PROPOSED MINING PERMIT APPLICATION AND STOCKPILE AREA ON THE REMAINING EXTENT OF ELANDS SPRUIT NO 5523, ALFRED DUMA MUNICIPAL, KWAZULU-NATAL

Wetland Assessment Report

Version 1.1

Date: 16th February 2023

Prepared by:

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Report No: EP671-01

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SPECIALIST ASSESSMENT REPORT DETAILS AND DECLARATION OF INDEPENDENCE

This is to certify that the following report has been prepared as per the requirements of:

- Section 32 (3) of the NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (Act No. 107 OF 1998) ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS 2014 as per Government Notice No. 38282 GOVERNMENT GAZETTE, 4 DECEMBER 2014 (as amended).
- The Department of Water & Sanitation for Water Use Licensing and wetland/aquatic assessment, as outlined in the 'Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals' contained in the Government Gazette No. 40713 of 24 March 2017.

Document Title:	Wetland Assessment Report
Project:	Proposed Mining Permit Application and Stockpile Area
Location:	The Remaining Extent of Elands Spruit NO. 5523, Alfred Duma Municipal, KZN
Report No.	671-01
Version No.	1.0
Date:	16th February 2023
Author & Sign Off:	**Ryan Kok** (*Pr.Sci.Nat.)* *Scientist: Wetland & Aquatic Ecology*
Field of study/Expertise:	Wetland and Aquatic Ecology
Professional affiliations:	SACNASP: *Pr.Sci.Nat.* 'Ecological Science' field of practice
Client:	Greenmined Environmental

I, **Ryan Kok**, hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the relevant environmental authorities.

Signed: ______________________ Date: 16th February 2023

Details of Specialist Team

The relevant experience of specialist team members involved in the compilation of this report are briefly summarized below. *Curriculum Vitae's* of the specialist team are available on request.

Specialist	Role	Details
Ryan Kok Scientist Eco-Pulse *Pr.Sci.Nat.*	Project Manager Field work Lead author & sign-off	Ryan is a Scientist and Wetland / Aquatic Ecologist at Eco-Pulse with a BSc degree in Environmental Science; BSc Honours and MSc degree in Biological & Ecological Sciences. He is a registered Professional Natural Scientist (Pr. Sci. Nat.) with >5 years' experience, having worked extensively on numerous specialist ecological assessment projects, for wetland/aquatic habitats in KZN, the Free State, Gauteng, Eastern Cape, and Mpumalanga.

EXECUTIVE SUMMARY

Raubex KZN (Pty) Ltd intends to establish an open-cast quarry (~4.9ha) and an area for stockpiling and crushing of material (~10.5ha) that is mined at the quarry on the Remaining Extent of the farm Elands Spruit No 5523, near Ladysmith, within the Alfred Duma Municipal, KZN. The applicant intends to apply for Environmental Authorisation and also apply for a water use license (WUL) through the Department of Water & Sanitation (DWS). This report sets out the findings of a Freshwater Ecosystem Impact Assessment to inform the EIA and WULA processes. The main findings of the report have been summarized below.

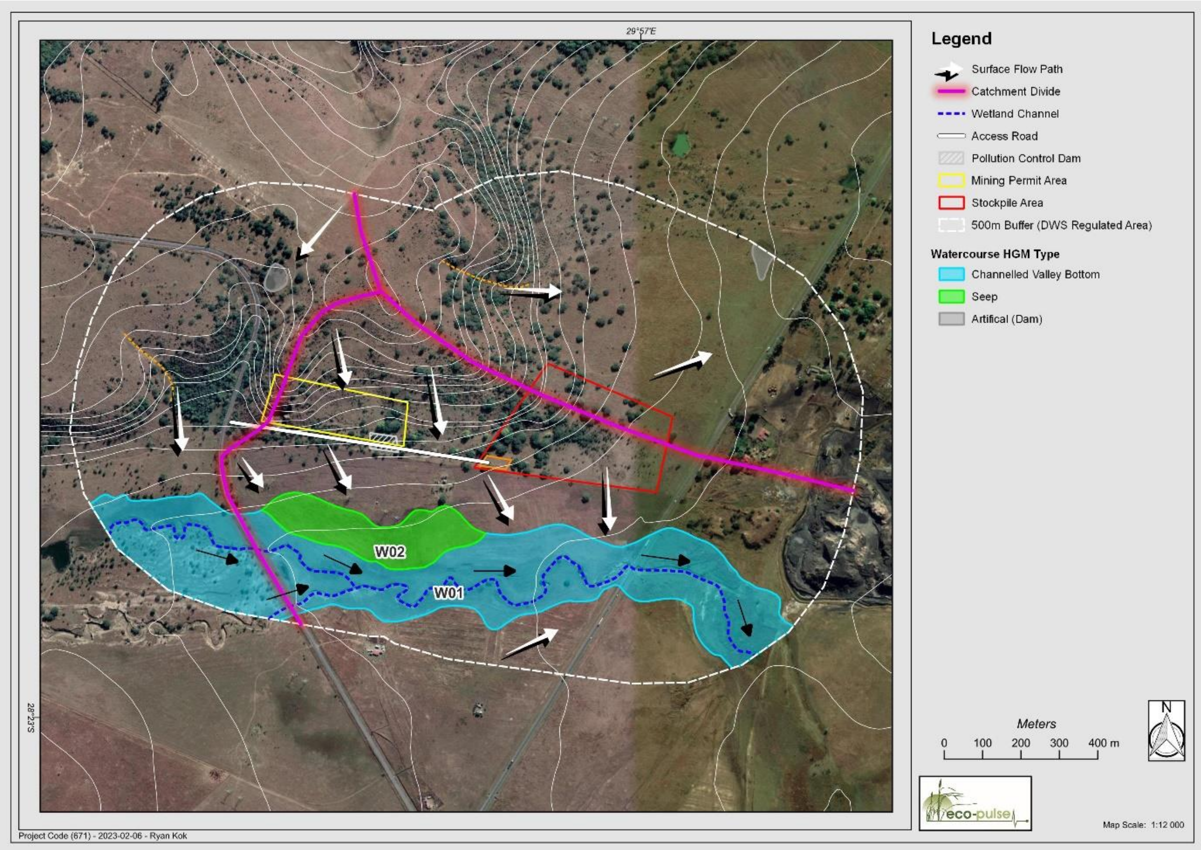
Baseline Aquatic Assessment:

The development site (i.e., preferred property) and area of study is located within DWA Quaternary Catchment V60C & V60B. These quaternary catchments are primarily drained by the perennial Sundays River. The site is located on a catchment divide with most of the site draining southwards in the V60C catchment. The local drainage network in the vicinity of the study area consists of two wetland systems located approximately 166m downslope of the mining permit area and 116m of the stockpiling area. The valley bottom wetland drains in a south easterly which forms part of a left bank tributary of the middle Sudays River system.

The infield sampling of soil and vegetation in conjunction with the recordings of diagnostic topographical / terrain indicators and features enabled the delineation of two wetland units (W01 & W02) downstream of the site that is at risk of being potentially measurably impacted during the construction and operational phases of the mining and stockpiling sites. NO RIVERS stand to be impacted either directly or indirectly, therefore only wetlands have been assessed and reported on. The baseline assessment focused on the wetland (seep), with the results summarised below:

Watercourse Units	PES	EIS	REC	RMO
Wetland W01	C: Moderately Modified	Moderate	C	Maintain
Wetland W02	B: Largely Natural	Moderately Low	B	Maintain

Map showing the delineated 'channelled valley bottom' and 'seep' wetland in relation to the mining permit area and stockpiling property boundary:



Resource Management Objectives & Recommendations:

Based on the consideration of the PES, EIS and realistic opportunities to improve the PES, the minimum recommended management objective for the assessed wetlands should be to '*maintain the current status quo of wetlands without any further loss of integrity/condition or functioning*' which can be achieved through careful management of catchment sediment, erosion, flow and water quality impacts/risks and by avoiding direct impacts to the wetland.

Risk and Impact Assessment:

The development will take place on the Remaining Extent of the farm Elands Spruit No 5523, which is mostly untransformed and undeveloped 'greenfields', with the expression of a historic quarry, used primarily as grazing land at present. The most significant ecological risks and impacts associated with the project are linked with the potential for sedimentation and erosion of downstream wetlands during the construction phase, and long-term stormwater (erosion) related risks and impacts during operation, as well as the potential risk of water quality impacts through surface pollutes from the surface runoff and increased water turbidity due to sediment inputs and / or erosion. These impacts can be mitigated with best management practices such that under a 'good' mitigation scenario, impact significance can be maintained at a 'low' level, which can be considered to be environmentally acceptable.

Mitigation of Risks and Impacts:

Recommendations to mitigate key risks and impacts related to the project have been provided in Chapter 7 of the wetland report. The focus of impact/risk mitigation has been on addressing potential construction and operational phase risks and impacts on freshwater wetland habitat. These include design recommendations to avoid wetlands and recommended buffer zones (development set-back and 'No-Go' areas), best-practice management measures and controls to minimise impact probability of occurrence and to reduce impact intensity where impacts cannot be avoided entirely and ecological monitoring recommendations.

Licensing & Permitting Requirements:

The activities associated with the mining and stockpiling sites are at this stage (based on information made available to Eco-Pulse) considered Section 21 (c), (g) and (i) water uses in terms of Section 21 and Chapter 4 of the National Water Act No. 36 of 1998 (NWA). Despite appropriate mitigation measures the operational quarry and stockpiling area will require a full Water Use License as the risk of altering the characteristics of downstream watercourses may be deemed 'Moderate' according to the DWS Risk Matrix/Assessment method applied to the project.

Conclusion:

Given that aquatic ecological risks and impacts can be mitigated and reduced to relatively 'low' levels generally, it is recommended that the proposed development be authorised and licensed from a Freshwater Ecosystems perspective, subject to implementation of the range of mitigation measures provided in Chapter 7 of this specialist Wetland Assessment Report which should be a specific condition of the EA / WUL where issued.

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1. INTRODUCTION

1.1 Introduction to Freshwater Ecosystem (Wetlands)

An ecosystem is a group of plants, animals and other organisms interacting with each other and with non-living (abiotic) components of their environment. Ecosystems can be classified broadly into terrestrial and aquatic ecosystems. Terrestrial ecosystems occur on land where water is a limiting factor, whereas aquatic ecosystems occur within landforms that are permanently or periodically inundated with flowing or standing water (Ollis *et al*., 2013). Freshwater ecosystems are a subset of the Earth's aquatic ecosystems and include all inland freshwater rivers, streams, wetlands, lakes, ponds and springs. This broad range of freshwater ecosystem types contains a multitude of habitats of varying ecological complexity and diversity (Wrona *et al*., 2016). Wetlands, streams and rivers fall under the umbrella term of 'freshwater ecosystems'.

Under Section 1(1)(xxiv) of the National Water Act (Act No. 36 of 1998) (NWA), a 'watercourse' is defined as:

a) a **river** or **spring**;
b) a **natural channel** in which water flows regularly or intermittently;
c) a **wetland, lake or dam** into which, or from which, water flows; and
d) 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.

This assessment focusses on the assessment of all natural watercourses and their associated habitats / ecosystems likely to be measurably affected by the proposed development, focussing specifically on wetlands. For the purposes of this assessment, wetlands are defined as follows:

- **Wetlands** are areas that have water on the surface or within the root zone for extended periods throughout the year such that anaerobic soil conditions develop which favour the growth and regeneration of hydrophytic vegetation (plants which are adapted to saturated and anaerobic soil conditions). In terms of Section 1 of the NWA, wetlands are legally defined as: (1) "…land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

1.2 Legislative Context Relevant to Freshwater Ecosystems

Wetlands as an ecosystem type are not formally protected by law but their alteration is regulated by the water use licensing process of the National Water Act (No. 36 of 1998) ('NWA'), the environmental authorization process of the National Environmental Management Act (No. 107 of 1998) ('NEMA'), the regulated activity permission process of the Conservation of Agricultural Resources Act (No. 43 of 1983) ('CARA'), and the resource directed measures (RDM) which form part of the regulation 810 published in Government Gazette No. 33541 dated 17 September 2010 defined the water resource management classes and a procedure (Water Resource Classification System – WRCS) to determine a Class.

1.3 Project Details

1.3.1 Project Background and Locality

The applicant Raubex KZN (Pty) Ltd currently holds a mining permit (DMRE Ref No: KZN 30/5/1/3/2/10518 MP) to mine aggregate from a 4.9 ha area on the Remaining Extent of the farm Elands Spruit No 5523, uThukela District, which is valid until February 2023. Due to the mining of the area being dependent on the upgrade of the N11 (SANRAL tender still to be awarded), mining has not yet commenced at the site. With the forthcoming lapsing of the existing mining permit, Raubex identified the need for a new mining permit. In addition to the mining of the quarry, Raubex also intends to establish an area for stockpiling and crushing of material that is mined at the quarry, on 10.5ha on the Remaining Extent of the farm Elands Spruit No 5523. The property is ±26 km north-east of Ladysmith between Collings Pass Road and the N11 national road. The earmarked area has an existing quarry that was historically mined but abandoned without rehabilitation.

In light of this, a specialist assessment is deemed necessary to understand the extent, type and sensitivity/importance of watercourses and the risk that mining and stockpiling poses to the freshwater environment.

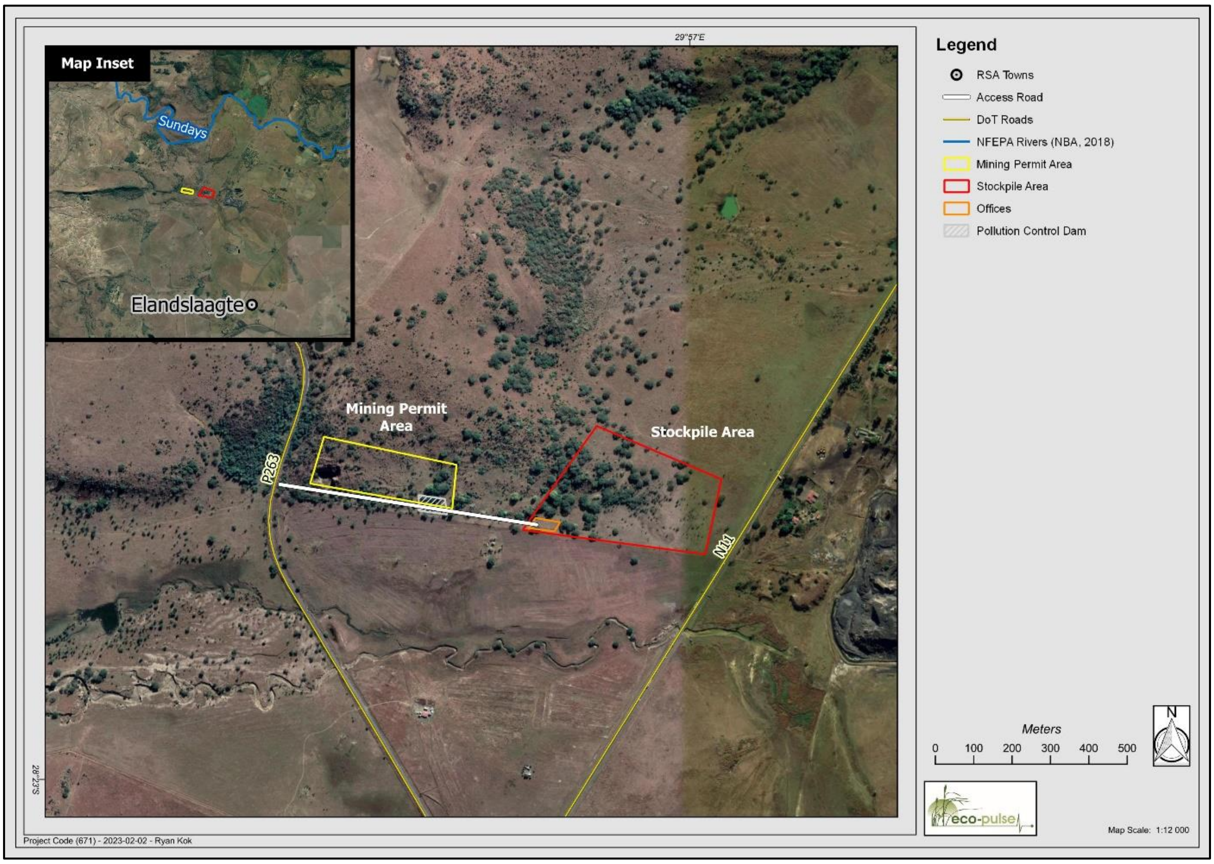


Figure 1 Locality map showing the location of the Mining Permit Area (outlined in "yellow") and the Stockpile Area (outlined in "purple"), with associated infrastructure (i.e., PCD, Access Road & Offices).

As the proposed activities may impact wetland ecosystems within and in the vicinity of the project area, the development activities associated with the project may be considered both listed activities under the National Environmental Management Act (NEMA) and water uses under the National Water Act (NWA). For this reason, Eco-Pulse Consulting Services have been appointed to undertake a Freshwater Habitat Impact Assessment to inform both the environmental authorization and water use license applications, as required.

1.3.2 Project Description

The proposed project will entail the extension of the existing quarry pit through open-cast mining of the hard rock (i.e., Mining Permit Area; Figure 2). The recovered material will then be stockpiled, crushed and screened to produce aggregate that can be used for road building purposes (Figure 2).

The planned activities intended to be conducted at thee site include:

- stripping and stockpiling of the topsoil of the proposed mining footprint area;
- loosening of the hard rock through blasting and excavation;
- crushing and screening of the hard rock to reduce it to various size aggregate;
- stockpiling of the product until it is used.

The proposed layout plan is shown in Figure 2 below.

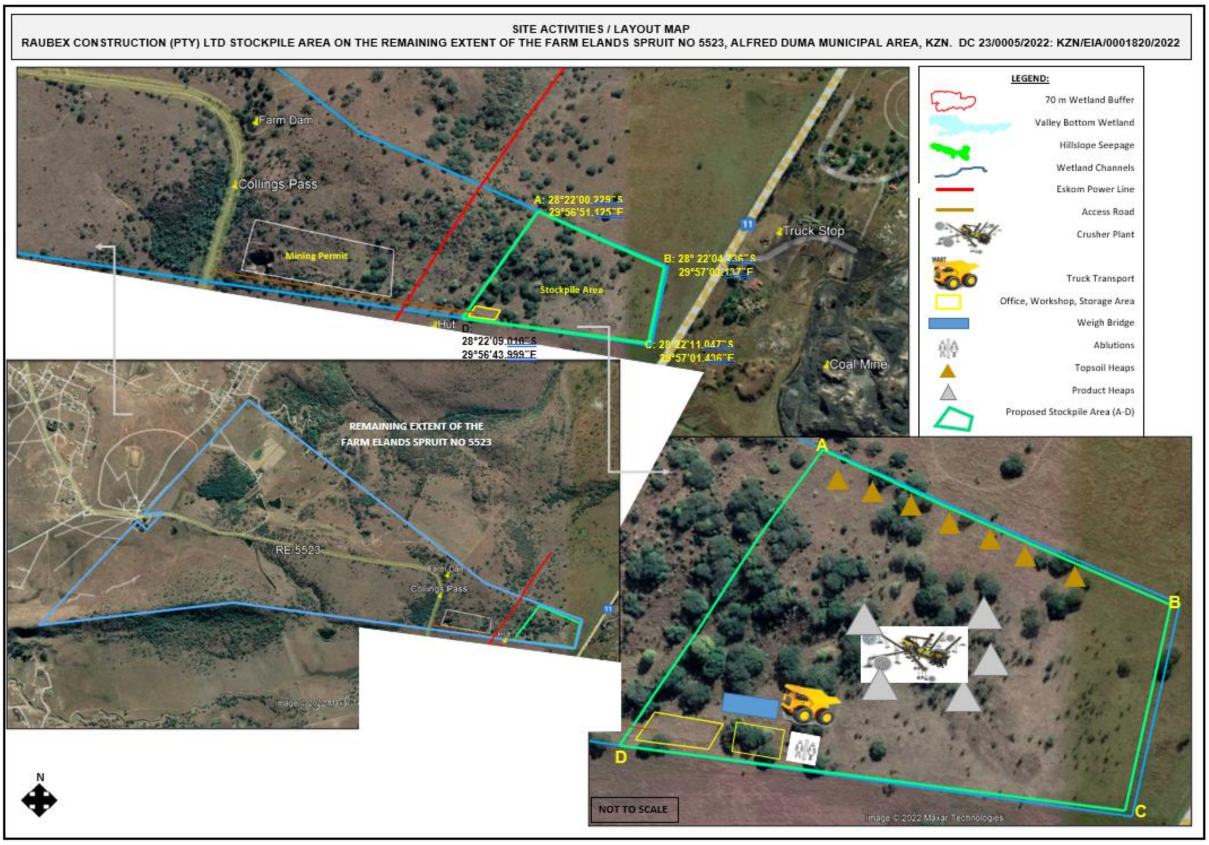
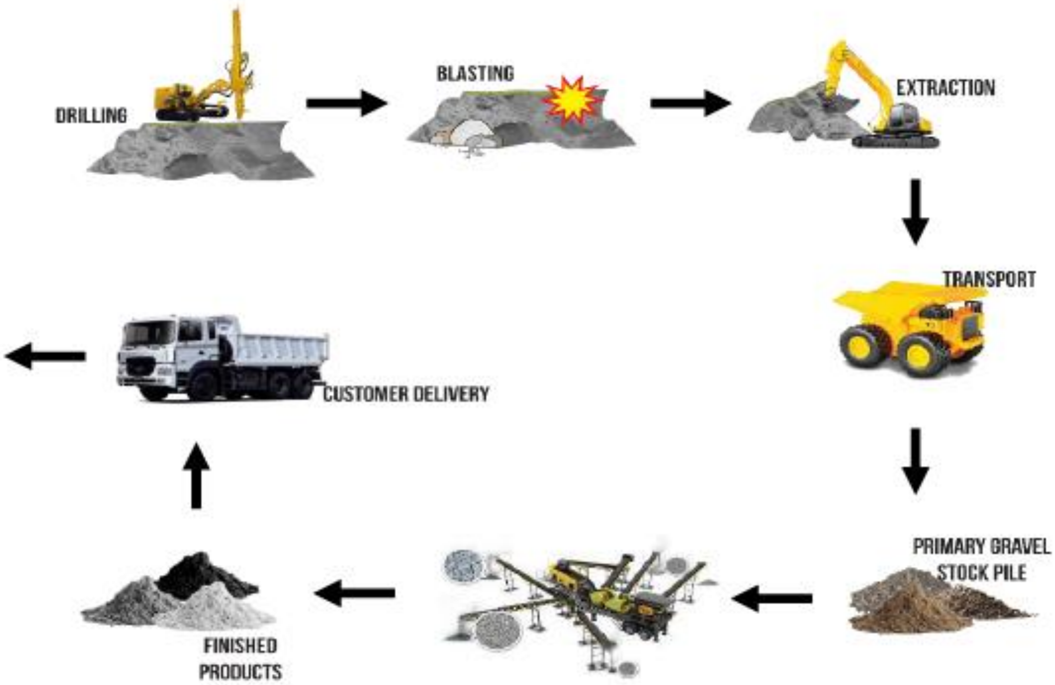


Figure 2 Proposed site plan on the preferred site.

In terms of the mining method and operational procedures, the following is proposed:

- The proposed mining method (as depicted below) will make use of blasting to loosen the hard rock.
- The material will then be loaded and hauled out of the excavation to the mobile crushing plant where it will be screened to various sized stockpiles. The material will be stockpiled until it is transported from site using trucks.
- The mine will be reached via the existing farm road that will be upgraded to allow comfortable movement of mining machinery.
- Water requirements will mainly be for dust suppression on the processing plant and access road.
- Any water required for the implementation of the project will be bought and transported to site.
- The proposed project will make use of generators to power the plant.



