Wetland Assessment for a proposed mining permit application on Portion 15 of the Farm Rietspruit 437 near the town of Ermelo, Mpumalanga Province.

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DECLARATION OF INDEPENDENCE

DPR Ecologists and Environmental Services is an independent company and has no financial, personal or other interest in the proposed project, apart from fair remuneration for work performed in the delivery of ecological services. There are no circumstances that compromise the objectivity of the study.

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Title	**Wetland Assessment for a proposed mining permit application on Portion 15 of the Farm Rietspruit 437 near the town of Ermelo, Mpumalanga Province.**		
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Executive Summary

The proposed site consists of a mining permit area which will entail a rock quarry for use in construction, with an associated stockpile area and the entire application area has an extent of 5 hectares. The application area is situated on Portion 15 of the Farm Rietspruit which is situated approximately 5 km to the south west of the town of Ermelo (Appendix A: Map 1). The site is also situated adjacent to the R39 tarred road which will be used to access the site. The site does contain some disturbances but is, for the most part, still largely natural, consisting of a rocky ridge with a well-developed but scattered tree layer and grass layer. The site slopes from north east to south west where clear wetland areas has originated along the southern border of the site. This wetland area will also form the focus of this assessment, in order to determine if the mining development will affect it in any way.

From the description of the study area, it is clear that although not situated on the site, a small wetland system is located adjacent to the southern border of the site (Appendix A: Map 1 & 2). Being a small wetland, almost its entire catchment originates in the immediate area, especially the low ridge of which the site also forms part. The site is located approximately 130 meters from this wetland. It is therefore also clear that the proposed mining operations is likely to also cause at least some impacts on this wetland which will therefore form the focus of this study. A small artificial dam and wetland area forming in previous excavations occur approximately 450 meters to the west of the site. These artificial wetland areas also fall within a separate catchment, upstream of the site and therefore the proposed mining area will not be able to have any affect on these artificial wetland areas and will be discussed only in overview.

Soil samples were quite clear but indicated only a seasonal/temporary zone of wetness within the interior of the valley-bottom wetland with a temporary zone of wetness along its borders (Appendix C). This also substantiates the small nature of the wetland and its seasonal nature. The area had received a high amount of recent rainfall but despite this, surface water and waterlogged soils were absent, also further indicating that this wetland area is strictly seasonal. This also confirms the border of the wetland area and that it is located not nearer than 130 meters from the site.

Unchanneled valley-bottom wetland (Appendix A: Map 2)

A quite small valley-bottom wetland is located adjacent to the southern border of the site. The wetland is fed by a small surrounding catchment, especially the slopes of a low rocky ridge, of which the site forms a part. The catchment is largely natural but with a few significant modifications which will also affect the valley-bottom wetland. The majority of the catchment still consists of natural grassland. The valley-bottom wetland itself has an elongated shape and is a linear system which is quite distinct and easily distinguished from the surrounding terrestrial areas, especially at this time when vegetation differentiation and hydrological regime is optimal. Though this wetland is clearly only seasonal and very seldom, if ever, contains surface flow, it is clearly a wetland system characterised by diffuse flow.

Western artificial dam and excavation

A small artificial dam and wetland area forming in previous excavations occur approximately 450 meters to the west of the site. These artificial wetland areas also fall within a separate catchment, upstream of the site and therefore the proposed mining area will not be able to have any affect on these artificial wetland areas. These two small depressions contain surface water and has

formed artificial wetland conditions, most likely of a perennial nature. As these areas are completely artificial and will not be affected by the proposed mining operations, they are not of consequence to the development and will therefore not be assessed in this study.

The determination of the condition of the unchanneled valley-bottom wetland to the south of the site will be based on a determination of the WET-Health of the system (Appendix D). The results of the WET-Health indicated an overall Present Ecological State of Category B: Largely Natural (Appendix D). This is considered relatively accurate given the largely natural catchment though a few impacts are affecting the system, therefore reducing its condition to some extent. The wetland should therefore be regarded as an important and sensitive system and the proposed mining operations should in no way decrease this condition. The EI&S of the valley-bottom wetland has been rated as being Moderate.

A Risk Assessment for the proposed mining permit application area in close proximity to the adjacent unchanneled valley-bottom wetland has been undertaken according to the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use (Appendix E). The mining area is located approximately 130 meters to the north of this wetland area and consequently will not have any direct impact on it. However, sediment runoff and flow diversion may still have some influence on this wetland.

Mining within close proximity of the valley-bottom wetland is anticipated to have a low risk as long as a 100 meter buffer between the edge of the wetland as delineated and the quarry excavations, stockpile areas, chemical toilets, wastes and any hazardous materials (diesel, etc.) are maintained.

Although the risk is anticipated to be low the quarry will likely still have impacts on the stream in terms of an increased sediment load. Through adequate mitigation, including storm water management measures, this can be minimised and provided adequate rehabilitation is undertaken no permanent modification to the functioning of the wetland will result. The principles of storm water management should be implemented, i.e. runoff generated in the surrounding natural areas should be diverted around the mining area and storm water generated on the mining footprint itself should be contained on the site.

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Wetland Assessment

1. Introduction

1.1 Background

Natural vegetation is an important component of ecosystems. Some of the vegetation units in a region can be more sensitive than others, usually as a result of a variety of environmental factors and species composition. These units are often associated with water bodies, water transferring bodies or moisture sinks. These systems are always connected to each other through a complex pattern. Degradation of a link in this larger system, e.g. tributary, pan, wetland, usually leads to the degradation of the larger system. Therefore, degradation of such a water related system should be prevented.

Though vegetation may seem to be uniform and low in diversity it may still contain species that are rare and endangered. The occurrence of such a species may render the development unviable. Should such a species be encountered the development should be moved to another location or cease altogether.

South Africa has a large amount of endemic species and in terms of biological diversity ranks as one the ten highest in the world. This has the result that many of the species are rare, highly localised and consequently endangered. It is our duty to protect our diverse natural resources.

South Africa's water resources have become a major concern in recent times. As a water scarce country we need to manage our water resources sustainably in order to maintain a viable resource for the community as well as to preserve the biodiversity of the system. Thus, it should be clear that we need to protect our water resources so that we may be able to utilise this renewable resource sustainably. Areas that are regarded as crucial to maintain healthy water resources include wetlands, streams as well as the overall catchment of a river system.

It is well known that quarry mining operations has several detrimental impacts on the environment. These impacts are numerous but the most pronounced impacts are associated with the excavation of large amounts of earth materials, the storage and disposal thereof and the sedimentation associated with it, especially where mining takes place near watercourses. This usually causes degradation of waterways due to sedimentation as well as the transformation of the vegetation and ecosystem on the site.

As a result of the above it is necessary to determine the presence of water sources and any associated wetland conditions in the study area and the likelihood that operations may impact on them.

The proposed site consists of a mining permit area which will entail a rock quarry for use in construction, with an associated stockpile area and the entire application area has an extent of 5 hectares. The application area is situated on Portion 15 of the Farm Rietspruit which is situated approximately 5 km to the south west of the town of Ermelo (Appendix A: Map 1). The site is also situated adjacent to the R39 tarred road which will be used to access the site. The site does contain some disturbances but is, for the most part, still largely natural, consisting of a rocky ridge with a well-developed but scattered tree layer and grass layer. The site slopes from north east to south west where clear wetland areas has originated along the southern border of the

site. This wetland area will also form the focus of this assessment, in order to determine if the mining development will affect it in any way.

A site visit was conducted on 8 February 2022. The study area included all watercourses and wetlands affected by the proposed mining permit area. The survey was undertaken during late summer after heavy rains and consequently both species identification and an active hydrological regime enabled accurate identification and delineation of wetlands and watercourses.

The report together with its recommendations and mitigation measures should be used to minimise the impact of the proposed development.

1.2 The value of biodiversity

The diversity of life forms and their interaction with each other and the environment has made Earth a uniquely habitable place for humans. Biodiversity sustains human livelihoods and life itself. Although our dependence on biodiversity has become less tangible and apparent, it remains critically important.

The balancing of atmospheric gases through photosynthesis and carbon sequestration is reliant on biodiversity, while an estimated 40% of the global economy is based on biological products and processes (Johnson 2005).

Biodiversity is the basis of innumerable environmental services that keep us and the natural environment alive. These services range from the provision of clean water and watershed services to the recycling of nutrients and pollution. These ecosystem services include:

- Soil formation and maintenance of soil fertility.
- Primary production through photosynthesis as the supportive foundation for all life.
- Provision of food, fuel and fibre.
- Provision of shelter and building materials.
- Regulation of water flows and the maintenance of water quality.
- Regulation and purification of atmospheric gases.
- Moderation of climate and weather.
- Detoxification and decomposition of wastes.
- Pollination of plants, including many crops.
- Control of pests and diseases.
- Maintenance of genetic resources.

1.3 Value of wetlands and watercourses

Freshwater ecosystems provide valuable natural resources, which contributes toward economic, aesthetic, spiritual, cultural and many recreational values. Yet the integrity of freshwater ecosystems in South Africa is rapidly declining in recent times. This crisis is largely a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (the need to utilise these recourses between different stakeholders, i.e. individuals, communities, corporate and industrial) and institutional (Implementing appropriate governance and management). Water affects every activity and aspiration of human society and sustains all ecosystems.

Freshwater ecosystems provide many of our fundamental needs, enable important regulating ecosystem services, supports functional faunal and floral communities:

- Water for drinking and irrigation
- Food such as fish and water plants.
- Building material such as clay and reeds.
- Preventing floods and easing the impacts of droughts.
- Remove excess nutrients and toxic substances from water
- Rivers, wetlands and groundwater systems maintain water supplies and buffer the effects of storms, reducing the loss of life and property to floods.
- Riverbanks help to trap sediments, stabilise river banks and break down pollutants draining from the surrounding land.

1.4 Details and expertise of specialist

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South African Council for Natural Scientific Professions No. (400284/13) (Ecological Science).

Membership with relevant societies and associations:

- South African Society of Aquatic Scientists (SASAQS0091)
- South African Association of Botanists
- South African Wetlands Society (3SLY4IG4)

Expertise:

- Qualifications: B.Sc. (Hons) Botany (2008), M.Sc. in Vegetation Ecology (2012) with focus on ephemeral watercourses.
- Vegetation ecologist with over 10 years experience of conducting ecological assessments.
- Founded DPR Ecologists & Environmental Services (Pty) Ltd in 2016.
- Has conducted over 200 ecological and wetland assessments for various developments.
- Regularly attend conferences and courses in order to stay up to date with current methods and trends:

  2017: Kimberley Biodiversity Symposium.
  2018: South African Association of Botanists annual conference.
  2018: National Wetland Indaba Conference.
  2019: SASS5 Aquatic Biomonitoring Training.
  2019: Society for Ecological Restoration World Congress 2019.

2019: Wetland rehabilitation: SER 2019 training course.
2020: Tools For Wetlands (TFW) training course.

2. Scope and limitations

- To provide a description of watercourses, wetlands and riparian vegetation included within the study area and immediately adjacent areas.
- Identify watercourses including rivers, streams, pans and wetlands and determine the presence of wetland conditions within these systems.
- Where wetland conditions have been identified the classification of the wetland system will be given.
- To identify possible negative impacts that could be caused by the operations.
- To evaluate the present state of the wetlands and riparian vegetation in close proximity to the development. The importance of the ecological function and condition will also be assessed.
- Determine the Present Ecological State (PES) and Ecological Importance & Sensitivity (EIS) for the watercourses in close proximity to the development.
- Conduct a risk assessment and determine the likelihood that watercourses and wetlands will be adversely affected by the development.

