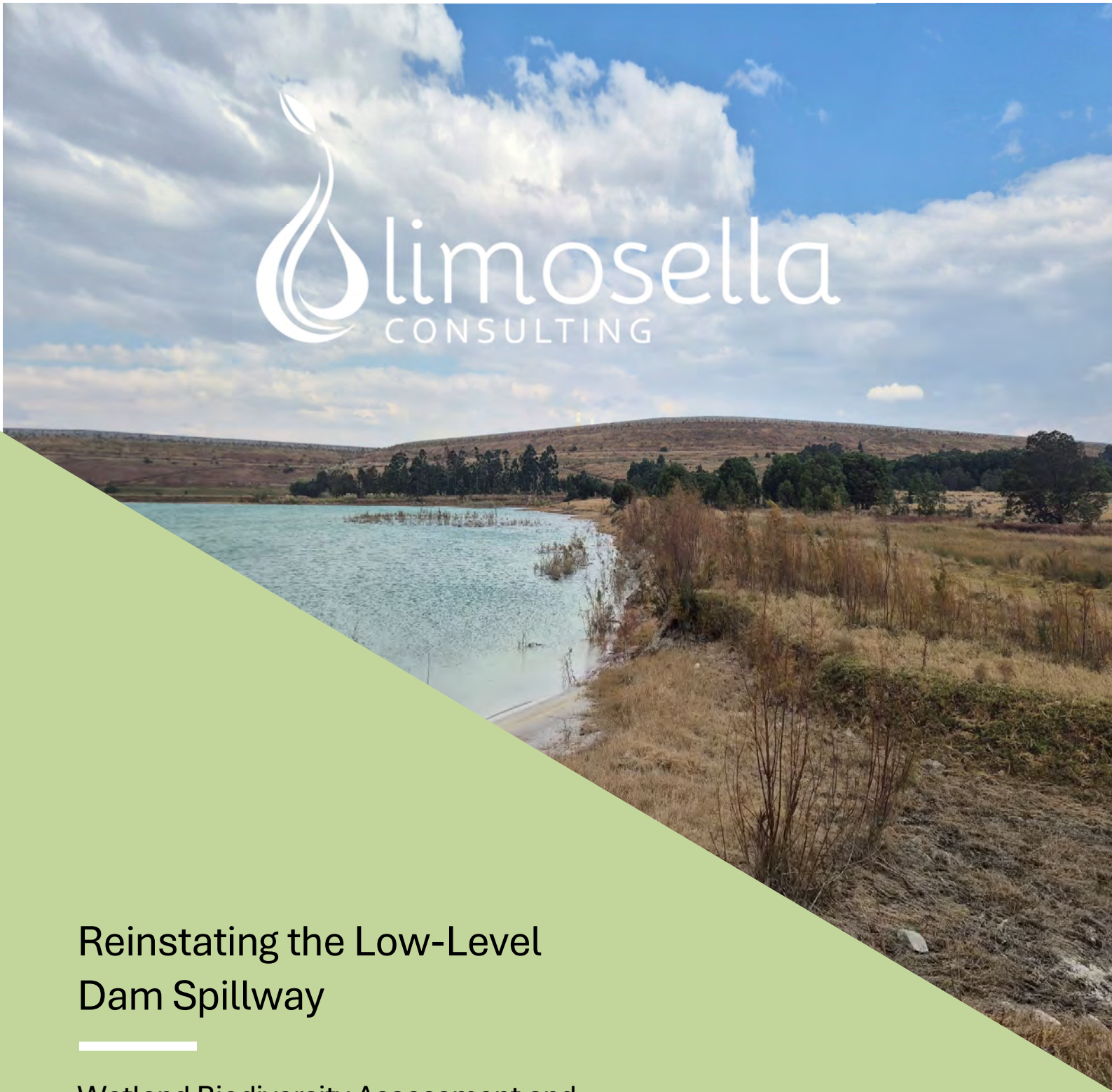
Annexure E: Specialist Studies

Annexure E1 Wetland Biodiversity Assessment and Aquatic Site Sensitivity Verification Report and confirmation letter



Reinstating the Low-Level Dam Spillway

Wetland Biodiversity Assessment and Aquatic Site Sensitivity Verification Report

June 2025

Shangoni Management Services (Pty) Ltd
Unit C8, Block@Nature, 472
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Declaration of Independence

I, **Rudi Bezuidenhoudt**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant.
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998).
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998).
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement.