1.4 Purpose of Assessment

The initial wetland assessment undertaken by Eco-Care Consultancy (Botha, 2017) focused on the wetland system and associated habitat downstream of the proposed mining permit area and did not address the broader wetland habitat further downstream of the proposed stockpile area. Eco-Care Consultancy provided a further supplementary wetland opinion letter undertaken in 2022 to inform the aspects not included within the original wetland assessment report and align the report with the current protocols.

Subsequent to the above mentioned, a supplement objection letter was received from Afrimat Aggregates KZN. It highlighted that the wetland report (2017) and wetland opinion/comments (2022) addressed some of the aspects, however, it was in the opinion that the previous assessment is incomplete due to not considering impacts relating to blasting, addressing cumulative impacts for the proposed mining operation and stockpile, crushing and screening area, and the overall natural extent of the wetland.

Since this time, a General Authorisation (GA) has been granted for the expansion of the Elandspruit quarry (WU23552). The applicant is applying for Environmental Authorisation for the quarry and stockpile area is and a Water Use License / GA for stockpile area. Greenmined Environmental on behalf of the Applicant (Raubex KZN) requested Eco-Pulse to undertake an additional wetland impact assessment for the proposed expansion of the quarry and stockpiling area. The focus will to be to undertake an appropriate impact and risk assessment of the potential impacts from the proposed mining and stockpiling on the downslope wetland.

1.5 Purpose and Scope of Assessment

The following scope of work was completed as part of this assessment:

- Contextualization of the study area in terms of important biophysical characteristics and freshwater conservation planning through a review of available spatial datasets and relevant conservation plans;
- Desktop mapping and classification of all watercourses within 500m of the proposed activities using aerial photography, contours and water resource inventory databases;
- Identification of the watercourses within 500m of the proposed activities that are likely to be measurably negatively affected (i.e. watercourses at risk) and the extent of the watercourses to be taken forward for detailed assessment (this constitutes the study area);
- Delineate all watercourses (e.g., wetlands, rivers, streams, dams) that occur within the study area (as defined above) according to the methods contained in the manual '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas'* (DWAF, 2005);
- Subdivision of delineated wetland areas into definable resource units and the classification of these units according to the national wetland and aquatic ecosystem classification system (Ollis *et al.,* 2013);
- Documentation of key biophysical characteristics of the delineated watercourses based on onsite observations.
- Assessment of the present ecological state (PES) of the delineated wetland units using the revised Level 1 WET-Health assessment tool (Macfarlane *et al*., 2020).
- Assessment of the Ecosystem Importance and Sensitivity of the watercourses within the study area using the following tools / methods:
  - Ecosystem services assessment for wetlands: Level 2 WET-EcoServices (Kotze et al., 2021).
  - Ecological Importance and Sensitivity (EIS) for wetlands: Wetland EIS tool developed by Eco-Pulse based on Rountree and Kotze (2013).
- Recommendations for impact mitigation have been provided in line with the 'mitigation hierarchy', which seeks first to avoid impacts, then minimize potential impacts and finally rehabilitate or offset to compensate for residual impacts to wetlands. This included:

- Provision of initial best-practice planning and design recommendations for discussion with the client. Key recommendations included:
  - Provision of suitable wetland buffer zones in accordance with the latest National Wetland Buffer Zone Guidelines (Macfarlane & Bredin, 2016);
  - Key stormwater management recommendations; and
  - Avoidance, rehabilitation and offset considerations.
- Understanding the site plan and associated infrastructure plans considered the above-listed planning and design recommendations as far as practically possible, the formal impact assessment commenced. The impact assessment involved the following tasks:
  - Subdivision of the proposed development into distinct activities which were assessed separately. Thereafter, the risks and impact pathways associated with each activity were identified and described.
  - Assessment of the significance of the potential impacts using a methodology developed by Eco-Pulse.
  - Application of the "DWS Risk Assessment Matrix" at a project level, as detailed in the General Authorization in terms of Section 39 of the National Water Act No. 36 of 1998 for Water Uses as defined in Section 21 (c) or Section 21 (i), as contained in Government Gazette No. 40229, 26 August 2016 and contained within the DWS document entitled 'Section 21(c) and (i) Risk-based assessment and authorization, October 2014, Edition 2' to inform water licensing requirements for the project (i.e. full WULA vs GA).
  - A description of any assumptions made and any uncertainties or gaps in knowledge, as well as recommendations regarding future specialist inputs.
- Reporting: Compilation of a single Specialist Wetland Assessment Report including all relevant maps and supporting information.

2. APPROACH & METHODS

2.1 General Approach

The general approach to the wetland assessment was based on the proposed framework for freshwater ecosystems assessment proposed in the Water Research Commission's (WRC) report titled: 'Development of a decision-support framework for wetland assessment in South Africa and a Decision-Support Protocol for the rapid assessment of wetland ecological condition' (Ollis *et al*., 2014). This is shown in Figure 3.

Note that the wetland and aquatic ecosystem impact assessment report has been developed in line with the requirements of the Department of Water & Sanitation (DWS) for Water Use Licensing, as outlined in the 'Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals' contained in the Government Gazette No. 40713 of 24 March 2017 and in accordance with the requirements in the latest NEMA Minimum Requirements and Protocol for Specialist Aquatic Biodiversity Impact Assessment as contained in the "*Procedures to be followed for the assessment and minimum criteria for reporting of identified environmental themes of Section 45 (a) and (h) of the National*

Environmental Management Act, 1998, when applying for Environmental Authorization", contained in Government Gazette No. 648 (10 May 2019).

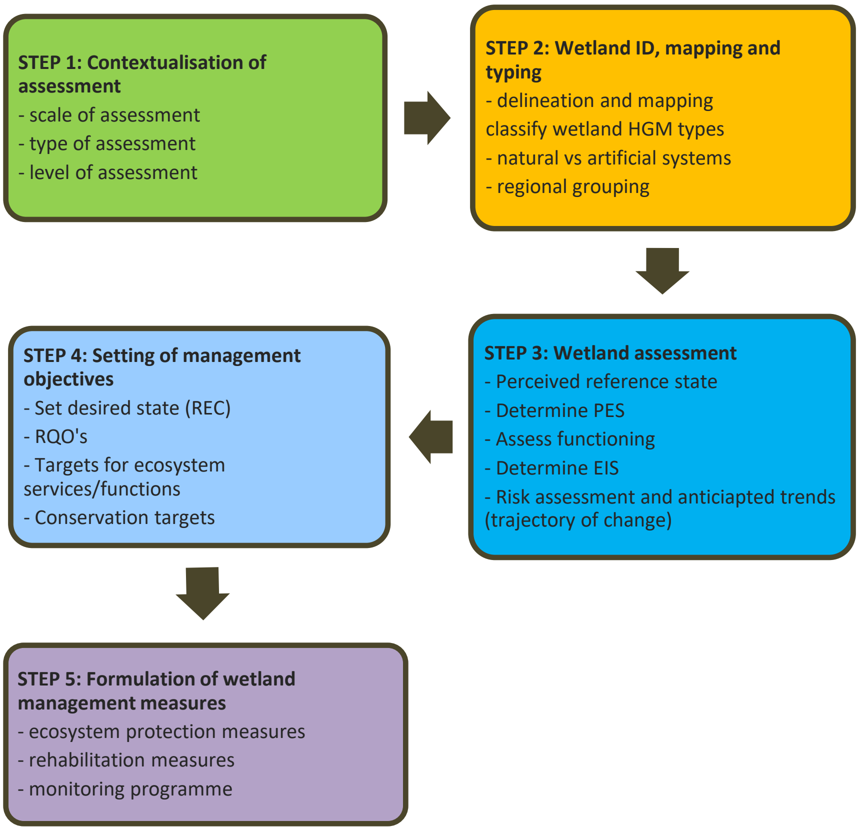


Figure 3 Proposed decision-support framework for wetland assessment in SA (after Ollis *et al*., 2014).

2.2 Desktop & Baseline Assessment Methods

2.2.1 Data Sources Consulted

The data sources and GIS spatial information listed in Table 1 (below) were consulted to inform the specialist assessment. The data type, relevance to the project and source of the information has been provided.

Table 1. Data sources and GIS information consulted to inform the baseline aquatic assessment.

DATA/COVERAGE TYPE	RELEVANCE	SOURCE
	Biophysical Context	
Colour aerial photography	*Desktop mapping of drainage network, wetlands, etc.*	NGI (online)
Latest Google Earth ™ imagery	*To supplement available aerial photography where needed*	Google Earth™ On
South African Vegetation Map (GIS Coverage)	*Classify vegetation types and determination of reference primary vegetation*	Mucina & Rutherford (2012)

DATA/COVERAGE TYPE	RELEVANCE	SOURCE
Biophysical Context		
NFEPA: river and wetland inventories (GIS Coverage)	*Highlight potential onsite and local rivers and wetlands*	WRC (2011)
Conservation Context		
Inland Aquatic (Freshwater) Realm of the 2018 SANBI National Biodiversity Assessment (GIS Coverage)	*Provides insight into the national conservation planning status of watercourses in the study area*	Van Deventer et al. (2019)
NFEPA: River, wetland, and estuarine FEPAs (GIS Coverage)	*Shows location of national aquatic ecosystems conservation priorities*	WRC (2011)
KZN Aquatic Systematic Conservation Plan (GIS Coverage)	*Provincial conservation planning importance.*	EKZNW (2007)

2.2.2 'Impact Potential' Screening Assessment

All watercourses within 500m of the mining permit area and stockpile area were mapped at a desktop level as DWS identify the 500m buffer as their area of regulation when licensing new activities and developments. Following the desktop identification and mapping exercise, watercourses were assigned preliminary 'likelihood of impact' ratings based on the likelihood that activities associated with the existing development will result in measurable direct or indirect changes to the mapped watercourse units. The 'impact potential' ratings were refined following the completion of the field work. The identified watercourse unit was ascribed a qualitative 'impact potential' rating according to the ratings and descriptions provided in Table 2, below.

Table 2. Qualitative 'likelihood of impact' ratings and descriptions.

Likelihood of Impact Rating	Description of Rating Guidelines
Likely	These resources are likely to require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within the footprint** of the proposed development activity and will definitely be impacted by the project; and/or ➢ resources located **within 15m upstream and/or upslope** of the proposed development activity and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located **within 15m or downslope** of the development and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located downstream within the following parameters: o **within 15m downstream** of a low risk development; o **within 50m downstream** of a moderate risk development; and/or o **within 100m downstream** of a high risk development e.g. mining, large industrial land uses.
Possible	These resources may require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within 32m but greater than 15m upstream, upslope or downslope** of the proposed development; and/or ➢ resources located within a range at which they are likely to incur indirect impacts associated with the development (such as water pollution, sedimentation and erosion) based on development land use intensity and development area. This is generally resources located downstream within the following parameters: o **within 32m downstream** of a low risk development; o **within 100m downstream** of a moderate risk development; and/or o **within 500m downstream** of a high risk development (note that the extent of the

Likelihood of Impact Rating	Description of Rating Guidelines
	affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants).
Unlikely	These resources are unlikely to require impact assessment or Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located a distance upstream, upslope or downslope (>32m) of the proposed development and which are unlikely to be impacted by the development project; and/or ➢ resources located downstream but well beyond the range at which they are likely to incur impacts associated with the development (such as water pollution, sedimentation and erosion). This is generally resources located downstream within the following parameters: ○ **greater than 32m downstream** of a low risk development; ○ **greater than 100m downstream** of a moderate risk development; and/or ○ **greater than 500m downstream** of a high risk development (note that the extent of the affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants).
None	These resources will not require impact assessment or a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within another adjacent sub-catchment and which will not be impacted by the development in any way, shape or form.

2.2.3 Baseline Watercourse Assessment

The methods of data collection, analysis and assessment employed as part of the baseline assessment are briefly discussed in this section. The assessments undertaken as part of this study are listed in Table 3 (below) along with the relevant published guidelines and assessment tools / methods / protocols utilised.

Table 3. Summary of methods used in the assessment of delineated water resource units.

Method/Technique		Reference for Methods/Tools Used
Riparian and wetland areas delineation		• A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005)
Classification of riparian and wetland units		• National Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013) • Classification system for channelled watercourses (Eco-Pulse, 2013)
Wetlands	**Present Ecological State (PES)**	• Level 1b WET-Health assessment (Macfarlane *et al*., 2020).
Wetlands	**Functional Importance (Eco-services assessment)**	• WET-EcoServices assessment (Kotze *et al*., 2021).
Wetlands	**Wetland Ecological Importance & Sensitivity (EIS)**	• Wetland EIS assessment tool developed by Eco-Pulse based on Rountree and Kotze (2013) and Duthie (1999).

2.1 Impact Assessment Framework & Methodology

For the purposes of this study, the assessment of potential freshwater impacts was undertaken using an "*Impact Assessment Methodology for EIAs*" adopted by Eco-Pulse (2020). This assessment was informed by baseline information contained in this report relating to the sensitivity of freshwater habitats and potential occurrence of protected species, as well as on information relating to the existing development. Note that the Freshwater Impact Assessment has been aligned as far as possible with the minimum criteria and requirements for Aquatic Biodiversity Impact Assessment contained in the "Procedures to be followed for the assessment and minimum criteria for reporting of identified environmental themes of Section 45 (a) and (h) of the National Environmental Management Act, 1998, when applying for Environmental Authorization", contained in Government Gazette No. 320 (20 March 2020).

The impact assessment process begins with a general description of the proposed development (construction and operation phases), with the various environmental stressors and risks associated with development activities then being defined (Table 16). Impacts are then described under four (4) distinct 'groups' with impact significance assessed for each group based on a range of assessment criteria. The general framework for the freshwater impact assessment is shown below in Table 4.

Table 4. Wetland impact assessment framework summary.

WETLAND & AQUATIC ECOSYSTEM IMPACT ASSESSMENT FRAMEWORK	
DEVELOPMENT ACTIVITIES	
Construction Phase Description:	**Operation Phase Description:**
Construction activities required to establish the mining and stockpile areas and associated infrastructure (cumulative).	Operation activities of the mining and stockpile areas and associated infrastructure (cumulative).
FRESHWATER ECOSYSTEM IMPACT & RISK ASSESSMENT GROUPS	
1	Direct physical loss or modification of freshwater habitat.
2	Alteration of hydrological and geomorphological processes (*flow, erosion & sediment regime changes*).
3	Impacts to water quality.
4	Impacts to ecological connectivity and / or ecological disturbance impacts.

The significance of potential impacts associated with the existing development on freshwater ecosystems was assessed for the following scenarios:

- **Realistic "poor mitigation" scenario** – this is a realistic worst-case scenario involving the poor implementation of construction mitigation, bare minimum incorporation of recommended design mitigation, poor operational maintenance, and poor onsite rehabilitation.
- **Realistic "good" scenario** – this is a realistic best-case scenario involving the effective implementation of construction mitigation, incorporation of most of the design mitigation, good operational maintenance, and successful rehabilitation.

The approach to the impact significance assessment is to identify the main ultimate ecological consequences associated with each impact group. The four ultimate ecological consequences are:

1. **Water resource management:** The inter-connected nature of water resources is emphasised here by recognising that an impact at a site will ultimately affect downstream users and the ability to meet user requirements. An understanding of the catchment context, with emphasis on the existing use of and reliance on water resources by downstream communities is therefore required. Key concerns therefore relate to any direct impacts on water quantity and quality together with habitat-related impacts that could exacerbate downstream impacts by undermining the ability of wetlands and riparian areas to attenuate floods, trap sediments and assimilate pollutants (regulating & supporting services).
2. **Ecosystem conservation:** The focus here is specifically on understanding the significance of impacts in relation to the ability to meet habitat conservation targets. This is informed by an understanding of conservation significance that is influenced by factors such as the ecosystem threat status, regional conservation context, condition of habitat, and connectivity to other intact habitats.
3. **Species conservation:** The focus here is specifically on species of special or notable conservation importance or concern, including Red Data Book or Red List taxa in threatened or conservation concern categories, Threatened or Protected Species listed under the National Environmental Management: Biodiversity Act, endemic taxa, locally threatened taxa and/ or any particular taxa of special management concern. Includes both fauna and flora.
4. **Direct use values:** The emphasis here is specifically on understanding and assessing the social impacts of the development based on an understanding of the impacts on provisioning (water supply, harvestable natural resources, cultivated foods or food for livestock) and cultural services available to local communities. This assessment is therefore based on an understanding of the current importance of water resources for local users and supporting local livelihoods, including religious ceremonies, tourism & recreation, or educational activities.

Once the ultimate ecological consequence has been selected for each impact group, and the impact intensity rated (according to Eco-Pulses rating scheme), the likelihood of the impact occurring, as well as the anticipated extent and duration of the impact are rated and combined in a structured way in order to determine the impact significance. This is done in accordance with the following formula:

Impact significance = (impact intensity + impact extent + impact duration) x impact likelihood

This formula is based on the basic risk formula: **Risk = consequence x probability**

Table 5. Impact significance categories and definitions.

Impact Significance	Definition
High	**Totally unacceptable** and fatally flawed from an environmental perspective. The activity should only be approved under very special circumstances (i.e., national priorities with large societal benefit). If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms.
Moderately High	**Generally unacceptable** and should ideally be avoided. The potential impact will affect a decision regarding the activity and require that the need and desirability for the project be clearly substantiated to justify the associated ecological risks. If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms.
Moderate	**Potentially unacceptable** and should ideally be reduced to lower significance levels. The potential impact should influence the decision regarding the activity and requires a clear and substantiated need and desirability for the project to justify the risks. If authorised, offsets should be considered to compensate for residual impacts.
Moderately Low	**Acceptable** with low to moderate risks. The potential impact may not have any meaningful influence on the decision regarding the activity.
Low	**Acceptable**. The potential impact is very small or insignificant and should not have any meaningful influence on the decision regarding the activity.

A confidence rating was also given to the rated impacts rated in accordance with the table below:

Table 6. Confidence ratings used when assigning impact significance ratings.

Level of confidence	Contributing factors affecting confidence
Low	A low confidence level is attributed to a low-moderate level of available project information and somewhat limited data and/or understanding of the receiving environment.
Medium	The confidence level is medium, being based on specialist understanding and previous experience of the likelihood of impacts in the context of the development project with a relatively large amount of available project information and data related to the receiving environment.
High	The confidence level is high, being based on quantifiable information gathered in the field.

2.2 Risk Assessment

Government Notice 509 of 2016 published in terms of Section 39 of the NWA sets out the terms and conditions for the General Authorization of Section 21(c[1]) and 21(i[2]) water uses, key among which is that only developments posing a 'Low Risk' to watercourses can apply for a GA. Note that the GA does not apply to the following activities:

- Water use for the rehabilitation of a wetland as contemplated in GA 1198 contained in GG 32805 (18 December 2009).
- Use of water within the 'regulated area'[3] of a watercourse where the Risk Class is **Medium or High.**
- Where any other water uses as defined in Section 21 of the NWA must be applied for.

[1] 21(c): Impeding or diverting the flow of water in a watercourse
[2] 21(i): Altering the bed, banks, course, or characteristics of a watercourse
[3] The 'regulated area' of a watercourse; for Section 21 (c) or (i) of the Act refers to:

i. The outer edge of the 1:100 yr flood line and/or delineated riparian habitat, whichever is greatest, as measured from the centre of the watercourse of a river, spring, natural channel, lake or dam.
ii. In the absence of a determined 1:100 yr flood line or riparian area, refers to the area within 100m from the edge of a watercourse (where the edge is the first identifiable annual bank fill flood bench).
iii. A 500m radius from the delineated boundary of any wetland or pan.

- Where storage of water results from Section 21 (c) and/or (i) water use.
- Any water use associated with the construction, installation or maintenance of any sewerage pipeline, pipelines carrying hazardous materials and to raw water and wastewater treatment works.

To this end, the DWS have developed a Risk Assessment Matrix/Tool to assess water risks associated with development activities. The DWS Risk Matrix/Assessment Tool (based on the DWS 2015 publication: 'Section 21 (c) and (i) water use Risk Assessment Protocol') was applied to the existing development. The tool uses the following approach to calculating risk:

RISK = CONSEQUENCE x LIKELIHOOD

whereby:

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

and

LIKELIHOOD = FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT + LEGAL ISSUES + DETECTION

The key risks associated with the existing development project are presented in Table 4, and are again outlined below:

1. Direct physical loss or modification of freshwater habitat.
2. Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes).
3. Impacts to water quality (pollution).
4. Impacts to ecological connectivity and/or ecological disturbance impacts

For each of the above stressors, risk was assessed qualitatively using the DWS risk matrix tool.

It is important to note that the risk matrix/assessment tool also makes provision for the downgrading of risk to low in borderline moderate/low cases subject to independent specialist motivation granted that (i) the initial risk score is within twenty-five (25) risk points of the 'Low' class and that mitigation measures are provided to support the reduction of risk. The tool was applied to the project for the highest risk activities and watercourses and was used to inform WUL requirements for the existing development.

2.3 Assumptions, Limitations & Information Gaps

The following limitations and assumptions apply to this assessment:

2.3.1 General assumptions & limitations

- This report deals exclusively with a defined area and the extent and nature of wetland ecosystems in the study area.
- Additional information used to inform the assessment was limited to data and GIS coverage's available for the province at the time of the assessment.

- All field assessments were limited to day-time assessments.

2.3.2 Sampling limitations & assumptions

- Although all watercourses occurring within 500m of the development activities were mapped at a desktop level, field investigations were confined to only those areas that stand to be measurably negatively affected (These areas constituted the study area of assessment). The watercourses making up the study area were determined using the Eco-Pulses qualitative 'likelihood of impact' rating system presented in Table
- 2, above.
- The mapping and classification of the watercourse units outside of the study area but occurring within a 500m radius of activities should be considered preliminary and coarse in resolution. These units were not verified in the field.
- The wetland delineations undertaken by Eco-Care Consultancy (2017) for the downstream wetlands were used as a starting point.
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled, which were extrapolated to the rest of the study area.
- Systematic sampling of was undertaken along transects spaced approximately 25-50m apart, and focused watercourses in the vicinity of the existing infrastructure. The outer boundary of the watercourses identified can be considered accurate in the vicinity of these transects. Between transects the outer boundary had to be extrapolated using aerial photography and 5m contours and, as such, the accuracy of such extrapolated sections has limitations and is open to the interpretation of the delineator.
- A Soil Munsell Colour Chart was used to determine the soil matrix colour of the soil sampled. However, it is important to note that the recording of the colours using the soil chart is highly subjective and varies significantly depending on soil moisture and the prevailing light conditions. In this case, all the soils sampled were dry and sampling was undertaken in sunny conditions.
- Soil wetness indicators (i.e., soil mottles, grey soil matrix), which in practice are primary indicators of hydromorphic soils, are not seasonally dependent (wetness indicators are retained in the soil for many years) and therefore seasonality has no influence on the delineation of wetland areas.
- The accuracy of the delineations is based solely on the recording of the onsite watercourse indicators using a GPS. GPS accuracy will therefore influence the accuracy of the mapped sampling points and therefore water resource boundaries, and an error of 1-5m can be expected. All soil/vegetation/terrain sampling points were recorded using a Garmin Montana™ Global Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
- All vegetation information recorded was based on the onsite visual observations of the author and no formal vegetation sampling was undertaken. Furthermore, only dominant and noteworthy plant species were recorded. Thus, the vegetation information provided has limitations for true botanical applications.
- Although every effort was made to correctly identify the plant species encountered onsite, wetland plants, particularly the *Cyperaceae* (sedge) family, are difficult to identify to species level. Every effort

as made to accurately identify plants species but where identification to species level could not be determined, such species were only identified to genus level.

- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
- While disturbance and transformation of habitats can lead to shifts in the type and extent of freshwater ecosystems, it is important to note that the current extent and classification is reported on here.
- Infield soil sampling and vegetation observations were only undertaken at strategic sampling points within the habitats likely to be negatively affected. Sampling by its nature, means that generally not all aspects of ecosystems can be assessed and identified.

2.3.3 'Seasonality' of the assessment

Eco-Pulse undertook an infield watercourse delineation in mid-January 2023. One infield visit does not fully cover the seasonal variation in conditions at the site. Nevertheless, seasonality is not a key factor for the target study area surveyed, and no further seasonal surveys will be required, for the following reasons:

- Seasonality can influence the species of flora encountered at the site, with the flowering time of many species often posing a challenge in species identification. Since the wetland vegetation in the study area was found to be largely secondary/degraded with low native plant diversity, seasonality would not be as significant a limitation when compared with a vegetation community that is largely natural or high in native plant diversity.
- Soil wetness indicators (i.e., soil mottles, grey soil matrix), which in practice are primary indicators of hydromorphic soils, are not seasonally dependent (wetness indicators are retained in the soil for many years) and therefore seasonality has no influence on the delineation of wetland areas where soil sampling was used to determine wetland extent.

2.3.4 Baseline ecological assessment

- The PES and EIS assessments make use of qualitative assessment tools and thus the results are open to professional opinion and interpretation. We have tried to substantiate all claims where applicable and necessary.
- The EIS assessment did not specifically address in detail all the finer-scale ecological aspects of the water resources such as a list of aquatic fauna likely to occur (i.e. invertebrates, amphibians and fish) within and make use of these systems.

2.3.5 Impact Assessment

- The impact significance assessment was only undertaken for the two ultimate consequences, namely (i) Impacts to water resource supply and quality; and (ii) Impacts to ecosystem and habitat conservation.
- The impact assessment was only undertaken for a single development scenario (cumulative impacts) under two mitigation scenarios referred to as the 'realistic poor mitigation' and 'realistic good mitigation' scenarios.

- The evaluation of impact significance under the 'realistic good mitigation' scenario assumes all project design and impact mitigation measures presented in Chapter 7 will be implemented during construction and operation of the mining and stockpiling areas.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor's working knowledge and experience with similar development projects.
- The impact descriptions and assessment are based on the author's understanding of the existing development based on information provided.

2.3.6 Risk Assessment

- All risk ratings generated by the DWS risk matrix are conditional on the effective implementation of the mitigation measures provided in the specialist freshwater habitat assessment report for the project.
- For the purposes of this study, the term 'stressor[4]' was favoured instead of the term 'aspect' referred to in the DWS risk matrix.
- For the purposes of this study, the criterion 'frequency of stressor occurrence' was favoured instead of the criterion 'frequency of activity' referred to in the DWS risk matrix.
- For the severity ratings, impacts were assessed on their merits rather than automatically scoring impacts as 'disastrous' as guided in the DWS risk matrix.
- The severity assessment for changes in flow regime and physico-chemical impacts were interpreted in terms of the changes to the local freshwater ecosystem represented by the potentially affected reaches.
- For the scoring of impact duration, the predicted change in PES was also considered which could override the actual duration of the impact where applicable e.g., if the impact duration was long term (typically a score of 4 out of 5) but the predicted change in PES is negligible, the impact duration was downs-scored to a score of 2 in line with the duration criteria descriptions in the risk matrix tool.

[4] Any physical, chemical, or biological entity that can induce an adverse response to the structure and function of an ecosystem (Reference: USEPA (1998). Guidelines for Ecological Risk Assessment; Notice Fed. Reg. 6326846-26924. Environmental Monitoring Systems Laboratory, Office of Research and Development, US Environmental Protection Agency, Cincinnati, Ohio.

3. DESKTOP CONTEXTUALISATION / SETTING ASSESSMENT

Understanding the biophysical and conservation context of the study area and surrounding landscape is important to inform decision making regarding the significance of the area to be affected.

3.1 Biophysical Setting

A summary of key biophysical details for study area and catchment area is presented in Table 7 below.

Table 7. Key biophysical setting details of the study area.

Location	The farm Elands Spruit No 5523, north-east of Ladysmith, KwaZulu-Natal
Ecoregion (DWAF, 2007)	14.02 – North-Eastern Uplands
National Water Act Water Management Area (WMA)	Pongola – Mtamvuna
Quaternary Catchment	V60C & V60B
Main Collecting River in the Catchment	Sundays River
Study Area Watercourse Types	Wetland
NFEPA Planning Unit (WRC, 2011)	3031 (V60C) & 2826 (V60B)
NFEPA Planning Unit Status (WRC, 2011)	Upstream Management Area (V60C) & River FEPA (V60B)

3.2 Review of Freshwater Ecosystem Context

3.2.1 Catchment and Drainage Setting

The study area is located within DWA Quaternary Catchment V60C & V60B. These quaternary catchments are primarily drained by the perennial Sundays River (Figure 4). The site is located on a catchment divide[5] with most of the site draining southwards in the V60C catchment. The local drainage network in the vicinity of the study area consists of two wetland systems located approximately 166m downslope of the mining permit area and 116m of the stockpiling area. The valley bottom wetland drains in a south easterly which forms part of a left bank tributary of the middle Sudays River system.

[5] A catchment divide is the line that separates neighbouring catchments. On rugged land, the divide lies along topographical ridges, and may be in the form of a single range of hills or mountains, known as a dividing range.

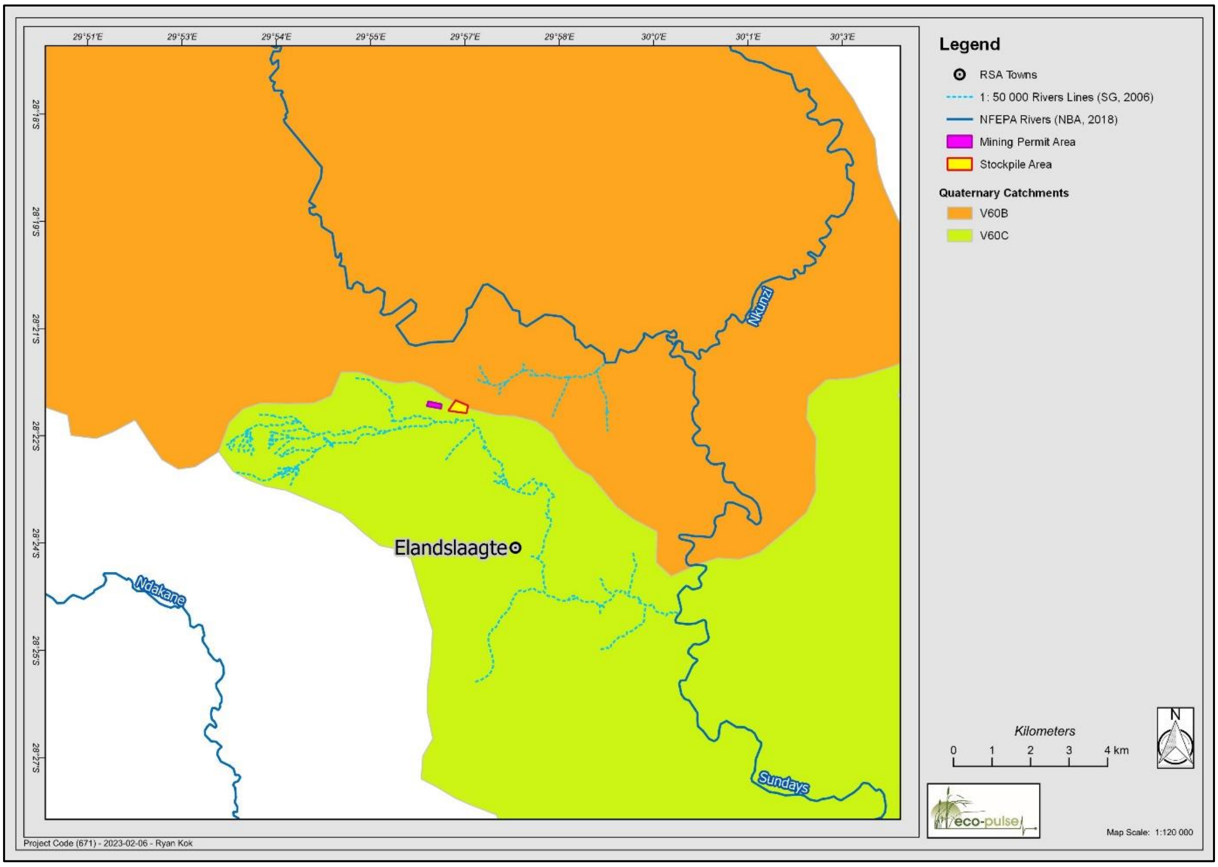


Figure 4 Map showing local drainage setting and catchment in relation to the mining and stockpiling sites.

3.2.2 Ecological and Conservation Setting

National and provincial conservation datasets were screened for the study area, the results of which are presented in Table 8.

Table 8. Key ecological and conservation context details for the study area.

NATIONAL LEVEL CONSERVATION PLANNING CONTEXT			
Conservation Planning Dataset		**Relevant Conservation Feature**	**Conservation Planning Status**
National Freshwater Ecosystem Priority Areas (NFEPA) (WRC, 2011)	Rivers	**Catchment Planning Unit 3031**	Upstream Management Area[6]
	Rivers	**Catchment Planning Unit 2826**	River FEPA[7]
	Wetlands	**Onsite NFEPA wetlands**	No FEPA wetlands present
	Wetlands	**Presence of wetland FEPAs within 500m of the study area**	Least Threatened

[6] Upstream Management Areas: are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. Upstream Management Areas do not include management areas for wetland FEPAs, which need to be determined at a finer scale.

[7] River FEPAs achieve biodiversity targets for river ecosystems and fish species, and were identified in rivers that are currently in a good condition (A or B ecological category; in this instance the Sundays River). Their FEPA status indicates that they should remain in a good condition in order to contribute to the biodiversity goals of the country.

NATIONAL LEVEL CONSERVATION PLANNING CONTEXT			
Conservation Planning Dataset		Relevant Conservation Feature	Conservation Planning Status
2018 National Biodiversity Assessment – Inland Aquatic / Freshwater Realm (GIS Coverage)	Wetlands	Sub-Escarpment Grassland Group 4	Channelled valley bottom wetland 'Least Threatened'
			Seep 'Endangered'
		Sub-Escarpment Grassland Bioregion	Channelled valley bottom wetland 'Critically Endangered'
			Seep 'Critically Endangered'
PROVINCIAL AND REGIONAL LEVEL CONSERVATION PLANNING CONTEXT			
Conservation Planning Dataset		Relevant Conservation Feature	Conservation Planning Status
KZN Aquatic Systematic Conservation Plan (EKZNW, 2007)		Sub-quaternary catchment & nearby Wetland	Freshwater Planning Unit No. 2353 & 2360 'Available' (no status)

4. DESKTOP MAPPING AND IMPACT POTENTIAL SCREENING

The main risks associated with the mining and stockpiling facility include:

1. **Alteration of catchment surface water processes / hydrological inputs** and associated **erosion and sedimentation impacts**; and
2. **Surface runoff contamination** from material stored on site and associated local watercourse **water quality deterioration.**

Based on the above-mentioned risks two (2) individual wetlands (labelled 'W01' and 'W02') units are rated as possibly being affected by the construction and operational phases of the mining permit area and stockpile area (see Figure 5). This watercourse unit therefore required further detailed assessment to inform the water use licence application (WULA) in terms of the requirements of Chapter 4 and Section 21 (c) and (i) water uses in terms of the National Water Act No. 36 of 1998.

It should be noted that wetlands will not be directly impacted by during the construction / establishment of the mining and stockpiling area due the location of the wetlands being well outside of the footprint proposed.

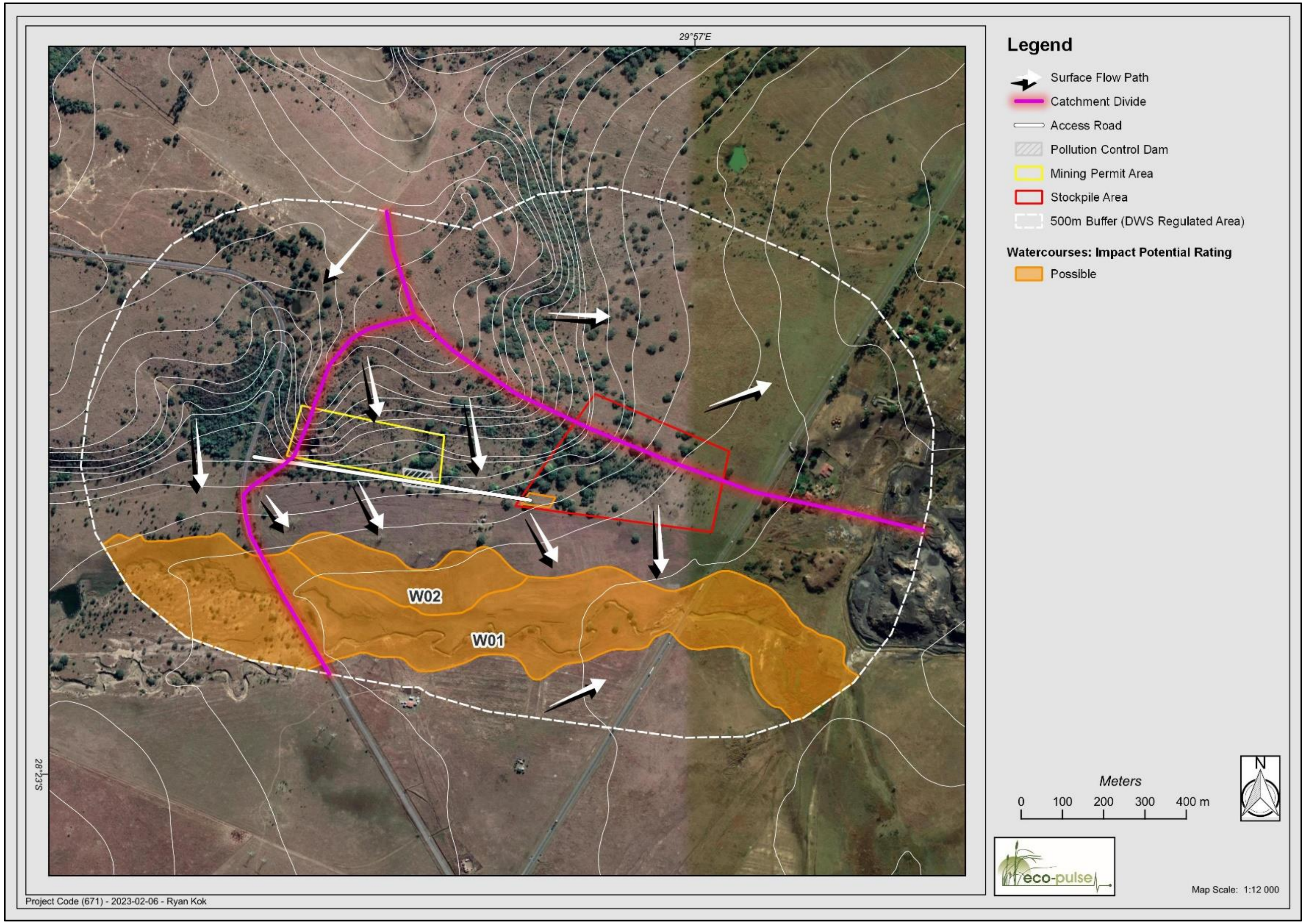


Figure 5 Outputs of the initial watercourse 'impact potential' assessment undertaken for the mining permit and stockpile areas. The map shows the positioning of the two area footprints ("Yellow" boundary line – mining permit area and "Red" boundary line – stockpile area) and associated infrastructure (i.e., PCD, offices & access road), with watercourses assessed with a 500m radius (i.e., the DWS regulated area for c & i water use – "white" dashed circle outline).

5. BASELINE HABITAT ASSESSMENT

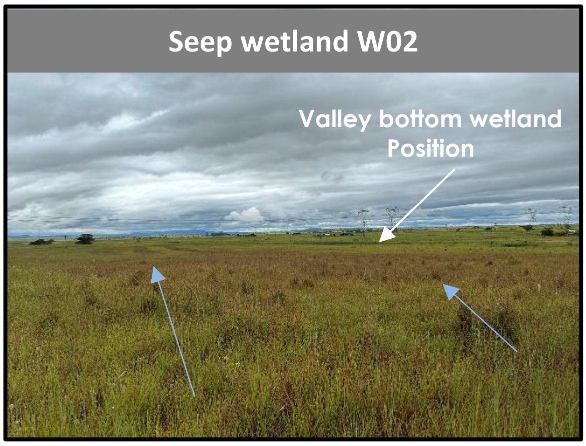
The extent (infield delineation), classification, habitat characteristics, present ecological state (PES) and ecological importance and sensitivity (EIS) of the target watercourse unit is discussed in this section of the report.

5.1 Delineation, Classification & Habitat Characteristics

The infield sampling of soil and vegetation in conjunction with the recording of diagnostic topographical / terrain indicators and features, enabled the delineation of two (2) wetland units (Table 9).

Table 9. Summary of the wetland HGM unit type encountered and the general characteristics.

Units	Classification (HGM unit)	Description
Wetland W01	**Channelled Valley Bottom**	Channelled valley bottom wetlands are characterised by their location on valley floors, the absence of characteristic floodplain wetland features (such as oxbows and natural levees) and the presence of channelled flow in the form of a river or stream running through the wetland. Water inputs are mainly from the adjacent hillslopes while the channels themselves are not typically major sources of water to the wetland except when channel banks overtop during high flows. Soils and vegetation sampled reflect both seasonal and permanent zones of water saturation.
Wetland W02	**Seep**	Seepage wetlands were found to be located in a valley-head setting and fed primarily by lateral subsurface water inputs controlled by generally low permeability shale bedrock at shallow depths. Water naturally moves through these wetlands as subsurface flow with some diffuse overland flow particularly after significant rainfall events. Soils and vegetation sampled reflect both seasonal and permanent zones of water saturation.



The location and extent of Wetland W01 (~33.82 ha in extent) and Wetland W02 (~5.77 ha in extent) is shown on the map in Figure 6, with a summary of the key biophysical characteristics of the delineated watercourse units provided in the sections that follows.

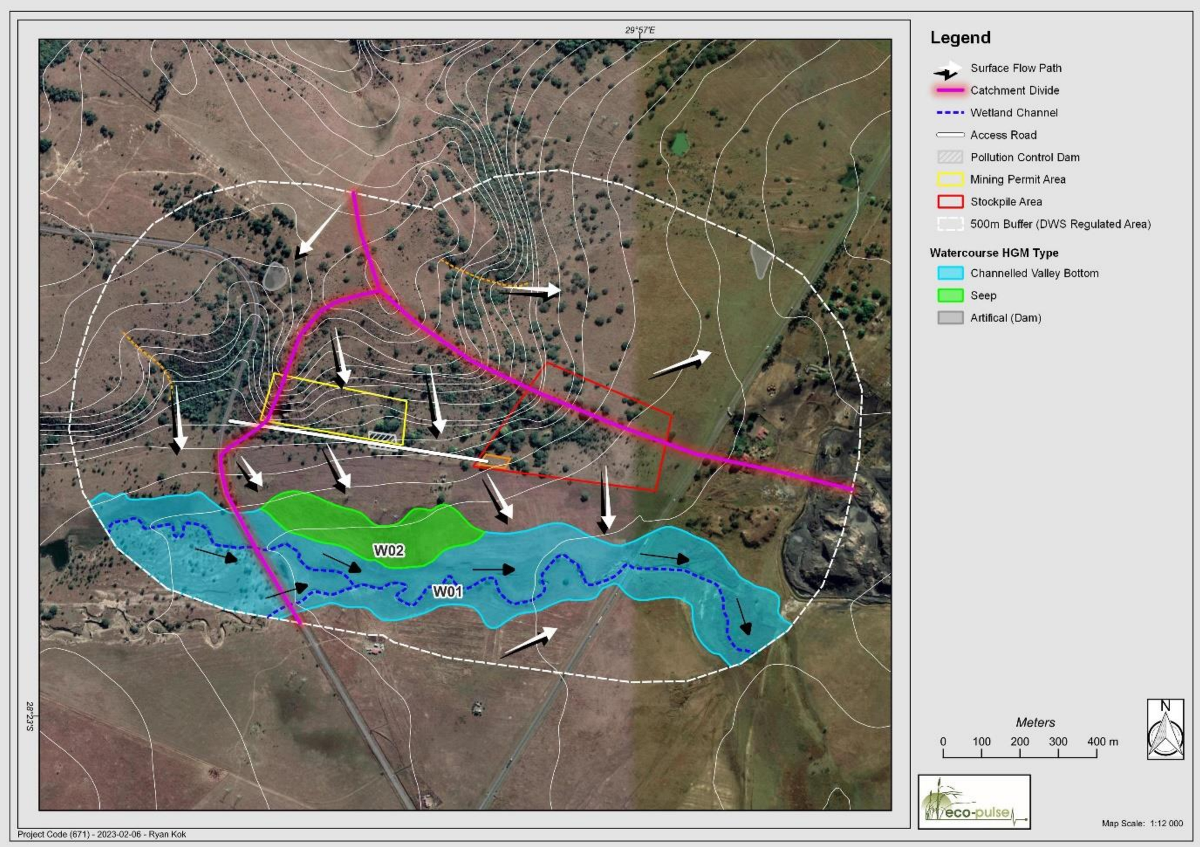


Figure 6 Wetland delineation map: the 'white/black' arrow markers on the map indicate the direction of surface flow paths with the 'pink' lines representing the catchment divide between micro-catchments in the study area.

5.1.1 Wetland Delineation

Soils sampled within the study area included both dryland soils (no hydric soil indicators) and wetland soils that showed signs of wetness / hydric soil indicators. Soil texture[8] was found to range between moderately and moderately fine textured soils (loam & clay) with a grey to grey-brown soil matrix[9] (hue[10] 10yr; value[11] 4; chroma[12] 1/2;). Strategic sampling points were taken along cross sections of the predominantly gentle terrain (with the large board low-lying area in the valley bottom, and slightly steeper slopes along the hillslopes subjected to marginally more intensive sampling). Redoximorphic features such as a gleyed soil matrix and the presence of soil mottles were observed within the lower lying areas and adjacent hillslopes. Temporary, seasonal and permanent wetland soil indicators were observed within the valley bottom wetland and wetland seep sampled, with seasonally saturated soils

[8] Soil texture - is a measure of the relative proportion of the various soil particle size fractions in soil (http://www.soilquality.org.au/factsheets/soil-texture).

[9] Soil matrix - is the portion of a given soil having the dominant colour, in most cases, the matrix will be the portion of the soil having more than 50 percent of the same colour.

[10] Hue - A characteristic of colour related to one of the main spectral colours (red, yellow, green, blue or purple), or various combinations of these principle colours, one of the three variables of colour, each colour chart in the Munsell Soil Colour Charts represents a specific hue.

[11] Value - refers to the lightness and darkness of a colour in relation to a neutral grey scale.

