatened (NT) [not an IUCN category]
GEOMETRIDAE	Nassinia pretoria		Not Threatened (NT) [not an IUCN category]
GEOMETRIDAE	Zerenopsis lepida	Leopard magpie moth	Not Threatened (NT) [not an IUCN category]
HESPERIIDAE	Afrogegenes sp.		
HESPERIIDAE	Afrogegenes letterstedti	Brown dodger	Least Concern (SABCA 2013)
HESPERIIDAE	Coeliades forestan forestan	Striped policeman	Least Concern (SABCA 2013)
HESPERIIDAE	Kedestes barberae barberae	Freckled ranger	Least Concern (SABCA 2013)
HESPERIIDAE	Kedestes mohozutza	Fulvous ranger	Least Concern (SABCA 2013)
HESPERIIDAE	**Metisella meninx**	**Marsh Sylph**	**Vulnerable** (Henning, 2009)
HESPERIIDAE	Metisella willemi	Netted sylph	Least Concern (SABCA 2013)
HESPERIIDAE	Pelopidas thrax	White-branded swift	Least Concern (SABCA 2013)
HESPERIIDAE	Spialia ferax	Striped sandman	Least Concern (SABCA 2013)
HESPERIIDAE	Spialia mafa mafa	Mafa sandman	Least Concern (SABCA 2013)
HESPERIIDAE	Spialia spio	Mountain sandman	Least Concern (SABCA 2013)
LIMACODIDAE	Chrysopoloma sp.		
LYCAENIDAE	Actizera lucida	Rayed blue	Least Concern (SABCA 2013)
LYCAENIDAE	Anthene amarah amarah	Black-striped ciliate blue	Least Concern (SABCA 2013)
LYCAENIDAE	Anthene definita definita	Steel-blue-ciliate blue	Least Concern (SABCA 2013)
LYCAENIDAE	Azanus moriqua	Black-bordered babul blue	Least Concern (SABCA 2013)
LYCAENIDAE	Azanus ubaldus	Velvet-spotted babul blue	Least Concern (SABCA 2013)
LYCAENIDAE	Cacyreus fracta fracta	Water geranium bronze	Least Concern (SABCA 2013)
LYCAENIDAE	Cacyreus virilis	Mocker bronze	Least Concern (SABCA 2013)
LYCAENIDAE	Chrysoritis aethon	Lydenburg opal	Least Concern (SABCA 2013)
LYCAENIDAE	Cupidopsis jobates jobates	Tailed meadow blue	Least Concern (SABCA 2013)
LYCAENIDAE	Deudorix antalus	Brown playboy	Least Concern (SABCA 2013)
LYCAENIDAE	Eicochrysops messapus mahallakoaena	Cupreous ash blue	Least Concern (SABCA 2013)
LYCAENIDAE	Euchrysops dolorosa	Sabie smoky blue	Least Concern (SABCA 2013)
LYCAENIDAE	Euchrysops malathana	Grey smoky blue	Least Concern (SABCA 2013)
LYCAENIDAE	Hypolycaena philippus philippus	Purple-brown hairstreak	Least Concern (SABCA 2013)
LYCAENIDAE	Lampides boeticus	Pea blue	Least Concern (SABCA 2013)
LYCAENIDAE	Leptotes sp.		
LYCAENIDAE	Leptotes pirithous pirithous	Common zebra blue	Least Concern (SABCA 2013)
LYCAENIDAE	Lycaena clarki	Eastern sorrel copper	Least Concern (SABCA 2013)
LYCAENIDAE	Tarucus sybaris sybaris	Dotted pierrot	Least Concern (SABCA 2013)
LYCAENIDAE	Tuxentius melaena melaena	Black pie	Least Concern (SABCA 2013)
LYCAENIDAE	Zintha hintza hintza	Hintza pierrot	Least Concern (SABCA 2013)
LYCAENIDAE	Zizeeria knysna knysna	African grass blue	Least Concern (SABCA 2013)
LYCAENIDAE	Zizula hylax	Tiny grass blue	Least Concern (SABCA 2013)
METARBELIDAE	Arbelodes sp.		
NYMPHALIDAE	Acraea acara acara	Acara acraea	Least Concern (SABCA 2013)
NYMPHALIDAE	Acraea anemosa	Broad-bordered acraea	Least Concern (SABCA 2013)
NYMPHALIDAE	Acraea natalica	Black-based acraea	Least Concern (SABCA 2013)
NYMPHALIDAE	Acraea neobule neobule	Wandering donkey acraea	Least Concern (SABCA 2013)
NYMPHALIDAE	Aeropetes tulbaghia	Table mountain beauty	Least Concern (SABCA 2013)
NYMPHALIDAE	Brakefieldia perspicua perspicua	Marsh patroller	Least Concern (SABCA 2013)
NYMPHALIDAE	Byblia ilithyia	Spotted joker	Least Concern (SABCA 2013)
NYMPHALIDAE	Catacroptera cloanthe cloanthe	Pirate	Least Concern (SABCA 2013)
NYMPHALIDAE	Charaxes achaemenes achaemenes	Bushveld charaxes	Least Concern (SABCA 2013)
NYMPHALIDAE	Charaxes ethalion ethalion	Satyr charaxes	Least Concern (SABCA 2013)
NYMPHALIDAE	Charaxes vansoni	Van Son's charaxes	Least Concern (SABCA 2013)
NYMPHALIDAE	Danaus chrysippus orientis	African plain tiger	Least Concern (SABCA 2013)
NYMPHALIDAE	Dingana alticola	Red-banded widow	Least Concern (SABCA 2013)

NYMPHALIDAE	Hypolimnas misippus	Common diadem	Least Concern (SABCA 2013)
NYMPHALIDAE	Junonia hierta cebrene	Yellow pansy	Least Concern (SABCA 2013)
NYMPHALIDAE	Junonia oenone oenone	Dark blue pansy	Least Concern (SABCA 2013)
NYMPHALIDAE	Junonia orithya madagascariensis	African blue pansy	Least Concern (SABCA 2013)
NYMPHALIDAE	Paternympha narycia	Spotted-eye small ringlet	Least Concern (SABCA 2013)
NYMPHALIDAE	Phalanta phalantha aethiopica	African leopard	Least Concern (SABCA 2013)
NYMPHALIDAE	Precis archesia archesia	Garden inspector	Least Concern (SABCA 2013)
NYMPHALIDAE	Precis ceryne ceryne	Marsh commodore	Least Concern (SABCA 2013)
NYMPHALIDAE	Precis octavia sesamus	Southern gaudy commodore	Least Concern (SABCA 2013)
NYMPHALIDAE	Pseudonympha magoides	False silver-bottom brown	Least Concern (SABCA 2013)
NYMPHALIDAE	Pseudonympha varii	Mountain marsh brown	Least Concern (SABCA 2013)
NYMPHALIDAE	Stygionympha curlei	Marsh hillside brown	Least Concern (SABCA 2013)
NYMPHALIDAE	Stygionympha wichgrafi wichgrafi	Wichgraf's hillside brown	Least Concern (SABCA 2013)
NYMPHALIDAE	Telchinia anacreon	Orange telchinia	Least Concern (SABCA 2013)
NYMPHALIDAE	Telchinia rahira rahira	Marsh telchinia	Least Concern (SABCA 2013)
NYMPHALIDAE	Telchinia serena	Dancing telchinia	Least Concern (SABCA 2013)
NYMPHALIDAE	Vanessa cardui	Painted lady	Least Concern (SABCA 2013)
NYMPHALIDAE	Ypthima impura paupera	Impure three-ring	Least Concern (SABCA 2013)
PAPILIONIDAE	Papilio dardanus cenea	Mocker swallowtail	Least Concern (SABCA 2013)
PAPILIONIDAE	Papilio demodocus demodocus	Citrus swallowtail	Least Concern (SABCA 2013)
PIERIDAE	Belenois aurota	Pioneer caper white	Least Concern (SABCA 2013)
PIERIDAE	Belenois creona severina	African caper white	Least Concern (SABCA 2013)
PIERIDAE	Belenois zochalia zochalia	Forest caper white	Least Concern (SABCA 2013)
PIERIDAE	Catopsilia florella	African migrant	Least Concern (SABCA 2013)
PIERIDAE	Colias electo electo	African clouded yellow	Least Concern (SABCA 2013)
PIERIDAE	Colotis euippe omphale	Southern round-winged orange tip	Least Concern (LC)
PIERIDAE	Colotis ione	Bushveld purple tip	Least Concern (SABCA 2013)
PIERIDAE	Eronia cleodora	Vine-leaf vagrant	Least Concern (SABCA 2013)
PIERIDAE	Eurema brigitta brigitta	Broad-bordered grass yellow	Least Concern (SABCA 2013)
PIERIDAE	Eurema desjardinsii regularis	Angled Grass Yellow	Least Concern (SABCA 2013)
PIERIDAE	Eurema hecabe solifera	Lowveld Yellow	Least Concern (SABCA 2013)
PIERIDAE	Leptosia alcesta inalcesta	African Wood White	Least Concern (SABCA 2013)