Rudi Bezuidenhoudt (*Pr*SciNat)

Ecologist/Botanist

SACNASP Reg. No. 008876

2025.08.08

Date

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Project name: Reinstating the Low-Level Dam Spillway | Wetland Biodiversity Assessment | June 2025

Nature of Signoff	Responsible Person	Role/Responsibility	Qualifications
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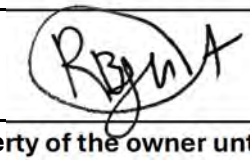
Document number	**Checked by:**	**Electronic Signature:**	**Date**
Client review			
Final Report	Rudi Bezuidenhoudt		2025.08.08

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EXECUTIVE SUMMARY

Limosella Consulting (Pty) Ltd has been appointed by Shangoni Management Services (Pty) Ltd to provide specialist wetland input in support of the proposed reinstatement of the Low-Level Dam (LLD) spillway and associated infrastructure at Duvha Power Station, located near eMalahleni in Mpumalanga Province. This report forms part of the environmental authorisation process and is intended to inform the necessary approvals in terms of relevant environmental legislation. This report incorporates a Site Sensitivity Verification component that precedes and informs the aquatic impact assessment. The site sensitivity verification was undertaken by a suitably qualified aquatic specialist and environmental assessment practitioner through a combination of desktop analysis, a preliminary site inspection, and the review of available and relevant information, as required by Section 2 of Government Notice No. 320.

Fieldwork was conducted on 9 June 2025.

The terms of reference for this assessment were as follows:

- Determine the presence/absence of natural wetlands within the proposed working area, if natural wetlands occur:
- Delineate the wetland and riparian areas.
- Classify the watercourse according to the system proposed in the national wetlands inventory, if relevant.
- Undertake functional and integrity assessment of wetlands areas within the area assessed, as specified in General Notice 267 of 24 March 2017.
- Undertake an impact assessment as specified in the NEMA 2014 regulations (as amended).
- Undertake a risk assessment as specified in Revised GA 4167 of 8 December 2023.
- Recommend suitable buffer zones as specified in General Notice 267 of 24 March 2017, and the buffer zone guidelines (Macfarlane & Bredin, 2017)
- Discuss appropriate mitigation and management procedures relevant to the conserving of watercourse areas on, and downstream of, the site.
- Based on the findings during the desktop and field assessments, a detailed risk assessment of all identified significant risks shall be done, including cumulative impacts on watercourse assemblages in the region.
- Recommendations shall be provided on management and mitigation measures (including opportunities and constraints) with regards to the development/operation of the proposed development to improve, manage and mitigate impacts (positive and negative) on the watercourse ecology of the area.
- To undertake a site sensitivity verification for aquatic and riparian features associated with the proposed low-level dam spillway reinstatement and weir construction, in accordance with the requirements of Government Notice No. 320 of 20 March 2020, and to use the verified sensitivities to inform the aquatic biodiversity assessment, impact assessment, and mitigation measures.

The study area consists of artificial wetland-like systems, including a seepage wetland, a canal, a breached dividing berm, and a wetland formed over historical diggings. These features exhibit saturated soils and