2.1 Riparian Vegetation

Aspects of the riparian vegetation that will be assessed include:

- The vegetation types of the region with their relevance to the study area.
- The overall status of the riparian vegetation along the wetlands and watercourses in the study area.
- Species composition with the emphasis on dominant-, rare- and endangered species.
- Presence of wetland conditions and riparian vegetation using obligate wetland and riparian species.

The amount of disturbance present on the study area assessed according to:

- The amount of grazing impacts.
- Disturbance caused by human impacts.
- Other disturbances.

2.2 Wetlands and watercourses

Aspects of the wetlands and watercourses that will be assessed include:

- Identification of watercourses including rivers, streams, pans and wetlands.
- Determine the presence of wetland conditions and riparian vegetation using obligate wetland and riparian species.
- Describe watercourses and wetlands and importance relative to the larger system.
- Conduct WET-Health assessment of watercourses to inform the condition and status of these systems.

2.3 Limitations

- Some geophytic or succulent species may have been overlooked due to a specific flowering time or cryptic nature.
- Although a comprehensive survey of the site was done it is still likely that several species were overlooked.
- Due to time constraints only limited soil sampling could be done.

- The wetlands and watercourses in the study area are seasonal in nature and do not contain an aquatic component (including invertebrates and fish species).
- Smaller drainage lines may have been overlooked where a distinct channel or riparian vegetation is absent.

3. Methodology

3.1 Several literature works were used for additional information.

General ecology:

- Red Data List (Raymondo *et al.* 2009).
- Vegetation types (Mucina & Rutherford 2006).
- NBA 2018: South African Inventory of Inland Aquatic Ecosystems (SAIIAE).
- NBA 2018 Technical Report: Inland Aquatic (Freshwater) Realm.
- NBA 2018 Technical Report Volume 1: Terrestrial Realm.
- NEM:BA: List of threatened ecosystems and Threatened Or Protected Species (TOPS).
- National Freshwater Ecosystem Priority Areas 2011 (NFEPA).
- Strategic Water Source Areas 2018 (SWSA).
- SANBI (2011): List of threatened ecosystems.
- Mpumalanga Biodiversity Sector Plan 2014 (MBSP).

Vegetation:

- Red Data List (Raymondo *et al.* 2009).
- Vegetation types (Mucina & Rutherford 2006).
- Field guides used for species identification (Bromilow 1995, 2010, Coates-Palgrave 2002, Fish *et al* 2015, Gibbs-Russell *et al* 1990, Griffiths *et al* 2015, Manning 2009, Moffett 1997, Onderstall 1996, Pooley 1998, 2003, Van Ginkel & Cilliers 2020, Van Oudtshoorn 2004, Van Wyk & Malan 1998, Van Wyk & Van Wyk 1997).

Wetland methodology, delineation and identification:
Department of Water Affairs and Forestry 2004, 2005, 2008, Collins 2006, Duthie 1999, Kleynhans *et al* 2008, Macfarlane, Ollis & Kotze 2020, Marnewecke & Kotze 1999, Nel *et al* 2011, Ollis *et al* 2013, SANBI 2009.

3.2 Survey

The site was assessed by means of transects and sample plots.

- Noted species include rare and dominant species.
- The broad vegetation types present at the site were determined.
- The state of the environment was assessed in terms of condition, grazing impacts, disturbance by humans, erosion and presence of invader and exotic species.
- The state of the habitat was also assessed.

All rivers, streams, pans and wetlands were identified and surveyed where they occurred in the study area. These systems were determined by use of topography (land form and drainage pattern) and riparian vegetation with limited soil sampling (Appendix B & C). The following outlines the process applied during the on-site survey in order to obtain all required data:

- Perform desktop overview of the study area utilising available resources (Section 3.1). From the desktop overview identify the different landscape forms, possible wetland areas, watercourses and their relative flow patterns. Using this information, identify transects and sample plots for possible on-site survey. This should be both

representative of the wetland or watercourse as a whole but should also include any prominent or significantly unique features.

- Possible sites identified during the desktop overview should be surveyed on-site. Where access is not possible or where desktop features are considered poor representatives of the wetland or watercourse the survey site or transect should be moved to another location, without compromising a comprehensive overview of the system.
- Where a lateral transect is taken of a watercourse this is done from the water's edge, across the marginal, lower and upper zones and extended across the floodplain until the edge of the riparian zone is reached.
- Where a transect is taken of a wetland system, this should preferably be taken across the entire wetland at its widest part or where it is most relevant to the proposed development, from the terrestrial surroundings, across the temporary, seasonal and perennial zones across the wetland.
- Soil samples are taken at 10 meter intervals along the survey transect, or where a distinct transition into a different zone is observed.
- A survey of the plant species within each distinct riparian or wetland zone is undertaken and includes the identification of obligate wetland species, riparian species, terrestrial species, exotic species and the general species composition and vegetation structure which allows for an accurate description of the watercourse or wetland.
- Visual survey of the general topography which substantiates the presence of riparian zones and wetland forms.
- Other general observations include any impacts observed, the overall ecosystem function, presence of fauna, surrounding land uses and the overall condition of the watercourse or wetland.
- Data is recorded by means of photographs with GPS coordinates taken at all relevant soil sampling sites and borders of riparian and wetland zones.

Data obtained during the on-site survey is utilised to provide the following information on the system:

- Desktop overview and assimilation of information on the likely impacts and functioning of the wetland system.
    - Review all available spatial data and resources in order to provide an estimate of the likely impacts and condition of the wetland or watercourse system.
- Confirm the presence of the wetland or watercourse system and provide an estimate of its borders.
    - The border of wetland conditions or the edge of the riparian zone will be confirmed by using soil sampling, obligate wetland vegetation and topography. This will also include the delineation of any temporary, seasonal or perennial zones of wetness along wetlands and the marginal, lower, upper and riparian zones along watercourses.
- Provide a description of the wetland or watercourse.
    - Provide the hydrogeomorphic setting of the wetland, a longitudinal profile which will aid in determining the erodibility of the wetland and provide an overall description of the wetland and impacts affecting it.
    - Provide a general description of the lateral zonation of the watercourse banks including the marginal, lower, upper and riparian zones and a description of the riparian vegetation along the banks of the watercourse. This will also include the description of any impacts or modification of the watercourse.

- Assess the current condition of the wetland or watercourse.
    - Utilising information obtained from the assessments listed above, determine the condition of this portion of the wetland by applying the WET-Health 2 tool.
    - Utilising information obtained from the assessments listed above, determine the condition of the relevant section of the watercourse by applying the Index of Habitat Integrity (IHI) tool.
- Utilising all of the information obtained from the assessment, provide recommendations to mitigate anticipated impacts that the development will have.

The following guidelines and frameworks were also used to determine the presence of the rivers, streams, pans and wetlands in the study area:

- Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Edition 1. Department of Water Affairs and Forestry, Pretoria.
- Marnewecke & Kotze 1999. Appendix W6: Guidelines for delineation of wetland boundary and wetland zones. In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

The following guidelines and frameworks were used to determine the sensitivity or importance of these identified watercourses or wetlands in the study area:

- Nel *et al.* (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

- Government of South Africa. 2008. National Protected Area Expansion Strategy for South Africa 2008: Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. Government of South Africa, Pretoria.

- Duthie, A. 1999. Appendix W5: IER (floodplain and wetlands) determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

These guidelines provide the characteristics which can be utilised to determine if a wetland or watercourse is present and also aids in determining the boundary of these systems.

The following were utilised to inform the condition and status of watercourses:

- Kleynhans, C.J., Louw, M.D. & Graham, M. 2008. Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity. Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 377-08.

The following were utilised to inform the condition and status of wetlands:

- Macfarlane, D.M., Ollis, D.J. & Kotze, D.C. 2020. WET-Health (Version 2.0): a refined suite of tools for assessing the present ecological state of wetland ecosystems. WRC Report No. TT 820/20.

A Risk Assessment will be conducted for the proposed development in or near watercourses and wetlands in accordance with the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use.

3.3 Criteria used to assess sites

Several criteria were used to assess the study area and determine the overall status of the environment.

3.3.1 Vegetation characteristics

Characteristics of the vegetation in its current state. The diversity of species, sensitivity of habitats and importance of the ecology as a whole.

Habitat diversity and species richness: normally a function of locality, habitat diversity and climatic conditions.
Scoring: Wide variety of species occupying a variety of niches – 1, Variety of species occupying a single nich – 2, Single species dominance over a large area containing a low diversity of species – 3.

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species.
Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely – 3.

Ecological function: All plant communities play a role in the ecosystem. The ecological importance of all areas though, can vary significantly e.g. wetlands, drainage lines, ecotones, etc.
Scoring: Ecological function critical for greater system – 1, Ecological function of medium importance – 2, No special ecological function (system will not fail if absent) – 3.

Degree of rarity/conservation value:
Scoring: Very rare and/or in pristine condition – 1, Fair to good condition and/or relatively rare – 2, Not rare, degraded and/or poorly conserved – 3.

3.3.2 Vegetation condition

The sites are compared to a benchmark site in a good to excellent condition. Vegetation management practises (e.g. grazing regime, fire, management, etc.) can have a marked impact on the condition of the vegetation.

Percentage ground cover: Ground cover is under normal and natural conditions a function of climate and biophysical characteristics. Under poor grazing management, ground cover is one of the first signs of vegetation degradation.
Scoring: Good to excellent – 1, Fair – 2, Poor – 3.

Vegetation structure: This is the ratio between tree, shrub, sub-shrubs and grass layers. The ratio could be affected by grazing and browsing by animals.

Scoring: All layers still intact and showing specimens of all age classes – 1, Sub-shrubs and/or grass layers highly grazed while tree layer still fairly intact (bush partly opened up) – 2, Mono-layered structure often dominated by a few unpalatable species (presence of barren patches notable) – 3.

Infestation with exotic weeds and invader plants or encroachers:
Scoring: No or very slight infestation levels by weeds and invaders – 1, Medium infestation by one or more species – 2, Several weed and invader species present and high occurrence of one or more species – 3.

Degree of grazing/browsing impact:
Scoring: No or very slight notable signs of browsing and/or grazing – 1, Some browse lines evident, shrubs shows signs of browsing, grass layer grazed though still intact – 2, Clear browse line on trees, shrubs heavily pruned and grass layer almost absent – 3.

Signs of erosion: The formation of erosion scars can often give an indication of the severity and/or duration of vegetation degradation.
Scoring: No or very little signs of soil erosion – 1, Small erosion gullies present and/or evidence of slight sheet erosion – 2, Gully erosion well developed (medium to large dongas) and/or sheet erosion removed the topsoil over large areas – 3.

3.3.3 Faunal characteristics

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species or very unique and sensitive habitats can potentially be a fatal flaw.
Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely.

3.4 Biodiversity sensitivity rating (BSR)

The total scores for the criteria discussed in section 3.3 were used to determine the biodiversity sensitivity ranking for the sites. On a scale of 0 – 30, five different classes are described to assess the biodiversity of the study area. The different classes are described in the Table 1:

Table 1: Biodiversity sensitivity ranking

BSR	BSR general floral description	Floral score equating to BSR class
Totally transformed (5)	Vegetation is totally transformed or in a highly degraded state, generally has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area has lost its inherent ecological function. The area has no conservation value and potential for successful rehabilitation is very low.	29 – 30
Advanced Degraded (4)	Vegetation is in an advanced state of degradation, has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area's ecological function is seriously hampered, has a very low conservation value and the potential for successful rehabilitation is low.	26 – 28
Degraded (3)	Vegetation is notably degraded, has a medium level of species diversity although no species of concern are present. Invasive plants are present but are still controllable. The area's ecological function is still intact but may be hampered by the current levels of degradation. Successful rehabilitation of the area is possible. The conservation value is regarded as low.	21 – 25
Good Condition (2)	The area is in a good condition although signs of disturbance are present. Species diversity is high and species of concern may be present. The ecological function is intact and very little rehabilitation is needed. The area is of medium conservation importance.	11 – 20
Sensitive/Pristine (1)	The vegetation is in a pristine or near pristine condition. Very little signs of disturbance other than those needed for successful management are present. The species diversity is very high with several species of concern known to be present. Ecological functioning is intact and the conservation importance is high.	0 - 10

4. Wetland Assessment

For the purpose of this report the general ecology of the study area will first be discussed followed by a discussion of the watercourses and wetland systems.