PIERIDAE	Mylothris agathina agathina	Eastern Dotted Border	Least Concern (SABCA 2013)
PIERIDAE	Mylothris rueppellii haemus	Twin Dotted Border	Least Concern (SABCA 2013)
PIERIDAE	Pinacopteryx eriphia eriphia	Zebra White	Least Concern (SABCA 2013)
PIERIDAE	Pontia helice helice	Southern Meadow White	Least Concern (SABCA 2013)
PIERIDAE	Teracolus subfasciatus	Lemon Traveller	Least Concern (SABCA 2013)
SPHINGIDAE	Odontosida pusillus		

Appendix E: Potential Bird Species

FAMILY	SPECIES	COMMON NAME	CONSERVATION STATUS
Accipitridae	*Accipiter melanoleucus*	Black Sparrowhawk	LC
Accipitridae	*Accipiter rufiventris*	Rufous-chested Sparrowhawk	LC
Accipitridae	*Buteo buteo vulpinus*	Steppe Buzzard	LC
Accipitridae	*Buteo rufofuscus*	Jackal Buzzard	LC
Accipitridae	*Circaetus cinereus*	Brown Snake Eagle	LC
Accipitridae	*Elanus caeruleus*	Black-shouldered Kite	LC
Accipitridae	*Haliaeetus vocifer*	African Fish Eagle	LC
Accipitridae	*Lophaetus occipitalis*	Long-crested Eagle	LC
Accipitridae	*Milvus aegyptius*	Yellow-billed Kite	LC
Accipitridae	*Polyboroides typus*	African Harrier-Hawk	LC
Acrocephalidae	*Acrocephalus baeticatus*	African Reed-warbler	LC
Acrocephalidae	*Acrocephalus gracilirostris*	Lesser Swamp-warbler	LC
Acrocephalidae	*Iduna natalensis*	Dark-capped Yellow Warbler	LC
Alaudidae	*Calandrella cinerea*	Red-capped Lark	LC
Alaudidae	*Certhilauda semitorquata*	Eastern Long-billed Lark	LC
Alaudidae	*Chersomanes albofasciata*	Spike-heeled Lark	LC
Alaudidae	*Mirafra africana*	Rufous-naped Lark	LC
Alaudidae	*Mirafra fasciolata*	Eastern Clapper Lark	LC
Alcedinidae	*Alcedo cristata*	Malachite Kingfisher	LC
Alcedinidae	*Ceryle rudis*	Pied Kingfisher	LC
Alcedinidae	*Halcyon albiventris*	Brown-hooded Kingfisher	LC
Alcedinidae	*Ispidina picta*	African Pygmy-Kingfisher	LC
Alcedinidae	*Megaceryle maximus*	Giant Kingfisher	LC
Anatidae	*Alopochen aegyptiacus*	Egyptian Goose	LC
Anatidae	*Anas capensis*	Cape Teal	LC
Anatidae	*Anas erythrorhyncha*	Red-billed Teal	LC
Anatidae	*Anas sparsa*	African Black Duck	LC
Anatidae	*Anas undulata*	Yellow-billed Duck	LC
Anatidae	*Dendrocygna bicolor*	Fulvous Whistling Duck	LC
Anatidae	*Dendrocygna viduata*	White-faced Duck	LC
Anatidae	*Netta erythrophthalma*	Southern Pochard	LC
Anatidae	*Plectropterus gambensis*	Spur-winged Goose	LC
Anatidae	*Spatula hottentota*	Hottentot Teal	LC
Anatidae	*Spatula smithii*	Cape Shoveler	LC
Anatidae	*Tadorna cana*	South African Shelduck	LC
Anatidae	*Thalassornis leuconotus*	White-backed Duck	LC

Anhingidae	*Anhinga rufa*	African Darter	LC
Apodidae	*Apus affinis*	Little Swift	LC
Apodidae	*Apus apus*	Common Swift	LC
Apodidae	*Apus barbatus*	African Black Swift	LC
Apodidae	*Apus caffer*	White-rumped Swift	LC
Apodidae	*Apus horus*	Horus Swift	LC
Apodidae	*Cypsiurus parvus*	African Palm-swift	LC
Apodidae	*Tachymarptis melba*	Alpine Swift	LC
Ardeidae	*Ardea cinerea*	Grey Heron	LC
Ardeidae	*Ardea melanocephala*	Black-headed Heron	LC
Ardeidae	*Ardea purpurea*	Purple Heron	LC
Ardeidae	*Ardeola ralloides*	Squacco Heron	LC
Ardeidae	*Bubulcus ibis*	Cattle Egret	LC
Ardeidae	*Egretta ardesiaca*	Black Heron	LC
Ardeidae	*Egretta garzetta*	Little Egret	LC
Ardeidae	*Egretta intermedia*	Yellow-billed Egret	LC
Ardeidae	*Nycticorax nycticorax*	Black-crowned Night Heron	LC
Burhinidae	*Burhinus capensis*	Spotted Thick-knee	LC
Caprimulgidae	*Caprimulgus pectoralis*	Fiery-necked Nightjar	LC
Caprimulgidae	*Caprimulgus rufigena*	Rufous-cheeked Nightjar	LC
Caprimulgidae	*Caprimulgus tristigma*	Freckled Nightjar	LC
Charadriidae	*Charadrius tricollaris*	Three-banded Plover	LC
Charadriidae	*Vanellus armatus*	Blacksmith Lapwing	LC
Charadriidae	*Vanellus coronatus*	Crowned Lapwing	LC
Charadriidae	*Vanellus senegallus*	African Wattled Lapwing	LC
Ciconiidae	*Ciconia abdimii*	Abdim's Stork	LC
Ciconiidae	*Ciconia ciconia*	White Stork	LC
Cisticolidae	*Apalis thoracica*	Bar-throated Apalis	LC
Cisticolidae	*Cisticola aberrans*	Lazy Cisticola	LC
Cisticolidae	*Cisticola ayresii*	Wing-snapping Cisticola	LC
Cisticolidae	*Cisticola chiniana*	Rattling Cisticola	LC
Cisticolidae	*Cisticola cinnamomeus*	Pale-crowned Cisticola	LC
Cisticolidae	*Cisticola fulvicapilla*	Neddicky	LC
Cisticolidae	*Cisticola juncidis*	Zitting Cisticola	LC
Cisticolidae	*Cisticola lais*	Wailing Cisticola	LC
Cisticolidae	*Cisticola textrix*	Cloud Cisticola	LC
Cisticolidae	*Cisticola tinniens*	Levaillant's Cisticola	LC
Cisticolidae	*Prinia flavicans*	Black-chested Prinia	LC
Cisticolidae	*Prinia hypoxantha*	Drakensberg Prinia	LC
Cisticolidae	*Prinia subflava*	Tawny-flanke Prinia	LC
Coliidae	*Colius striatus*	Speckled Mousebird	LC
Coliidae	*Urocolius indicus*	Red-faced Mousebird	LC
Columbidae	*Columba arquatrix*	African Olive-pigeon	LC
Columbidae	*Columba guinea*	Speckled Pigeon	LC
Columbidae	*Columba livia*	Rock Dove	LC
Columbidae	*Oena capensis*	Namaqua Dove	LC