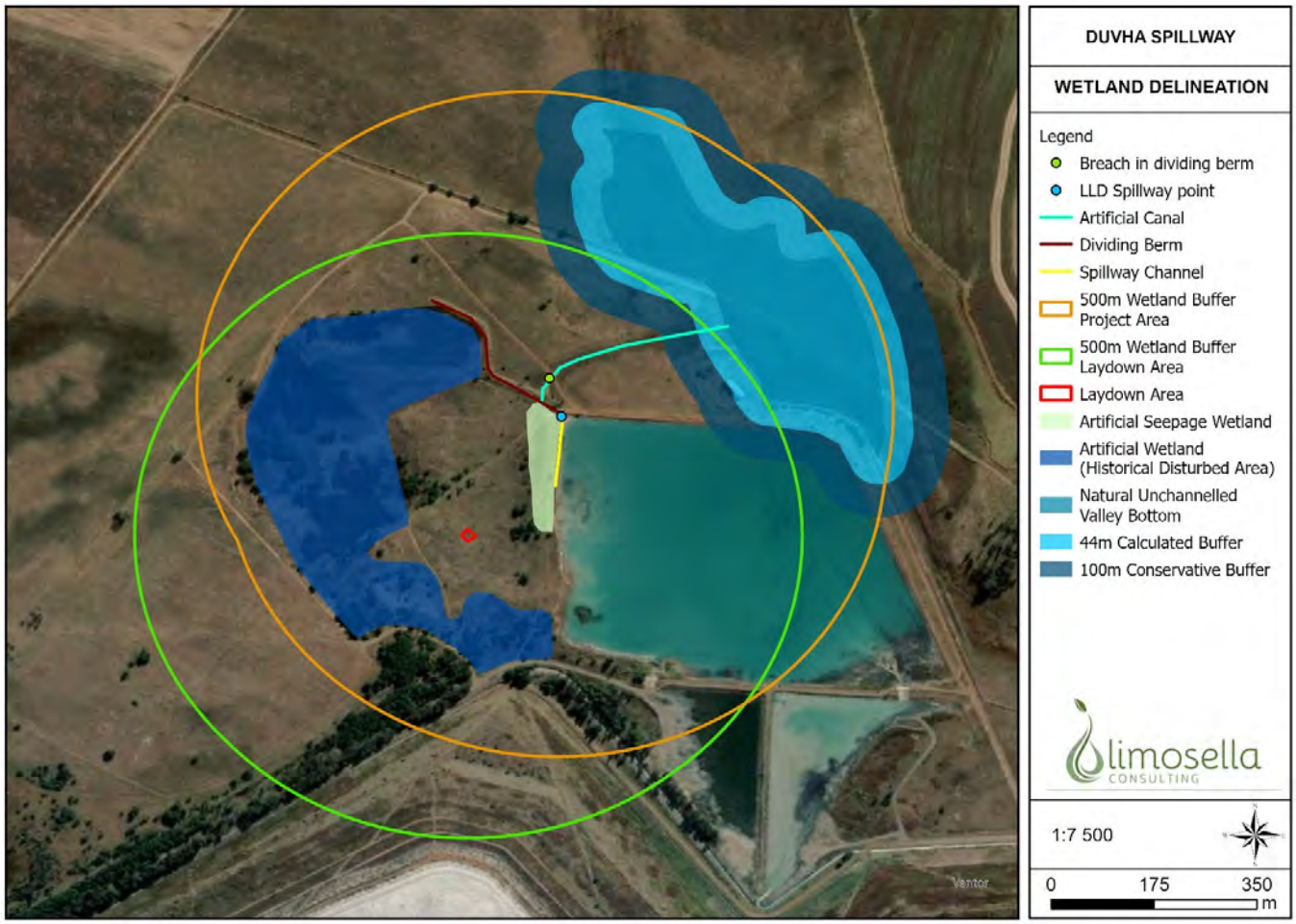
hydrophytic vegetation but are not natural wetlands, having formed through dam seepage or excavation. Historical imagery confirms their absence in earlier decades. The only natural aquatic feature in the area is an unchannelled valley-bottom wetland located approximately 320 metres north of the proposed works, well beyond the calculated (44 m) and conservative (100 m) buffer zones. The natural wetlands are confirmed to be highly sensitive as indicated in the screening report, the artificial wetlands are less sensitive but does contribute to some extent to ecosystem services.

A WET-EcoServices assessment was conducted for the artificial wetland areas and confirmed very low functional value across all ecosystem services. No WET-Health or REC assessment was applied, as these tools are not suited to artificial systems. An Ecological Importance and Sensitivity (EIS) rating was completed to support the interpretation of functional relevance, while a precautionary DWS Risk Assessment Matrix (RAM) was included despite the limited applicability under Section 21(c) and (i) of the National Water Act.