4.1 Ecology and description of the study area

Refer to the list of species encountered on the site in Appendix B.

According to Mucina & Rutherford (2006) the area consists of Amersfoort Highveld Clay Grassland (Gm 13) while the north eastern border of the site consists of a marginal portion of Soweto Highveld Grassland (Gm 8) (Appendix A: Map 1). Both of these vegetation types are heavily affected by transformation for agricultural crop production though Amersfoort Highveld Clay Grassland is still regarded as being Least Concern (LC) while Soweto Highveld Grassland is a listed Threatened Ecosystem under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004). The Soweto Highveld Grassland remaining in the area is currently listed as being Vulnerable (VU). The vegetation on the site itself is largely still natural while areas to the south and west have been transformed by previous mining activities.

The Mpumalanga Biodiversity Sector Plan (2014) has been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e. Critical Biodiversity Areas. The terrestrial component of the site has been listed as a Critical Biodiversity Area (CBA), mostly as it contains portions of a threatened ecosystem, intact grassland containing a significant species diversity and is an optimal area for meeting the required conservation targets. A portion of the site is also listed as an Ecological Support Area (ESA) as it forms part of an ecological corridor for maintaining ecosystem function. The freshwater component of the site is regarded as an Other Natural Area (ONA) which indicates that it does not form part of a Strategic Water Source Area (SWSA).

The proposed site consists of a mining permit area which will entail a rock quarry for use in construction, with an associated stockpile area and the entire application area has an extent of 5 hectares. The application area is situated on Portion 15 of the Farm Rietspruit which is situated approximately 5 km to the south west of the town of Ermelo (Appendix A: Map 1). The site is also situated adjacent to the R39 tarred road which will be used to access the site. The site does contain some disturbances but is, for the most part, still largely natural, consisting of a rocky ridge with a well-developed but scattered tree layer and grass layer. The site slopes from north east to south west where clear wetland areas has originated along the southern border of the site. This wetland area will also form the focus of this assessment, in order to determine if the mining development will affect it in any way.

The site itself still consists of natural vegetation which is dominated by scattered trees and a well-developed grass layer (Appendix A: Map 1). The site is largely situated on a low dolerite ridge and surface rock and boulders are abundant. Disturbances are present and include overgrazing by domestic livestock and low-level infestation by exotic weeds and shrubs, though overall the site is still largely natural. However, the surrounding areas, especially toward the south and west of the site, has been heavily modified by previous mining activities. Here an existing borrow pit, stockpile areas, overburden and waste dumps are abundant and has caused significant transformation of the surface water drainage patterns.

Figure 1: Aerial view of the proposed site (Google Earth 2021). The site consisting of scattered trees and grass layer is visible and situated along a low rocky ridge. Note extensive transformation to the south and west, associated with previous mining activities.

The topography of the site is dominated by a low rocky ridge which has a moderate slope from north east toward the south west. Soils on the site consist of fairly shallow soils overlying dolerite rock and gravel. Surface dolerite rock and boulders are abundant. The slope of the site also indicates that surface runoff will flow from north east to south west and consequently a wetland area has also formed to the south west of the site, where surface water flow accumulates. The site therefore also forms part of the catchment of this wetland area to the south west. The site has an approximate elevation of 1760 m along the north eastern border decreasing to 1730 m along the south western border. This also clearly indicates the moderate slope of the site providing runoff to the adjacent wetland area (Appendix A: Map 1 & 2).

The site falls within the highveld climate and can be expected to have warm, wet summers, and mild, dry winters, with equivalent evaporation depths exceeding precipitation. Average annual rainfall for the site from showers and thunderstorms is about 726 mm/year and the evaporation 1400 mm/year, based on available records for the Ermelo weather station (C1E009).

Average daily maximum temperatures vary from 25ºC in January to 16ºC in June, but in extreme cases these may rise to 34 and 23ºC, respectively. In comparison, average daily minima of 13 and 0ºC can be expected, with temperatures falling to 5 and –10ºC, respectively, on unusually cold days.

Sediments of the Vryheid formation comprise the local geology. The sediments of the Vryheid Formation were deposited in a fluvio-deltaic environment where swamps and marshes existed, in which peat accumulated. Shales, mudstones, siltstones and sandstones constitute the bulk of the formation, with interlayering of these sediments throughout. The site itself also consists of a low dolerite ridge consisting of Late Triassic to Middle Jurassic aged Dolerite sills and feeder dykes, which intruded the Vryheid Formation.

Photographs of the site also provides a general overview of the terrestrial environment of the site (Figures 2 – 5).

Figure 2: View of the site (red) which is clearly situated on a low rocky ridge, being dominated by scattered trees and a grass layer. The site also clearly drains toward the south west (arrow).

Figure 3: The surroundings are dominated by natural grassland although previous mining to the south west of the site has caused transformation of the vegetation and topography (red).

Figure 4: Areas where previous mining had occurred has also promoted the establishment of exotic weeds and modification of the surface drainage pattern.

Figure 5: Coupled to the topography and surface drainage, a clearly defined wetland area originates to the south of the site.

4.2 Wetland and Watercourses Assessment

4.2.1 Introduction

From the description of the study area, it is clear that although not situated on the site, a small wetland system is located adjacent to the southern border of the site (Appendix A: Map 2). Being a small wetland, almost its entire catchment originates in the immediate area, especially the low ridge of which the site also forms part. The site is located approximately 130 meters from this wetland. It is therefore also clear that the proposed mining operations is likely to also cause at least some impacts on this wetland which will therefore form the focus of this study. A small artificial dam and wetland area forming in previous excavations occur approximately 450 meters to the west of the site. These artificial wetland areas also fall within a separate catchment, upstream of the site and therefore the proposed mining area will not be able to have any affect on these artificial wetland areas and will be discussed only in overview.

Unchanneled valley-bottom wetland adjacent to the site (Appendix A: Map 2)

As indicated, the small wetland system adjacent to the southern border of the site is situated in relatively close proximity to it (approximately 130 meters). This wetland is mostly fed by the catchment situated along the low rocky ridge of which the site also forms a part. As runoff and groundwater flow from this ridge flows onto the lower lying valley, water concentrates on the surface and upper soil layers, promoting the formation of a small valley bottom wetland. The manner in which this groundwater and surface water concentrates on the surface and upper soil layers, promotes the formation of a small valley bottom wetland area with approximate size of 2 hectares. The outline of this wetland system is quite clear and elongated in shape. The wetland is dominated by short but dense wetland vegetation and surrounding by dense but somewhat degraded grassland.

This valley bottom wetland system then drains through a quite degraded area, caused by previous mining operations. It drains toward the west, eventually forming a defined channel and then flowing into the Klein-Xspruit approximately 13 km to the west of the site. The Klein-Xspruit is also listed as a Freshwater Ecosystem Priority Area (FEPA): Upstream system and is therefore of high conservation value.

Western artificial wetland excavations

Two small wetland areas, one which is an excavation with earthen embankment forms an artificial dam, while the other is a shallow excavation, being confined by the embankments of adjacent gravel roads. Both of these are clearly being formed by artificial conditions associated with the

previous mining operations. Despite being artificial, they still play a role in the surface water drainage of the area and should therefore not be affected by the proposed mining operations. These wetland areas are however located approximately 450 meters to the west of the site, upstream of it, and outside the catchment of the permit application area. The proposed mining operations should therefore have no impact on these areas and will therefore not be included in this assessment.

The term watercourse refers to a river, stream, wetland or pan. The National Water Act (NWA, 1998) includes rivers, streams, pans and wetlands in the definition of the term watercourse. This definition follows:

Watercourse means:

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

Riparian habitat is an accepted indicator of watercourses used to delineate the extent of wetlands, rivers, streams and pans (Department of Water Affairs and Forestry 2005).

The classification of stream orders from 1 to 3 can be illustrated by means of the Strahler 1952 classification:

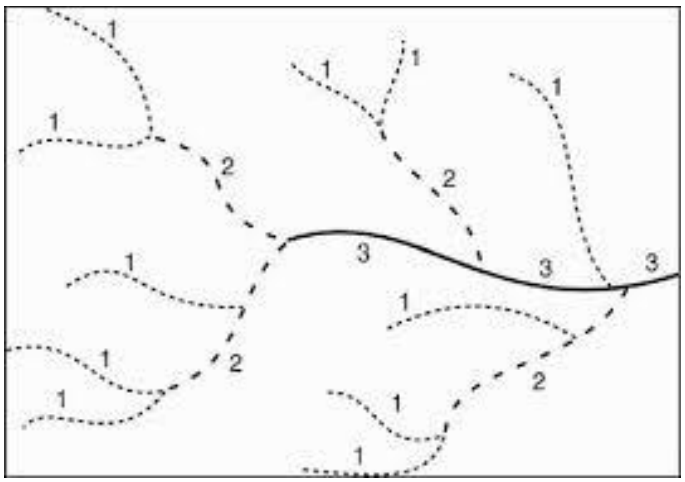

Figure 6: The classification of stream orders from 1 to 3 (Strahler 1952)

4.2.2 Wetland indicators

Obligate wetland vegetation was utilised to determine the presence and border of wetland conditions. Due to time constraints soil samples were only taken along three perpendicular transects across the unchanneled valley bottom wetland system. Soil samples were investigated for the presence of anaerobic evidence which characterises wetland soils (Appendix C).

Soil samples were quite clear but indicated only a seasonal/temporary zone of wetness within the interior of the valley-bottom wetland with a temporary zone of wetness along its borders. This also substantiates the small nature of the wetland and its seasonal nature. The area had received

a high amount of recent rainfall but despite this, surface water and waterlogged soils were absent, also further indicating that this wetland area is strictly seasonal. This also confirms the border of the wetland area and that it is located not nearer than 130 meters from the site.

The soil samples taken across the valley-bottom wetland allowed for easy and accurate delineation of the wetland areas (Appendix C). In addition, when coupled with obligate wetland plants this even further improved the accuracy of delineation (Appendix B). Obligate wetland species are confined to wetlands and cannot occur in conditions outside of these systems. As a result, where they occur, wetland conditions can be considered to occur.

4.2.3 Classification of wetland systems

The wetland conditions identified within the valley-bottom wetland area can be classified into a specific wetland type or hydrogeomorphic (HGM) unit.

The wetland conditions associated with the valley-bottom wetland area can be characterised as an unchanneled valley-bottom wetland system (SANBI 2009):

"a mostly flat valley-bottom wetland area without a major channel running through it, characterised by an absence of distinct channel banks and the prevalence of diffuse flows, even during and after high rainfall events. Water inputs are typically from an upstream channel, as the flow becomes dispersed, and from adjacent slopes (if present) or groundwater. Water generally moves through the wetland in the form of diffuse surface flow and/or interflow (with some temporary containment of water in depressional areas), but the outflow can be in the form of diffuse or concentrated surface flow. Infiltration and evaporation from unchannelled valley-bottom wetlands can be significant, particularly if there are a number of small depressions within the wetland area. Horizontal, unidirectional diffuse surface-flow tends to dominate in terms of the hydrodynamics."