[12] Chroma - refers to the intensity or brightness of the colour and has also been described as the purity of the colour. It has also been described as the richness of the colour.

more widely prevalent across wetland unit W01 and W02 to the south. The soil matrix of seasonally saturated soils was found to be predominately dark grey to light grey in colour, with soil mottles moderately abundant. These characteristics are indicative of soils that are seasonally wet or saturated for part of the year and can be attributed to the fluctuation between anaerobic (saturated) and aerobic (dry/unsaturated) soil conditions typical of seasonal wetland environments. Anaerobic (saturated) conditions cause minerals (such as Fe/Al) naturally occurring in soil to go into solution, resulting in a greyish/gleyed soil matrix. However, when the soils transition from a saturated state to an unsaturated state (due to a fluctuating water table) the dissolved minerals return to an insoluble state and appear as orange/yellow soil particles. The recurrence of this cycle over time creates grey soils with orange/yellow/ lighter coloured mottles.

Photos 1 - 4 provide an example of selected soil samples collected onsite.

Photo1: Example of a typical dryland soil sample.

Photo 2: Example of a temporary saturated soil (brown-grey matrix with faint soil mottles).

Photo 3: Example of a typical seasonal saturated soil (grey matrix with abundant soil mottles).

Photo 4: Example of a typical permanent saturated soil (grey matrix with the absence of soil mottles).

Vegetation is usually a principle indicator of wetland habitat with the presence of wetland plants or 'hydrophytes' typically suggesting the presence of water-saturated soils (for a period of at least 2 weeks of the year). At present, the majority of the wetland habitat appeared to be temporarily to seasonally activated and supporting a **vegetation community dominated by a mix of hydric and dryland grass species** with scattered sedges, tufted grasses and forbs. The hygrophilous grass-dominated vegetation communities feature a range of native grass and sedge species including: *Leersia hexandra, Paspalum urvillei, Imperata cylindrical, Eragrostis planiculmis, Panicum repens, Bulbostylis hispidula, Cyperus articulatus, Eleocharis acutangula, Schoenoplectus corymbosus, Pycreus macranthus and Kyllinga erecta* being the most prevalent, with other grass species scattered in between occasionally such as *P. urvillei and Eragrostis plana*. The drier marginal area of the wetland had been slightly impacted by grazing activities, dominated by species such as *Paspalum notatum, P. dilatatum, P. urvillei, Cynodon dactylon, C. incompletes, Imperata cylindrical, Eragrostis plana, E. chloromelas* and *E. micrantha*. The seep wetland was found to host a monotonous stand of *Imperata cylindrical* with *Paspalum urvillei, Eragrostis planiculmis, E. micrantha* and *Pycreus macranthus* interspersed between *I. cylindrical,* amongst other.

Importantly, some of these species are known as 'Increaser' grasses that are present under disturbance and particularly veld that is or has been over historically subjected to overgrazing by livestock. Some scattered alien/exotic species were observed, namely *Schkuhria pinnata, Xanthium spinosum, Cirsium vulgare, Verbena bonariensis, Verbena aristigera, Gomphrena celosioides, Centella asiatica, Richardia brasiliensis, Paspalum urvillei, Paspalum notatum,* and *Cyperus esculentus.*

Selected digital photographs showing the various wetland vegetation communities and habitats have been included below:

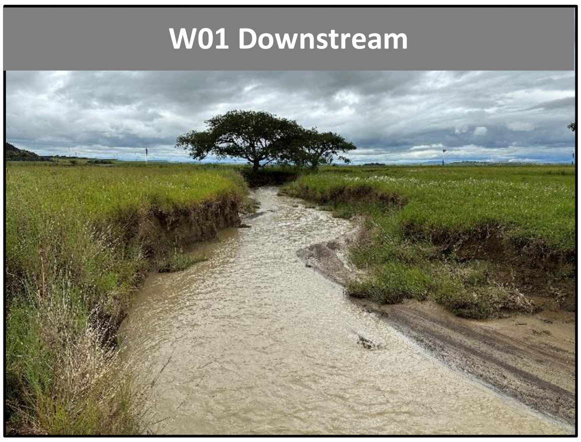
Photo 5: View looking upstream over wetland W01 showing the short grassland vegetation comprising of, *Imperata cylindrical, Leersia hexandra Eleocharis acutangula and Paspalum urvillei, amongst others.*

Photo 6: View looking downstream of wetland W02 showing the monotonous stand of Imperata cylindrical, with wetland W01 in the background.

5.1.2 Classification of Wetland Unit

Wetland Unit W01

Wetland W01 was identified as a **channelled valley bottom** wetland (being ~33.82 ha in extent) and located south of the mining permit and stockpile areas (as shown mapped in Figure 7). The wetland drains in a easterly direction that forms part of the broader network eventually feeding into the Sundays River. The wetland is supported by a large (18.2 ha) catchment, most of which is secondary degraded veld with areas of alien plants, an existing quarry within the mining permit area, a tarred road located in the mid reaches of the wetland system and presence of dams and cattle paths along the upper reach of the wetland. The vegetation within the wetland itself was found to comprise mix of hydric and dryland grass species and sedges (as described in section 5.1.1).



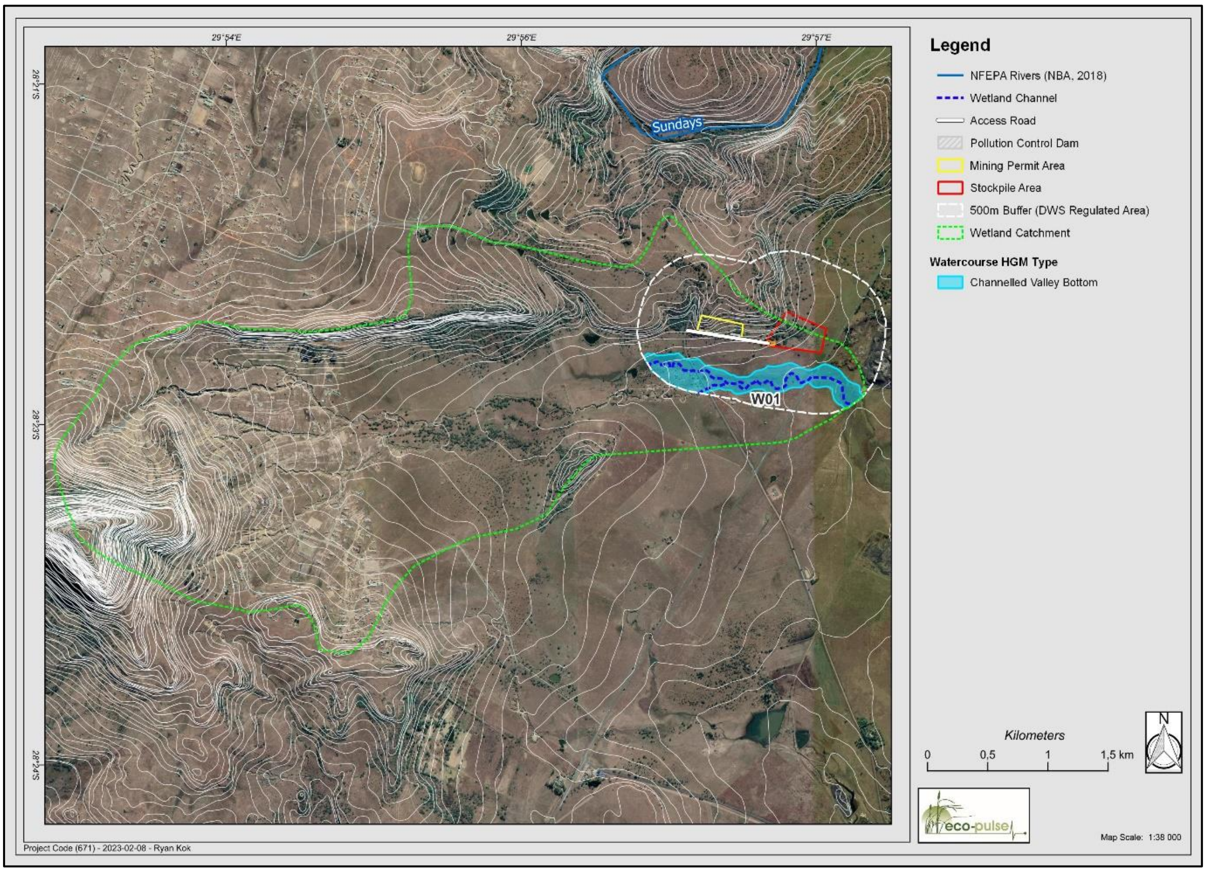
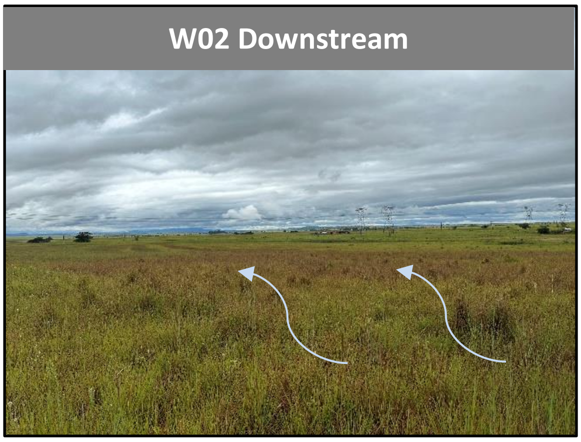


Figure 7 Map showing the delineated channelled valley bottom wetland 'W01' and its supporting catchment area (present day).

Wetland Unit W02

Wetland W02 was identified as a hillslope **seep** wetland (being ~5.77 ha in extent) and located south of the mining permit area and southwest of the stockpiling area (as shown mapped in Figure 8). The wetland drains in a south easterly direction feeding into to broader valley bottom wetland that forms part of the broader network eventually feeding into the Sundays River. The wetland is supported by a small (18.2 ha) catchment, most of which is secondary degraded veld and *Acacia sp*. Thornveld with small areas of alien plants and presence of an existing quarry, dirt road & cattle paths along the upper reach of the wetlands catchment. The vegetation within the wetland itself was found to comprise mix of short hydric and dryland grass species (as described in section 5.1.1). Notably, the drier marginal area had been slightly impacted by grazing activities and historic agriculture activities.



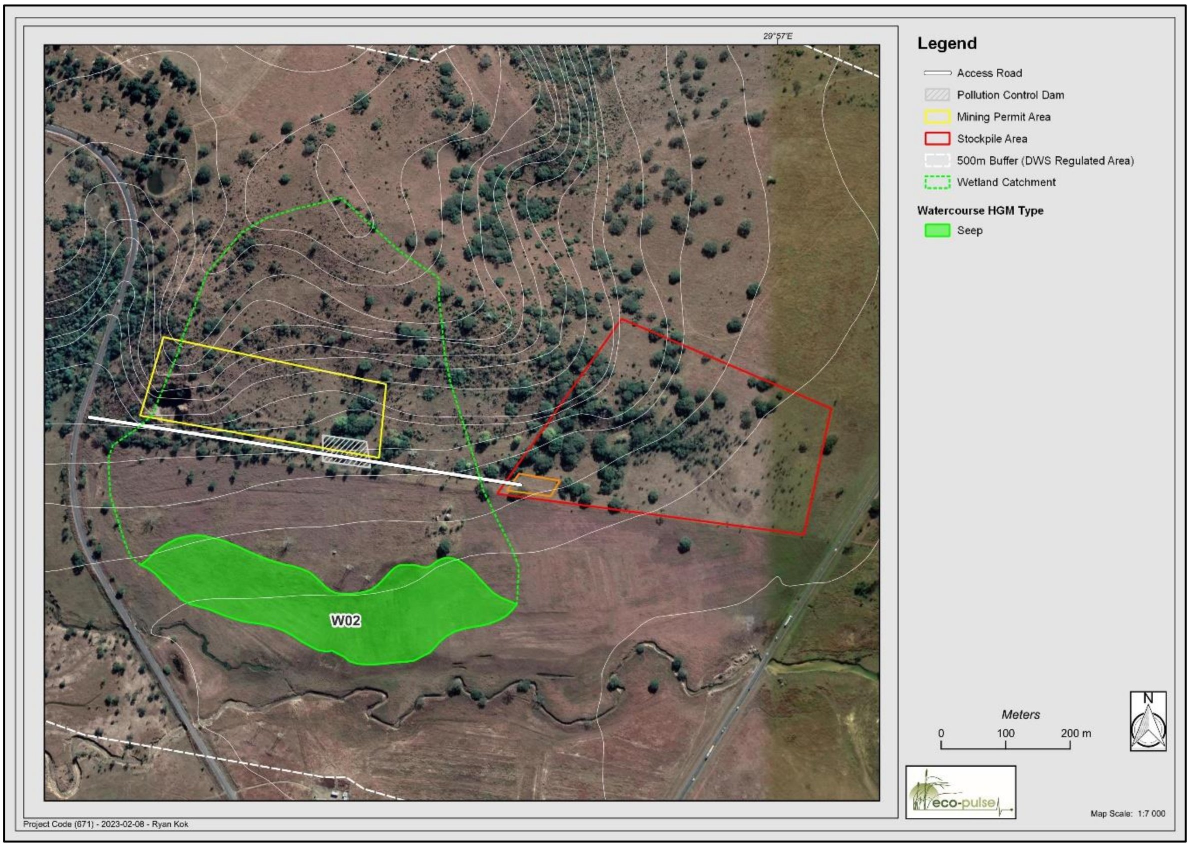


Figure 8 Map showing the delineated seep wetland 'W02' and its supporting catchment area (present day).

5.2 Present Ecological State (PES) Assessment

This section documents the findings of the PES assessment and provides descriptions of key impacts and PES scores and ratings for each of the wetland units assessed.

5.2.1 Wetland PES: WET-Health

The latest (version 2) WET-Health assessment tool (Macfarlane *et al.,* 2020) was applied to wetlands W01, and W02 at a rapid level 1B assessment level. A key step in a Level 1B assessment involves the division of the wetland, its associated 200m buffer and catchment into landcover classes. The landcover classes each have their own impact intensity scores associated with Water Inputs, Sediment Inputs and Water Quality. The landcover delineation and mapping process was completed for both wetlands following sampling and recording of various landcover classes using aerial imagery.

A summary of the baseline PES assessments for the channelled valley bottom wetland is provided in Tables 10. The wetland is considered to be in a '**Moderately Modified' state ('C' PES Category)** characterised by few existing impacts and is roughly 75% intact at the time of the field survey based on the WET-Health condition (PES) assessment undertaken.

Table 10. Summary of the baseline wetland PES assessment for wetland 'W01' using WET-Health.

WET-Health PES Summary for Wetland W01			
Category	**Impact Score**	**PES Category**	**Impact Description**
Hydrology	3.9 / 10 61% intact	'C' PES	**Hydrologically**, wetland W01 has been affected by slight increase in flood peaks due to reduced basal cover through overgrazing and hardened surfaces in its catchment. The presence of multiple dams in the catchment that altered natural water distribution and retention pattens for the downstream wetland. Overall, the combined effect of catchment and within-wetland impacts has resulted in a **moderately modified hydrological condition.**
Geomorphology	2.0 / 10 80% intact	'C' PES	The **geomorphological** template of the wetland remains predominantly intact, with only minor modifications as a result of increased catchment runoff rates and sedimentation associated with reduced basal vegetation cover in the supporting upstream catchment. Furthermore, localised areas of the wetland have been subjected to trampling by livestock and erosion (with headcuts present). Overall, the combined effect of these various impacts has resulted in a moderate modification to wetland **geomorphology**.
Water Quality	1.0 / 10 90% intact	'B' PES	The **water quality** impact contribution is a combination of the wetland's catchment and within wetland land use. Stormwater runoff from the dirt roads/livestock paths as well as potential nutrient inputs from livestock dung has likely contributed to minor/limited modification of the wetlands water quality. Based on the current land use, water quality is estimated to be **largely natural.**
Vegetation	2.5 / 10 75% intact	'C' PES	The **vegetation** of the wetland has remained fairly intact, with the only impacts being due to erosion, overgrazing and livestock trampling. In its current state the **wetland vegetation is considered to be moderately modified.**
Overall (combined PES)	**2.5 / 10** 75% intact	**'C' PES**	***Moderately Modified.*** *A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.*

A summary of the baseline PES assessments for the hillslope seep wetland is provided in Tables 11. The wetland is considered to be in a '**Largely Natural' state ('B' PES Category)** characterised by few existing impacts and were roughly 84% intact at the time of the field survey based on the WET-Health condition (PES) assessment undertaken.

Table 11. Summary of the baseline wetland PES assessment for wetland 'W02' using WET-Health.

WET-Health PES Summary for Wetland W01			
Category	**Impact Score**	**PES Category**	**Impact Description**
Hydrology	1.6 / 10 84% intact	'B' PES	**Hydrologically**, basal cover in some areas of the upstream catchment have been reduced through overgrazing. Wetland W02 has had limited modifications, both within the wetland and catchment, that has resulted in a small change in hydrological processes. Upstream catchment impacts (i.e., overgrazing, presence of dirt roads/cattle paths) have had a limited on the wetland. Overall, the combined effect of catchment and within-wetland impacts has resulted in a **largely natural hydrological condition.**

WET-Health PES Summary for Wetland W01			
Category	Impact Score	PES Category	Impact Description
Geomorphology	1.8 / 10 82% intact	'B' PES	The **geomorphological** template of the wetland remains predominantly intact, with only minor modifications as a result of increased catchment runoff rates and sedimentation associated with reduced basal vegetation cover in the supporting upstream catchment. Furthermore, localised areas of the wetland have been subjected to trampling by cattle. Overall, the combined effect of these various impacts has had little effect on the **wetland geomorphology which remains largely natural and intact**.
Water Quality	1.0 / 10 90% intact	'B' PES	The **water quality** impact contribution is a combination of the wetland's catchment and within wetland land use. The potential nutrient inputs from cattle dung has likely contributed to minor/negligible modification of the wetlands water quality. Based on the current land use, water quality is estimated to **remain largely natural.**
Vegetation	2.7 / 10 73% intact	'C' PES	The **vegetation** of the wetland has remained fairly intact, with the only impacts being overgrazing and livestock trampling. In its current state the **wetland vegetation is considered to be moderately modified.**
Overall (combined PES)	**1.8 / 10** 82% intact	**'B' PES**	***Largely natural.*** *Overall, A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.*

5.3 Wetland Ecosystem Services Assessment

Wetlands are known to provide a range of ecosystem goods and services to society, and it is largely on this basis that policies aimed at protecting wetlands have been founded. This section of the report provides a summary of the predicted level of importance of the various wetland ecosystems in terms of their effectiveness in providing aquatic ecosystem goods and benefits.

The most important services provided by the assessed wetland units are sediment trapping, phosphate and nitrate assimilation in terms of regulating and supporting services. This is due to the increased inputs of nutrients into the system. Whilst the demand for these services is relatively high given the landscape context, the overall importance rating for these services is lowered somewhat due to the limited supply potential due to the slightly degraded nature of the watercourse. 'Biodiversity maintenance' is also considered to be of 'moderate' to moderately-low' importance given the conservation/threat status (Critically Endangered), the relatively natural ecological condition and the wetland's location in a largely natural landscape with high levels of ecological connectivity between natural habitats. In terms of direct benefits, the wetlands are considered 'low' to 'moderately-low' important only for livestock grazing. A summary of the importance of the wetland unit in providing a range of services is provided in Table 12.

Table 12. Summary of the outputs of the WET-EcoServices assessment for the wetland unit W01 & W02 assessed.

ECOSYSTEM SERVICE		Importance Rating	
		W01: CVB	W02: Seep
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.2 (Low)	0.0 (Very Low)
	Stream flow regulation	0.5 (Very Low)	0.5 (Very Low)
	Sediment trapping	1.5 (Moderately Low)	1.4 (Moderately Low)
	Erosion control	0.3 (Very Low)	0.0 (Very Low)
	Phosphate assimilation	1.4 (Moderately Low)	1.8 (Moderate)
	Nitrate assimilation	1.3 (Moderately Low)	1.9 (Moderate)
	Toxicant assimilation	0.8 (Low)	1.1 (Low)
	Carbon storage	1.0 (Low)	1.2 (Low)
	Biodiversity maintenance	1.9 (Moderate)	1.6 (Moderately Low)
PROVISIONING SERVICES	Water for human use	0.2 (Very Low)	0.0 (Very Low)
	Harvestable resources	0.0 (Very Low)	0.0 (Very Low)
	Food for livestock	1.4 (Moderately Low)	1.4 (Moderately Low)
	Cultivated foods	0.2 (Very Low)	0.2 (Very Low)
CULTURAL SERVICES	Tourism and Recreation	0.0 (Very Low)	0.0 (Very Low)
	Education and Research	0.0 (Very Low)	0.0 (Very Low)
	Cultural and Spiritual	0.0 (Very Low)	0.0 (Very Low)

5.4 Ecological Importance & Sensitivity (EIS) Assessment

The Ecological Importance of wetlands and rivers is an expression of the importance of the water resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007).

The wetland EIS assessment involved rating four (4) major components, namely:

- Ecological Importance in terms of biodiversity maintenance
- Ecological Importance in terms of ecological functions
- Ecological Importance in terms of regulating functions
- Ecological sensitivity

A summary of the EIS assessment is provided in Table 13. The wetland unit W01 was assessed as being of 'moderate' EIS and W02 regarded as being of 'Moderately Low' EIS. This rating was driven by the wetlands 'Moderate' to 'Moderately-Low' Biodiversity Importance and Ecological Functional Importance, limited direct use importance and combined with a relatively low ecological sensitivity rating which is linked to an overall diversity of habitats, and limited ecosystem services importance in general.

Table 13. Summary of wetland EIS scores and ratings for the assessed wetland unt.

	Unit W01	Unit W02
Ecological Importance	1.85 (Moderate)	1.59 (Moderately Low)
Ecological Sensitivity	0.90 (Very Low)	0.7 (Very Low)
Overall EIS Score	**1.85**	**1.59**
Overall EIS Rating	**Moderate**	**Moderately Low**

5.5 Recommended Ecological Category (REC) & Management Objectives (RMOs)

The future management of the freshwater ecosystems considered in this study should ideally be informed by recommended management objectives for the specific water resource units which, in the absence of classification, is generally based on the current status or PES (Present Ecological State) and the EIS (Ecological Importance and Sensitivity) for the resource (see Table 14, below – after DWAF, 2007).

Table 14. Generic matrix for the determination of REC and RMO for water resources.

			EIS			
			Very high	**High**	**Moderate**	**Low**
PES	**A**	**Pristine/Natural**	A Maintain	A Maintain	A Maintain	A Maintain
	B	**Largely Natural**	A Improve	A/B Improve	B Maintain	B Maintain
	C	**Good - Fair**	B Improve	B/C Improve	C Maintain	C Maintain
	D	**Poor**	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	**Very Poor**	D Improve	E/F Improve	E/F Maintain	E/F Maintain

Based on this matrix (Table 14) and the catchment context, the REC for the wetland HGM units W01 and W02 is a 'C' and 'B' Ecological Condition Category, respectively, with the RMO being to 'maintain' the current PES and functioning of the wetlands.

Table 15. REC and RMO for the delineated watercourse units based on their PES and EIS ratings.

Watercourse Units	PES	EIS	REC	RMO
Wetland W01	C: Moderately Modified	Moderate	C	Maintain
Wetland W02	B: Largely Natural	Moderately Low	B	Maintain

The maintenance of the current PES condition for the assessed watercourses can be achieved through careful management of catchment sediment, flow and water quality impacts/risks and by avoiding direct impacts to the watercourses. This is further supported by Ezemvelo KZN Wildlife (EKZNW) in their guideline document: Guidelines for Biodiversity Impact Assessment (EKZNW, 2013). According to the document, the guiding principle with regards to biodiversity conservation and sustainable development adopted by EKZNW (2013) is one of ***"no net loss of biodiversity and ecosystem processes".*** To achieve this principle, a proactive approach to planning and biodiversity conservation must be adopted to ensure:

- The early identification and evaluation of potential ecological impacts that may constitute 'fatal flaws', or significant biodiversity related/management issues;
- The early identification and evaluation of conceptual alternatives which could prevent, avoid or reduce significant impacts on aquatic biodiversity, or enhance or secure opportunities for ecosystem conservation; and
- The appropriate design of mitigation through the mitigation hierarchy which should strive first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining residual negative impacts on biodiversity.