All impacts associated with the proposed development are considered localised, temporary, and readily mitigatable. No work will take place within or directly impact any natural wetland. Construction-phase risks such as erosion, sedimentation, and invasive species spread will be managed through standard mitigation and rehabilitation measures. Operationally, the project is expected to reduce long-term hydrological risk and improve controlled overflow conditions, thereby enhancing downstream protection. The important factors relevant to Environmental Authorisation for the project, are summarised in the table below:

Quaternary Catchment and WMA areas	B11G Limpopo-Olifants (LOCMA) #2 - Olifants: Major rivers include Elands, Wilge, Steelpoort, Olifants and Letaba Rivers
Watercourse	The primary watercourse feature is the Low Level Dam (LLD), an artificial off-channel ash return dam. Although mapped as a wetland in the NFEPA and NBA2018 datasets, it does not represent a natural wetland system but rather an engineered containment structure with wetland-like characteristics. Downstream of the LLD, the spillway channel connects to a valley-bottom wetland associated with a non-perennial river. This wetland drains into the Witbak Dam. • NBA (2018) list the watercourses as **Vulnerable** • NFEPA (2011) list the watercourses as **Vulnerable**
Classification (SANBI, 2013)	Artificial Wetland Areas
WetEcoServices	Very Low for all metrics
EIS (Kotze, et al., 2020)	**Low Category -** Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers
Coj Generic Buffer and Calculated Buffer Zone (Macfarlane *et al,* 2015)	**Calculated Buffer Zone: 44 m** **Conservative Buffer: 100 m** **Artificial Wetland Areas: No Buffer**
DWS 2024 Risk Assessment	Risk scores fall in the **Low category**

National Screening Tool Findings	This study confirms that the natural wetlands are highly sensitive as indicated on the screening report, the artificial wetlands are less sensitive.



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1 Introduction

Limosella Consulting (Pty) Ltd has been appointed by Shangoni Management Services (Pty) Ltd to provide specialist wetland input in support of the proposed reinstatement of the Low Level Dam (LLD) spillway and associated infrastructure at Duvha Power Station, located near eMalahleni in Mpumalanga Province. This report forms part of the environmental authorisation process and is intended to inform the necessary approvals in terms of relevant environmental legislation. This report incorporates a Site Sensitivity Verification component that precedes and informs the aquatic impact assessment. The site sensitivity verification was undertaken by a suitably qualified aquatic specialist and environmental assessment practitioner through a combination of desktop analysis, a preliminary site inspection, and the review of available and relevant information, as required by Section 2 of Government Notice No. 320.

Fieldwork was conducted on 9 June 2025.

1.1 Description of the Project:

The proposed project entails the reinstatement and upgrading of the Low-Level Dam (LLD) spillway and associated infrastructure at Duvha Power Station (**Figure 1**). The LLD is an off-channel storage facility used for the containment of ash return water and contaminated stormwater from the station and its surrounding areas. The dam is located approximately 1.2 km southeast of the Witbank Dam and has a spillway level capacity of 811,240 m^3.

In 2013, an earth berm was constructed along the LLD spillway, significantly reducing its width and creating non-compliance in terms of the Dam Safety Regulations. In 2019, the dam experienced overtopping risk when water levels reached 7.7 m, leaving a freeboard of only 300 mm. This triggered the need to remove the berm and restore the spillway to meet regulatory discharge capacity standards.

The scope of the proposed works includes the following:

- **Spillway Reinstatement**: Removal of the earth berm and widening of the spillway to 62 m to accommodate a peak flow of approximately 130 m^3/s, in line with the Safety Evaluation Discharge (SED) for a Category II dam. A reinforced concrete sill and an elevated brick masonry headwall will be constructed.
- **Concrete Weir Construction**: A new weir structure will be installed at a breach in the dividing berm (between the dirty and clean water sections) to manage high-flow events and prevent erosion. Retaining walls and erosion protection measures such as *Armorflex* and Reno mattresses will be incorporated.
- **LLD Crest Raising**: Due to observed settlement along the dam crest (±3%), the crest will be levelled and compacted with G3–G4 gravel material to restore freeboard and prevent ponding.
- **Temporary Laydown Area** – A small laydown area of 217m^2 will be located adjacent to an access road.