Columbidae	*Streptopelia capicola*	Cape Turtle-dove	LC
Columbidae	*Streptopelia semitorquata*	Red-eyed Dove	LC
Columbidae	*Streptopelia senegalensis*	Laughing Dove	LC
Columbidae	*Turtur chalcospilos*	Emerald-spotted Wood Dove	LC
Coraciidae	*Coracias garrulus*	European Roller	LC
Corvidae	*Corvus albus*	Pied Crow	LC
Corvidae	*Corvus capensis*	Cape Crow	LC
Cuculidae	*Centropus burchellii*	Burchell's Coucal	LC
Cuculidae	*Chrysococcyx caprius*	Diderick Cuckoo	LC
Cuculidae	*Chrysococcyx klaas*	Klaas's Cuckoo	LC
Cuculidae	*Cuculus clamosus*	Black Cuckoo	LC
Cuculidae	*Cuculus solitarius*	Red-chested Cuckoo	LC
Dicruridae	*Dicrurus adsimilis*	Fork-tailed Drongo	LC
Emberizidae	*Emberiza capensis*	Cape Bunting	LC
Emberizidae	*Emberiza flaviventris*	Golden-breasted Bunting	LC
Emberizidae	*Emberiza tahapisi*	Cinnamon-breasted Bunting	LC
Estrildidae	*Amadina erythrocephala*	Red-headed Finch	LC
Estrildidae	*Amandava subflava*	Orange-breasted Waxbill	LC
Estrildidae	*Coccopygia melanotis*	Swee Waxbill	LC
Estrildidae	*Estrilda astrild*	Common Waxbill	LC
Estrildidae	*Ortygospiza fuscocrissa*	African Qualfinch	LC
Estrildidae	*Spermestes cucullatus*	Bronze Mannikin	LC
Estrildidae	*Uraeginthus angolensis*	Blue Waxbill	LC
Falconidae	*Falco amurensis*	Amur Falcon	LC
Falconidae	*Falco biarmicus*	Lanner Falcon	LC
Falconidae	*Falco naumanni*	Lesser Kestrel	LC
Falconidae	*Falco peregrinus*	Peregrine Falcon	LC
Falconidae	*Falco rupicolus*	Rock Kestrel	LC
Fringillidae	*Crithagra atrogularis*	Black-throated Canary	LC
Fringillidae	*Crithagra gualris*	Streaky-headed Seedeater	LC
Fringillidae	*Crithagra mozambicus*	Yellow-fronted Canary	LC
Fringillidae	*Serinus canicollis*	Cape Canary	LC
Gruidae	***Anthropoides paradiseus***	**Blue Crane**	**VU**
Gruidae	***Balearica regulorum***	**Grey Crowned Crane**	**EN**
Hirundinidae	*Cecropis abyssinica*	Lesser striped swallow	LC
Hirundinidae	*Cecropis cucullata*	Greater Striped Swallow	LC
Hirundinidae	*Cecropis semirufa*	Red-breasted Swallow	LC
Hirundinidae	*Delichon urbicum*	Common House-martin	LC
Hirundinidae	*Hirundo albigularis*	White-throated Swallow	LC
Hirundinidae	*Hirundo dimidiata*	Pearl-breasted Swallow	LC
Hirundinidae	*Hirundo fuligula*	Rock Martin	LC
Hirundinidae	*Hirundo rustica*	Barn Swallow	LC
Hirundinidae	*Hirundo spilodera*	South African Cliff-swallow	LC

Hirundinidae	*Psalidoprocne holomelaena*	Black Saw-wing	LC
Hirundinidae	*Riparia cincta*	Banded Martin	LC
Hirundinidae	*Riparia paludicola*	Brown-throated Martin	LC
Indicatoridae	*Indicator indicator*	Greater Honeyguide	LC
Jacanidae	*Actophilornis africanus*	African Jacana	LC
Laniidae	*Lanius collaris*	Common (Southern) Fiscal	LC
Laniidae	*Lanius collurio*	Red-backed Shrike	LC
Laniidae	*Telophorus zeylonus*	Bokmakierie	LC
Laridae	*Childonias leucopterus*	White-winged Tern	LC
Laridae	*Chlidonias hybrida*	Whiskered Tern	LC
Laridae	*Chroicocephalus cirrocephalus*	Grey-headed Gull	LC
Leiothrichidae	*Turdoides jardineii*	Arrow-marked Babbler	LC
Locustellidae	*Bradypterus baboecala*	Little Rush-warbler	LC
Lybiidae	*Lybius torquatus*	Black-collared Barbet	LC
Lybiidae	*Trachyphonus vaillantii*	Crested Barbet	LC
Macrosphenidae	*Sphenoeacus afer*	Cape Grassbird	LC
Malaconotidae	*Dryoscopus cubla*	Black-backed Puffback	LC
Malaconotidae	*Laniarius ferrugineus*	Southern Boubou	LC
Malaconotidae	*Tchagra senegalus*	Black-crowned Tchagra	LC
Meropidae	*Merops apiaster*	European Bee-eater	LC
Meropidae	*Merops bullockoides*	White-fronted Bee Eater	LC
Monarchidae	*Terpsiphone viridis*	African Paradise-flycatcher	LC
Motacillidae	*Anthus cinnamomeus*	African Pipit	LC
Motacillidae	*Anthus vaalensis*	Buffy Pipit	LC
Motacillidae	*Macronyx capensis*	Cape Longclaw	LC
Motacillidae	*Motacilla aguimp*	African Pied Wagtail	LC
Motacillidae	*Motacilla capensis*	Cape Wagtail	LC
Muscicapidae	*Campicoloides bifasciatus*	Buff-streaked Chat	LC
Muscicapidae	*Cercomela familiaris*	Familiar Chat	LC
Muscicapidae	*Cossypha caffra*	Cape Robin-chat	LC
Muscicapidae	*Melaenornis silens*	Fiscal Flycatcher	LC
Muscicapidae	*Monticola rupestris*	Cape Rock-thrush	LC
Muscicapidae	*Muscicapa striata*	Spotted Flycatcher	LC
Muscicapidae	*Myrmecocichla formicivora*	Anteating Chat	LC
Muscicapidae	*Oenanthe bisfasciata*	Buff-streaked Chat	LC
Muscicapidae	*Oenanthe monticola*	Mountain Wheatear	LC
Muscicapidae	*Oenanthe pileata*	Capped Wheatear	LC
Muscicapidae	*Saxicola torquatus*	African Stonechat	LC
Muscicapidae	*Thamnolaea cinnamomeiventris*	Mocking Cliff-chat	LC
Nectariniidae	*Chalcomitra amethystina*	Amethyst Sunbird	LC
Nectariniidae	*Cinnyris afer*	Greater Double-collared Sunbird	LC
Nectariniidae	*Cinnyris talatala*	White-bellied Sunbird	LC

Nectariniidae	*Nectarinia famosa*	Malachite Sunbird	LC
Numididae	*Numida meleagris*	Helmeted Guineafowl	LC
Oriolidae	*Oriolus larvatus*	Black-headed Oriole	LC
Otididae	***Eupodotis caerulescens***	**Blue Korhaan**	**NT**
Passeridae	*Passer diffusus*	Southern Grey-headed Sparrow	LC
Passeridae	*Passer domesticus*	House Sparrow	LC
Passeridae	*Passer melanurus*	Cape Sparrow	LC
Phalacrocoraci dae	*Phalacrocorax africanus*	Reed Cormorant	LC
Phalacrocoraci dae	*Phalacrocorax carbo*	White-breasted Cormorant	LC
Phasianidae	*Coturnix coturnix*	Common Quail	LC
Phasianidae	*Peliperdix coqui*	Coqui Francolin	LC
Phasianidae	*Pternistis natalensis*	Natal Spurfowl	LC
Phasianidae	*Pternistis swainsonii*	Swainson's Spurfowl	LC
Phasianidae	*Scleroptila afra*	Grey-winged Francolin	LC
Phasianidae	*Scleroptila levaillantii*	Red-winged Francolin	LC
Phoenicopteri dae	***Phoeniconaias minor***	**Lesser Flamingo**	**NT**
Phoeniculidae	*Phoeniculus purpureus*	Green Wood-hoopoe	LC
Phylloscopidae	*Phylloscopus trochilus*	Willow Warbler	LC
Picidae	*Dendropicos fuscescens*	Cardinal Woodpecker	LC
Picidae	*Jynx ruficollis*	Red-throated Wryneck	LC
Platysteiridae	*Batis molitor*	Chinspot Batis	LC
Ploceidae	*Amblyospiza albifrons*	Thick-billed Weaver	LC
Ploceidae	*Euplectes afer*	Yellow-crowned Bishop	LC
Ploceidae	*Euplectes albonotatus*	White-winged Widowbird	LC
Ploceidae	*Euplectes ardens*	Red-collared Widowbird	LC
Ploceidae	*Euplectes axillaris*	Fan-tailed Widowbird	LC
Ploceidae	*Euplectes capensis*	Yellow Bishop	LC
Ploceidae	*Euplectes orix*	Southern Red Bishop	LC
Ploceidae	*Euplectes progne*	Long-tailed Widowbird	LC
Ploceidae	*Ploceus capensis*	Cape Weaver	LC
Ploceidae	*Ploceus cucullatus*	Village Weaver	LC
Ploceidae	*Ploceus velatus*	Southern Masked Weaver	LC
Ploceidae	*Quelea quelea*	Red-billed Quelea	LC
Podicipedidae	*Podiceps cristatus*	Great Crested Grebe	LC
Podicipedidae	*Tachybaptus ruficollis*	Little Grebe	LC
Pycnonotidae	*Pycnonotus tricolor*	Dark-capped Bulbul	LC
Rallidae	*Amaurornis flavirostris*	Black Crake	LC
Rallidae	*Fulica cristata*	Red-knobbed Coot	LC
Rallidae	*Gallinula chloropus*	Common Moorhen	LC
Rallidae	*Porphyrio madagascariensis*	African Purple Swamphen	LC
Rallidae	*Rallus caerulescens*	African Rail	LC
Recurvirostrida e	*Himantopus himantopus*	Black-winged Stilt	LC
Sarothruridae	*Sarothrura rufa*	Red-chested Flufftail	LC