6. IMPACT AND RISK ASSESSMENT

This section deals with the assessment of the potential construction and operation phase risks and impacts associated with the proposed mining, blasting and excavation, crushing and screening of aggregate and stockpiling of the product. Each of the potential impact consequences are discussed and assessed separately for the construction and operational phases under a 'realistic poor' and 'realistic good' / 'best practical' mitigation scenarios as defined in the 'methods' section of the report (*refer specifically to Section* 2.6).

6.1 Impact Sigificance Assessment

6.1.1 Identification of Impacts-Causing Activities

Potential impact-causing (cumulative) activities identified for the construction and operational phases of the Elandsspruit mining permit and stockpiling areas are summarised in table 16, below.

Table 16. Potential impact-causing activities identified for the construction and operation phases of the expansion of the Elandsspruit Quarry and stockpiling area.

Construction Phase Activities & Aspects	Operational Phase Activities & Aspects
Access road to the sites: • Site clearing of terrestrial vegetation and disturbance of soil within catchment area of wetlands, stripping and stockpiling. **Quarry & stockpiling site:** • Construction of the property boundary & main site camp • Stripping and stockpiling of vegetation and topsoil • Blasting & development of supporting infrastructure • Construction of stormwater management infrastructure, pollution control dam, office & sediment management, and hazardous substances handling and storage. • Construction of internal access road	**Operation of quarry, stockpiling area, and access road:** • Blasting, excavation, stockpiling, crushing and haulage of aggregate • Management of stormwater runoff and concentrated flows • Operational impacts of access roads impeding flows

6.1.2 Impact Significance Assessment

Summaries of the impact significance assessment for the construction and operational phases of the Elandsspruit quarry and stockpiling area is contained in Tables 17 and 18, respectively.

Construction Phase:

Table 17. Summary results of the impact significance assessment for construction phase impacts associated with the quarry, stockpiling area and associated infrastructure.

<table>
<tr><td colspan="2" rowspan="2">Construction Phase Impact Assessment</td><td colspan="2">Impact Significance</td></tr>
<tr><td>‘poor’ mitigation scenario</td><td>‘good’ mitigation scenario</td></tr>
<tr><td>C1</td><td>Direct physical loss or modification of wetland habitat</td><td>Low</td><td>Low</td></tr>
<tr><td colspan="4">Based on the latest revised draft layout of the quarry & stockpile area received from Greenmined, the quarry and stockpile area is unlikely to directly result in the destruction and/or modification of the watercourses given that the quarry and stockpiling infrastructure and working areas is located >100m downslope. Through impact avoidance (sound environmental planning to avoid wetland areas), impact significance is likely to be ‘Low’ and environmentally acceptable. Key mitigation measures for avoiding direct impacts are listed below.

Key mitigation recommendations:
• Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to the wetland buffer zones, with planned development infrastructure to remain outside of the recommended wetland buffer zone.
• Demarcate the edge of wetland buffer on the ground to avoid incursions into these areas.
• Restrict access to wetland areas beyond the development footprint.
• Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, and buffer zones.
• Implement appropriate ecological monitoring during construction and use findings to inform site management.
• Construction phase method statement(s) to be developed and finalised prior to construction taking place, taking into consideration the wetland impact mitigation measures and requirements of the EMPr to be developed.</td></tr>
<tr><td rowspan="3">C2</td><td rowspan="3">Alteration of hydrological and geomorphological processes (erosion and sediment)</td><td colspan="2">Impact Significance</td></tr>
<tr><td>‘poor’ mitigation scenario</td><td>‘good’ mitigation scenario</td></tr>
<tr><td>Moderate</td><td>Moderately Low</td></tr>
<tr><td colspan="4">Flow modification and related erosion/sedimentation impacts are likely to arise during the construction of access road and other quarry infrastructure (offices, hardened platforms/surfaces, etc.). During construction, altered storm water flows and velocities could be a problem but are likely to be localised, with catchment impacts from clearing and earthworks upslope of watercourses effectively reducing groundcover and infiltration rates and leading to slightly increased peak discharges reaching watercourses. The impact of erosion and sedimentation from vegetation stripping and bare soils is likely to be the most intensive and potentially harmful impact to adjacent and downstream wetlands and rivers. The construction of the road infrastructure and associated drainage infrastructure will likely intercept and concentrate surface flows prior to discharge into the environment, resulting in erosion and potential sedimentation of downstream aquatic ecosystems. Some of the key ecological consequences associated with the sedimentation of freshwater habitat and increased water turbidity include:
o Reductions in soil saturation rates of areas buried with sediment and/or eroded; and
o Colonisation by alien invasive and weedy plant species associated with recent erosional and depositional features.
These impacts are likely to be more pronounced during heavy rainfall events. Such impacts could potentially alter the geomorphic structure and hydrological regime of nearby wetlands and could affect freshwater habitat and flora. Should these impacts occur they are however likely to be indirect, temporary and are unlikely to significantly affect long-term ecological processes associated with onsite watercourses.

Overall, given the ‘moderate’ to ‘moderately low’ EIS of the wetlands (limited ecological importance/sensitivity), impact intensity is likely to be relatively low, however hydrological and geomorphological impacts are therefore also likely to be of ‘moderate’ ecological significance. Best practical mitigation should be implemented (as listed below and explained in detail in Chapter 7 of this report), this will enable to reduce the impact to ‘moderately low’ and environmentally acceptable level.</td></tr>
</table>

Key mitigation recommendations:

- Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands, with planned development infrastructure to remain outside of the recommended wetland buffer zones.
- To maximise effectiveness, buffer zones will need to be maintained with indigenous vegetation cover (without erosion features/concentrated flow paths) as open space natural grassland areas with appropriate alien plant control and/or slashing to maintain grass cover.
- Limit construction activities to the dry (winter) season where possible, to reduce erosion and sediment risks.
- Address potential construction-phase erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control.
- Temporary erosion and sediment control measures are to be implemented, with a greater level of need if construction proceeds into the summer (wet/rainy) period. Temporary erosion/sediment control to remain in place until construction has been completed and operational stormwater management infrastructure is suitably in place and operating correctly.
- Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.
- Implement appropriate ecological monitoring during construction and use findings to inform site management.
- Construction phase method statement(s) to be developed and finalised prior to construction taking place, taking into consideration the wetland impact mitigation measures and requirements of the EMPr to be developed.

		Impact Significance	
C3	**Impacts to water quality**	'poor' mitigation scenario	'poor' mitigation scenario
		Moderate	**Low**

Stripping of vegetation, disturbance of soil and stockpiling of excavated soil are likely to be the chief sources of sediment during the construction phase of the quarry & stockpile area. If not managed adequately, overland flows from rainfall events or stormwater outlets are likely to transport sediment to downstream watercourses. High quantities of sediment entering watercourses have the following impacts; (i) increase turbidity of water, leading to increased attenuation and a consequent lowering of primary productivity, (ii) an influx of heavy metals and other pollutants adsorbed onto the sediment particles, and (ii) increase sediment deposition leading to an alteration of the physical structure of the wetland (aggradation), water availability and consequently distribution of aquatic organisms.

Water pollution impacts can potentially be experienced during the construction phase of the project, the quantity of pollutants is likely to be limited and thus be of 'moderate' significance for wetlands in the area of study. This is especially relevant given the presence of a 'well-vegetated' buffer zone between the quarry and stockpile area and the nearest watercourses, such that the intensity and probability of such impacts being sustained by the wetland downstream the quarry and stockpile area is likely to be low, with impact significance also likely to be relatively 'Low' during the construction phase where well-managed (*as per the impact mitigation recommendations listed below and explained in detail in Chapter 7 of this report*).

Key mitigation recommendations:

- Limit construction activities to the dry (winter) season where possible, to reduce erosion and sediment risks.
- Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control.
- Sediment controls (e.g., silt fences/berms) should be implemented to reduce sediment inputs to the nearby wetlands.
- Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management.
- Rehabilitate any spill related impacts as soon as practically possible.
- A suitable spill response and remediation plan is to be developed for the construction phase.
- Implement appropriate ecological monitoring during construction and use findings to inform site management.

- Construction phase method statement(s) to be developed and finalised prior to construction taking place, taking into consideration the wetland impact mitigation measures and requirements of the EMPr to be developed.

C4	**Impacts to ecological connectivity and/or ecological disturbance impacts**	**Impact Significance**	
		'poor' mitigation scenario	'poor' mitigation scenario
		Moderately Low	**Low**

Since the quarry, stockpile area and associated infrastructure will be positioned outside of the delineated wetland and recommended buffer zone, the probability of incurring direct impacts to the delineated wetland is unlikely, hence impacts to wetland ecological connectivity are expected to be of 'Low' significance overall and wetland habitat fragmentation is highly unlikely to take place. Maintaining the recommended wetland buffer zone will also discourage edge disturbance and related impacts and maintain some form of ecological connectivity between wetland and adjacent terrestrial grassland habitats.

The blasting, excavation, presence of workers and machinery during the construction phase may create ecological noise and vibration disturbances have the potential to disturb and is place fauna that may be using the watercourse for movement and refuge. Given the distance from the site activities, faunal impacts are likely to be Low, meaning that disturbance-related impacts during the construction phase could be of 'Moderately Low' significance. Best practical mitigation should be still implemented (*as listed below and explained in detail in Chapter 7 of this report*) to maintain the impact at a an appreciably low and environmentally acceptable level.

Key mitigation recommendations:

- Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands, with planned development infrastructure to remain outside of the recommended wetland buffer zones.
- Demarcate the edge of wetland buffers on the ground to avoid incursions into these areas.
- Restrict worker and machinery access to the active construction site and construction site camp areas only.
- Prohibit the poaching of animals and/or collection of plants and biota from natural areas, including wetlands.
- Temporary erosion/sediment control to be removed only once construction has been completed and operational storm water management infrastructure is suitably in place and operating correctly.
- Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, riparian areas and buffer zones.

Operational Phase:

Table 18. Summary results of the impact significance assessment for operational phase impacts associated with the quarry, stockpiling area and associated infrastructure.

Operational Phase Impact Assessment		**Impact Significance**	
		'poor' mitigation scenario	'good' mitigation scenario
O1	**Direct physical loss or modification of instream/riparian habitat**	**Low**	**Low**

This is largely a construction phase risk/impact and given that the quarry, stockpiling area and associated infrastructure will be planned to avoid the delineated wetland and its recommended buffer zones, direct loss or modification impacts are unlikely to occur during the operational phase.

Key mitigation recommendations:

- Appropriate stormwater management to be implemented with a focus on reducing erosion risk.
- No solid waste dumping to take place within wetlands or buffers.
- Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands and buffer zones.

<table>
<tr><td rowspan="3">O2</td><td rowspan="3">Alteration of hydrological and geomorphological processes (erosion and sediment)</td><td colspan="2">Impact Significance</td></tr>
<tr><td>'poor' mitigation scenario</td><td>'good' mitigation scenario</td></tr>
<tr><td>Moderate</td><td>Moderately Low</td></tr>
<tr><td colspan="4">During quarry operations, crushing, sorting and stockpiling of aggregate, it is expected that there will be increased water inputs to the downstream wetlands due to runoff of stormwater being directed to the adjacent/downstream drainage system via some form of operational storm water management system. Greater volumes of water are generated more quickly while smaller and longer-duration flows that would occur under less developed conditions are reduced or perhaps eliminated. The amount of impervious surface within a contributing basin is a key influence on hydrologic patterns, and even small changes in watershed conditions have measurable influences on the flows and volumes of water in the system. Increased imperviousness (more hardened or impermeable surfaces) will experience an increase in the magnitude of runoff volume from a given storm event. Catchment hardening/reduced basal cover can also cause a decrease in interflow (shallow subsurface flow) and base flow from the developed catchment, with changes in the volume of interflow typically influencing the hydroperiod of downstream wetlands fed by shallow subsurface flow. Instead of water infiltrating the ground and recharging groundwater which feeds the wetland throughout the dry season, it will flow straight into the wetland and likely be lost to evapotranspiration (during early vegetation succession especially), surface and sub-surface outflow. Ultimately, the consequences of the interplay between rates, volumes, and durations of flows are complex and research on the impacts of catchment modifications on stormwater and watershed processes indicates that catchment hardening/basal vegetation cover reduction can result in several disturbances that can impact wetlands and rivers, including:
• Increased erosion;
• Sediment movement and deposition;
• Burying of vegetation;
• Increased depths of inundation;
• Water level fluctuations;
• Down-cutting or incising of natural channels (which can remove vegetation from the channel valley bottom);
• Changes in the seasonal extent and duration of saturation and inundation; and
• Unstable substrates.

Appropriate stormwater outfall and attenuation design should be implemented, and bearing this in mind, the impact could potentially be reduced to a 'Moderately Low' impact significance with best practical ecological design incorporated to allows flows and sediment fluxes to remain largely unmodified.

<u>Key mitigation recommendations:</u>
• Appropriate Storm Water Management Plan (SMWP) to be implemented with a focus on reducing downstream erosion risk.
• Monitoring plan to be implemented for water quality and erosion/sediment.
• Correct and appropriate design and size of the pollution control dam (PCD).
• Maintain stormwater infrastructure as necessary through unblocking of drains, desilting where required, etc.
• Implement and adhere to the recommended buffer zones for wetlands.
• Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.</td></tr>
<tr><td rowspan="3">O3</td><td rowspan="3">Impacts to water quality</td><td colspan="2">Impact Significance</td></tr>
<tr><td>'poor' mitigation scenario</td><td>'good' mitigation scenario</td></tr>
<tr><td>Moderate</td><td>Moderately Low</td></tr>
<tr><td colspan="4">Potential sources of contaminants during the operational phase are likely to be fewer than for the construction phase but can vary greatly. Of most concern during the operational phase is the poor management of sediment laden stormwater generated by the quarry and stockpiling site. Discharge of sediment laden water into adjoining watercourses can potentially alter the water quality which will have a knock-on effect on aquatic species. The significance of this impact can be 'moderate' under a worst-case scenario. Other pollutants may also enter watercourses via runoff of storm water from the site. Pollutants such as oils, grease, heavy metals will accumulate on the road surface where they will be flushed into adjacent/downstream watercourses after rainfall events albeit to a 'moderately low' level. This is likely to be of greatest concern during the first rains when the concentration of contaminants is likely to be highest on constructed road surfaces and associated infrastructure.</td></tr>
</table>

Key mitigation recommendations:

- Measures to capture solid waste and debris entrained in stormwater entering the stormwater management system (inlet protection devices) must be incorporated into the design of the system.
- Stormwater conveyance through bio-retention methods should be used where possible as these are an effective means of removing suspended solids, heavy metals, hydrocarbons, organic compounds, and dissolved nutrients from stormwater.
- Storm water management systems will be designed with longevity in mind and in order to require little maintenance by catering for silting, etc.
- Design and implementation of storm water management plan and associated infrastructure according to best-practice storm water management guidelines. Regular monitoring and maintenance of storm water infrastructure.
- Develop an 'Freshwater Environmental Contingency Plan', as required.
- Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management.
- Rehabilitate wetland areas and buffer zones, as and where necessary.

		Impact Significance	
O4	**Impacts to ecological connectivity and/or ecological disturbance impacts**	'poor' mitigation scenario	'good' mitigation scenario
		Low	**Low**

Operationally, impacts to wetland ecological connectivity are expected to be of 'Low' significance overall and wetland habitat fragmentation is highly unlikely to take place given that the facility will be located well outside of the delineated wetland. Maintaining the recommended wetland buffer zones will also discourage edge disturbance and related impacts and maintain some form of ecological connectivity between wetland and adjacent terrestrial grassland habitats. Best practical mitigation should be still implemented (*as listed below and explained in detail in Chapter 7 of this report*) to maintain the impact at a an appreciably 'low' and environmentally acceptable level.

Key mitigation recommendations:

- Strict avoidance of the delineated wetland is to be made a priority and implement and adhere to buffer zones for the wetland.
- Restrict worker and machinery access to the broader property and planned access roads only.
- Eradicate and/or control Invasive Alien Plant species as necessary.
- Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetland areas and buffer zones.

A summary of the impact significance assessment ratings for the construction and operational phases of the quarry and stockpiling site is contained in Table 19, below.

Table 19. Impact significance assessment summary table for construction and operational phase impacts.

Impact Type	Impact Significance	
	'poor' mitigation scenario	'good' mitigation scenario
CONSTRUCTION PHASE (C)		
C1 Direct physical loss or modification of freshwater habitat	Low	Low
C2 Alteration of hydrological and geomorphological processes	Moderate	Moderately Low
C3 Impacts to water quality	Moderate	Low
C4 Impacts to ecological connectivity and/or ecological disturbance impacts	Moderately Low	Low
OPERATIONAL PHASE (O)		
O1 Direct physical loss or modification of freshwater habitat	Low	Low
O2 Alteration of hydrological and geomorphological processes	Moderate	Moderately Low
O3 Impacts to water quality	Moderate	Moderately Low
O4 Impacts to ecological connectivity and/or ecological disturbance impacts	Low	Low

*For further details on impact assessment scores and ratings refer to **Annexure B** of this report.*

6.2 Risk Assessment to inform S21 c & i Water Use Licensing

It is our understanding that the purpose of the risk matrix tool developed by the DWS is to give a preliminary indication of the likely impact / degree of change (consequence) of activities (water uses) to local and regional water resource quality. For the purposes of this study, the degree of change is reflected in PES change and/or the change in the supply of regulating ecosystem services.

Possible activities, aspects (or stressors) and potential ecological risks associated with the quarry and stockpiling site, that could potentially manifest in impacts to the four drivers of wetland condition/functioning as defined by the DWS have already been identified in Section 6.1.1 (see Table 16) of this report, and include the following aspects/activities:

- Site clearing of terrestrial vegetation and disturbance of soil within catchment area of wetlands, stripping and stockpiling.
- Construction of the property boundary & main site camp
- Blasting & development of supporting infrastructure
- Construction of stormwater management infrastructure, pollution control dam, office & sediment management, and hazardous substances handling and storage.
- Construction of internal access road
- Blasting, excavation, stockpiling, crushing and haulage of aggregate

- Management of stormwater runoff and concentrated flows
- Operational impacts of access roads

The risk assessment summary results in Table 20 and Annexure E indicate that the risks posed by the construction and operation of the proposed quarry and stockpiling development project on water resources (i.e., wetlands), range from being 'Low' to 'Moderate' overall under a standard mitigation scenario, with moderate risk ratings driven largely by alteration of hydrological and geomorphological processes as well as water quality related risks. With the addition of mitigation measures, some of the risk rating can be reduced a 'low' level overall, however the risk associated with the operations of the quarry (i.e., blasting excavation, increased sedimentation and alterations of natural flows, and runoff) remain 'Moderate'. This suggests that **the project cannot authorised in terms of the GA (General Authorisation) for Section 21 (c) and (i) water use due to the 'moderate' risk presented by the operation of the quarry and stockpiling site and is therefore subject to a full WULA.**

Ultimately, it is up to the DWS to confirm whether a full WULA is required, or a GA may be applied for.

Table 20. Summary of the risk matrix assessment scores and ratings for each activity and risk group.

PHASE	Activity	Aspect	Risk of Impact	Risk Rating	Borderline LOW / MODERATE Rating Classes
CONSTRUCTION	Access road to the quarry site	1.1 Site clearing of terrestrial vegetation and disturbance of soil within catchment area of wetlands, stripping and stockpiling.	Clearing of vegetation, disturbance of soils and habitat.	Low	
CONSTRUCTION	Development of the quarry and stockpile area for aggregate	2.1 Construction of the property boundary & main site camp	Disturbance of soil, sedimentation of downslope watercourses	Low	
CONSTRUCTION	Development of the quarry and stockpile area for aggregate	2.2 Stripping and stockpiling of vegetation and topsoil	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface flow patterns - increased runoff	Low	
CONSTRUCTION	Development of the quarry and stockpile area for aggregate	2.3 Blasting & development of platforms and supporting infrastructure	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface flow patterns - increased runoff	Moderate	*Low
CONSTRUCTION	Development of the quarry and stockpile area for aggregate	2.4 Construction of stormwater management infrastructure, pollution control dam, office & sediment management, and hazardous substances handling and storage	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface flow patterns - increased runoff	Moderate	*Low
CONSTRUCTION	Development of the quarry and stockpile area for aggregate	2.5 Construction of internal access road	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface flow patterns - increased runoff	Low	

PHASE	Activity	Aspect	Risk of Impact	Risk Rating	Borderline LOW / MODERATE Rating Classes
OPERATION	Operation of the quarry for aggregate, stockpiling and access roads	3.1 Blasting, excavation, stockpiling, crushing and haulage of aggregate	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface and subsurface flow patterns.	Moderate	
		3.2 Management of stormwater runoff and concentrated flows	Increased erosion and sedimentation risks, alteration of natural surface flow patterns.	Moderate	
		3.3 Operational impact of access roads impeding flows	Flow impedance, increased runoff, erosion, and sedimentation risks.	Moderate	

For further details on risk assessment scores and ratings refer to ***Annexure C*** *of this report.*

7. IMPACT & RISK MITIGATION

A strong legislative framework which backs up South Africa's obligations to numerous international conservation agreements and creates the necessary enabling legal framework for the protection and management of freshwater resources in the country. Given the value of wetland and aquatic ecosystems, it is against the law to deliberately damage wetlands and rivers. The law therefore places, directly and indirectly, the responsibility on landowners and other responsible parties, to manage and restore aquatic ecosystems where relevant.

The purpose of the National Water Act, 1998 (No. 36 of 1998), sensitive, vulnerable, highly dynamic or stressed ecosystems, such as wetlands, rivers and similar systems is to ensure the nation's water recourses are protected, used, developed, conserved, managed and controlled in a way which take into account amongst other factors. The NWA emphasises the protection of water resources by seeking to maintain the quality of water resources to the extent that the water resources may be used in an ecologically sustainable way, preventing the degradation of water resources, and rehabilitating water resources.

Of importance is the requirement of 'duty of care' with regards to environmental remediation in Section 19(1) of the NWA (National Water Act, 1998, No. 36 of 1998):

> **Duty of care preventing and remedying effects of pollution**: (1) *An owner of land, a person in control of land or a person who occupies or uses the land on which any activity or process is or was performed or undertaken; or any other situation exists, which causes, has caused or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring."*

7.1 The 'Mitigation Hierarchy': Best Practice Environmental Planning Framework

The protection of water resources begins with the avoidance of adverse impacts and where such avoidance is not feasible, to apply appropriate mitigation in the form of reactive practical actions that minimizes or mitigate such impacts. 'Impact Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts because of potentially harmful activities. This generally follows some form of 'mitigation hierarchy' (see Figure 9), which aims firstly at avoiding disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided, to minimise, rehabilitate, and then finally offset any remaining significant residual impacts.