All construction activities will be undertaken in accordance with engineering standards and applicable environmental management requirements. The upgrades are designed to ensure dam safety compliance, improve operational capacity, and reduce the risk of uncontrolled overflow events.

Figure 1: Water extraction proposal

1.2 Terms of Reference

The terms of reference for the current aquatic study were as follows:

- Determine the presence/absence of natural wetlands within the proposed working area
- Delineate the wetland and riparian areas.
- Classify the watercourse according to the system proposed in the national wetlands inventory, if relevant.
- Undertake functional and integrity assessment of wetlands areas within the area assessed, as specified in General Notice 267 of 24 March 2017.
- Undertake an impact assessment as specified in the NEMA 2014 regulations (as amended).
- Undertake a risk assessment as specified in Revised GA 4167 of 8 December 2023.

- Recommend suitable buffer zones as specified in General Notice 267 of 24 March 2017, and the buffer zone guidelines (Macfarlane & Bredin, 2017)
- Discuss appropriate mitigation and management procedures relevant to the conserving of watercourse areas on, and downstream of, the site.
- Based on the findings during the desktop and field assessments, a detailed risk assessment of all identified significant risks shall be done, including cumulative impacts on watercourse assemblages in the region.
- Recommendations shall be provided on management and mitigation measures (including opportunities and constraints) with regards to the development/operation of the proposed development to improve, manage and mitigate impacts (positive and negative) on the watercourse ecology of the area.
- To undertake a site sensitivity verification for aquatic and riparian features associated with the proposed low-level dam spillway reinstatement and weir construction, in accordance with the requirements of Government Notice No. 320 of 20 March 2020, and to use the verified sensitivities to inform the aquatic biodiversity assessment, impact assessment, and mitigation measures.

1.3 Assumptions and Limitations

- All wetlands within 500 m of any developmental activities should be identified as per the DWS authorisation regulations, as well as 100 m from any river. Watercourses that fall outside of the site, but that fall within 100/500 m of the proposed activities were delineated based on desktop analysis of vegetation gradients visible from aerial imagery.
- Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage.
- The specialist responsible for this study reserves the right to amend this report, recommendations and/or conclusions at any stage should any additional or otherwise significant information come to light.
- Floodline calculations fall outside the scope of the current assessment.
- A Red Data scan, fauna and flora, were not included in the current study.
- Species composition described for landscape units aimed at depicting characteristic species and did not include a survey for cryptic or rare species.
- The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters.
- Watercourses delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, while converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by for example photocopying and printing.

- Determination of permissible abstraction rates, volumes, or thresholds was not included in the scope of this study. This information must be compiled separately by a suitably qualified hydrologist or water resource specialist in support of the Section 21(a) water use application.
- It is acknowledged that new or unforeseen environmental impacts, natural events, or human interventions may alter the state of the watercourses and surrounding landscape after this assessment is completed. As such, this report reflects conditions at the time of the site visit and desktop review.

2 Definitions and Legal Framework

2.1 Wetlands and Riparian Areas

The **National Water Act, 1998 (Act No. 36 of 1998) [NWA]** establishes the legal basis for water resource management in South Africa, ensuring pollution prevention, ecological conservation, and sustainable utilisation. Under this Act, all water resources are state property and regulated by the Department of Water and Sanitation (DWS). The NWA outlines principles for water use decisions that may significantly affect water resources, defining a water resource to include watercourses, surface water, estuaries, and aquifers. A watercourse encompasses rivers, springs, natural channels with intermittent or regular water flow, wetlands, lakes, pans, dams, and any water collection declared as such by the Minister, along with their beds and banks. The NWA defines a wetland as land transitioning between terrestrial and aquatic systems, with the water table usually near the surface or covered periodically by shallow water, supporting vegetation adapted to saturated soil conditions.

Riparian habitats are vital for ecological and hydrological functions, similar to wetlands, and serve as indicators for delineating river footprints. The NWA defines riparian habitat as areas associated with watercourses, characterised by alluvial soils, and inundated or flooded to support distinct vegetation compared to adjacent lands.