Scolopacidae	*Calidris minuta*	Little Stint	LC
Scolopacidae	*Calidris pugnax*	Ruff	LC
Scolopacidae	*Gallinago nigripennis*	African Snipe	LC
Scolopacidae	*Tringa glareola*	Wood Sandpiper	LC
Scolopacidae	*Tringa nebularia*	Common Greenshank	LC
Scopidae	*Scopus umbretta*	Hamerkop	LC
Strigidae	*Asio capensis*	Marsh Owl	LC
Strigidae	*Bubo africanus*	Spotted Eagle-Owl	LC
Struthionidae	*Struthio camelus*	Common Ostrich	LC
Sturnidae	*Acridotheres tristis*	Common Myna	LC
Sturnidae	*Cinnyricinclus leucogaster*	Violet-backed Starling	LC
Sturnidae	*Creatophora cinerea*	Wattled Starling	LC
Sturnidae	*Lamprotornis bicolor*	Pied Starling	LC
Sturnidae	*Lamprotornis nitens*	Cape glossy Starling	LC
Sturnidae	*Onchognathus morio*	Red-winged Starling	LC
Threskiornithid ae	*Bostrychia hagedash*	Hadeda Ibis	LC
Threskiornithi dae	***Geronticus calvus***	**Southern Bald Ibis**	**VU**
Threskiornithid ae	*Platalea alba*	African Spoonbill	LC
Threskiornithid ae	*Threskiornis aethiopicus*	African Sacred Ibis	LC
Turdidae	*Turdus libonyana*	Kurrichane Thrush	LC
Turdidae	*Turdus litsitsirupa*	Groundscraper Thrush	LC
Turdidae	*Turdus olivaceus*	Olive Thrush	LC
Turdidae	*Turdus smithi*	Karoo Thrush	LC
Tytonidae	*Tyto alba*	Barn Owl	LC
Upupidae	*Upupa africana*	African Hoopoe	LC
Viduidae	*Anomalospiza imberbis*	Cuckoo Finch	LC
Viduidae	*Vidua macroura*	Pin-tailed Whydah	LC
Viduidae	*Vidua paradisaea*	Long-tailed Paradise Whydah	LC
Zosteropidae	*Zosterops capensis*	Cape White-eye	LC

Appendix F: Plant Species Expected to Occur

Family	Species Name	IUCN Status
Lamiaceae	*Aeollanthus buchnerianus*	LC
Lamiaceae	*Ailanthus altissima*	LC
Orobanchaceae	*Alectra sessiliflora*	LC
Lythraceae	*Ammannia schinzii*	LC
Poaceae	*Aristida junciformis*	LC
Poaceae	*Brachiaria eruciformis*	LC
Bryaceae	*Bryum argenteum*	LC
Cyperaceae	*Bulbostylis densa subsp. afromontana*	LC
Cyperaceae	*Bulbostylis hispidula subsp. pyriformis*	LC
Poaceae	*Calamagrostis epigejos subsp. capensis*	LC
Compositae	*Cineraria parvifolia*	LC
Asteraceae	*Cirsium vulgare**	LC
Cucurbitaceae	*Citrullus lanatus*	LC
Commelinaceae	*Commelina africana var. krebsiana*	LC
Commelinaceae	*Commelina benghalensis*	LC
Commelinaceae	*Commelina subulata*	LC
Apocynaceae	*Cordylogyne argillicola*	LC
Cyperaceae	*Cyperus congestus*	LC
Cyperaceae	*Cyperus esculentus var. esculentus*	LC
Cyperaceae	*Cyperus longus subsp. longus*	LC
Cyperaceae	*Cyperus rupestris*	LC
Cyperaceae	*Cyperus squarrosus*	LC
Poaceae	*Digitaria eriantha*	LC
Poaceae	*Digitaria sanguinalis*	LC
Poaceae	*Digitaria tricholaenoides*	LC
Orchidaceae	*Disa woodii*	LC
Poaceae	*Echinochloa jubata*	LC
Poaceae	*Echinochloa pyramidalis*	LC
Poaceae	*Eleocharis dregeana*	LC
Poaceae	*Eragrostis curvula*	LC
Poaceae	*Eragrostis lappula*	LC
Poaceae	*Eragrostis lehmanniana*	LC
Poaceae	*Eragrostis virescens*	LC
Ericaceae	*Erica drakensbergensis*	LC
Asteraceae	*Erigeron canadensis**	LC
Iridaceae	*Gladiolus crassifolius*	LC
Fabaceae	*Gleditsia triacanthos**	LC
Orchidaceae	*Habenaria epipactidea*	LC
Orchidaceae	*Habenaria filicornis*	LC
Orchidaceae	*Habenaria nyikana*	LC
Orchidaceae	*Habenaria schimperiana*	LC
Pedaliaceae	*Harpagophytum zeyheri subsp. zeyheri*	LC
Poaceae	*Harpochloa falx*	LC
Scrophulariaceae	*Hebenstretia angolensis*	LC
Asteraceae	*Helichrysum difficile*	LC
Asteraceae	*Helichrysum mixtum*	LC
Asteraceae	*Helichrysum rugulosum*	LC
Asteraceae	*Helichrysum stenopterum*	LC
Poaceae	*Heteropogon contortus*	LC
Poaceae	*Hyparrhenia anamesa*	LC
Asteraceae	*Hypochaeris radicata*	LC
Fabaceae	*Indigofera melanadenia*	LC
Cyperaceae	*Isolepis setacea*	LC
Juncaceae	*Juncus dregeanus subsp. dregeanus*	LC
Juncaceae	*Juncus lomatophyllus*	LC
Aiozazeae	*Khadia carolinensis*	**VU**
Asteraceae	*Lactuca inermis*	LC
Hyacinthaceae	*Ledebouria cooperi*	LC
Poaceae	*Leersia hexandra*	LC
Poaceae	*Leptochloa fusca*	LC
Hyacinthaceae	*Merwilla natalensis*	**NT**
Geraniaceae	*Monsonia angustifolia*	LC
Amaryllidaceae	*Nerine rehmannii*	LC
Nymphaeaceae	*Nymphaea nouchali*	LC
Oleaceae	*Olea europaea**	LC
Ophioglossaceae	*Ophioglossum polyphyllum*	LC
Asteraceae	*Osteospermum muricatum subsp. muricatum*	LC
Geraniaceae	*Pelargonium luridum*	LC
Rubiaceae	*Pentanisia angustifolia*	LC
Caryophyllaceae	*Pollichia campestris*	LC
Polygalaceae	*Polygala africana*	LC
Polygalaceae	*Polygala hottentotta*	LC
Asteraceae	*Pseudognaphalium oligandrum*	LC
Asteraceae	*Pulicaria scabra*	LC
Ricciaceae	*Riccia stricta*	LC
Asteraceae	*Schistostephium crataegifolium*	LC
Gentianaceae	*Sebaea grandis*	LC
Scrophulariaceae	*Selago densiflora*	LC
Asteraceae	*Seriphium plumosum*	LC
Poaceae	*Setaria sphacelata var. torta*	LC

Solanaceae	*Solanum elaeagnifolium*	LC
Solanaceae	*Solanum lichtensteinii*	LC
Solanaceae	*Solanum nigrum*	LC
Solanaceae	*Solanum pseudocapsicum*	LC
Orobanchaceae	*Striga asiatica*	LC
Lamiaceae	*Syncolostemon pretoriae*	LC
Asteraceae	*Tagetes minuta**	LC
Asphodelaceae	*Trachyandra reflexipilosa*	LC
Poaceae	*Tristachya leucothrix*	LC
Fabaceae	*Vachellia tenuispina*	LC
Campanulaceae	*Wahlenbergia banksiana*	LC
Campanulaceae	*Wahlenbergia undulata*	LC
Leguminosae-Papilionoideae	*Zornia linearis*	LC