This is considered an accurate description of this small valley-bottom wetland located to the south of the proposed mining permit area (Appendix A: Map 2). It is situated beneath the low rocky ridge in a lower lying valley bottom area and though it is linear, it clearly does not contain a defined channel or channel banks. Furthermore, concentrated surface flow is clearly absent and diffuse flow dominates. Water inputs are also clearly from the surrounding slopes. A defined channel also becomes more prominent in downstream areas. The portion of this valley-bottom wetland to the south of the site, is still largely natural, though immediately to the west it becomes heavily modified by a small artificial dam and previous mining operations which had heavily modified its flow pattern.

4.2.4 Description of wetlands

The proposed mining operations does not contain any wetland or watercourses although a small valley-bottom wetland occurs approximately 130 meters downslope of the site and is therefore likely to be affected by it (Appendix A: Map 2). It will therefore form the main focus of this study. A small artificial dam and excavation which has formed wetland conditions are completely artificial and situated outside the catchment of the site which will therefore have no affect on these areas.

Obligate wetland vegetation was also used to determine the presence of wetland conditions. Obligate wetland species are confined to wetlands and are only able to occur in wetlands. They

are therefore reliable indicators of wetland conditions. Field observations over time as well as the following sources were used to determine FW and OW species:

- Marnewecke, G. & Kotze, D. 1999. Appendix W6: Guidelines for delineation of wetland boundary and wetland zones. In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

- DWAF. 2008. Updated manual for the identification and delineation of wetlands and riparian areas, prepared by M.Rountree, A.L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Unchanneled valley-bottom wetland (Appendix A: Map 2)

A quite small valley-bottom is located adjacent to the southern border of the site. The wetland is fed by a small surrounding catchment, especially the slopes of a low rocky ridge, of which the site forms a part. This valley-bottom wetland then drains toward the west where it has been quite heavily modified by previous mining operations.

The wetland has a small catchment which is confined to the immediate area. The catchment will also directly affect the condition of the wetland. The catchment is largely natural but with a few significant modifications which will also affect the valley-bottom wetland. The majority of the catchment still consists of natural grassland but which has been disturbed to some degree by overgrazing of domestic livestock. This causes visible trampling and also the establishment of exotic weeds in some areas. An existing borrow pit occurs to the south of the wetland and this will have some significant impacts in terms of sediment runoff and modification of the surface flow patterns. To the west of the site, the wetland is heavily modified by previous mining operations which is also visible in the vegetation composition of the wetland, where exotic weeds become abundant, indicating high levels of disturbance. The vegetation and soil samples in the surrounding catchment indicate the absence of wetland conditions and no seepage areas occur and neither does any artificial obstructions cause the formation of wetland areas. The vegetation in the surrounding catchment is dominated by grasses such as *Sporobolus fimbriatus, Themeda triandra, Harpochloa falx* and *Eragrostis curvula*. Herbaceous plants are also abundant in the catchment and include *Senecio discodregeanus, Helichrysum rugulosum, Berkheya macrocephala* and *Hermannia geniculata.* Exotic weeds are not abundant though *Richardia braziliensis* are scattered. This assemblage of species are indicative of a still natural grass layer within the catchment and which will also promote the natural functioning of the valley-bottom wetland. This natural grass layer will also function as a buffer to any anticipated impacts and will aid in preventing the proposed mining area from having a significant impact on the wetland.

Figure 7: Fairly natural grassland dominated the catchment of the valley-bottom wetland (blue) and will aid in alleviating any anticipated impacts on it.

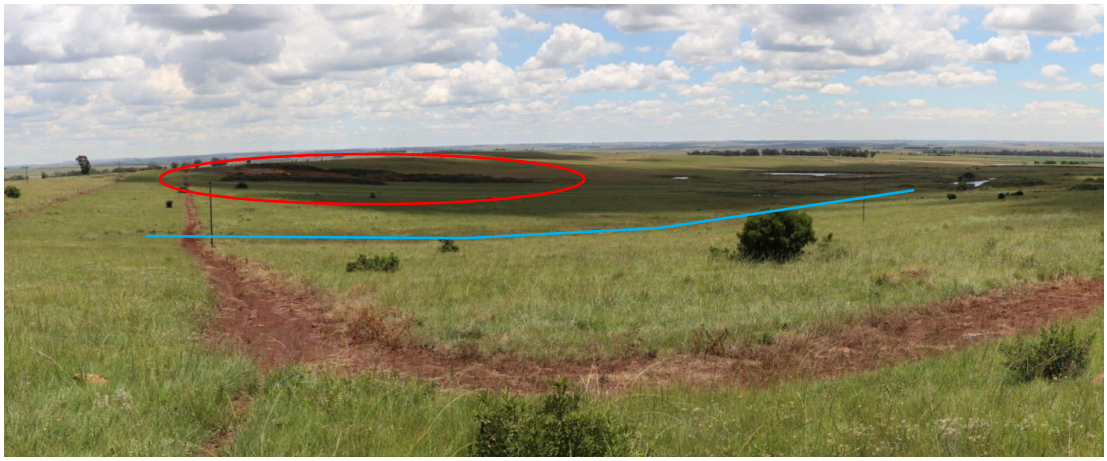

Figure 8: The catchment of the valley-bottom wetland (blue) is clearly still largely natural. However, note a dirt track and mining activities in the background (red).

The valley-bottom wetland itself has an elongated shape and is a linear system which is quite distinct and easily distinguished from the surrounding terrestrial areas, especially at this time when vegetation differentiation and hydrological regime is optimal. Though this wetland is clearly only seasonal and very seldom, if ever, contains surface flow, it is clearly a wetland system characterised by diffuse flow. The central portion of the wetland, containing the highest moisture regime, contains clear indications of a seasonal zone of wetness. Here, soils show distinct mottling with bright red mottles being indicative of seasonal soil saturation. Surface water is however absent and is likely to only be present for short periods after rainfall events, flow being dominated by diffuse groundwater flow for most of the time. This is characteristic and normally the manner in which such unchanneled valley-bottom wetland functions. Vegetation within the central portion is also quite prominently dominated by obligate hygrophilous grasses, i.e. water loving grasses dependant on wetland conditions. These grasses include *Pennisetum sphacelatum, Andropogon appendiculatus* and *Arundinella nepalensis*. This is a mixture of Facultative- and Obligate Wetland grasses and also indicates that though wetland conditions are definitely present, that it is a seasonally functioning system. A sedge, *Pycreus sp.* is also abundant and adapted to seasonally saturated soils. A few herbaceous plants are also abundant here which are well known to be associated with wetland areas. These are *Centella asiatica, falkia oblonga* and *Wahlenbergia grandiflora.* Around the edges of the seasonally saturated

portion of the wetland, forming the borders between the wetland area and the surrounding terrestrial habitats, a temporary zone of wetness occurs. This zone is characterised by a mixture of terrestrial plants and facultative wetland plants and with soils that contain only a few, feint reddish mottles. This is considered indicative of the border of the wetland and indicates the transition from saturated soils to terrestrial soils. Wetland plants such as *Pycreus sp., Pennisetum sphacelatum* and *Andropogon appendiculatus* are scattered and indicates the border of wetland conditions. Terrestrial species become abundant here and include *Helichrysum rugulosum, Themeda triandra, Euphorbia striata* and *Monopsis decipiens*. This zone varies in width from one to several meters but remains fairly distinct and can be readily distinguished from surrounding terrestrial areas.

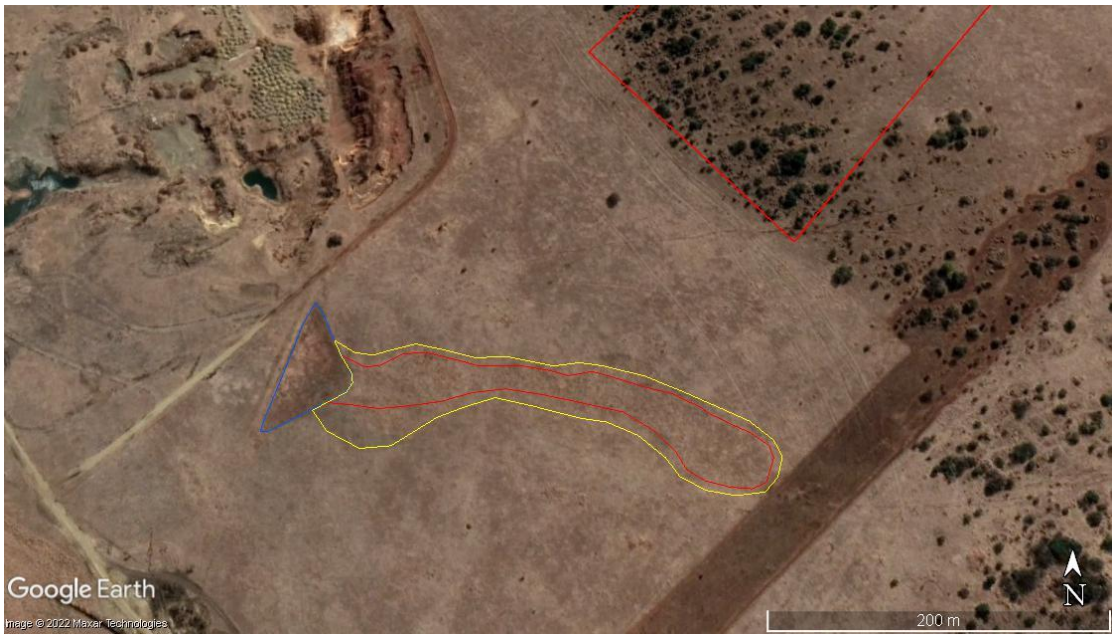

Figure 9: Aerial view of the valley-bottom wetland (Google Earth 2021). The border and temporary zone (Yellow), seasonal (red) and artificial dam (Blue) is indicated. Note that the wetland is situated to the south and downslope of the mining area. Downstream there is also extensive transformation caused by previous mining.

Figure 10: View of the valley-bottom wetland (red) as seen from the direction of the site.

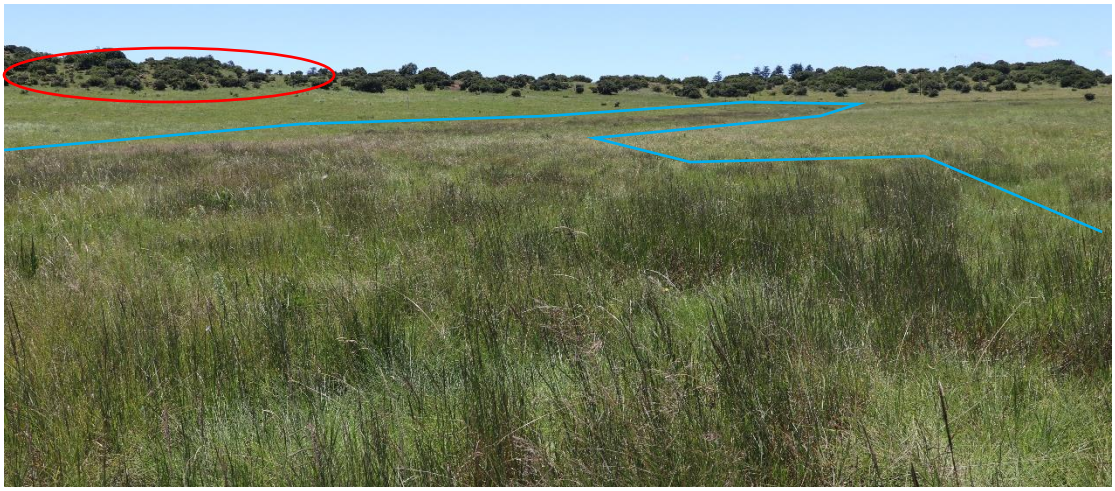

Figure 11: Vegetation within the wetland (blue) is dominated by hygrophilous grasses and is quite distinct form the surrounding terrestrial grassland. The location of the mining area is also indicate (red).