2.2 Authorisations for Water Use Activities

Water use authorisations, outlined in Section 21 of the NWA, apply to activities related to watercourses, specifically (**Table 1**):

Table 1: Water uses associated with the project/

Section 21(c): Impeding or diverting water flow in a watercourse	• Construction of a new concrete weir structure at the breach in the dividing berm. This structure will regulate overflow from the LLD into adjacent water pathways and is specifically designed to manage high-flow stormwater events (≥1:50-year floods). While engineered to improve control and minimise downstream erosion, it alters the existing hydrology and introduces a permanent impeding feature within the watercourse. • Reinstatement of the spillway, which includes the removal of the earth berm and excavation along a 62 m section of the original spillway alignment. Although the removal of the berm restores capacity, it also changes the current flow regime temporarily during construction, and permanently by reconfiguring flow volume and velocity. • Installation of Reno mattresses and *Armorflex*-type protection downstream of the spillway and weir. These erosion protection measures modify flow paths and reduce energy, which constitutes a deliberate intervention in the natural hydraulic regime.
Section 21(i): Altering the bed, banks, course, or characteristics of a watercourse	• Excavation of in-situ material to reinstate the spillway channel and construct the concrete sill, weir, and retaining structures. These activities will physically alter the shape, gradient, and composition of the watercourse bed and banks. • Raising and shaping of the LLD crest, which will adjust the embankment and runoff characteristics into the surrounding area, including potential overland flow paths during high rainfall events. • Backfilling and compacting activities associated with spillway, weir, and berm reshaping. These modify not only the topography but also the infiltration capacity and hydraulic behaviour of the area. • Use of materials such as concrete, terrablocks, and rip-rap to line and reinforce sections of the flow path alters the natural substrate and bank composition, thereby modifying the watercourse's physical characteristics.
Spills from the Low-Level Dam into the natural wetland downstream are not included within the scope of this application. As such, Section 21(f) (discharge of waste or water containing waste into a water resource) and Section 21(g) (disposal of waste in a manner which may impact a water resource) of the National Water Act are not applicable to this assessment.	

Government Notice 4167 of 8 December 2023 replaced Government Notice 509 of 2016 and regulates these activities under Section 21(c) and (i). This notice provides General Authorisation (GA) for low-risk activities as determined by the Risk Assessment matrix. Medium or high-risk activities require a Water Use Licence (WUL) from the DWS.

Conditions for activities impacting watercourses include site selection criteria to avoid bends, high gradient areas, unstable slopes, actively eroding banks, interflow zones, springs, and seeps.

2.3 Additional Legislation and Frameworks

Compliance with the following national legislation, conventions, and regulations is required for wetlands, riparian zones and other aquatic areas (**Table 2**).

Table 2: Legislation/Regulation and Relevance to the WULA and Proposed Development

Legislation	Relevance to Proposed Development
Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP)	Ensures the protection of wetland ecosystems that may be affected by site preparation, water use, or drainage activities.
National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998)	Provides overarching principles for sustainable development and environmental management, applicable to all phases of development.
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)	Protects biodiversity, requiring mitigation of impacts on habitats, species, and ecosystems affected by development activities.
National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003)	Regulates activities in or near protected areas, which may overlap or border proposed sites.
NEMA Regulations GN R.982, R.983, R.984, and R.985 of 2014	Outlines the need for Environmental Impact Assessments (EIAs) and the listing of activities that require environmental authorisation for sewer projects.
Regulations and Guidelines on Water Use under the NWA	Ensures compliance with water use authorisations for construction and operation, including abstraction for panel cleaning or other operational needs.
South African Water Quality Guidelines under the NWA	Guides the quality of water discharged or used onsite to ensure minimal contamination of surrounding water resources.
DWS General Notice 267 of 24 March 2017	Provides specific requirements for activities near wetlands and watercourses, relevant for compliance during site selection and development.
Revised General Authorisation (GA) 4167 of 8 December 2023	Updates general authorisation requirements for water use activities, including those associated with sewer construction and maintenance.
National Water Act (NWA), 1998 (Act No. 36 of 1998)	Governs the use, management, and protection of water resources, critical for managing water abstraction and discharge during sewer construction and operation.
Hazardous Substances Act, 1973 (Act No. 15 of 1973)	Regulates the handling and storage of hazardous substances, such as batteries used in Battery Energy Storage Systems (BESS).
Electricity Regulation Act, 2006 (Act No. 4 of 2006)	Governs the licensing and regulation of electricity production, including renewable energy facilities.