*Denotes Alien Invasive Species

Appendix G: GPS Location of Floral SCC

Description	Latitude	Longitude	Project Site/Portion
Aloe ecklonis	-25.864003	30.010797	EFN
Eucomis autumnalis	-25.860806	30.023425	EFN
Gladioulus crassifolius	-25.860091	30.023813	EFN
Brunsvigia radulosa	-25.844189	30.024252	EFN
Watsonia lepida	-25.844009	30.024223	EFN
Agapanthus inapertus	-25.741602	29.996281	40
Aloe ecklonis	-25.729033	30.007399	40, 2, 29
Aloe ecklonis	-25.741662	29.996673	40, 2, 30
Aloe ecklonis	-25.741733	29.996609	40, 2, 31
Aloe ecklonis	-25.740949	29.99522	40, 2, 32
Aloe ecklonis	-25.748612	29.996895	40, 2, 33
Aloe ecklonis	-25.749734	29.977553	40, 2, 34
Aloe ecklonis	-25.749675	29.977137	40, 2, 35
Aloe ecklonis	-25.75281	29.974122	40, 2, 36
Aloe ecklonis	-25.752345	29.974163	40, 2, 37
Aloe ecklonis and Eucomis autumnalis	-25.74168	29.996084	40
Aloe ecklonis and Eucomis autumnalis	-25.741544	29.995942	40
Aloe ecklonis and Eucomis autumnalis	-25.741062	29.996514	40
Aloe ecklonis and Eucomis autumnalis	-25.741095	29.996739	40
Babiana bainesii	-25.720467	30.019978	13
Boophone disticha	-25.717814	30.023116	13, 2
Boophone disticha	-25.715195	30.02184	13, 3
Boophone disticha	-25.753732	29.973711	13, 4
Boophone disticha	-25.753253	29.973867	13, 5
Boophone disticha	-25.753291	29.973741	13, 6
Boophone disticha	-25.753304	29.973709	13, 7
Boophone disticha	-25.753387	29.973661	13, 8
Cave/Shaft	-25.754445	29.981454	2
Cave/Shaft	-25.753758	29.981981	2
Crinum bulbispermum	-25.719615	30.018086	13,40,30
Crinum bulbispermum	-25.744018	30.003781	13,40,31
Crinum bulbispermum	-25.725832	30.002367	13,40,32
Dierama pictum	-25.735836	29.990265	28
Eucomis autumnalis	-25.741256	29.997568	40
Eucomis autumnalis	-25.741262	29.997642	40
Eucomis autumnalis	-25.741294	29.997704	40

DIGBY WELLS ENVIRONMENTAL

Eucomis autumnalis	-25.741427	29.997345	40
Eucomis autumnalis	-25.741469	29.997326	40
Eucomis autumnalis	-25.741541	29.997399	40
Eucomis autumnalis	-25.741556	29.997492	40
Eucomis autumnalis	-25.741771	29.996682	40
Eucomis autumnalis	-25.74131	29.995489	40
Eucomis autumnalis	-25.709004	29.996873	40
Eucomis autumnalis	-25.714146	29.995631	40
Eucomis autumnalis	-25.746236	30.000247	40
Eucomis autumnalis	-25.746163	30.000265	40
Eucomis autumnalis	-25.745494	30.000386	40
Eucomis autumnalis	-25.745072	30.000317	40
Eulophia welwitschii	-25.72498	29.994289	30
Gladioulus crassifolius	-25.709234	29.99967	5
Gladioulus dalenii	-25.741441	29.997353	40
Haemanthus humilis	-25.719692	30.022864	13
Kniphofia typhoides	-25.750935	29.989617	2
Mossia intervallaris	-25.752841	29.973205	2
Watsonia lepida	-25.709036	29.999467	5, EFN

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Appendix B: Impact Assessment Methodology

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or highly sensitive environments. Irreplaceable damage to highly sensitive cultural/social resources.	Noticeable, on-going natural and/or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or moderate to highly sensitive environments. Irreplaceable damage to cultural/social resources of moderate to highly sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Serious loss and/or damage to physical or biological resources or highly sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.

Biodiversity Impact Assessment
Biodiversity Impact Assessment for the North Block Complex (Pty) Ltd NBC Colliery
UCD6860

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
4	Serious loss and/or damage to physical or biological resources or moderately sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures/items of cultural significance.	Average to intense natural and/or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Significance

Probability	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3

Probability	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
7	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

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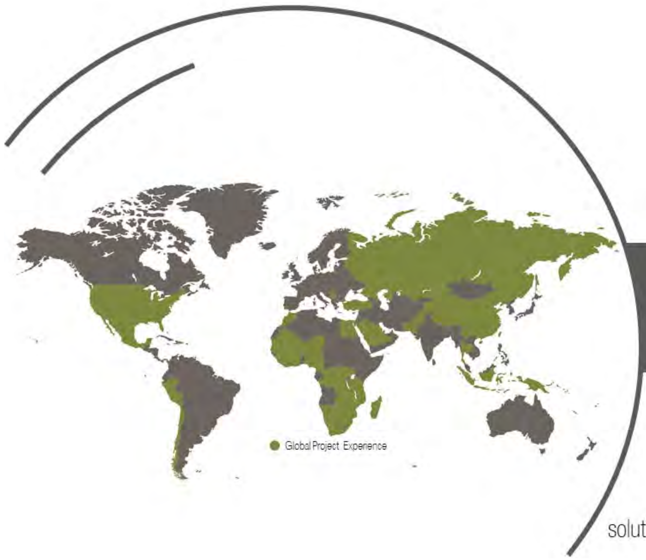
Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to the long-term effect on the natural and/or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short-term effects on the natural and/or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development from being approved. These impacts will result in negative medium to short-term effects on the natural and/or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to the long-term effect on the natural and/or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)



DIGBY WELLS ENVIRONMENTAL

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Biodiversity Land Management Plan for the NBC Complex

Biodiversity Land Management Plan

Prepared for:

Universal Coal (Pty) Ltd

Project Number:

UCD6860

April 2021

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This document has been prepared by Digby Wells Environmental.

Report Type:	Biodiversity Land Management Plan
Project Name:	Biodiversity Land Management Plan for the NBC Complex
Project Code:	UCD6860

Name	Responsibility	Signature	Date
Lisa Hester	Report Compiler		19 April 2021
Stephen Burton	Report Review		19 April 2021

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1 Biodiversity Land Management Plan

The content of this document is based on the fauna and flora findings from the biodiversity baseline assessment for the portions constituting the Paardeplaast 380 JS and the Eerstelingsfontein (EFN) 406 farms (hereafter referred to as the 'Project area'). For the purpose and practicality of this Land Management Plan, tailored recommendations and management measures will be discussed and listed per farm portion within the Project area. This document should be read as an annexure to the Biodiversity Impact Assessment. The ecological impacts associated with the current and potential mining activities are included in Section 8 of the impact assessment referred to above. Key concerns found within the Project area are listed below:

- High levels of sedimentation within Portion 5 (Glisa);
- Alien Invasive Plant (AIP) proliferation;
- Erosion;
- Degradation of important landscapes such as wetlands and rocky outcrops;
- Presence of sensitive landscapes and ecosystems; and
- Presence of Species of Conservation Concern (SCC).

1.1 Land management Plan Objectives

The content of this document expands on, and makes intensive use of, the data collected as part of the baseline study and Biodiversity Impact Assessment (BIA) (Digby Wells, 2021)

The fauna and flora survey in December 2020 recorded several SCC, sensitive ecosystems and niche habitats. The objective of this report is to therefore outline priority areas and to:

- Ensure clearing of SCC and/or communities is avoided within regulator approved clearing areas to an extent that it is reasonably practical;
- Ensure no unauthorised disturbances occur;
- Ensure AIP sprawl and proliferation is contained and monitored;
- Protect the diversity and distribution of floral SCC and sensitive ecosystems and habitats within the area of influence;
- Promote the creation of ecological corridors;
- Manage impacts to conserve faunal and floral SCC as well as ensuring rehabilitation of disturbed areas and ecosystems to improve the overall biodiversity.

1.2 Biodiversity Planning

At present, mining is currently taking place in portions 1, 2, 3 ,4, 5, 24 and expanding into 30 of the Paardeplaats JS 380, whereas EFN has previously been mined and then rehabilitated. Digby Wells has been informed that mining activities will persist through the remaining portions

of the Paardeplaats region. In completing a BIA related to open cast mining and the mitigation of expected impacts, many of the objectives within the mitigation hierarchy have been achieved (avoidance, minimization and mitigation). Achieving the objectives laid out in this Land Management Plan will enhance the biodiversity of the Project area and mitigate the negative impacts imparted by the mining activities. Sensitive ecological communities and habitats sustain most of the SCC identified within the Project area, they consist of the Rocky Outcrops and Wetland communities. Biodiversity conservation involves the incorporation of the following aspects:

- Awareness: raising awareness regarding the biodiversity sensitivities and issues amongst the mining officials and employees will benefit biodiversity conservation.
- Monitoring: on-going monitoring to detect changes in the ecological functioning of systems over extensive periods of time.
- Rehabilitation: with the aim to re-establish and/or supplement habitats that have been altered and impacted, as well as re-colonizing these habitats with endemic and indigenous species.

Priority areas have been highlighted as areas with high sensitivity and are depicted in the Sensitivity Map (Figure 7-1). Table 1-1 discusses the measures and recommendations to mitigate the negative impacts form the mining activities.