Figure 12: View of the wetland as seen from its origin. It clearly slopes downwards and is situated within a shallow valley.

Toward the western portion of the valley-bottom wetland it is being confined by a small artificial berm, forming a small impoundment. This causes significant disturbance and modification of the wetland. Because diffuse flow is being confined here, surface water accumulates and forms a perennial saturated area. As a result, vegetation within this dam is dominated by obligate wetland plants also being able to withstand prolonger periods of inundation. These include the sedges, *Schoneoplectus sp., Eleocharis dregeana* and the aquatic grass, *Paspalum distichum*. Due to this modification of the system, disturbance is quite evident, especially seen as an abundance of exotic weeds. This disturbance may also be influenced by the current mining area to the south. These weeds include *Cirsium vulgare, Solanum panduriforme, Schkuhria pinata, Bidens pillosa* and *Verbena rigida*.

Figure 13: A small artificial impoundment (red) at the western end of the wetland results in significant modification and disturbance of the system.

Figure 14: This small dam will contain shallow surface water for long periods and consequently the vegetation here is much modified from the upstream, more natural section.

Downstream of the small impoundment, discussed in the previous paragraph, the wetland becomes extensively modified and degraded. A large haul road, dirt tracks and adjacent areas will have a large impact on the system. This is also visible in the vegetation, containing a high degree of exotic weeds, and in the modification of the geomorphology of the wetland.

Figure 15: Downstream of the small impoundment (red), the wetland becomes exceedingly disturbed and modified.

Figure 16: Downstream of the small impoundment the wetland contains a large degree of exotic weeds.

Western artificial dam and excavation

A small artificial dam and wetland areas forming in previous excavations occur approximately 450 meters to the west of the site. These artificial wetland areas also fall within a separate catchment, upstream of the site and therefore the proposed mining area will not be able to have any affect on these artificial wetland areas. These two small depressions contain surface water and has formed artificial wetland conditions, most likely of a perennial nature. Vegetation is dominated by wetland plants adapted to prolonged inundation and soils also exhibit a prominent grey matrix and mottling. The soils are however also dominated by gravels, further substantiating that these wetland areas are a result of previous mining disturbance. As these areas are completely artificial and will not be affected by the proposed mining operations, they are not of consequence to the development and will therefore not be assessed in this study.

Figure 17: A small excavation caused by previous mining activities, now forms a small artificial wetland area to the west of the site.

Figure 18: A second small artificial wetland has also formed as a result of mining activities but is also likely linked to flow obstruction caused by gravel roads (red) caused obstruction of flow and consequently the accumulation of surface water.

4.3.5 Condition and importance of the affected wetland

The determination of the condition of the unchanneled valley-bottom wetland to the south of the site will be based on a determination of the WET-Health of the system (Appendix D). The site falls almost completely within the catchment of this wetland and any impacts resulting from the mining operations will affect this wetland, which will in turn affect downstream areas. Therefore, a WET-Health determination will be done for this unchanneled valley-bottom wetland which should give an accurate indication of the current condition of the system and its vulnerability to impacts of the development. The WET-Health will be taken as representative of the Present Ecological State (PES) of this system.

Table 3 refers to the determination and categorisation of the Present Ecological State (PES; health or integrity) of various biophysical attributes of rivers relative to the natural or close to the natural reference condition. The purpose of the EcoClassification process is to gain insights and understanding into the causes and sources of the deviation of the PES of biophysical attributes from the reference condition. This provides the information needed to derive desirable and attainable future ecological objectives for the river (Kleynhans & Louw 2007).

Table 4 refers to the Ecological Importance and Sensitivity (EIS) of wetlands. "Ecological importance" of a water resource is an expression of its importance to the maintenance of

ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The Ecological Importance and Sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC).

Table 3: Ecological categories for Present Ecological Status (PES).

Ecological Category	Description
A	Unmodified, natural
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.
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominately unchanged.
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem function has occurred.
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	Critically/Extremely modified. Modifications have reached a critical level and the system has been modified completely with 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 4: Ecological importance and sensitivity categories.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very High Floodplains that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these floodplains is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High Floodplains that are considered to be ecologically important and sensitive. The biodiversity of these floodplains may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate Floodplains that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2	C
Low/marginal Floodplains that are not ecologically important and sensitive at any scale. The biodiversity of these floodplains is	>0 and <=1	D

ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.		

The downstream portion of the wetland has been rated at the desktop level as being Moderately Modified (Van Deventer *et al* 2018). The section of the wetland situated to the south of the site has however not been mapped, most likely as a result of its small size.

As indicated, the catchment of the small unchanneled valley-bottom wetland is still largely natural although a few significant impacts are present and will result in some modification of the system. The main activities will most likely be associated with adjacent mining activities and the small artificial impoundment situated in the wetland at the western end of the study area. These impacts and the modification they cause will be discussed below.

A few small dirt tracks cross over the wetland, one at its origin and one below the small artificial dam. In both instances these tracks clearly influence the flow regime with concentrated flow becoming evident and the tracks themselves act as flow obstructions. Exotic weeds are also abundant within the wetland where these tracks cross it and includes *Cirsium vulgare* and *Solanum sisymbriifolium*. This is also a clear indication that though these tracks are small and the impact local, they do cause some disturbance of the wetland system.

Figure 19: Dirt track crossings (red) clearly cause some local disturbance of the wetland and the proliferation of exotic weeds.

Figure 20: Dirt tracks (red) also clearly act as obstruction to natural flow.

Current and previous mining operations to the south of the wetland as well as downstream will most certainly have significant impacts on the wetland. The mining excavations to the south of the wetland will mostly have an impact in terms of increased sediment runoff, though natural vegetation should act as a suitable buffer to this. Another significant impact will be associated with the modification in surface runoff due to the modification in the surface topography. Previous mining operations downstream of the site has clearly had a much higher impact on the wetland but since these areas are located downstream of the proposed mining area it has not been taken into consideration here.

Figure 21: Mining activities to the south of the wetland (red) will certainly have at least some impacts on the wetland.

Probably the most significant impact on the wetland (other than mining operations downstream of the site) is a small impoundment in the western portion of the wetland. This impoundment clearly has a significant impact on the hydrology of the wetland, where the natural, diffuse flow, is impounded and surface water accumulates. This also significantly modifies the natural vegetation from hygrophilous grasses adapted to saturated soils to a sedge dominated vegetation adapted to prolonged inundation.

Figure 22: A small artificial impoundment (red) at the western end of the wetland results in significant modification and disturbance of the system.

From the above described impacts it should be clear that the catchment and wetland itself is still largely natural although affected by a few significant impacts. A WET-Health determination was undertaken for the valley-bottom wetland to determine its current condition given the impacts affecting it. The results of the WET-Health indicated an overall Present Ecological State of Category B: Largely Natural (Appendix D). This is considered relatively accurate given the largely natural catchment though a few impacts are affecting the system, therefore reducing its condition to some extent. The wetland should therefore be regarded as an important and sensitive system and the proposed mining operations should in no way decrease this condition.

The EI&S of the valley-bottom wetland has been rated as being Moderate: Floodplains that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers. This is also most likely a function of the small extent of the wetland.

4.4 Risk Assessment

A Risk Assessment for the proposed mining permit application area in close proximity to the adjacent unchanneled valley-bottom wetland has been undertaken according to the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use (Appendix E). The mining area is located approximately 130 meters to the north of this wetland area and consequently will not have any direct impact on it. However, sediment runoff and flow diversion may still have some influence on this wetland.

Mining within close proximity of the valley-bottom wetland is anticipated to have a low risk as long as the following buffers are maintained:

- A 100 meter buffer between the edge of the wetland as delineated and the quarry excavations, stockpile areas, chemical toilets, wastes and any hazardous materials (diesel, etc.).

Although the risk is anticipated to be low the quarry will likely still have impacts on the stream in terms of an increased sediment load. Through adequate mitigation, including storm water management measures, this can be minimised and provided adequate rehabilitation is undertaken no permanent modification to the functioning of the wetland will result. The principles of storm water management should be implemented, i.e. runoff generated in the surrounding natural areas should be diverted around the mining area and storm water generated on the mining footprint itself should be contained on the site.

Low Risks: Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.

Mitigation as recommended should be implemented as far as possible which should considerably alleviate the risk on the seasonal stream.

For the complete risk assessment please refer to Appendix E.

No.	Phases	Activity	Aspect	Impact	Risk Rating	Confidence level	Control measures
1	Mostly Operational Phase but also extending to a degree beyond the closure phase	Quarry and excavation of dolerite	Mining in close proximity of a wetland system	Mining will require removal of the vegetation layer in the catchment of the adjacent wetland system. This activity will not entail modification of the wetland itself but will nonetheless also entail erosion and increased sedimentation of the wetland. The functioning of the wetland is anticipated to remain largely intact. Establishment of exotic weeds is likely due to disturbance caused by mining.	**L**	**80**	This impact will be mainly during the operational phase but will only cease once rehabilitation has been completed and an indigenous vegetation layer has become established. This activity is anticipated to have a low risk of impact as long as adequate mitigation and comprehensive rehabilitation is adhered to. Measures must be implemented to minimise the amount of sediment entering the wetland. A storm water management system should be implemented and adhered to. Comprehensive rehabilitation should be applied and should aim to re-instate the natural topography as far as possible and establish an indigenous vegetation layer.

5. Biodiversity Sensitivity Rating (BSR)

Habitat diversity and species richness:
The habitat diversity on the site and surroundings are considered at least moderate. Habitats include a small valley-bottom wetland, natural grassland and a low rocky ridge with scattered trees. These also contribute toward the species diversity in the area and consequently a moderate species diversity is also present.

Presence of rare and endangered species:
The mining permit application area and surroundings contain numerous protected species. These include *Eucomis montana, Haemanhtus humilis* subsp. *hirsutus, Gladiolus dalenii* subsp. *dalenii, Gladiolus ecklonii, Boophone distichia, Zantedeschia rehmannii* and *Gladiolus* crassifolius. Though fairly widespread these protected plants will still retain a significant conservation value. Though no rare or endangered species could be identified, it remains likely that such a species may occur.

Ecological function:
The ecological function of the site remains intact, while the surroundings, especially downstream has been modified to a significant degree. The site functions as habitat for fauna, sustains a specific vegetation type, i.e. Amersfoort Highveld Clay Grassland and also forms part of the immediate catchment of the adjacent wetland system (Appendix A: Map 1). The site itself still consists of natural vegetation with low levels of disturbance, which in turn, provides natural habitat to fauna which should still be largely representative of the natural population. The functioning of the site in terms of the catchment of the valley-bottom wetland also remains intact and will still function in the natural runoff and drainage pattern of the area. This functioning is also considered important as it will also affect the wetland system and downstream sections.

Immediately downstream, the area has been heavily modified by previous mining operations which will affect the vegetation, habitat, faunal population and natural hydrology but since it does not form part of the proposed site and is located downstream of it, it does not play a significant role in the ecological functioning of the site itself (Appendix A: Map 1).

Degree of rarity/conservation value:
As previously discussed, the proposed site is largely still natural, the section of the valley-bottom wetland to the south of the site is also still largely natural. The area consists of Amersfoort Highveld Clay Grassland (Gm 13) while the north eastern border of the site consists of a marginal portion of Soweto Highveld Grassland (Gm 8) (Appendix A: Map 1). Both of these vegetation types are heavily affected by transformation for agricultural crop production though Amersfoort Highveld Clay Grassland is still regarded as being Least Concern (LC) while Soweto Highveld Grassland is a listed Threatened Ecosystem under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004). The Soweto Highveld Grassland remaining in the area is currently listed as being Vulnerable (VU).