This legal framework ensures that the environmental impacts of activities related to aquatic and wetland resources are properly assessed and managed, promoting sustainable development and conservation.

3 Locality of the study site

The study site is located within the boundaries of Duvha Power Station, situated approximately 15 km east of eMalahleni in the Mpumalanga Province of South Africa. The power station falls under the jurisdiction of the Emalahleni Local Municipality within the Nkangala District Municipality. The specific focus of the proposed works is the Low-Level Dam (LLD) and associated infrastructure, which lies approximately 1.2 km southeast of the Witbank Dam and approximately 1.7 km from the Ash Dam complex. The LLD is an off-channel facility used for the containment of return water and contaminated stormwater associated with ash handling and operational activities at the power station. (**Figure 2**).

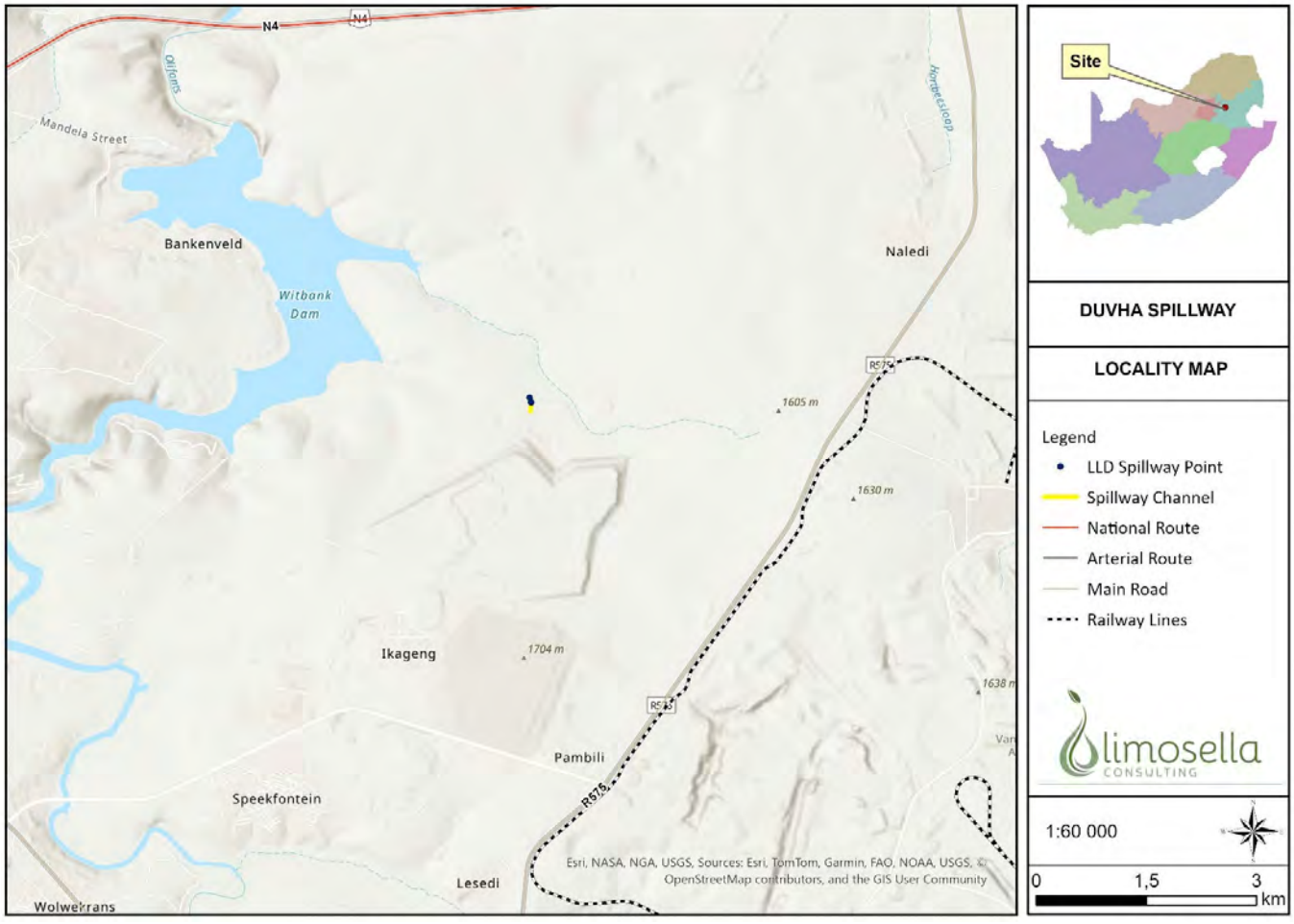

Figure 2: Locality Map

4 Description of the Receiving Environment

A review of available literature and spatial data formed the basis for the characterisation of the biophysical environment in its theoretically undisturbed state, and consequently an analysis of the degree of impact to the ecology of the study site in its current state. **Table 1** below provides a summary of the important aspects.

Table 3: A summary of relevant site information obtained from a review of available spatial data.

National Screening Tool (Https://screening.environment.gov.za/screeningtool)	
	The spillway is located on an area classified as having Low Aquatic Sensitivity, however, the wetlands in the north and east is classified as having **Very High Aquatic Sensitivity**
General Description (Mucina & Rutherford , 2006))	
Broad Vegetation Units (Figure 3)	**Gm 12 - Eastern Highveld Grassland**
Conservation Status	**Endangered**
Topography	Slightly to moderately undulating plains, including some low hills and pan depressions.