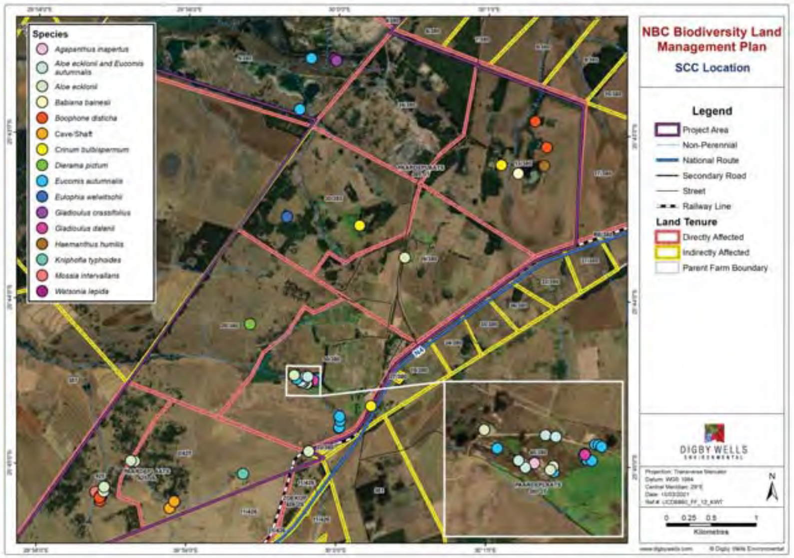

Figure 1-1: Land Tenure Map for the Paardeplaats 380 JS

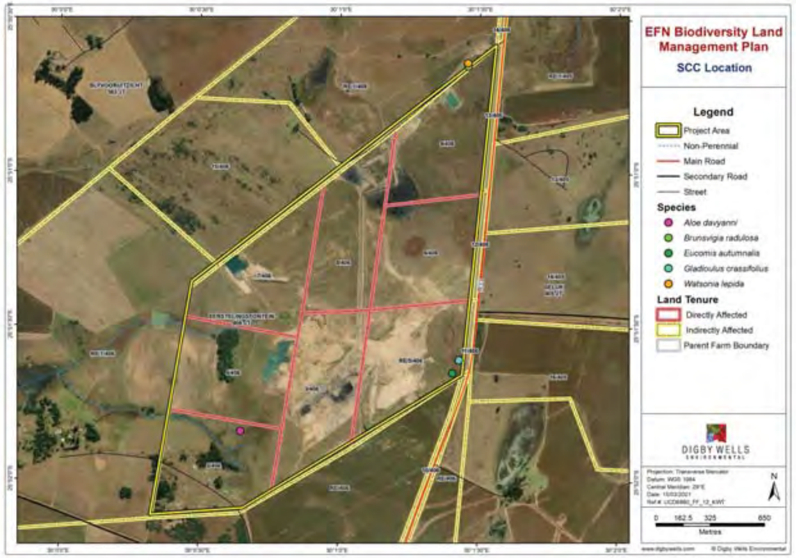

Figure 1-2: Land Tenure Map for the Eerstelingfontein 406

Table 1-1: Land Management Plan

Farm Portion	Current State Description		Impacts	Recommended Mitigation Measures	Action Plan	Person Responsible	Biodiversity Sensitivity
Glisa Mine (1, 2, 3, 4, & 5)/830	Fauna	These portions have been significantly altered from their original (or natural) state. Large extents of erosion, sedimentation, and AIP proliferation were observed in these portions. Very little faunal activity was observed during the site assessment and it is evident that due to habitat alterations, the portions provide little to no use to most faunal species. However, one SCC, the Vulnerable Marsh Sylph, was recorded in the Unchanneled Valley Bottom Wetland (See Section 6.4.4). Colonies of *Leersia hexandra* were recorded in the wetland, this grass provides suitable sustenance for the Marsh Sylph.	• AIP sprawl; • Contamination of water bodies; • Dust pollution; • Erosion; and • Loss of fauna and floral biodiversity.	The geomorphology and hydrology of the wetlands have been impacted severely, and in such a way that rehabilitation may be difficult and costly (involving gabions, engineered stormwater channels). Thus, the aspects that can be improved substantially are the biodiversity, vegetation, soils and water quality. Ecosystem services (ES) can potentially be improved through this mechanism. For example: • Introducing species that will provide habitat for biodiversity thereby improving the health (Present Ecological Score - PES) of the wetland as well as increasing biodiversity maintenance of the wetland; • Water-loving AIP species impact the hydrology of the wetland and AIPs also tend to proliferate creating homogenous landscapes, thereby reducing biodiversity. By removing AIPs, improvements are possible relating to the hydrology and vegetation aspects of the PES. The biodiversity maintenance ES is improved though this; • Removal and disposal of sedimentation to registered landfill sites. The area should then be topsoiled with soils naturally occurring within the area and subsequent revegetation must follow; • To prevent erosion gullies, ensure reseeding and rehabilitation of bare patches with species that form part of the regional vegetation (Section 6.1) • Reconstruct faunal habitat refugia, such as placement of waste overburden material that will imitate a rocky outcrop habitat to provide refugia for cryptic species such as herpetofauna. It is recommended that a Wetland Rehabilitation Plan be implemented, this plan will entail quarterly biomonitoring of the soils, water, and biodiversity (flora and fauna) to detect significant fluctuations in the biological and ecological environment.	• Compile a Wetland Rehabilitation Plan; • Compile and implement an AIP Management Plan; • Conduct a Soil Contamination Assessment to determine and measure the source of sediment and develop measures to rehabilitate the contamination; • Compile a Waste Management Plan to ensure the correct disposal of waste material and an action plan for spillages and runoff from the mining activities; • Awareness programmes: raising awareness regarding biodiversity issues as part of an ongoing program to educate and train mining officials. • Ensure quarterly biomonitoring of the NBC Complex to detect changes on the biodiversity. • Implement and maintain adequate dust suppression and monitor throughout the life of the mine.	• Environmental Officer and Consultants	Moderate
	Flora	The field assessment did not encounter floral SCC. The area has been heavily altered from its' natural state and this has resulted in fragmentation and degradation of the identified regional vegetation. AIP proliferation has subsequently lowered the species diversity					
	Wetlands	A series of wetlands have previously been delineated and identified by various consultants (see Section 6.3.1.4). The freshwater watercourses within these portions have been heavily modified as a result of the surrounding mining activities. Impacts including sedimentation, AIP proliferation and erosion.					
24/380	Fauna	No faunal SCC were encountered within this portion. Evidence of grazing and rooting from Bushpig and Scrub Hare was apparent with no other signs of cattle grazing. Mining activities from	• AIP sprawl; • Dust pollution;	The mining activities has significantly altered the natural environment and has resulted in AIP sprawl. Priority pro-active	• Awareness programmes: raising awareness regarding	Environmental Officer and Consultants	Low