The site and surroundings has also been identified as being a Critical Biodiversity Area 1 and Ecological Support Area which significantly increases the conservation value. The site also falls within the Mpumalanga Protected Area Expansion Strategy (MPAES) which also contributes toward its conservation value.

Although not part of the site, the adjacent wetland system to the south has a high conservation value and its continued integrity is dependent on the runoff generated on the site which the

proposed mining area may impact on (Appendix A: Map 2). The overall conservation value of the site is therefore still regarded as high.

Percentage ground cover:
The percentage vegetation cover on the site and immediate surroundings, being dominated by natural grassland is regarded as moderate and near natural. Overgrazing by domestic livestock, a few dirt tracks and mining activities to the south do decrease the vegetation cover but overall this is still regarded as moderate.

Vegetation structure:
The vegetation structure in a large portion of the site is still natural i.e. a single grass layer without any prominent shrub or tree components and with the low rocky ridge containing a more prominent scattered tree component. A few exotic weeds and shrubs do influence the natural vegetation structure, but only to a moderate degree.

Infestation with exotic weeds and invader plants:
Numerous exotic species occur on the site with exotic weeds being abundant but does not form dominant stands (except in downstream mining excavations) (Appendix B). Overall this is therefore regarded as moderate for the site and immediate surroundings.

Degree of grazing/browsing impact:
Grazing by domestic livestock is still considered moderate and clearly evident on the site and surroundings.

Signs of erosion:
No signs of erosion could be observed and as a result of natural vegetation cover on the site and surroundings, this will aid in preventing any unnatural erosion from occurring.

Terrestrial animals:
Signs and tracks of mammals are still present on the site and despite the impacts, disturbances and adjacent mining disturbances a significant mammal population is still present on the site. This is also most likely due to the site and surroundings still containing natural grassland and vegetation and being situated within natural surroundings which still provides adequate habitat for mammals.

Table 2: Biodiversity Sensitivity Rating for the proposed mining permit development.

	Low (3)	Medium (2)	High (1)
Vegetation characteristics			
Habitat diversity & Species richness		2	
Presence of rare and endangered species		2	
Ecological function			1
Uniqueness/conservation value			1
Vegetation condition			
Percentage ground cover		2	
Vegetation structure		2	
Infestation with exotic weeds and invader plants or encroachers		2	
Degree of grazing/browsing impact		2	
Signs of erosion			1
Terrestrial animal characteristics			
Presence of rare and endangered species		2	
Sub total	0	14	3
Total		17	

6. Biodiversity Sensitivity Rating (BSR) interpretation

Table 3: Interpretation of Biodiversity Sensitivity Rating.

Site	Score	Site Preference Rating	Value
Rietspruit mining permit application	17	Good Condition	2

7. Discussion and conclusions (Appendix A: Map 1 & 2)

The site for the proposed mining permit application has been rated as being in a Good Condition, this is mostly as a result of the largely natural condition and the presence of elements of conservation value.

The proposed site consists of a mining permit area which will entail a rock quarry for use in construction, with an associated stockpile area and the entire application area has an extent of 5 hectares. The application area is situated on Portion 15 of the Farm Rietspruit which is situated approximately 5 km to the south west of the town of Ermelo (Appendix A: Map 1). The site is also situated adjacent to the R39 tarred road which will be used to access the site. The site does contain some disturbances but is, for the most part, still largely natural, consisting of a rocky ridge with a well-developed but scattered tree layer and grass layer. The site slopes from north east to south west where clear wetland areas has originated along the southern border of the site. This wetland area will also form the focus of this assessment, in order to determine if the mining development will affect it in any way.

The site itself still consists of natural vegetation which is dominated by scattered trees and a well-developed grass layer (Appendix A: Map 1). The site is largely situated on a low dolerite ridge and surface rock and boulders are abundant. Disturbances are present and include overgrazing by domestic livestock and low-level infestation by exotic weeds and shrubs, though overall the site is still largely natural. However, the surrounding areas, especially toward the south and west of the site, has been heavily modified by previous mining activities. Here an existing borrow pit, stockpile areas, overburden and waste dumps are abundant and has caused significant transformation of the surface water drainage patterns.

From the description of the study area, it is clear that although not situated on the site, a small wetland system is located adjacent to the southern border of the site (Appendix A: Map 1 & 2). Being a small wetland, almost its entire catchment originates in the immediate area, especially the low ridge of which the site also forms part. The site is located approximately 130 meters from this wetland. It is therefore also clear that the proposed mining operations is likely to also cause at least some impacts on this wetland which will therefore form the focus of this study. A small artificial dam and wetland area forming in previous excavations occur approximately 450 meters to the west of the site. These artificial wetland areas also fall within a separate catchment, upstream of the site and therefore the proposed mining area will not be able to have any affect on these artificial wetland areas and will be discussed only in overview.

Soil samples were quite clear but indicated only a seasonal/temporary zone of wetness within the interior of the valley-bottom wetland with a temporary zone of wetness along its borders (Appendix C). This also substantiates the small nature of the wetland and its seasonal nature. The area had received a high amount of recent rainfall but despite this, surface water and waterlogged soils were absent, also further indicating that this wetland area is strictly seasonal. This also confirms the border of the wetland area and that it is located not nearer than 130 meters from the site.

The soil samples taken across the valley-bottom wetland allowed for easy and accurate delineation of the wetland areas (Appendix C). In addition, when coupled with obligate wetland plants this even further improved the accuracy of delineation (Appendix B). Obligate wetland species are confined to wetlands and cannot occur in conditions outside of these systems. As a result, where they occur, wetland conditions can be considered to occur.

The wetland conditions associated with the valley-bottom wetland area can be characterised as an unchanneled valley-bottom wetland system (SANBI 2009). This is considered an accurate description of this small valley-bottom wetland located to the south of the proposed mining permit area (Appendix A: Map 2). It is situated beneath the low rocky ridge in a lower lying valley bottom area and though it is linear, it clearly does not contain a defined channel or channel banks. Furthermore, concentrated surface flow is clearly absent and diffuse flow dominates. Water inputs are also clearly from the surrounding slopes. A defined channel also becomes more prominent in downstream areas. The portion of this valley-bottom wetland to the south of the site, is still largely natural, though immediately to the west it becomes heavily modified by a small artificial dam and previous mining operations which had heavily modified its flow pattern.

Unchanneled valley-bottom wetland (Appendix A: Map 2)

A quite small valley-bottom wetland is located adjacent to the southern border of the site. The wetland is fed by a small surrounding catchment, especially the slopes of a low rocky ridge, of which the site forms a part. This valley-bottom wetland then drains toward the west where it has been quite heavily modified by previous mining operations. The wetland has a small catchment which is confined to the immediate area. The catchment is largely natural but with a few significant modifications which will also affect the valley-bottom wetland. The majority of the catchment still consists of natural grassland but which has been disturbed to some degree by overgrazing of domestic livestock. This causes visible trampling and also the establishment of exotic weeds in some areas. An existing borrow pit occurs to the south of the wetland and this will have some significant impacts in terms of sediment runoff and modification of the surface flow patterns. To the west of the site, the wetland is heavily modified by previous mining operations which is also visible in the vegetation composition of the wetland, where exotic weeds become abundant, indicating high levels of disturbance. The valley-bottom wetland itself has an elongated shape and is a linear system which is quite distinct and easily distinguished from the surrounding terrestrial areas, especially at this time when vegetation differentiation and hydrological regime is optimal. Though this wetland is clearly only seasonal and very seldom, if ever, contains surface flow, it is clearly a wetland system characterised by diffuse flow.

Western artificial dam and excavation

A small artificial dam and wetland area forming in previous excavations occur approximately 450 meters to the west of the site. These artificial wetland areas also fall within a separate catchment, upstream of the site and therefore the proposed mining area will not be able to have any affect on these artificial wetland areas. These two small depressions contain surface water and has formed artificial wetland conditions, most likely of a perennial nature. Vegetation is dominated by wetland plants adapted to prolonged inundation and soils also exhibit a prominent grey matrix and mottling. The soils are however also dominated by gravels, further substantiating that these wetland areas are a result of previous mining disturbance. As these areas are completely artificial and will not be affected by the proposed mining operations, they are not of consequence to the development and will therefore not be assessed in this study.

The determination of the condition of the unchanneled valley-bottom wetland to the south of the site will be based on a determination of the WET-Health of the system (Appendix D). As indicated, the catchment of the small unchanneled valley-bottom wetland is still largely natural although a few significant impacts are present and will result in some modification of the system. The main activities will most likely be associated with adjacent mining activities and the small artificial

impoundment situated in the wetland at the western end of the study area. From the described impacts it should be clear that the catchment and wetland itself is still largely natural although affected by a few significant impacts. A WET-Health determination was undertaken for the valley-bottom wetland to determine its current condition given the impacts affecting it. The results of the WET-Health indicated an overall Present Ecological State of Category B: Largely Natural (Appendix D). This is considered relatively accurate given the largely natural catchment though a few impacts are affecting the system, therefore reducing its condition to some extent. The wetland should therefore be regarded as an important and sensitive system and the proposed mining operations should in no way decrease this condition. The EI&S of the valley-bottom wetland has been rated as being Moderate.

A Risk Assessment for the proposed mining permit application area in close proximity to the adjacent unchanneled valley-bottom wetland has been undertaken according to the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use (Appendix E). The mining area is located approximately 130 meters to the north of this wetland area and consequently will not have any direct impact on it. However, sediment runoff and flow diversion may still have some influence on this wetland.

Mining within close proximity of the valley-bottom wetland is anticipated to have a low risk as long as a 100 meter buffer between the edge of the wetland as delineated and the quarry excavations, stockpile areas, chemical toilets, wastes and any hazardous materials (diesel, etc.) are maintained.

Although the risk is anticipated to be low the quarry will likely still have impacts on the stream in terms of an increased sediment load. Through adequate mitigation, including storm water management measures, this can be minimised and provided adequate rehabilitation is undertaken no permanent modification to the functioning of the wetland will result. The principles of storm water management should be implemented, i.e. runoff generated in the surrounding natural areas should be diverted around the mining area and storm water generated on the mining footprint itself should be contained on the site.

8. Recommendations

- The following recommendations and mitigation measures should be implemented in order to manage impacts on the adjacent valley-bottom wetland to the south of the site (Appendix A: Map 2).
  - The small valley-bottom wetland to the south of the site should be treated as no-go area during the lifetime of the mining area and kept as a natural area (Map 2). This should include that the area not be used as stockpile areas, laydown areas, parking or any other activities associated with mining operations.
  - Mining within close proximity of the valley-bottom wetland is anticipated to have a low risk as long as a 100 meter buffer between the edge of the wetland as delineated and the quarry excavations, chemical toilets, wastes and any hazardous materials (diesel, etc.) are maintained.
  - The principles of the separation of clean and dirty storm water must be implemented and runoff generated in the surrounding natural areas should be diverted around the mining footprint and storm water generated on the site itself should be contained on the site.
  - During the operation of the mining area it is also important that storm water management be implemented to prevent erosion and sedimentation from entering the adjacent wetland system. The storm water management should therefore also include measures such as structures along the border of the mining area including berms and cut-off trenches.
  - All structures and mitigation measures should be maintained throughout the lifetime of the mining operations.
  - The necessary authorisations should be obtained from the Department of Water and Sanitation (DWS).

- Adequate monitoring of weed establishment and their continued eradication must be maintained (Appendix B). Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004.

- No littering must be allowed and all litter must be removed from the site.

- Mining should be confined to the site footprint and should not encroach into adjacent areas.

- Monitoring of mining operations including weed establishment and erosion should take place.