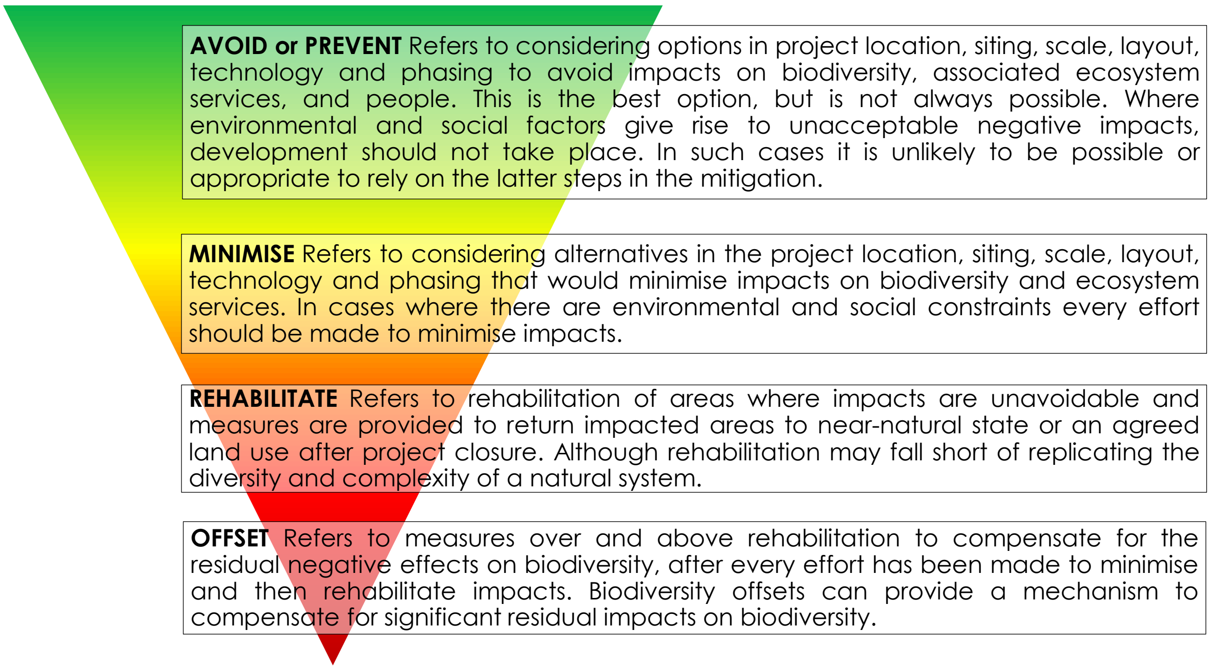


Figure 9 Diagram illustrating the 'mitigation hierarchy' (after DEA *et al.,* 2013).

The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives in terms of project location, siting, scale, layout, technology, and phasing until the proposed development can be best accommodated without incurring significant negative impacts to the surrounding environment. Where ecological impacts can be severe, the guiding principle should generally be "*anticipate and prevent*" rather than "*assess and repair*". This principle is in line with the recommended management objective for the project and receiving freshwater environment, that being to '*maintain the current status quo of aquatic ecosystems without any further loss of integrity (PES) or functioning*'.

A stepped approach has therefore been followed in trying to minimize impacts, which included:

i. **Firstly, attempting to avoid/prevent impacts through appropriate project design and location:** *Development set-backs / bufferzones recommended.*

ii. **Secondly, employing mitigation measures aimed at minimizing the likelihood and intensity of potential risks/impacts**: *Provision of construction and operation phase management and mitigation measures to avoid any unnecessary direct or indirect impacts to watercourses.*

iii. **Thirdly, addressing residual impacts to areas adjacent to the development site which may be impacted:** *Provision of a suitable conceptual-level wetland rehabilitation and management plan.*

iv. **Lastly, compensating for any remaining/residual impacts associated with permanent habitat transformation:** *Not applicable to this project (no direct residual loss of wetland areas).*

7.2 Wetland Buffer Zone Recommendations

'Buffer zones' or 'buffers' (also termed "development set-backs") are essentially strips of vegetated undeveloped land typically designed to act as a protective barrier between human activities and sensitive habitats such as wetlands, rivers and forests. Research shows that buffer zones are useful at performing a wide range of functions such as sediment trapping and nutrient retention, and in doing so, play an important role in protecting water resources from the adverse impacts that are typically associated with various land-uses and developments. Although there are no legislative requirements regarding the establishment of buffers around water resources in the South African legislation, the application of buffers is aligned with the principles of the National Water Act (1998), which is to provide for the sustaining of water quality and preserving natural aquatic habitats and ecosystem functions.

According to the draft Guidelines for Biodiversity Impact Assessment in KZN (EKZNW, 2011), a standard buffer width of 30m from the outer edge of the delineated wetlands and the riparian zone of rivers in the Province of KZN, often irrespective of site conditions and development/land use type. The guideline document goes on to recommend that the determination of ecological buffers should rather be based on a number of site-specific factors. A national protocol for buffer determination around rivers, wetlands and estuaries has recently been developed (Macfarlane & Bredin, 2016) and represents emerging best-practice in aquatic buffer zone determination.

The national buffer zone determination tool for wetlands and rivers (Macfarlane & Bredin, 2016) was applied for the assessed wetlands. Potential risk to wetlands in terms of a range of criteria (see Table 21) are estimated by the buffer model and used to allocate suitable buffers based on the generic risk levels associated with the proposed development type (refined at a site level). The "*Low-risk quarrying operations*" category was used to inform operational risks/threats in the buffer tool.

According to the Preliminary Guideline for the Determination of Buffer Zones (Macfarlane & Bredin, 2016), buffer zone requirements are only advocated where scientific studies have shown that they can be an effective mitigation measure. Table 21 (below) also highlights situations where the implementation of suitable aquatic buffer zones can have a potentially positive mitigating effect and should be considered in impact mitigation (e.g., water quality and sediment impacts) and those situations where buffers are not particularly suited at mitigating impacts/risks and where other forms of mitigation should be identified (e.g., water quantity impacts, including stream flow reduction activities).

Table 21. Preliminary desktop-level threats used in the aquatic buffer assessment and the best approaches for addressing these threats.

Threat Type	Preliminary Threat Ratings		Approach for Addressing Threats
	Construction Phase	Operation Phase	
1. Alteration to flow volumes	Very Low	Low	• Source directed controls • Restricting surface flow requirement (SFR) activities
2. Alteration of patterns of flows (increased flood peaks)	Low	Moderate	• Control of water inputs
3. Increase in sediment inputs & turbidity	Very High	Very High	• **Buffer zones** • Other suitable on-site BMPs
4. Increased nutrient inputs	Very Low	Low	
5. Inputs of toxic organic contaminants	Very Low	Low	
6. Inputs of toxic heavy metal contaminants	Low	Low	
7. Alteration of acidity (pH)	Very Low	Low	• On-site BMPs and other measures
8. Increased inputs of salts (salinization)	Very Low	Low	
9. Change (elevation) of water temperature	Very Low	Low	
10. Pathogen inputs (i.e. disease-causing organisms)	Very Low	Very Low	• **Buffer zones** • Other suitable on-site BMPs

Based on the threats posed by the proposed development, the buffer model calculated appropriate buffer widths under two scenarios:

1. With 'Standard' Mitigation; and
2. With 'Site-specific / Best Practical' Mitigation

With specific mitigation (focusing on the management of sediment inputs, storm water runoff and erosion control), the model recommends a **40m wide buffer zone** for both wetland units, as per Table 22. The recommended wetland buffer is shown spatially on the map in Figure 10.

Table 22. Wetland buffer zone widths recommended to inform development planning.

Wetland Unit	Buffer Widths Recommended	
	Construction Phase	Operational Phase
W01	40m	**40m**
W02		

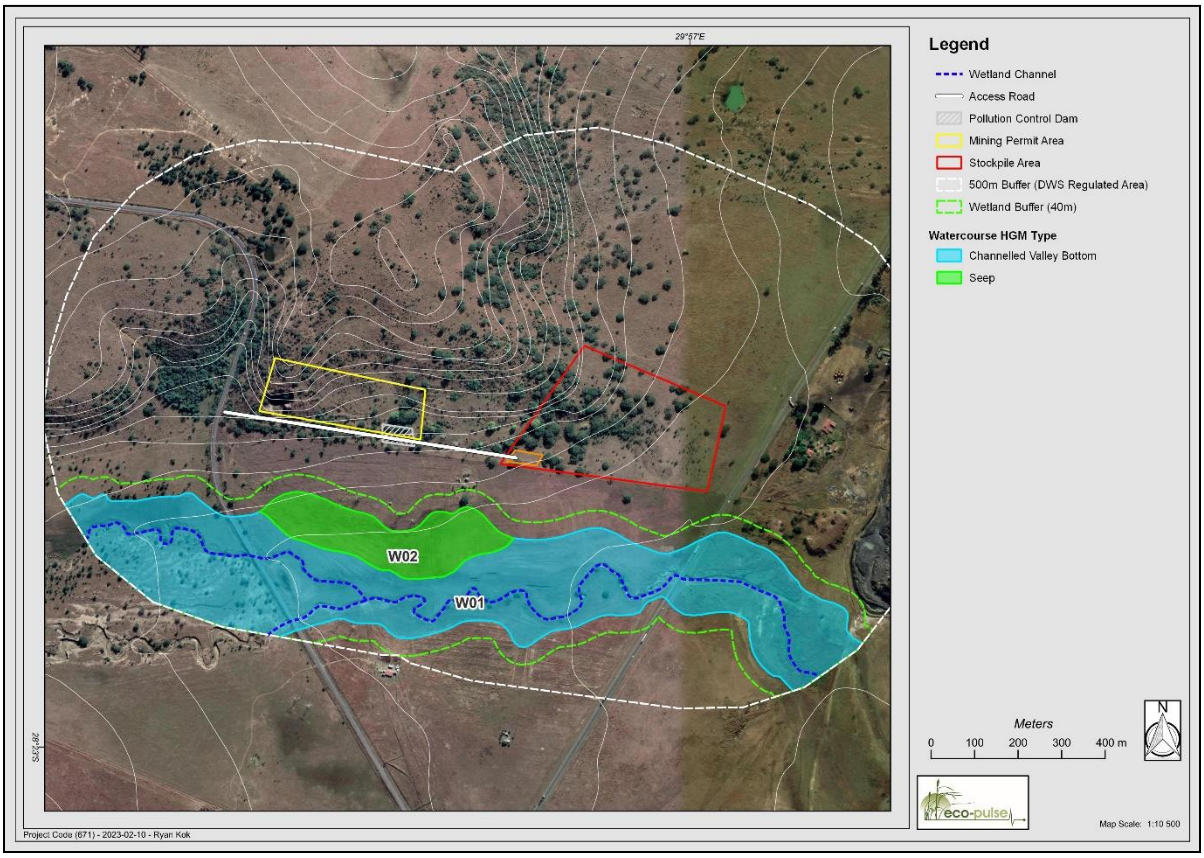


Figure 10 Map showing the recommended 40m wide 'buffer zone' for the downstream wetlands (W01 & W02) used to inform the development layout of the proposed quarry, stockpiling area and associated infrastructure.

Key assumptions and criteria considered in determining suitable buffers is provided below:

- Key construction phase risks linked with the proposed development type include increased sediment inputs and turbidity and possible water pollution from heavy metal contaminants.
- Key operation phase risks linked with development are likely to include increased flood peaks, sediment inputs and possible water pollution.
- The buffer width is also driven by the moderately steep to steep slopes of the valley.
- For impacts involving the concentration of surface flow (e.g., storm water discharge, etc.), buffers have a limited capacity to function at attenuating flows and trapping sediment / nutrients / pollutants.
- In order to maximise their effectiveness, buffer zones will need to be established and maintained with indigenous vegetation cover (without erosion features/concentrated flow paths) as open space natural grassland areas with appropriate alien plant control and/or slashing to maintain grass cover.
- We assumed that a functional stormwater management plan will be developed for the quarry, designed to manage runoff, erosion, and sedimentation.

7.3 Planning and Design Recommendations

At the forefront of mitigating impacts to the wetlands downstream should be the incorporation of ecological and environmental sustainability concepts into the design of the development project, with a central focus around:

1. Ensuring that direct impacts to watercourses are avoided wherever possible through ecologically sound and sustainable development layout planning that takes into account the location and sensitivity of the remaining ecological infrastructure at the site;
2. Employing creative design principles and ecologically sensitive methods in infrastructure design and layouts to minimise the risk of indirect impacts;
3. Ensuring that stormwater management design and implementation considers the requirements of the environment, including wetlands and rivers; and
4. Taking necessary efforts aimed at minimising/reducing potential waste streams.

7.3.1 Access road design guidelines

- All roads (including those for temporary access) will need to be located outside of wetlands and buffer zones.
- It is recommended that a semi-pervious material be used to construct roads that allows for some infiltration rather than using impermeable tarred/asphalted road surfaces wherever practically possible and financially feasible.
- Roads should follow natural contours where possible in order to maintain gentle gradients so as to minimise the risk of surface water runoff, high flow velocities and soil erosion.
- Roads should have shallow berms/cut-off drains at regular intervals along steep slopes that direct surface run-off from the road into adjacent grassland or wooded areas to avoid rill erosion and gully formation.

7.3.2 Road stormwater management design recommendations

If internal roads are to be developed to services the expansion area, stormwater generated by the road should be formally managed using open grassed swales and discharged into the environment at regular intervals. in a controlled manner that does not cause erosion.

7.3.3 Storm water management guidelines for the operational quarry site and stockpiling area

An operational stormwater management plan (SWMP) must be developed for the quarry and stockpiling site and should incorporate the following environmental recommendations:

- The stormwater management plan (SWMP) must be sustainable over the life cycle of the quarry & stockpiling area and over different hydrological cycles and must incorporate principles of risk management.
- Dirty water must be collected and contained in a system separate from the clean water system and the risk of spillage or seepage into clean water systems must be minimized.

- Clean water must be kept clean and be routed to a natural watercourse by a system separate from the dirty water system while preventing or minimizing the risk of spillage of clean water into dirty water systems. Ideally clean water must not be contained but returned to natural watercourses under controlled conditions.
- Adequate drainage systems should be provided to minimise surfaces water runoff into the quarry workings. This can be achieved through use of a cut-off drain at the top of the quarry face.
- All stormwater runoff from site must be managed through use of swales, berms or trenches, sediment barriers, and a series of stormwater settling/detention ponds. Runoff must be collected and diverted into a series of detention/settling ponds where sediment-laden water can be detained for a period of time appropriate for sediment to settle prior to water being released back into the environment.
- Stormwater released back to the environment must be attenuated to pre-development flow conditions, with adequate erosion protection and velocity dissipation prior to water entering downstream watercourses.
- Multiple smaller stormwater outlets to the environment are preferable to fewer, larger ones.
- No stormwater must be attenuated outside the fenced-off development site.
- There must be a sufficient buffer between the quarry operational area and the site boundary to allow for establishment of stormwater infrastructure such as detention ponds, stormwater channels etc. which should not be located within wetlands. This should be clearly reflected in the layout plan and stormwater management plan.
- Any non-polluted water abstracted from the quarry must be discharged into the stormwater system for treatment (mainly in the form of detention for removal of sediment) or a system for recycling and re-use of this water on-site should be devised and implemented.
- Quarry design can also promote the conservation and efficient utilisation of water, implement rainwater harvesting measures, the recycling / re-use through grey water systems, etc.

7.4 Onsite Construction Phase Mitigation and Management Measures

The following mitigation measures must be implemented in conjunction with any generic measures to be provided in the Environmental Management Programme (EMPr) for the project.

7.4.1 Timing of construction

It is recommended that construction be undertaken during the dry season to reduce erosion and sedimentation risks associated with summer rainfall in this region. Conducting construction during the dry season could also potentially negate or reduce the risk of erosion and sedimentation of the watercourse during the construction phase.

7.4.2 Access to construction areas

- It is recommended that access to the site by workers and construction machinery be via the existing informal dirt road network wherever possible. This will greatly limit the disturbance of habitat during the construction phase of this project.
- New access routes should only be established where considered absolutely necessary to complete the works.

7.4.3 Demarcation of the quarry and stockpile site

- Prior to commencement of construction, the quarry site must be fenced off using a 1.8m or higher, high-visibility bonnox fence or other suitable fencing material.
- A green or khakhi shade cloth should be fixed to the bonnox fence to screen the quarry and catch dust.
- In addition to the bonnox fence and shade cloth, a silt fence must be installed at the bottom of the fence to catch sediment carried by surface runoff from bare surfaces at the site.
- All demarcation work must be signed off by the ECO before any work commences.

7.4.4 Demarcation of 'No-Go' areas and construction site

- Prior to the commencement of any construction activities, the following features must be staked out by a surveyor and demarcated as such:
  - Outer edge of the delineated watercourse (wetlands) and associated buffer zone.
- The demarcation work must be signed off by the Environmental Control Officer (ECO) before any work commences.
- Demarcations are to remain until construction complete.
- All areas outside of this demarcated working servitude must be considered 'no-go' areas for the entire construction phase. Any contractor found working within 'no-go' areas must be fined as per fining schedule/system setup for the project.
- Vegetation removal/stripping must be limited to the construction footprint. No areas outside the construction footprint may be cleared.
- No equipment laydown or storage areas must be located within delineated wetland areas and associated buffer zones.
- No equipment laydown or storage areas must be located within 40m of any watercourse and/or within the 1:100-year flood line, whichever is greater in width.
- Access to and from construction areas should, as far as practically possible, be via existing roads or via the construction servitude.
- Should additional access roads to the construction site/camps/equipment lay-down areas be required, these routes must be approved by the Environmental Control Officer (ECO), and the outer edge of these access route must be staked out by the contractor using brightly coloured stakes prior to the access route being used by machinery.
- All disturbed areas beyond the construction area that are intentionally or accidentally disturbed during the construction phase must be rehabilitated immediately to the satisfaction of the ECO.

7.4.5 Runoff, erosion, and sediment control

- Wherever possible, existing vegetation cover at the site should be maintained during the construction phase. The unnecessary removal of groundcover, from steep slopes in particular, must be prevented where possible.
- If heavy rains are expected, clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
- Once shaped, all exposed/bare surfaces and embankments must be re-vegetated immediately. When re-vegetating the species used needs to align with species that would be compatible with the vegetation types occurring at the site.
- If re-vegetation of exposed surfaces cannot take place immediately due to phasing issues, temporary erosion, and sediment control measures (silt fences or hay bale berms) must be installed and maintained until such a time that re-vegetation can commence.
- All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas.
- After heavy rainfall events, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and/or silt fences until vegetation has re-colonised the rehabilitated area.

7.4.6 Soil management

- Large soil stockpiles must be established outside of wetlands and at least 40m from the edge of watercourses.
- Erosion/sediment control measures, such as silt fences, must be placed around the stockpiles to limit sediment runoff from stockpiles.
- Subsoil and topsoil must be stockpiled separately. Stockpiled soil must be replaced in the reverse order as to which it was removed (subsoil first followed by topsoil).
- Stockpiles of construction materials must be clearly separated from soil stockpiles to limit any contamination of soils.
- The contractor must, as far as possible, avoid stockpiling materials in vegetated areas that will not be cleared.
- Stockpiled soils are to be kept free of weeds and are not to be compacted.
- If soil stockpiles are to be kept for more than 3 months, they must be hydroseeded.
- The slope and height of stockpiles must be limited to 1.5m and are not be sloped more than 1:2 to avoid collapse.

7.4.7 Establishment and Management of Construction Camp, Storage and Laydown Areas

- When locating the construction camp and equipment yard, watercourses and areas susceptible to soil erosion and/or water contamination must be avoided. The camp must be situated at least 100m away from the edge of the nearest watercourse.
- The camp should be established on level ground.
- The location of the camp site should be approved by the appointed Environmental Control Officer (ECO).
- Weekly servicing of the chemical toilets on site needs to be practiced by the supplier and service records are to be submitted to the ECO on a monthly basis. Toilets on site need to be kept in a clean and hygienic state.
- Contractors must ensure that no spillage occurs when chemical toilets are cleaned and that the contents are properly stored and removed off-site.

7.4.8 Hazardous substances / materials management

- The proper storage and handling of hazardous substances (e.g., fuel, oil, cement, etc.) needs to be administered.
- Mixing and/or decanting of all chemicals and hazardous substances must take place on an impermeable surface and must be protected from the ingress and egress of stormwater.
- Drip trays should be utilised at all dispensing areas.
- No refuelling, servicing or chemical storage should occur within 50m of any watercourse.
- Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period. Bund walls should be high enough to contain at least 110% of any stored volume. The surface of the bunded surface should be graded to the centre so that spillage may be collected and satisfactorily disposed of.
- An emergency spill response procedure must be formulated for the site, and staff are to be trained in spill response.
- All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.
- Drums must be kept on site to collect contaminated soil. These should be disposed of at a registered hazardous waste site.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- Vehicle maintenance should not take place on site unless a specific bunded area is constructed for such a purpose.

7.4.9 Solid waste management

- Litter generated by the construction crew must be collected in rubbish bins and disposed of at registered landfill sites.

- Adequate rubbish bins and waste disposal facilities must be available on site and at the construction camp.
- Regular clearing/maintenance of bins is required.
- The contractor must clear and completely remove all general waste, construction plant, equipment, surplus rock, and other foreign materials from the site once construction has been completed.

7.4.10 Water abstraction and use

- No water is to be abstracted from onsite watercourses for use in construction activities without prior approval by the DWS, subject to acquiring a relevant Water Use License in terms of Section 21 (a) of the National Water Act for taking water from a water resource.
- Water abstraction is to be by suction pumps connected to water carts only. Water carts are to utilise existing access roads to abstraction points and are not to encroach into "no-go" areas.
- Care is to be taken not to disturb the channel bed of watercourses during abstraction of water using suction pumps.
- Employees are not to make use of any natural water sources for the purposes of swimming, bathing, or washing of equipment, machinery, or clothes.

7.4.11 Invasive Alien Plant Control

- All alien invasive vegetation that colonise the construction site must be removed or controlled as per the NEM: BA requirements for invasive species. The contactor should consult the ECO regarding the method of removal.
- All bare surfaces across the construction site must be checked for IAPs every two weeks and IAPs removed by hand pulling/uprooting and adequately disposed. Herbicides should be utilised where hand pulling/uprooting is not possible. ONLY herbicides which have been certified safe for use in aquatic environments by independent testing authority are to be used. The ECO must be consulted in this regard.

7.4.12 Noise, dust, and light pollution minimisation

- Temporary noise pollution due to construction works should be minimized where possible.
- Water trucks will be required to suppress dust by spraying water on affected areas producing dust. This will likely be required daily and may be subject to a water use license from the DWS.

7.4.13 Rehabilitation of Accidental / Unintended Physical Disturbance

Any damage to the watercourses and the buffer zones that occurs during the construction phase must be rehabilitated immediately.

7.4.14 Construction phase monitoring measures

- The ECO must undertake regular compliance monitoring audits. Freshwater ecosystem aspects that must be monitored include:
    - The condition of the temporary runoff, erosion and sediment control measures and evidence of any failures or sediment deposits within watercourses.
    - Evidence of elevated turbidity levels.
    - Evidence of gully or bed/bank erosion.
    - Visual assessment instream water quality.
    - The condition of waste bins and the presence of litter within the working area.
    - Evidence of solid waste within the no-go areas.
    - Evidence of hazardous materials spills and soil contamination.
    - Presence of alien invasive and weedy vegetation within the working area.
    - Rehabilitation and re-vegetation success and failures.
- Once the construction and rehabilitation has been completed, the ECO should conduct a close out site audit 1 month after the completion of rehabilitation.

7.5 Operational Phase Mitigation and Management Measures

In dealing with long-term impacts to watercourses a number of operation phase mitigation measure shave been provided below.

7.5.1 Strom Water Infrastructure Management

It is the applicant's responsibility to ensure the proper functioning of the formal stormwater system in perpetuity.