Farm Portion	Current State Description		Impacts	Recommended Mitigation Measures	Action Plan	Person Responsible	Biodiversity Sensitivity
		the Glisa portion has extended into this portion and has resultantly deterred many faunal species	• Contamination of water bodies; • Loss of fauna and floral biodiversity.	measures should be centralised around the remaining sensitive landscapes or features within this portion. Measures should include: • Avoidance of highly sensitive wetland habitats and rocky outcrops; • Permits will be required for the removal and/or destruction of the *Khadia carolinensis;* • Continually remove all categorised AIP species to prevent spread. Veld management should also ensure that any other weedy species, whether alien or not, should be managed; • The natural vegetated areas should be linked as far as is possible so that species can move freely. Buffer areas should be constructed around the natural areas to promote ecological corridors; • Supress dust on the haul and travel roads; and • Construct underpasses (beneath roads) that will provide potential linkages and corridors between the wetland systems. This will promote wildlife movement to move safely during high flow conditions.	biodiversity issues as part of an ongoing program to educate and train mining officials. • Compile and implement an AIP Management Plan; • If necessary, permit applications from the local authorities for the removal and/or destruction of floral SCC.		
	Flora	Floral SCC, *Khadia carolinensis* (VU) was previously recorded by De Castro & Brits (2020) on the sandstone of the 'sheetrock wetland'. Additionallly, *Eucomis autumnalis* was recorded on the footslopes of the 'sheetrock wetland'. The identified wetland is encapsulated by mining activities and dense stands of AIPs consisting of *Eucalyptus viminalis* and *Acacia mearnsii*. The high density of the AIP has altered the hydrological reggime of the wetland.					
13/380	Fauna	Portion 13 has previous recordings of the Grey Crowned Crane (EN) (Section 6.4.2). habitats that support numerous faunal species are located within this portion and include wetlands, grasslands and rocky outcrops. Numerous waterfowl were observed in the artificial dams as they serve as sustenance and breeding grounds for numerous avifaunal species.	• Loss of fauna and floral biodiversity. • Loss of sensitive ecosystems. • Water contamination. • AIP sprawl.	• A 200m protective buffer should be applied to the wetlands within this portion. This conservative buffer has been drafted by the Mpumalanga Wetland Forum as Grey Crowned Crane are selected as an indicator species for wetlands. This buffer will protect the catchment of the wetlands servicing the Cranes, as well as protect the birds from noise, pollution and activities associated with the mine; • Reconstruct faunal habitat refugia, such as placement of waste overburden material that will imitate a rocky outcrop habitat to provide refugia for cryptic species such as herpetofauna. Rock refugia must be replaced; • If removal of wetlands is to occur in this portion, provisions for a Wetland Rehabilitation Plan (as mentioned above) will need to me made; • Water contamination may occur due to the surrounding mining activities thus water contamination prevention is essential and will entail the following: o All dirty water will have to be drained into Pollution Control Dams (PCD), which includes processed, storm and mine waste waters; o Maintenance of trenches, ensuring no seepage into local aquifers; and o Remove used oil and other hazardous liquid wastes for appropriate disposal by a contractor at licensed disposal sites. • Continually remove all categorised AIP species to prevent spread. Veld management should also ensure that any	• Awareness programmes: raising awareness regarding biodiversity issues as part of an ongoing program to educate and train mining officials. • Compile and implement an AIP Management Plan; • If necessary, permit applications from the local authorities for the removal and/or destruction of floral SCC. • Ensure quarterly biomonitoring of the NBC Complex to detect changes on the biodiversity.	Environmental Officer and Consultants	High
	Flora	Floral SCC, *Boophone disticha, Crinum bulbispermum, Gladiolus dalenii,* and *Haemanthus humilis*, were recorded in this farm portion in and amongst rocky outcrops. These habitats host a high floral diversity and support very specialised vegetation communities and biota relative to their size. It was evident that edge effects of the surrounding AIP sprawl was enclosing the remaining extent of the portion. *Eucalyptus* sp and *Populus* sp are encroaching and intervention is required to contain the spread.					

Farm Portion	Current State Description		Impacts	Recommended Mitigation Measures	Action Plan	Person Responsible	Biodiversity Sensitivity
				other weedy species, whether alien or not, should be managed; • Avoidance of highly sensitive wetland habitats and rocky outcrops; • Permits are required for the removal and/or destruction of the floral SCC identified within this portion; • Fire management plan is recommended in case of uncontrolled fires during the dry season; and • Ensure subsistence hunting and poaching is not taking place. This can be done by regular and periodic monitoring of fences and internal areas for snares, and suspicious human activity.			
30/380	Fauna	No faunal SCC were encountered during the site survey in December 2020. Many exotic stands were observed negatively impacting indigenous faunal assemblages.	• Water contamination. • AIP sprawl. • Loss of floral SCC. • Loss of sensitive ecosystems.	• Permits are required for the removal and/or destruction of the floral SCC identified within this portion; • Continually remove all categorised AIP species to prevent spread. Veld management should also ensure that any other weedy species, whether alien or not, should be managed; • Water contamination may occur due to the surrounding mining activities thus water contamination prevention is essential and will entail the following: o All dirty water will have to be drained into Pollution Control Dams (PCD), which includes processed, storm and mine waste waters; o Maintenance of trenches, ensuring no seepage into local aquifers; and o Remove used oil and other hazardous liquid wastes for appropriate disposal by a contractor at licensed disposal sites. • If removal of wetlands is to occur in this portion, provisions for a Wetland Rehabilitation Plan (as mentioned above) will need to me made.	• If necessary, permit applications from the local authorities for the removal and/or destruction of floral SCC. • Water Contamination Prevention. • Compile and implement an AIP Management Plan; • Wetland Rehabilitation Plan.	Environmental Officer and Consultants	Moderate
	Flora	Two floral SCC were encountered, *Eulophia welwitschia* and *Crinum bulbispermum* in the open grassland adjacent to the exotic stands of AIPs. The dense exotic stands have impacted the hydrological regime of the previously delineated wetlands (Tony de Castro, 2020).					
29/30	Fauna	This area has homestead settlements and is currently being utilized by the residents. Majority of the portion has been previously cultivated and as a result of the transformations, indigenous fauna was expectantly low.	• AIP sprawl. • Loss of floral SCC.	• Permits are required for the removal and/or destruction of the floral SCC identified within this portion; • Continually remove all categorised AIP species to prevent spread. Veld management should also ensure that any other weedy species, whether alien or not, should be managed; • Vegetation management is required and entails a soil fertility test to determine ameliorant requirements and reseeding with indigenous seed mix; • Avoidance of highly sensitive wetland habitats and rocky outcrops.	• If necessary, permit applications from the local authorities for the removal and/or destruction of floral SCC. • AIP Management Plan	Environmental Officer and Consultants	Low
	Flora	The previous land activities have altered the indigenous floral composition and many landscapes are carpeted with *Pennisetum clandestinum*. One floral SCC, *Zantedeschia pentlandii*, was encountered among discarded rubble					
28/380	Fauna	Majority of the faunal observations were observed in this portion and portion 40. A long stretch of the rocky sheath is exposed and transects along the		• It is recommend that ongoing monitoring programs be implemented during the operation of the mine. The	• Mammalian Monitoring Programs.	Environmental Officer and Consultants	High

Farm Portion	Current State Description		Impacts	Recommended Mitigation Measures	Action Plan	Person Responsible	Biodiversity Sensitivity
		two portions. The rocky outcrop is renowned for providing habitat and steppingstone habitats for numerous faunal assemblages (discussed in Section 6.3.1.3). The sensitive landscapes were marked with a high sensitivity as high faunal activity was observed along the sheaths and faunal SCC were recorded within these margins.	• Loss of fauna and floral biodiversity. • Loss of sensitive ecosystems. • Water contamination. • AIP sprawl. • Monitoring programs of small mammals.	monitoring programs should be centred around key species (predators and keystone species (faunal SCC)). The identified faunal SCC are extremely important representatives of the sensitive habitats and their presence, movements and general ecology will be dependent on the health of the trophic levels below. Therefore, small mammal monitoring programs are vital to determine the diversity and density of the small mammal population as this represents the sensitivity of any given monitoring point. Methods for monitoring mammals can be obtained from a lead mammologist and include: o Camera trapping points; o Collaring of key predators; o Regular biomonitoring of the small mammals through Sherman trapping; and o Regular spoor tracking. • Permits are required for the removal and/or destruction of the floral SCC identified within this portion; • Avoid the rocky outcrop sensitive landscape as far as possible. However, reconstruction of faunal habitat refugia, such as placement of waste overburden material that will imitate a rocky outcrop habitat to provide refugia for cryptic species such as herpetofauna. Rock refugia must be replaced if it is removed. Rocky outcrops require the following actions to enhance their biodiversity and productivity: o Control or fully exclude livestock; o Carefully monitor and control pest animals such as rabbits, jackals and porcupine; o Revegetate with native trees and shrub; o Do not remove surface rock or logs; and o Protected or enhanced rocky outcrops provide an opportunity to re-establish rare and threatened plants. This can create reservoirs and seed banks for such species.	• Enhance sensitive habitats. • AIP Management Plan. • If necessary, permit applications from the local authorities for the removal and/or destruction of floral SCC.		
	Flora	The rocky outcrop was found to have a diverse floral composition with numerous SCC encountered. Most of these SCC were encountered in the adjacent portion (Portion 40) of the rocky sheath. The southern region of this portion has been overgrazed due to un-monitored livestock grazing					
40/380	Fauna	The rocky outcrop is renowned for providing habitat and steppingstone habitats for numerous faunal assemblages (discussed in Section 6.3.1.3). The sensitive landscapes were marked with a high sensitivity as high faunal activity was observed along the sheaths and faunal SCC were recorded within these margins.	• Loss of fauna and floral biodiversity. • Loss of sensitive ecosystems. • Water contamination. • AIP sprawl.	• A livestock management plan should be compiled by a registered scientific professional in the field of ecological sciences, with the relevant experience to ensure that the area is managed at stocking rates which does not degrade the area further while giving the natural areas time to recover. It is imperative that livestock be excluded from wetland systems, that provide habitat for faunal SCC. • Permits are required for the removal and/or destruction of the floral SCC identified within this portion; • Avoid the rocky outcrop sensitive landscape as far as possible. However, reconstruction of faunal habitat refugia, such as placement of waste overburden material that will imitate a rocky outcrop habitat to provide refugia for cryptic species such as herpetofauna. Rock refugia	• Livestock Grazing Management Plan. • AIP Management Plan. • If necessary, permit applications from the local authorities for the removal and/or destruction of floral SCC.	Environmental Officer and Consultants	High
	Flora	A large community of floral SCC were encountered on the rocky outcrop margin of the portion. Species occurring included, *Mossia intervallaris, Gladiolus dalenii, Agapanthus inapertus* and *Aloe ecklonis*. The isolation of the outcrops supports endemicity and rare species.					