- After completion of mining operations comprehensive rehabilitation of the mining area should be implemented and should include the following:
  - Overburden and tailings resulting from the mining operations should be returned to excavations in order to aid in re-establishing a more natural topography.
  - The topography of the site should be re-instated as far as possible.
  - Eradication and monitoring of weed establishment should take place and should be extended after cessation of mining (Appendix B).
  - Topsoil should be removed prior to mining, protected from wind erosion and weed establishment and replaced on the site during rehabilitation.

- Adequate monitoring of rehabilitation success should be done and remedial action taken where required.
- After mining has ceased all manmade materials should be removed from the site, i.e. structures, concrete, waste, etc.

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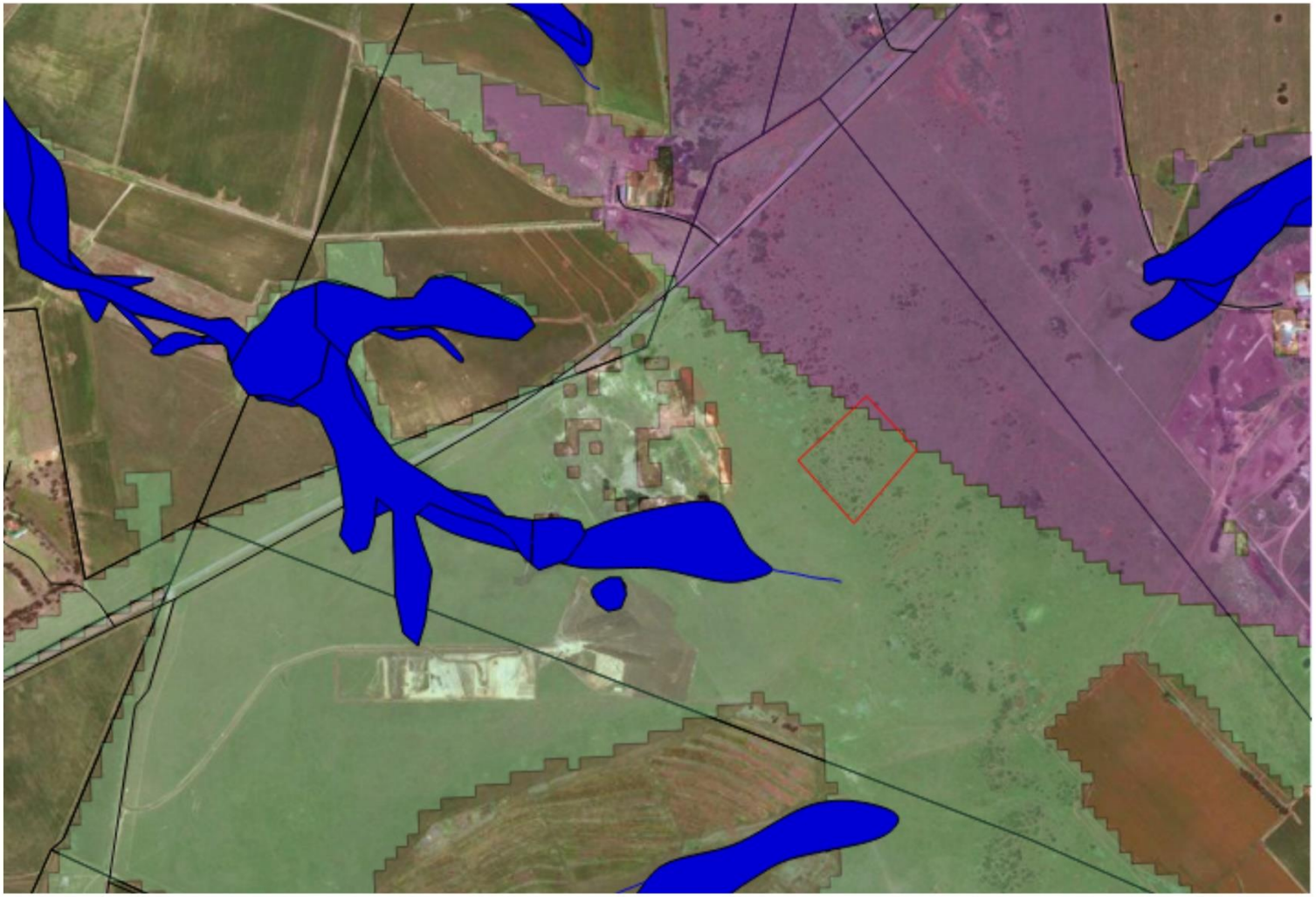
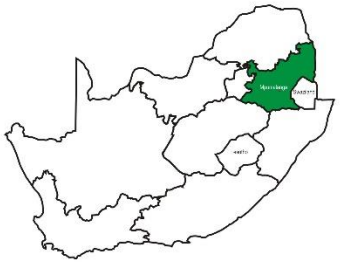
Annexure A: Maps

Locality and general ecology map for the proposed mining permit application on Portion 15 of the Farm Rietspruit 437 near the town of Eremlo, Mpumalanga Province.





Preparred for:
Greenmined Environmental
Baker Square
Somerset West
7130

Legend:

- Application area
- Road network
- Wetlands and impoundments
- Soweto Highveld Grassland
- Amersfoort Highveld Grass

Map Information

Spheroid: WGS 84

Quantum GIS

Scale: 1:20 000

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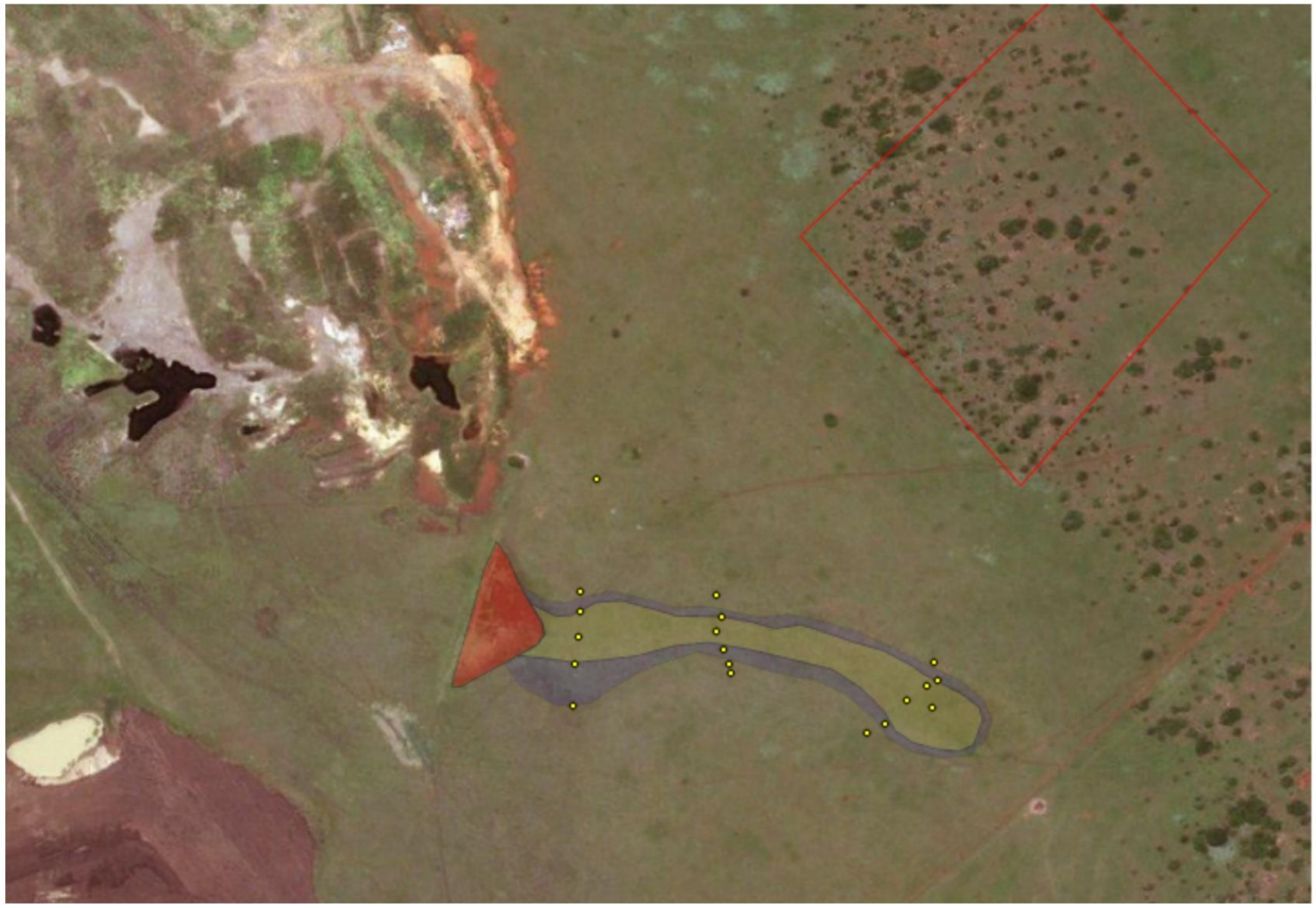
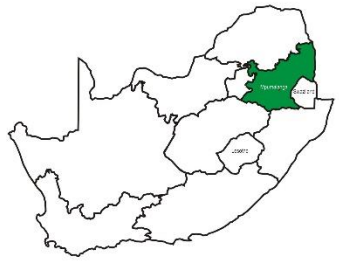
Map 1: Locality and general ecology map of the proposed mining permit application on Portion 15 of the farm Rietspruit 437. The vegetation types in the area are indicated, note that large areas around the site still consists of natural grassland. The site and wetland system consist of Amersfoort Highveld Clay Grassland while the site marginally intrudes into the Soweto Highveld Grassland. Using available spatial resources, the anticipated wetlands, watercourses and impoundments in the area are indicated. It is clear that a wetland system occurs to the south of the site. This also corresponds with the on-site delineation although the boundaries of the wetland system could be determined with much higher accuracy (See Map 2).

Wetland delineation map for the proposed mining permit application on Portion 15 of the Farm Rietspruit 437 near the town of Eremlo, Mpumalanga Province.





Preparred for:
Greenmined Environmental
Baker Square
Somerset West
7130

Legend:

- Application area
- Temporary wetland zone
- Seasonal wetland zone
- Permanent wetland zone
- Sampling sites

Map Information

Spheroid: WGS 84

Quantum GIS

Scale: 1:10 000

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Map 2: Wetland adelineation map of the proposed mining permit application on Portion 15 of the farm Rietspruit 437. The application area is indicated to the north of a small unchanneled valley-bottom wetland approximately 130 meters from it. This wetland, the seasonal zone and temporary zone (indicating the wetland boundary) is indicated as well as a small artificial dam into which it flows, representing a permanent zone of wetness. The sampling sites along the wetland is also indicated along three separate transects. Note also extensive transformation downstream and to the south of this wetland caused by previous mining operations. The proposed site is clearly situated along a low rocky ridge.

Appendix B: Species list

Species indicated with an * are exotic.

Protected species are coloured orange and Red Listed species red.

The species list is only based on the unchanneled valley-bottom wetland and immediate surroundings.

Species	Growth form
**Bidens pillosa*	Herb
**Cirsium vulgare*	Herb
**Falkia oblonga*	Herb
**Richardia braziliensis*	Herb
**Schkuhria pinata*	Herb
**Solanum panduriforme*	Herb
**Solanum sisymbriifolium*	Herb
**Verbena rigida*	Herb
Agrostis eriantha	Grass
Andropogon appendiculatus	Grass
Arundinella nepalensis	Grass
Berkheya macrocephala	Herb
Centella asiatica	Herb
Cyperus congestus	Sedge
Eleocharis dregeana	Sedge
Eragrostis curvula	Grass
Euphorbia striata	Herb
Harpochloa falx	Grass
Helicrhysum rugulosum	Herb
Hermannia geniculata	Herb
Juncus exertus	Rush
Kyllinga erecta	Sedge
Monopsis decipiens	Herb
Paspalum distichum	Grass
Pennisetum sphacelatum	Grass
Pycreus sp.	Sedge
Schoenoplectus sp.	Sedge
Senecio discodregeanus	Herb
Sporobolus fimbriatus	Grass
Themeda triandra	Grass
Typha capensis	Bulrush
Wahlenbergia grandiflora	Herb

Appendix C: Soil Samples Methodology

Obligate wetland vegetation was utilised to determine the presence and border of wetlands. Soil samples were used to confirm the wetland conditions in the study area. Soil samples were investigated for the presence of anaerobic evidence which characterises wetland soils.