To ensure that the stormwater infrastructure functions efficiently and effectively it is important the following management and monitoring mitigation measures are successfully implemented during the operational phase of the quarry:

- No dirty water emanating from the quarry shall be discharged into the natural environment or any watercourse. All runoff must be channelled into the stormwater system.
- Erosion berms installed to manage any surface flows must be checked for any damage on a weekly basis. Any damages found must be repaired timeously.
- All stormwater conveyance structures must be inspected every week for any increased sediment deposition or blockage. If a blockage has been identified, it must be cleared immediately.
- Settlement ponds must be checked every month to assess the amount of sediment collected. Sediment must be removed at a predetermined depth of sediment (to be determined by engineers) and stockpiled separately.
- After every major rainfall event, all erosion and sediment control structures or interventions will need to be inspected for damage immediately after the rains and repaired accordingly.

- Dewatering of any areas needs to be done so in a manner that does not cause erosion and does not result in silt-laden water flowing into any watercourse. Water must be pumped into the stormwater management system for treatment.

7.5.2 Erosion / Sediment Control

Erosion and sediment control will best be addressed during operation in the operational Storm Water Management Plan (SWMP) which will need to be developed for the project based on the environmental design guidelines provided in Section 7.3 of this report. In addition, where ecological monitoring (discussed under Section 7.6 of the report) identifies erosion/sediment problems requiring attention, these are to be addressed on a case-by-case basis and by following these guidelines:

- Identify eroded areas and assess whether soft or hard engineered options will be required to stabilise eroded areas such as gullies.
- Methods such as shaping of eroded areas and revegetation of bare surfaces may be considered for minor eroded areas.
- Larger eroded areas, such as large erosion gulley's, created by concentrated flows may require hardened interventions such as concrete/gabions to halt erosion and rehabilitate these areas. In these instances, a rehabilitation engineer would need to be involved in recommending and designing interventions to halt erosion.
- Sediment deposited within watercourses from eroded areas on the quarry or created by quarry runoff water should be removed sensitivity (preferably by hand clearing) and disposed of outside of wetlands where this material cannot be remobilised easily by storm water runoff/flows. Where necessary, disturbed areas will need to be revegetated using suitable indigenous vegetation.

7.5.3 Pollution prevention measures

During quarry operation, there are bound to be potential sources of liquid/chemical and solid waste and contaminate that could potentially pollute the downstream environment. It is therefore recommended that a similar suite of pollution prevention and waste management measures to those recommended under the Construction Phase Impact Mitigation Measures in Section 7.4 be implemented during quarry operation (as and where applicable).

7.5.4 Freshwater Ecosystem Rehabilitation and Management

If any freshwater ecosystems are measurably impacted by the construction and operational activities of the project, these areas will need to be rehabilitated. Such rehabilitation should be informed by a suitably qualified and experienced freshwater ecologist.

In terms of management, the landowner is encouraged to ensure that negative impacts to the watercourses within the farm property resulting from onsite activities are minimised and managed in perpetuity (while the owner).

At a minimum, long-term monitoring should involve alien invasive plant control. In line with the requirements of Section 2(2) and Section 3(2) the National Environmental Management: Biodiversity Act (NEM:BA), which obligates the landowner/developer to control IAPs on his property, all IAPs within the study area must be controlled on an on-going basis. The need for this exercise should be reviewed based on the presence of IAPs during the operational phase of the project.

7.6 Freshwater Ecosystem Monitoring

Monitoring is required to ensure that the environment associated with the proposed quarry development and operation are maintained in their current ecological state but incurring no net loss to condition and functionality because of the project. It is recommended that a suitable Ecological Monitoring Programme be developed and implemented in accordance with the following guidelines:

A. Responsibilities for Monitoring

Compliance monitoring will be the responsibility of a suitably qualified/trained ECO (Environmental Control Officer) with any additional supporting ESO's (Environmental Site Officers) having the required competency skills and experience to ensure that monitoring is undertaken effectively and appropriately.

B. Construction Monitoring Objectives

Key monitoring objectives during the construction-phase should include:

- Ensuring that management and mitigation measure are adequately implemented to limit the potential impact on aquatic resources; and
- Ensuring that disturbed areas have been adequately to stabilise and rehabilitated to minimise residual impacts to affected resources.

C. Record keeping

The ECO shall keep a record of activities occurring on site, including but not limited to:

- Meetings attended;
- Method Statements received, accepted and approved;
- Issues arising on site and cases of non-compliance with the EMPr;
- Corrective actions taken to solve problems that arise;
- Penalties/fines issued; and
- Complaints from interested and affected parties.

D. Construction Phase Monitoring Requirements

This involves the monitoring of construction related impacts as identified in this report. Regular monitoring of the construction activities is critical to ensure that problems are picked up in a timeous manner. In this regard, the following potential concerns should be taken into consideration:

- Destruction of habitat outside the construction servitude including 'No Go' areas;
- Erosion of wetland channel and banks;
- Erosion of disturbed soils and soil stockpiles by surface wash processes;

- Sedimentation of wetland habitat downstream of work areas;
- Altering the hydrology and through flows to downstream wetland habitat during construction;
- Pollution of water resource units (with a focus on hazardous substances such as fuels, oils and cement products); and
- Poorly maintained and damaged erosion control measures (e.g., sandbags, silt fences and silt curtains).

These risks can be monitored visually on-site by the ECO (together with construction staff) with relative ease and should be reported on regularly during the construction process. Any concerns noted should be prioritised for immediate corrective action and implemented as soon as possible.

E. Directly after construction (rehabilitation effectiveness)

This involves monitoring the effectiveness of rehabilitation activities. The monitoring and evaluation of rehabilitation activities and outcomes is critical in assessing the extent to which the rehabilitation has achieved what it set out to accomplish. Monitoring the condition of the re-established vegetation cover will be necessary to assess particular aftercare or plant maintenance requirements. Visual monitoring of the site must be carried out in accordance with the rehabilitation plan at regular intervals during the rehabilitation process. The benefit of regular monitoring will be that problems can be quickly identified and easily addressed during the process whilst rehabilitation teams are busy at the site.

The monitoring process must be conducted in the presence of the main contractor by a suitably qualified external/independent party, such as an Environmental Control Officer (ECO) but can also be undertaken by the Environmental Site Officer (ESO), Competent Authority and Interested and Affected Parties (I&APs). Should any defects or failures be identified during each monitoring exercise, the main contractor must take all necessary and relevant actions address these immediately and accordingly. The recovery of disturbed areas that have been rehabilitated should be assessed for at least the first 3 months following rehabilitation completion to assess the success of rehabilitation actions. Any areas that are not progressing satisfactorily must be identified (e.g., on a map) and action must be taken to actively re-vegetate these areas. If natural recovery is progressing well, no further intervention may be required. The ECO should assess the need / desirability for further monitoring and control after the first 6 months and include any recommendations for further action to the relevant environmental authority. Table 23 (below) provides a basic monitoring framework and checklist of aspects of the rehabilitation plan to be monitored.

Table 23. Description of basic visual monitoring requirements to assess the success of riparian areas rehabilitated.

Aspect	Description	Frequency of monitoring
Solid waste and construction rubble	Has all solid waste, litter and construction rubble been adequately cleared from the site and disposed of at a registered site?	Weekly
Salvaged indigenous species	Are salvaged indigenous species being watered twice a week? Are there any mortalities?	Bi-weekly

Aspect	Description	Frequency of monitoring
Watering/maintenance requirements of planted grass, trees and shrubs	What is the plant survival rate? Are there areas of bare soil/poor growth? Is there a need for follow-up revegetation?	Daily until plants are established, thereafter weekly
Response of planted grass, trees and shrubs	What is the progress of revegetation planting? Are there areas of bare soil/poor growth?	Bi-weekly
Alien plant control and eradication (including follow-up control	Are there dense infestations of alien plants within and around the rehabilitated site? (Seedlings, shoots, coppice growth, etc.) Is there a need for further follow-up control?	Weekly during and immediately after rehab, thereafter on a monthly basis
Sediment barriers/traps and erosion control measures	Are sediment/erosion controls functioning adequately? Have these been properly maintained? Are there signs of erosion/sedimentation?	Daily during rehabilitation

At the completion of site rehabilitation, an evaluation of the success of the rehabilitation project will need to be undertaken in order to facilitate the dissemination of lessons learnt and provide a means of reporting on the success of specific rehabilitation initiatives. In order to evaluate project success, the following attributes/rehabilitation indicators need to be clearly defined and understood:

i. Aspects/values of interest referred to herewith as 'concerns';

ii. Level of achievement required to consider the rehabilitation exercise successful; and

iii. Quantitative performance level used as a desirable target.

Table 24, below, provides for basic rehabilitation evaluation guidelines useful for evaluating the success of the rehabilitation project. The evaluation process can be conducted by the developer, Competent Authority, I&APs or an independent ECO after a period of 3-6 months post-completion of the rehabilitation process. An external audit report on performance should ideally be provided as part of the rehabilitation project success evaluation process.

Table 24. Summary guideline for evaluating the success of rehabilitation.

Item	Concern	Performance indicator	Desired Target
1	There should be low levels of Invasive Alien Plants	IAP species cover/abundance	<10% IAP cover
2	Indigenous vegetation should be re-instated	Indigenous species cover/abundance	>80% indigenous cover
3	Erosion and slope instability should be managed appropriately	Signs of soil erosion and slope/bank instability	No signs of erosion
4	Riparian areas should be adequately re-planted	Indigenous tree/shrub cover/abundance	No large gaps in the vegetation structure or bare soils
5	Sedimentation of water resources must be limited	Signs of sedimentation in downstream channel	No signs of major sedimentation/turbidity in water column
6	There should be no foreign solid waste materials or waste within rehabilitated areas	Solid waste/litter levels	No solid waste remaining

F. Operation phase monitoring requirements

This involves annual monitoring of watercourse units (rivers/streams) affected by the development in order to ensure that operational impacts are being effectively managed. This can also be achieved through basic visual inspections by the ECO and support staff, documenting issues such as:

- Invasive Alien Plant infestation;
- Scouring and deposition associated with storm water runoff;
- Development of erosion 'headcuts';
- Channel incision downstream of development;
- Blockage/siltation of culvert infrastructure;
- Scouring around infrastructure at river/stream crossings; and
- Erosion or instability of road embankments.

8. LICENSING AND PERMIT REQUIREMENTS

8.1 Water Use License Requirements

Section 21 of the National Water Act (No 36 of 1998) lists certain activities for which water use must be licensed, unless its use is excluded. There are several reasons why water users are required to register and license their water use with the Department of Water and Sanitation (DWS), the most important being: (i) to manage and control water resources for planning and development; (ii) to protect water resources against over-use, damage and impacts; and (iii) to ensure fair allocation of water among users.

The specialist wetland assessment undertaken, and the resulting specialist report (this document) has been compiled in support of the Water Use License (WUL) application process being undertaken by the Applicant in consultation with the Department of Water and Sanitation.

Depending on its nature, a range of water uses as specified in terms of Chapter 4, Section 21 of the National Water Act No. 36 of 1998 could potentially be triggered by the quarry and stockpiling site and would then require a Water Use License (WUL) from the DWS. Triggered water use activities are subject to interpretation by the DWS and therefore clarity must be sought from the DWS prior to applying for a WUL. The water uses described in Table 25 (below) have been identified as being associated with the proposed retirement village development.

Table 25. Section 21 'water uses' associated the proposed mining and stockpiling site

<table>
<tr><th>NWA Section 21 Water Use</th><th>Development activity constituting the water use</th></tr>
<tr><td>Section 21 (c): Impeding or diverting the flow of water in a water course</td><td rowspan="2">• Quarry open-cast mining operation (blasting and excavation) expansion and associated infrastructure within 500m of a wetland.
• Stockpiling area (crushing, screening, stockpiling and transporting) and associated infrastructure within 500m of a wetland.
• Pollution Control Dam within 500m of a wetland</td></tr>
<tr><td>Section 21 (i): Altering the bed, banks, course or characteristics of a water course</td></tr>
</table>

NWA Section 21 Water Use	Development activity constituting the water use
	• Access road within 500m of a wetland
Section 21 (g): Disposing of waste in a manner which may detrimentally impact on a water resource.	• Pollution control dam

Given that the above water uses have been identified and apply to the development project, the project will need to be licenced according to Chapter 4 and Section 21 of the National Water Act (No. 36 of 1998). It is envisaged that a full WULA is required, and a GA is not applicable to the development based on the range of potential water uses identified, and 'moderate' risk rating provided for c & i water uses.

8.2 National Environmental Management Act (No. 107 of 1998) ('NEMA')

No listed activities related to impacts to freshwater ecosystems / watercourses will be triggered.

9. CONCLUSION

The findings of the Specialist Wetland Assessment undertaken by Eco-Pulse Consulting in January/February 2023 are contained in this report and revealed that two wetland units a channelled valley bottom (W01) and a seep (W02) stands to be potentially impacted by the planned quarry and stockpiling site near Ladysmith, Alfred Duma Municipal, KZN.

The main findings of the wetland assessment indicate that the proposed quarry development and stockpiling area indicates that there no wetlands or watercourses identified within the property boundaries, with the nearest wetland located approx. 166m downslope of the mining permit area and 116m of the stockpiling area from the southern property boundaries. Wetlands were found to be in a 'moderately modified' (W01 - 'C' PES Class and 'moderate' EIS) and 'largely natural' state/condition (W02 - 'B' PES Class and 'moderately low' EIS). Future management of the wetland ecosystems associated with the study area should be to *maintain the current status quo of aquatic ecosystems without any further loss of integrity/functioning (PES/EIS)*. This is also supported by Ezemvelo KZN Wildlife (EKZNW) whose guiding principle with regards to biodiversity conservation and sustainable development is one of no net loss of biodiversity and ecosystem processes.

All wetlands will be avoided through appropriate layout planning and design that considers wetland buffer zones recommended by Eco-Pulse. Through appropriate design, planning and impact mitigation/management that includes onsite storm water and erosion/pollution controls and ecological monitoring recommendations, impacts can be potentially reduced to acceptably 'low' impact significance levels. This should be sufficiently low to protect the freshwater environment from further deterioration and can then be considered to be generally acceptable as no loss of critical resources, habitats, services or threatened/endangered species is likely to be associated with the quarry and stockpiling development project.

The proposed development can be considered acceptable from an ecological perspective based on the provision that the various mitigation measures proposed in this report are strictly adhered to during the various phases of the quarry and stockpiling development project. It therefore recommended that the relevant sections of this report which deal with 'Impact Mitigation/Management' be referenced in the Environmental Authorisation (EA) and Water Use License (WUL) for this project as a specific condition of the EA/WUL.

The operational quarry and stockpiling area will also require a full Water Use License as the risk of altering the characteristics of downstream watercourses may be deemed 'Moderate' (even with appropriate mitigation) according to the DWS Risk Matrix/Assessment method applied to the project.

Should you have any queries regarding the findings and recommendations in this Specialist Wetland Impact Assessment report, please contact Eco-Pulse Consulting directly.

Yours sincerely

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11. ANNEXURES

ANNEXURE A: Detailed Assessment Methods.

A1 Wetland areas delineation

A GPS (Global Positioning System) was used to capture the location of sampling points used to inform the delineation while additional information on plant and soil indicators were also captured.

Wetland delineation

Onsite delineation efforts were informed by the flagging process as a first step but were limited in some instances on the ground based on accessibility. The following principles were applied based on-site accessibility with the proposed road alignment:

- **Within easily accessible areas**, most watercourses within the road reserve were delineated in the field, with limited extrapolation using aerial photography.
- **In moderately accessible areas**, field work will be limited to a selection of watercourses along the route that can be accessed within the time-frames allocated for field work. Where sites cannot be accessed, delineation will be based on desktop information, informed by an understanding of wetland indicators for that area or region.
- **In highly inaccessible areas** that cannot be practically accessed, delineation will be undertaken at a desktop level.

The watercourses were identified and delineated according to the **Department of Water Affairs wetland delineation manual '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas'*** *(*DWAF, 2005a). Three specific indicators were used in the detailed field delineation, which include:

➢ **Terrain unit indicator**

A practical index used for identifying those parts of the landscape where wetlands are likely to occur based on the general topography of the area (Figure 11).

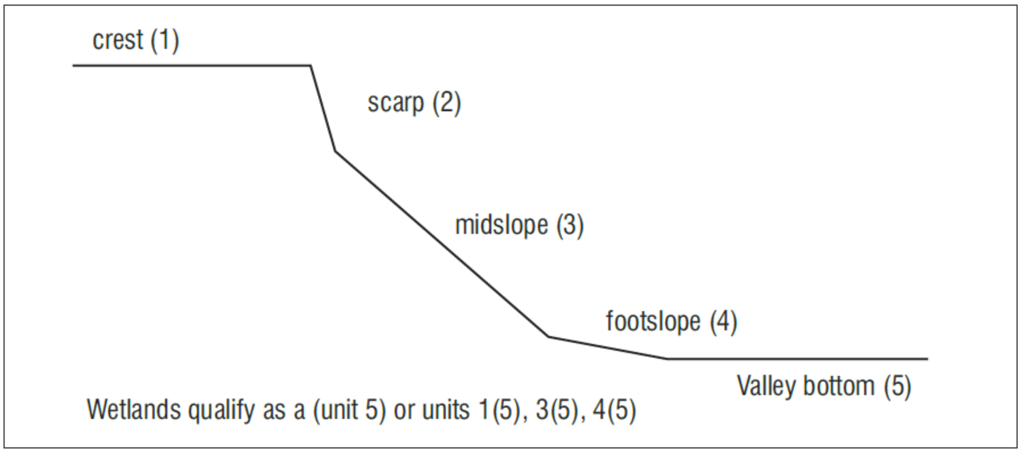


Figure 11 Diagram representing the different terrain units (DWAF, 2005a).

➢ **Wetland vegetation indicator**

Vegetation in an untransformed state is a useful guide in finding the boundary of a wetland as plant communities generally undergo distinct changes in species composition as one proceeds along the wetness gradient from the centre of a wetland towards adjacent terrestrial areas. An example of criteria used to classify wetland vegetation and inform the delineation of wetland zones is provided in Table 26.

Table 26. Criteria used to inform the delineation of wetland habitat based on wetland vegetation (adapted from Macfarlane et al., 2007 and DWAF, 2005a).

Vegetation	Temporary wetness zone	Seasonal wetness zone	Permanent wetness zone
Herbaceous	Mixture of non-wetland species and hydrophilic plant species restricted to wetland areas	Hydrophilic sedges and grasses restricted to wetland areas	Emergent plants including reeds and bulrushes; floating or submerged aquatic plants
Woody	Mixture of non-wetland and hydrophilic species restricted to wetland areas	Hydrophilic woody species restricted to wetland areas	Hydrophilic woody species restricted to wetland areas with morphological adaptations to prolonged wetness (e.g.: prop roots)
SYMBOL	**HYDRIC STATUS**	**DESCRIPTION/OCCURRENCE**	
ow	Obligate wetland species	Almost always grow in wetlands (>90% occurrence)	
fw	Facultative wetland species	Usually grow in wetlands (67-99% occurrence) but occasionally found in non-wetland areas	
f	Facultative species	Equally likely to grow in wetlands (34-66% occurrence) and non-wetland areas	
fd	Facultative dry-land species	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34% occurrence)	
d	Dryland species	Almost always grow in drylands	

➢ **Soil wetness indicator**

According to the wetland definition used in the National Water Act (NWA, 1998), vegetation is the primary indicator which must be present under normal circumstances. However, in practice the soil wetness indicator (informed by investigating the top 50cm of wetland topsoil) tends to be the most important, and the other three indicators are used to refine the assessment. The reason for this is that vegetation responds relatively quickly to changes in soil moisture and may be transformed by local impacts; whereas the soil morphological indicators are far more permanent and will retain the signs of frequent saturation (wetland conditions) long after a wetland has been transformed/drained (DWAF, 2005a). Thus, the on-site assessment of wetland indicators focused largely on using soil wetness indicators, determined through soil sampling with a soil auger, with vegetation and topography being a secondary indicator. A Munsell Soil Colour Chart was used to ascertain soil colour values including hue, colour value and matrix chroma as well as degree of mottling in order to inform the identification of wetland (hydric) soils. Soil sampling points were recorded using a GPS (Global Positioning System) and captured using Geographical Information Systems (GIS) for further processing. An example of soil criteria used to assess the presence of wetland soils is provided below in Table 27 while Figure 12 provides a conceptual overview of soil and vegetation characteristics across the different wetness zones.

Table 27. Soil criteria used to inform wetland delineation using soil wetness as an indicator (after DWAF, 2005a).

Soil depth	Temporary wetness zone	Seasonal wetness zone	Permanent wetness zone
0 – 10cm	**Matrix chroma**: 1- 3 (Grey matrix <10%) **Mottles**: Few/None high chroma mottles **Organic Matter**: Low **Sulphidic**: No	**Matrix chroma**: 0- 2 (Grey matrix >10%) **Mottles**: Many low chroma mottles **Organic Matter**: Medium **Sulphidic**: Seldom	**Matrix chroma**: 0- 1 (Prominent grey matrix) **Mottles**: Few/None high chroma mottles **Organic Matter**: High **Sulphidic**: Often
30 – 50cm	**Matrix chroma**: 0 – 2 **Mottles**: Few/Many	As Above	As Above

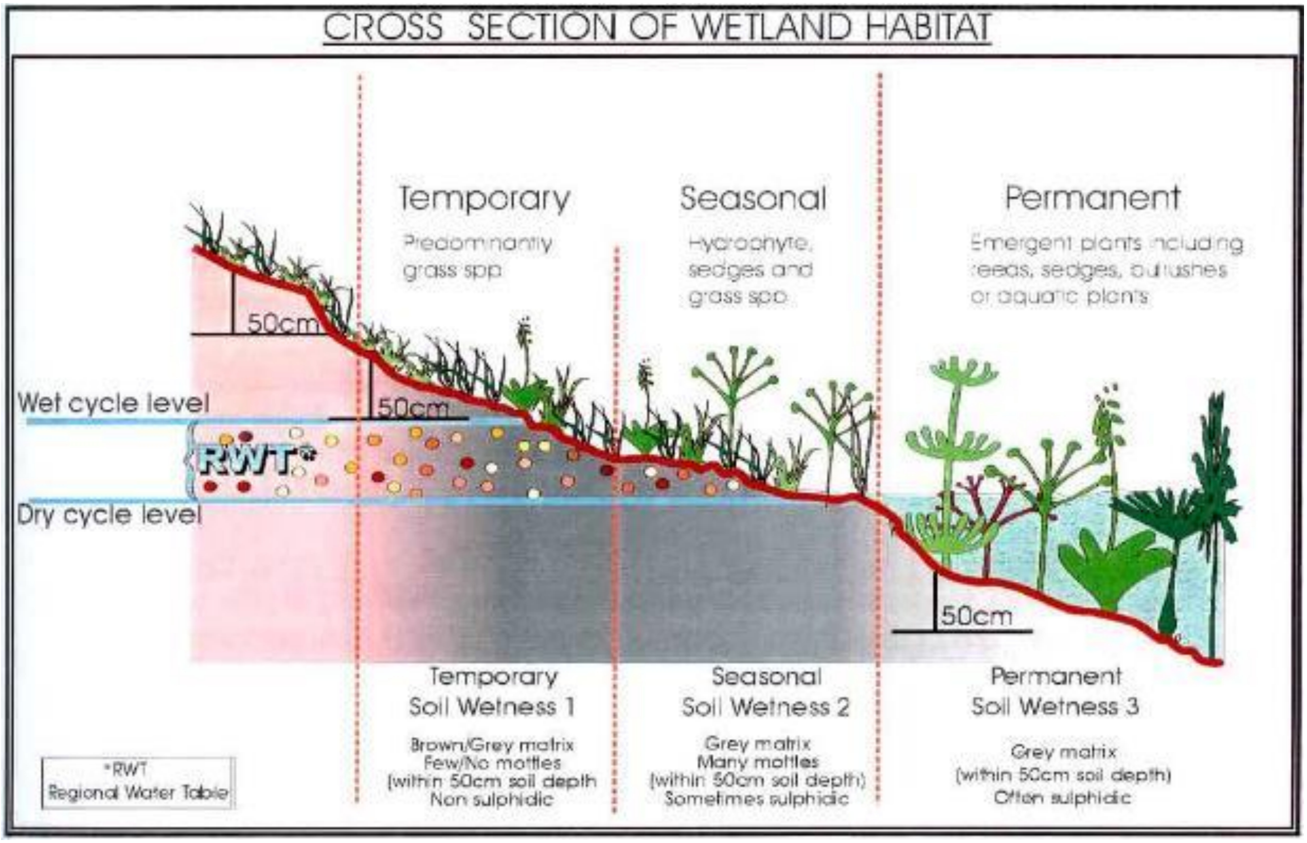


Figure 12 Diagram representing the different zones of wetness found within a wetland (DWAF, 2005a).