Farm Portion	Current State Description		Impacts	Recommended Mitigation Measures	Action Plan	Person Responsible	Biodiversity Sensitivity
		High sensitivity is assigned to this habitat and measures must be taken preserve its stature. Surrounding the slopes into the rocky sheaths, is transformed grasslands that have been over grazed by un-monitored livestock grazing. The transformed landscape has permitted the proliferation of AIP stands and is promoting edge effects.		must be replaced if it is removed. Rocky outcrops require the following actions to enhance their biodiversity and productivity: o Control or fully exclude livestock; o Carefully monitor and control pest animals such as rabbits, jackals and porcupine; o Revegetate with native trees and shrub; o Do not remove surface rock or logs; and o Protected or enhanced rocky outcrops provide an opportunity to re-establish rare and threatened plants. This can create reservoirs and seed banks for such species.			
425 & 2/425	Fauna	Unique habitat features provide suitable faunal refugia in this portion, such as wetlands, rocky outcrops and a potential cave (see Section 6.3.1.3.)	• Loss of sensitive ecosystems. • Water contamination. • AIP sprawl	• Permits are required for the removal and/or destruction of the floral SCC identified within this portion; • Continually remove all categorised AIP species to prevent spread. Veld management should also ensure that any other weedy species, whether alien or not, should be managed; • Avoidance of highly sensitive wetland habitats and rocky outcrops. Mitigation for rocky outcrop removal and rocky outcrop enhancement is discussed above; • A livestock management plan should be compiled by a registered scientific professional in the field of ecological sciences, with the relevant experience to ensure that the area is managed at stocking rates which does not degrade the area further while giving the natural areas time to recover. It is imperative that livestock be excluded from wetland systems, that provide habitat for faunal SCC; • On-going monitoring programs of faunal SCC, as discussed above is recommended for this portion; and • All wetland remediation measures, discussed above are applicable to disturbed wetlands.	• If necessary, permit applications from the local authorities for the removal and/or destruction of floral SCC. • AIP Management Plan. • Livestock Grazing Management Plan.	Environmental Officer and Consultants	Moderate
	Flora	The isolation of the outcrops supports endemicity and rare species. High sensitivity is assigned to this habitat and measures must be taken preserve its stature. Encroaching the rocky sheaths, is transformed grasslands that have been over grazed by un-monitored livestock grazing. The transformed landscape has permitted the proliferation of AIP stands and is promoting edge effects. Dense *Eucalyptus* sp. stands have proliferated and require immediate action.					
EFN	Fauna	Previous studies conducted in 2011 (NSS, 2011) indicated numerous avifaunal SCC. The 2020 assessment did not encounter the SCC. However, given the extent of the wetland habitats within and surrounding the portion, avifaunal SCC has a high probability of occurring and thus increases the sites sensitivity.	• Loss of sensitive ecosystems. • Water contamination. • AIP sprawl.	• Continually remove all categorised AIP species to prevent spread. Veld management should also ensure that any other weedy species, whether alien or not, should be managed. Subsequent reseeding with indigenous seed mix to re-establish the transformed landscape and provide soil stability; • Implement mitigation and enhancement for rocky outcrop as discussed above; • Measures to protect the presence of Grey Crowned Cranes, as discussed above, apply to this portion, as they have been previously recorded here; • All wetland remediation measures, discussed above are applicable to disturbed wetlands; • A soil erosion management plan should be compiled in conjunction with Soil, Land Use and Land Capability	• Compile and implement an AIP Management Plan; • Conduct a Soil Contamination Assessment to determine source of sediment and develop measures to rehabilitate the contamination; • Wetland Rehabilitation Plan. • Livestock Grazing Management Plan.	Environmental Officer and Consultants	Moderate
	Flora	Various floral SCC were encountered in the 2020 assessment, including *Brunsvigia radulosa,* and *Watsonia lepida.* These species were recorded within the wetland portions of the site. SCC, *Khadia carolinensis* was previously recorded in 2012 (Digby Wells, 2012) on exposed ferricrete sheaths. The 2020 site assessment did not locate					

Farm Portion	Current State Description		Impacts	Recommended Mitigation Measures	Action Plan	Person Responsible	Biodiversity Sensitivity
		the previous recordings and the ferricrete was completely striped. The portion was subjected to extensive mining activities and has thus been rehabilitated. However, upon site inspection, erosion and numerous AIPs were observed amongst the reformed land.		Assessment. It should consider the following aspects: soil conditions, topography (slope), vegetation cover and storm water management as well as unnecessary off-road driving; and • Unmonitored grazing near the homestead in the south western portion has negatively impacted the wetland in that region. Livestock management plan, discussed above is recommended to mitigate the negative impacts on the sensitive ecosystem.			

2 Conclusion

A Land Management Plan has been developed for the Paardeplaats and Eerstelingfontein farm portions that addresses the past, present and potential impacts from the mining activities. This method of planning considers the findings from the baseline field assessment conducted in December 2020 and incorporates the findings from previous studies conducted in the Project area. Sensitive areas delineated in the Sensitivity Map are comprised of the rocky outcrops and wetland habitats as they are vital for biodiversity, refugia for faunal and floral SCC and paramount to the areas ecosystem services. Maintaining the connectivity of the landscapes and creating protective buffer zones around sensitive habitats is key to maintaining the biodiversity and the services they provide. Connectivity of the natural vegetation prompt contiguous natural open space systems and mitigate the deleterious impacts from edge effects and habitat fragmentation. The recommendations stipulated in this report will help alleviate negative impacts on the biodiversity and its' ecosystem functioning.

The action plans and recommended mitigation measures prescribed in Table 1-1 should be prioritised in order of immediate action to moderate considerations. The prescribed action plans and their priority ranking is listed in Table 2-1 below, with 1 ranking as immediate action required. The ranking order is described in Table 2-2 below.

Table 2-1: Priority planning for the prescribed Action Plans

Priority	Action Plan	Reasoning	Farm Portions
1	AIP Management Plan	The plan should assess, map and compile an AIP Eradication Plan. Implement the Eradication Plan and continuously monitor through the life of mine to prevent and maintain further sprawling.	1, 2, 3, 4, 5, 24, 30, 13, 29, 28, 40, 425, 2/425, and EFN.
1	Wetland Rehabilitation Plan	To maintain and repair the geomorphological and hydrological characteristics of the wetlands that have sustained severe impacts from the current mining and land use activities.	1, 2, 3, 4, 5, 24, 30, 40, and EFN.
2	Permit Application for provincially protected flora	Prior construction it is vital to assess the extent and locality of protected flora in relation to the proposed mining infrastructure. Compile and submit permit applications for the removal and/or destruction of protected flora.	24, 30, 13, 29, 28, 40, 425, and 2/425.
3	Soil Contamination Assessment	To determine source of sediment and develop measures to rehabilitate the contamination.	1, 2, 3, 4, 5, 24, 30, and EFN.
3	Quarterly Biomonitoring	Regular biomonitoring of the wetlands, aquatic systems, soils, fauna and flora will detect changes in ecological health of the NBC Complex and prevent further degradation of the area by highlighting key concerns.	1, 2, 3, 4, 5, 24, 30, 13, 29, 28, 40, 425, 2/425, and EFN
2	Awareness Programmes	Awareness programmes ensure that mining personal and contractors are aware of the key concerns	1, 2, 3, 4, 5, 24, 30, 13, 29, 28, 40, 425, 2/425, and EFN
2	Waste Management Plan	to ensure the correct disposal of waste material, (such as the sedimentation) and an action plan for spillages and runoff from the mining activities;	1, 2, 3, 4, 5, 24, and 30.
3	Mammalian Monitoring Program	It is recommended that monitoring key stone species such as previously identified SCC Brown Hyena and Serval, will provide an indication of the overall ecological health.	13, 29, 28, 40, 425, 2/425, and EFN.
4	Livestock Grazing Management Plan	To ensure that the area is managed at stocking rates to prevent over grazing and to allow natural areas to recover.	13, 29, 28, 40, 425, 2/425 and EFN.
2	Dust Monitoring and Suppression	To prevent further degradation to vegetation and wetlands surrounding the mining activities, dust pollution control must be enforced to protect the sensitive landscapes.	1, 2, 3, 4, 5, and 24.

Table 2-2: Priority Ranking

Rank	Description
1	Requires immediate attention and action.
2	Important and must be considered immediately after priority actions are addressed.

3	Actions that require long-term planning and involve numerous specialists.
4	Must be considered once all high-ranking actions are addressed.