Within wetlands the hydrological regime differs due to the topography and landscape. For instance; a valley bottom wetland would have a main channel that is below the water table and consequently permanently saturated, i.e. permanent zone of wetness. As you move away from the main channel the wetland would become dependent on flooding in order to be saturated. As a result along this hydrological regime areas of permanent saturation, seasonal and temporary saturation would occur. At some point along this gradient the saturation of the soil would be insufficient to develop reduced soil conditions and therefore will not be considered as wetland.

Within wetland soils the pores between soil particles are filled with water instead of atmosphere. As a result available oxygen is consumed by microbes and plantroots and due to the slow rate of oxygen diffusion oxygen is depleted and biological activity continues in anaerobic conditions and this causes the soil to become reduced.

Reduction of wetland soils is a result of bacteria decomposing organic material. As bacteria in saturated soils deplete the dissolved oxygen they start to produce organic chemicals that reduce metals. In oxidised soils the metals in the soil give it a red, brown, yellow or orange colour. When these soils are saturated and metals reduced the soil attains a grey matrix characteristic of wetland soils.

Within this reduction taking place in the wetland soils there may be reduced matrix, redox depletions and redox concentrations. The reduced matrix is characterised by a low chroma and therefore a grey soil matrix. Redox depletions result in the grey bodies within the soil where metals have been stripped out. Redox concentrations result in mottles within the grey matrix with variable shape and are recognised as blotches or spots, red and yellow in colour.

Soil wetness indicator is used as the primary indicator of wetlands. The colour of various soil components are often the most diagnostic indicator of hydromorphic soils. Colours of these components are strongly influenced by the frequency and duration of soil saturation. Generally, the higher the duration and frequency of saturation in a soil profile, the more prominent grey colours become in the soil matrix.

Coloured mottles, another feature of hydromorphic soils, are usually absent in permanently saturated soils and are at their most prominent in seasonally saturated soils, becoming less abundant in temporarily saturated soils until they disappear altogether in dry soils (Collins 2005).

The following soil wetness indicators can be used to determine the permanent, seasonal and temporary wetness zones. The boundary of the wetland is defined as the outer edge of the temporary zone of wetness and is characterised by a minimal grey matrix (<10%), few high chroma mottles and short periods of saturation (less than three months per year). The seasonal zone of wetness is characterised by a grey matrix (>10%), many low chroma mottles and significant periods of wetness (at least three months per year). The permanent zone of wetness is characterised by a prominent grey matrix, few to high chroma mottles, wetness all year round and sulphuric odour (rotten egg smell). According to convention hydromorphic soil must display signs of wetness within 50 cm of the soil surface (DWAF 2005).

Table 1: Soil samples taken along a longitudinal transect from south to north, across the affected valley-bottom wetland at its western end prior to flowing into a small artificial dam.

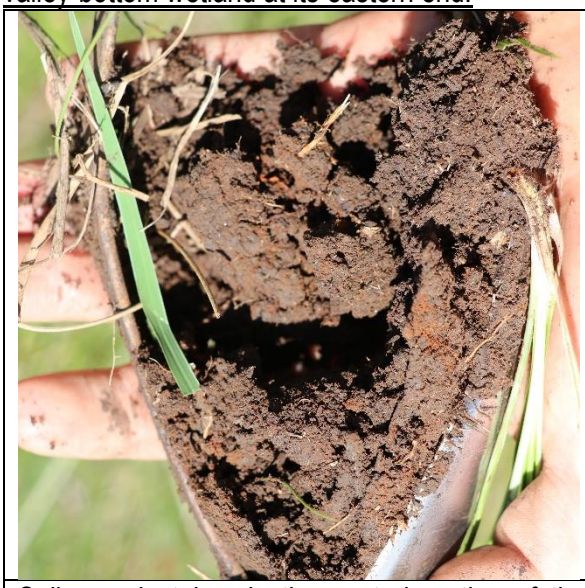
	
Soil sample taken in the central portion of the valley-bottom wetland. A grey matrix is not prominent though a high clay content is present with several reddish, clearly visible mottles indicating a seasonal zone of wetness. Wetland conditions are therefore clearly present.	Soil sample taken toward the north border of the valley-bottom wetland. A grey matrix is not prominent (<10%) though mottling remains clearly visible and seasonal wetland condition are therefore still present.
	
Soil sample taken along the northern border of the valley-bottom wetland. A grey matrix is not discirnible and only a few very indistinct mottles are visible. This is taken as the temporary zone of wetness and indicates the border of the wetland.	Soil sample taken to the north and well outside the border of the wetland. This sample is taken as a reference for the terrestrial surroundings. Note a reddish colouration, no mottles, being a mixture of clay and loam.

Table 2: Soil samples taken along a longitudinal transect from north to south, across the affected valley-bottom wetland in the central portion to the south of the proposed site.

	
Soil sample taken to the north and outside the border of the wetland. A reddish colour, absence of mottles and a clay-loam content clearly indicates the absence of wetland conditions.	Soil sample taken at the northern border of the wetland. Soils contain a somewhat higher clay content but with a reddish colour and no mottles and indicate the absent of wetland conditions.
	
Soil sample taken just inside the border of the valley-bottom wetland. Soils contain a significant clay content and with a few feint mottles visible. This is taken as the temporary zone of wetness and indicates the border of the wetland.	Soil sample taken in the central portion of the valley-bottom wetland. A grey matrix is not prominent though a high clay content is present with several reddish, clearly visible mottles indicating a seasonal zone of wetness. Wetland conditions are therefore clearly present.

	
Soil sample taken toward the southern border of the valley-bottom wetland. A grey matrix is not prominent (<10%) though mottling remains clearly visible and seasonal wetland condition are therefore still present.	Soil sample taken outside the southern border of the wetland. A reddish colour, absence of mottles and a clay-loam content clearly indicates the absence of wetland conditions.

Table 3: Soil samples taken along a longitudinal transect from south to north, across the affected valley-bottom wetland at its eastern end.

	
Soil sample taken in the central portion of the valley-bottom wetland. A grey matrix is not prominent though a high clay content is present with several reddish, clearly visible mottles indicating a seasonal zone of wetness. Wetland conditions are therefore clearly present.	Soil sample taken toward the north border of the valley-bottom wetland. A grey matrix is not prominent (<10%) though mottling remains clearly visible and seasonal wetland condition are therefore still present.

	
Soil sample taken along the northern border of the valley-bottom wetland. A grey matrix is not discirnible and only a few very indistinct mottles are visible. This is taken as the temporary zone of wetness and indicates the border of the wetland.	Soil sample taken to the north and outside the border of the wetland. A reddish colour, absence of mottles and a clay-loam content clearly indicates the absence of wetland conditions.

Appendix D: WET-Health Summary

For the complete WET-Health please contact the author of this report.

Wetland Attributes	
The information in this sheet must be captured before continuing with any other aspects of the assessment. Not capturing all the information required will lead to errors in the spreadsheet calculations, which will prevent a final outcome being obtained.	
Wetland Name	Rietspruit Valley-botom wetland
Assessment Unit Name / No.	1
Assessor	Darius van Rensburg
Date of Assessment	08/02/2022
HGM Type (Basic)	Unchannelled VB wetland
	UVB
HGM Type (Refined)	Unchannelled VB wetland
	UVB
Conceptual model	Water and sediment inputs from the topographically defined catchment are assumed to emanate largely from the catchment upstream of the wetland, with limited lateral inputs. For the the purposes of geomorphic and water quality assesments, a weighting of 70% is therefore allocated to impacts associated with the upstream catchment whereas impacts associated with lateral inputs only contribute 30% to final catchment impact scores. For the hydrological assessment, weightings are based on the relative extent of contributing areas rather than default weightings.
Wetland size (Ha)	1.72
Upslope catchment size (Ha)	74.58
Quaternary Catchment[1]	C11F
MAR (Mm3)	20.2
MAR per unit area (m3/Ha)	469.0
MAP (mm)	659
PET (mm)	1450
MAP:PET ratio	0.5
Vulnerability Factor	0.9
Hydrogeological Type Setting[2]	Other
Connectivity of wetland to a regional aquifer	No connection
Change in groundwater levels in the regional aquifer	
Water quality of regional aquifer	
Channel characteristics (if present)	
Natural wetness regimes	Mix of seasonal and temporarily saturated soils
Broad vegetation attributes	Hygrophilous grasses dominate with a mixture of facultative and obligate species. Exotic weeds are present but not abundant.
Number of dams in the catchment	1
Average surface area of dams (m2)	0
Perimeter of wetland (m)	774
Perimeter-to-area ratio (m/ha)	450.0
Down-slope length of wetland (m)	340
Elevation change over length (m)	16
Longitudinal Slope (%)	4.7%
Propensity to erode (Category)[3]	Moderate
Propensity to erode (Score)	0.8
Dominant sediment accumulation process	Clastic

WET-Health Level 2 assessment: PES Summary

This worksheet provides an overall summary of the WET-Health Assessment that can be used for reporting purposes

	Wetland PES Summary
Wetland name	**Rietspruit Valley-botom wetland**
Assessment Unit	**1**
HGM type	Unchannelled VB wetland
Areal extent (Ha)	1.7 Ha

Unadjusted (modelled) Scores

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.4	2.7	0.8	1.6
PES Score (%)	76%	73%	92%	84%
Ecological Category	**C**	**C**	**A**	**B**
Combined Impact Score	1.9			
Combined PES Score (%)	81%			
Combined Ecological Category	**B**			
Hectare Equivalents	1.4 Ha			
Confidence (modelled results)	RATE-TO-HIGH: Field-based assessment including information about the regional a			

Final (adjusted) Scores

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.4	2.7	0.8	1.6
PES Score (%)	76%	73%	92%	84%
Ecological Category	**C**	**C**	**A**	**B**
Trajectory of change				
Confidence (revised results)	Not rated	Not rated	Not rated	Not rated
Combined Impact Score	1.9			
Combined PES Score (%)	81%			
Combined Ecological Category	**B**			
Hectare Equivalents	1.4 Ha			

Appendix E: Risk Assessment Matrix

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP REGISTERED PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE

					Severity																
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures
1	Mostly Operational Phase but also extending to a degree beyond the closure phase	Quarry and excavation of dolerite	Mining in close proximity of a wetland system	Mining will require removal of the vegetation layer in the catchment of the adjacent wetland system. This activity will not entail modification of the wetland itself but will nonetheless also entail erosion and increased sedimentation of the wetland. The functioning of the wetland is anticipated to remain largely intact. Establishment of exotic weeds is likely due to disturbance caused by mining.	1	2	1	1	1.25	1	2	4.25	2	2	5	2	11	46.75	L	80	This impact will be mainly during the operational phase but will only cease once rehabilitation has been completed and an indigenous vegetation layer has become established. This activity is anticipated to have a low risk of impact as long as adequate mitigation and comprehensive rehabilitation is adhered to. Measures must be implemented to minimise the amount of sediment entering the wetland. A storm water management system should be implemented and adhered to. Comprehensive rehabilitation should be applied and should aim to re-instate the natural topography as far as possible and establish an indigenous vegetation layer.