A2 Classification of wetlands

For the purposes of this study, wetlands were classified according to HGM (hydro geomorphic) type (Level 4A classification level) using the National Wetland Classification System which was developed for the South African National Biodiversity Institute (SANBI, 2009) as outlined in Table 28, below.

Table 28. Wetland classification (after SANBI, 2009).

LEVEL 3	LEVEL 4A	
Landscape Setting	**HGM Type**	**Description**
SLOPE	Channel (river)	*Areas of channelled flow including rivers and streams where water is largely confined to a main channel during low flows. Flood waters may over top the banks of the channel and spread onto an adjacent floodplain*
	Hillslope seep	*Wetlands on slopes formed mainly by the discharge of sub-surface water.*
VALLEY FLOOR	Channel (river)	*River channels in a valley floor setting.*
	Channelled valley-bottom wetland	*Valley floors with one or more well-defined stream channels, but lacking characteristic floodplain features.*
	Unchanneled valley-bottom wetland	*Valley floors with no clearly defined stream channel.*
	Floodplain wetland	*Valley floors with a well-defined stream channel, gently sloped and characterised by floodplain features such as oxbows and natural levees.*
	Depression	*Basin-shaped areas that allow for the accumulation of surface water, an outlet may be absent (e.g. pans).*
	Valleyhead seep	*Seeps located at the head of a valley, often the source of streams.*
PLAIN	Channel (river)	*River channels in a plain landscape setting.*
	Floodplain wetland	*Floodplain wetlands as above but in a plain landscape setting.*
	Unchanneled valley-bottom wetland	*Unchanneled valley bottom type wetlands as above but in a plain landscape setting.*
	Depression	*Depression type wetlands as above but in a plain landscape setting.*
	Flat	*Extensive areas characterised by level, gently undulating or uniformly sloping land with a very gentle gradient.*
BENCH (HILLTOP / SADDLE / SHELF)	Depression	*Depression wetlands located on a bench.*
	Flat	*Flat wetlands located on a bench.*

A3 Present Ecological State (PES) of wetlands

Whilst a detailed assessment of wetland condition and EIS using tools such as WET-Health (Macfarlane *et al.*, 2020) and WET-Ecoservices (Kotze *et.al.*, 2021) would be ideal, these tools are too cumbersome for an assessment of this nature where numerous small wetlands, with typically small catchments and similar characteristics need to be assessed. The following streamlined approach will therefore be applied to assess wetlands along the route:

WET-Health Assessment (Wetland Integrity/Present Ecological State)

This was based on the principles contained in the WET-Health (Macfarlane *et al*, 2020) but informed by expert judgment rather than the collection of detailed quantitative data. This involved:

- Investigating broad land-use in the wetlands catchment and assigning a “catchment alteration score” reflecting anticipated changes to water and sediment inputs to the system;
- Identifying and subjectively rating within-wetland impacts such as those associated with dams, erosion, agriculture and infrastructure on wetland **vegetation, hydrology** and **geomorphology**;
- Assigning a PES score based on joint consideration of catchment and within-wetland impacts for each component of wetland health.

- Calculating an overall combined PES score (as per WET-Health calculation below) and assigning an overall PES category for each wetland system (Table 29).

Calculating an overall combined PES score (as per WET-Health calculation below) and assigning an overall PES category for each wetland system (Table 29).

Table 29. Guideline for interpreting the magnitude of impacts on wetland integrity (after Macfarlane et al., 2020).

IMPACT CATEGORY	DESCRIPTION	IMPACT SCORE RANGE
None	No discernible modification or the modification is such that it has no impact on wetland integrity.	0-0.9
Small	Although identifiable, the impact of this modification on wetland integrity is small.	1-1.9
Moderate	The impact of this modification on wetland integrity is clearly identifiable, but limited.	2-3.9
Large	The modification has a clearly detrimental impact on wetland integrity. Approximately 50% of wetland integrity has been lost.	4-5.9
Serious	The modification has a clearly adverse effect on this component of habitat integrity. Well in excess of 50% of the wetland integrity has been lost.	6-7.9
Critical	The modification is present in such a way that the ecosystem processes of this component of wetland health are totally / almost totally destroyed.	8-10

Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table 30, below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic systems.

Table 30. Health categories used by WET-Health for describing the integrity of wetlands (after Macfarlane et al., 2020)

ECOLOGICAL CATEGORY	DESCRIPTION	IMPACT SCORE*	PES SCORE (%)*
A	Unmodified, natural.	0 - 0.9	90 - 100
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 - 1.9	80 - 89
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 - 3.9	60 - 79
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 - 5.9	40 - 59
E	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 - 7.9	20 - 39
F	Critically modified. Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	0 - 19

An overall wetland health score was calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula:

Overall health rating = [(Hydrology*3) + (Geomorphology*2) + (Vegetation*2)] / 7

This overall score assists in providing an overall indication of wetland health/functionality which can in turn be used for recommending appropriate management measures.

It should be noted that while WET-Health is the most appropriate technique currently available to undertake assessments of this nature, it is nonetheless a rapid assessment tool that relies on qualitative information and expert judgment. While the tool has been subjected to an initial peer review process, the methodology is still being tested and will be refined in subsequent versions. *WET-Health datasheets will be made available to the client on request.*

A4 Ecological Importance & Sensitivity (EIS) for wetlands

This was based on the principles of WET-Ecoservices (Kotze *et.al.*, 2020) and the EIS (Ecological Importance and Sensitivity) assessment tools (Rountree, *in prep*). The EIS assessment of wetland resources will involve subjectively assessing ecological importance and hydrological / functional importance and importance (Table 31) using available desktop information and field data through a simplified process as detailed below:

- The **Ecological importance (EI)** of each wetland was assessed by considering (i) the threat status of the wetland based on the wetland vegetation group in which the wetland is located and (ii) the present ecological state of the wetland.
- **Hydrological / Functional importance (HI)** was based on (i) typical levels of services provided by different wetland types (Kotze *et al.*, 2020), (ii) the anticipated demand for hydrological services (e.g. flood attenuation & water quality enhancement) based on the location of the wetlands relative to upstream impacts and downstream beneficiaries and (iii) the size of the wetland (larger wetlands are likely to be more important than small wetlands at providing these services.

Table 31. Descriptions of common wetland ecosystem goods and services (after Kotze et al., 2021).

	ECOSYSTEM SERVICE	Description
Hydrological/functional importance	Flood Attenuation	*Refers to the effectiveness of wetlands at spreading out and slowing down storm flows and thereby reducing the severity of floods and associated impacts.*
	Stream Flow Regulation	*Refers to the effectiveness of wetlands in sustaining flows in downstream areas during low-flow periods.*
	Sediment Trapping	*Refers to the effectiveness of wetlands in trapping and retaining sediments from sources in the catchment.*
	Nutrient & Toxicant Retention and Removal	*Refers to the effectiveness of wetlands in retaining, removing or destroying nutrients and toxicants such as nitrates, phosphates, salts, biocides and bacteria from inflowing sources, essentially providing a water purification benefit.*
	Erosion Control	*Refers to the effectiveness of wetlands in controlling the loss of soil through erosion.*
	Carbon Storage	*Refers to the ability of wetlands to act as carbon sinks by actively trapping and retaining carbon as soil organic matter.*
Ecological importance	Biodiversity Maintenance	*Refers to the contribution of wetlands to maintaining biodiversity through providing natural habitat and maintaining natural ecological processes.*

The level of predicted importance of ecosystem services provided by wetlands was rated according to the rating table found in Table 32, below. This was informed by wetland characteristics that affect the ability of wetlands to supply benefits and local and catchment context that affects the demand placed on wetlands to provide goods and services.

Table 32. Rating table used to rate importance of different ecosystem services.

Score	Rating	Importance or level of supply of ecosystem services
<1	**Low**	The wetland is not considered to be important for providing this service/benefit.
1-1.8	**Moderately-Low**	The importance of the wetland in providing ecosystem goods and services is regarded as moderately low.
1.8 – 2.8	**Moderate**	The wetland is considered important for providing this particular ecosystem service to a moderate degree.
2.8 – 3.4	**Moderate-High**	The wetland is considered important for providing this particular ecosystem service to a high degree.
>3.4	**High**	The wetland is considered very important for providing this particular ecosystem service to a high degree.

The final EIS was then determined based on the maximum score obtained for each of the different values assessed.

ANNEXURE B: Wetland delineation field assessment details

GENERAL	Project Reference:	**Proposed Mining Permit Application and Stockpile Area**	
	Date of Field Assessment:	January 2023	
	Weather Conditions:	Sunny | Cloudy	
	Area of wetland:	Combined area ~39.59ha	
	Site Disturbance:	Historic Soil disturbance, erosion and alien vegetation	
	Wetland Indicators Present:	☒ Terrain unit indicator ☒ Soil type Indicator	☒ Soil wetness indicator ☐ Vegetation indicator
	Difficulties Encountered	Increased saturation levels due to stormwater inputs	
WETLAND CLASSIFICATION	Landscape setting (Level 3)	☒ slope ☐ plain	☒ valley floor ☐ bench
	Hydrogeomorphic type (Level 4A)	☒ Channelled valley bottom ☐ Unchannelled valley bottom ☒ Hillslope seep ☐ Valley head seep ☐ Artificial	☐ Floodplain ☐ Channel ☐ Depression ☐ Flat
	Landform (Level 4B)	Seep and Channelled valley bottom wetland	
	Drainage (Level 4C&D)	**Outflow:** un-channelled and channelled	**Inflow:** diffuse, seepage

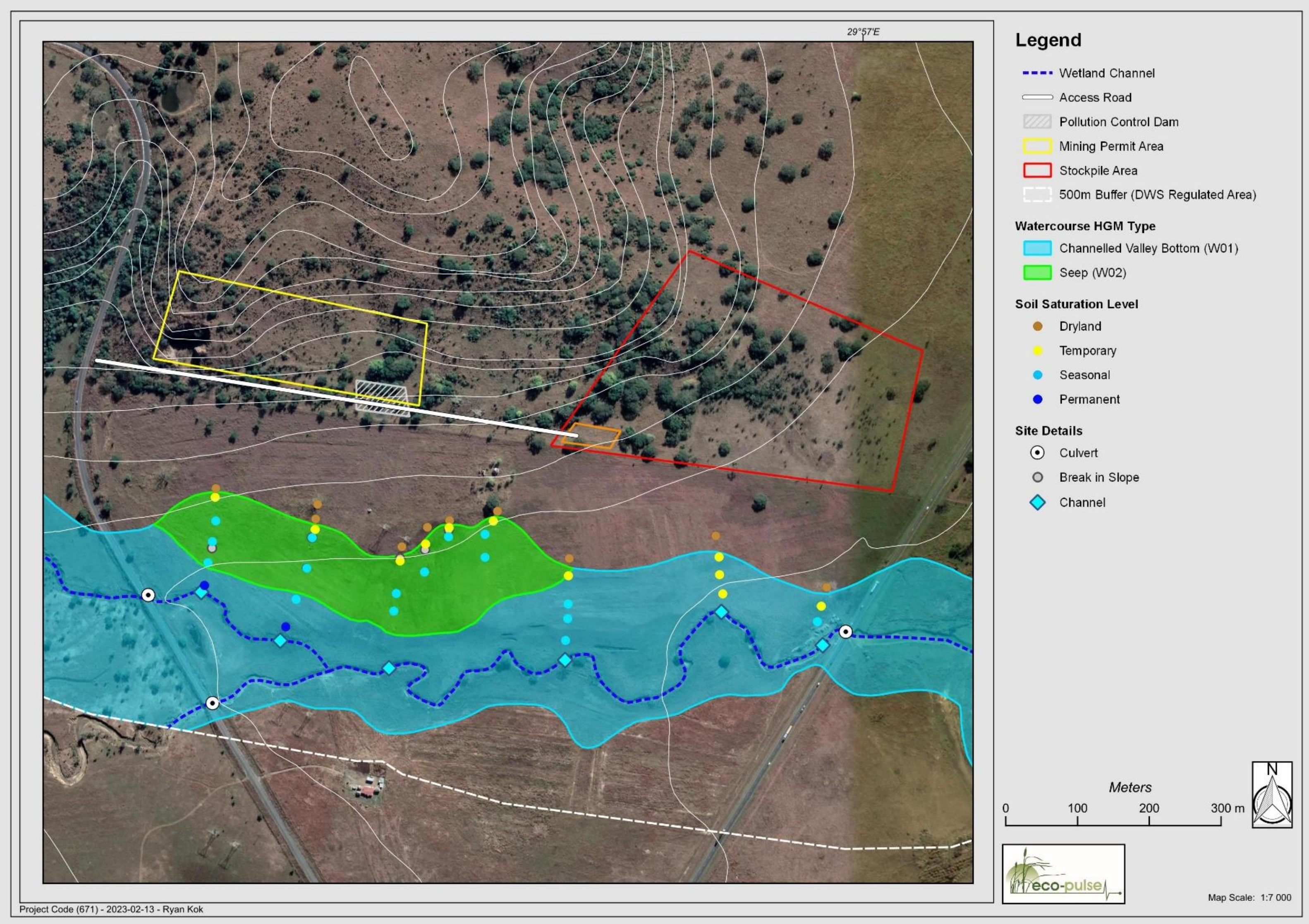
WETLAND CLASSIFICATION	Rating scale	0 = absent (0%) 1 = rare (>0% – 10%)	2 = sparse (>10% – 35%) 3 = common (>35% – 75%)	4 = abundant (>75% < 100) 5 = entire (100%)

Hydrological regime (Level 5)		**Inundation periodicity**		**Saturation periodicity**		**Inundation depth class**
	2	Permanently inundated	4	Not applicable	4	Not applicable
	4	Seasonally inundated	2	Permanently saturated	0	Limnetic (>2m depth)
	2	Intermittently inundated	3	Seasonally saturated	1	Littoral (<2m depth)
	4	Never inundated	3	Intermittently saturated		
		Unknown		Unknown		

Terrain Unit Indicator:	Terrain unit	☐ crest ☐ scarp ☒ midslope ☐ footslope ☒ valley bottom

Soil Wetness Indicator:	General Soil Type	☒ Mineral Soil ☐ Organic Soil	☒ High clay content ☒ High sand content ☐ High silt content		
	Soil Sample Type	Terrestrial /non-wetland soil type	Temporary wetland soil type	Seasonal wetland soil type	Permanent wetland soil type
	Sample Depth	0 - 50cm	30 - 50cm	10 - 40cm	0 – 20cm
	Hue | Value | Chroma	7.5YR | 3 | 1 - 2	10YR | 3 | 1	10YR | 4 | 1 - 2	10YR | 4 - 5 | 1 - 2
	Mottling	No mottles	Few orange mottles	Abundant orange mottles	No mottles
	Organic Matter (estimated)	Very Low/Negligible	Low	Low-Moderate	Low
	Description	Dark brown medium loam, low cohesion	Dark Gray Brown clay loam	Dark gray sandy clay loam	Deep gray clay loam
	Sample Photo				
	Sample location	Terrestrial areas on the periphery of the wetland boundary	Generally broad area, between seasonal wetland and the terrestrial environment, with dark gray brown clay loam soils	Generally narrow zone, comprising seasonally saturated dark gray clay loam soils	Generally narrow zone, comprising permanent saturated light gray clay loam soils

ANNEXURE C: Map showing the location of GPS sampling points used to inform the wetland delineation.



ANNEXURE D: Impact Significance Assessment Summary Sheets.

Construction Phase Impact Significance Assessment

Realistic 'Poor' (standard) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
C1	Direct physical loss or modification of freshwater habitat	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Long-term	Unlikely	Low	Medium
C2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-High	Local	Medium-term	Highly Probable	Moderate	Medium
C3	Impacts to water quality	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-High	Local	Long-term	Probable	Moderate	Medium
C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderate	Surrounding Area	Long-term	Probable	Moderately-Low	Medium

Realistic 'Good' (best-practical) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
C1	Direct physical loss or modification of freshwater habitat	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Site	Short-term	Unlikely	Low	Medium
C2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-High	Surrounding Area	Short-term	Probable	Moderately-Low	Medium
C3	Impacts to water quality	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-High	Surrounding Area	Short-term	Possible	Low	Medium
C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderate	Surrounding Area	Short-term	Probable	Low	Medium

Operational Phase Impact Significance Assessment

Realistic 'Poor' (standard) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
O1	Direct physical loss or modification of freshwater habitat	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Long-term	Unlikely	Low	Medium
O2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-High	Local	Long-term	Highly Probable	Moderate	Medium
O3	Impacts to water quality	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-High	Local	Long-term	Probable	Moderate	Medium
O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Long-term	Possible	Low	Medium

Realistic 'Good' (best-practical) Mitigation Scenario

No.	Impact Type	Status	Ultimate Ecological Consequences: Impact Intensity Ratings				Intensity	Extent	Duration	Probability	Significance	Confidence
			Water resource management	Ecosystem Conservation	Species Conservation	Direct Use Values						
O1	Direct physical loss or modification of freshwater habitat	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Site	Long-term	Unlikely	Low	Medium
O2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-High	Surrounding Area	Long-term	Probable	Moderately-Low	Medium
O3	Impacts to water quality	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-High	Surrounding Area	Long-term	Probable	Moderately-Low	Medium
O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Moderately-Low	Surrounding Area	Long-term	Possible	Low	Medium

ANNEXURE E: Aquatic Risk Assessment Summary Sheet.

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and i Water Use Risk Assessment Protocol)

Project Name:	Proposed Mining Permit Application and Stockpile Area On The Remaining Extent of Elands Spruit No 5523, Alfred Duma Municipal, Kwazulu-Natal		
Date:	04/03/2022		
Name of Assessor:	Ryan Kok (Pr.Sci.Nat.)	**SACNASP Registration No(s).**	122290

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

Phase(s)	Activity	Aspect	Impact	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence Level	Control measures	Revised Risk Rating	Borderline LOW / MODERATE Rating Classes	PES & EIS of Affected Watercourse
Construction	Access road to the quarry site	**1.1 Site clearing of terrestrial vegetation and disturbance of soil within catchment area of wetlands, stripping and stockpiling.**	Clearing of vegetation, disturbance of soils and habitat.	1	2	3	1	1,75	1	1	3,75	1	5	5	1	12	45	Low	90	Management of site activities, site demarcation and access control, limiting the extent of the development footprint.	45	Low	W01 - 'C' PES, 'Moderate' EIS; W02 - 'B' PES, 'Moderately Low' EIS

Phase(s)	Activity	Aspect	Impact	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence Level	Control measures	Revised Risk Rating	Borderline LOW / MODERATE Rating Classes	PES & EIS of Affected Watercourse
	Development of the quarry and stockpile area for aggregate	**2.1 Construction of the property boundary & main site camp**	Disturbance of soil, sedimentation of downslope watercourses	1	1	1	1	**1**	1	1	**3**	1	1	5	2	**9**	**27**	Low	90	Maintaining adequate buffer zones (development setbacks), restricting access to watercourses.	27	Low	W01 - 'C' PES, 'Moderate' EIS; W02 - 'B' PES, 'Moderately Low' EIS
		2.2 Stripping and stockpiling of vegetation and topsoil	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface flow patterns - increased runoff	2	1	2	1	**1,5**	2	2	**5,5**	1	1	5	2	**9**	**49,5**	Low	80	Maintaining adequate buffer zones (development setbacks), restricting access to watercourses, soil stabilisation and revegetation of disturbed terrestrial areas.	49,5	Low	
		2.3 Blasting & development of platforms and supporting infrastructure	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface flow patterns - increased runoff	2	3	2	1	**2**	2	2	**6**	2	3	5	2	**12**	**72**	Moderate	70	Maintaining adequate buffer zones (development setbacks), restricting access to watercourses, soil stabilisation and revegetation of disturbed terrestrial areas.	47	Low	

Phase(s)	Activity	Aspect	Impact	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence Level	Control measures	Revised Risk Rating	Borderline LOW / MODERATE Rating Classes	PES & EIS of Affected Watercourse
		2.4 Construction of stormwater management infrastructure, pollution control dam, office & sediment management, and hazardous substances handling and storage	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface flow patterns - increased runoff	3	3	2	1	**2,25**	2	2	**6,25**	1	3	5	2	**11**	**68,75**	**Moderate**	70	Design and implementation of storm water management plan and associated infrastructure according to best-practice storm water management guidelines.	43,8	**Low**	
		2.5 Construction of internal access road	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface flow patterns - increased runoff	2	2	2	1	**1,75**	1	2	**4,75**	1	2	5	2	**10**	**47,5**	**Low**	70	Maintaining adequate aquatic buffer zones (development setbacks), restricting access to watercourses, soil stabilisation and revegetation of disturbed terrestrial areas, sediment and pollution control BMPs.	47,5	**Low**	

Phase(s)	Activity	Aspect	Impact	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence Level	Control measures	Revised Risk Rating	Borderline LOW / MODERATE Rating Classes	PES & EIS of Affected Watercourse
Operation	Operation of the quarry for aggregate, stockpiling and access roads	**3.1 Blasting, excavation, stockpiling, crushing and haulage of aggregate**	Disturbance of soil, sedimentation of downslope watercourses, alteration of natural surface and subsurface flow patterns.	3	4	3	2	**3**	2	3	**8**	4	4	5	3	**16**	**128**	**Moderate**	70	Maintaining adequate buffer zones, restricting access to sensitive areas, storm water, erosion/sediment and pollution control dam.	103	**Moderate**	W01 - 'C' PES, 'Moderate' EIS; W02 - 'B' PES, 'Moderately Low' EIS
		3.2 Management of stormwater runoff and concentrated flows	Increased erosion and sedimentation risks, alteration of natural surface flow patterns.	4	3	3	1	**2,75**	2	3	**7,75**	5	4	5	2	**16**	**124**	**Moderate**	80	Design and implementation of storm water management plan and associated infrastructure according to best-practice storm water management guidelines. Regular monitoring and maintenance of storm water infrastructure.	99	**Moderate**	
		3.3 Operational impact of access roads impeding flows	Flow impedance, increased runoff, erosion and sedimentation risks.	2	1	2	1	**1,5**	1	3	**5,5**	4	4	5	3	**16**	**88**	**Moderate**	70	Maintaining adequate buffer zones, restricting access to sensitive areas, storm water, erosion/sediment and pollution control.	63	**Moderate**	