Climate	Summer rainfall with very dry winters. MAP between about 600 and 700 mm. Frost fairly frequent in winter. Strongly seasonal summer rainfall, with very dry winters. MAP 650–900 mm (overall average: 726 mm), MAP relatively uniform across most of this unit, but increases significantly in the extreme southeast. The coefficient of variation in MAP is 25% across most of the unit, but drops to 21% in the east and southeast. Incidence of frost from 13–42 days, but higher at higher elevations.
Hydrology and National Freshwater Ecosystem Priority Area (NFEPA, 2011) (NBA, 2018) **Database**	
Important Rivers (Figure 4) National Freshwater Ecosystem Priority Areas (NFEPA) (Driver, et al., 2012) **and National Biodiversity Assessment (NBA)** (SANBI, 2018)**Wetlands**	The primary watercourse feature is the Low Level Dam (LLD), an artificial off-channel ash return dam. Although mapped as a wetland in the NFEPA and NBA2018 datasets, it does not represent a natural wetland system but rather an engineered containment structure with wetland-like characteristics. Downstream of the LLD, the spillway channel connects to a valley-bottom wetland associated with a non-perennial river. This wetland drains into the Witbak Dam. • NBA (2018) list the watercourses as **Vulnerable** • NFEPA (2011) list the watercourses as **Vulnerable**
Quaternary Catchment	B11G
Catchment Management Areas (CMA) Invalid source specified	Limpopo-Olifants (LOCMA)
Water Management Areas (WMA) (Government Gazette, 16 September 2016)	#2 - Olifants: Major rivers include Elands, Wilge, Steelpoort, Olifants and Letaba Rivers

Wetland Ecosystem Type (Ollis, et al., 2013)	Mesic Highveld Grassland Group 4 **Ecosystem Threat Status: Critically Endangered** **Protection Level: Not Protected**
Eco-Region Level 2 (DWS, 2024)	Highveld 11.02
Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES) Model (DWA, 2024)	The Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES) were determined per Sub-Quaternary Reaches (SQR) for Secondary Catchments in South Africa. The SQRs of the study site is: • 1155(PES=D)(EI=High)(ES=High)
Surface Strategic Water Source (GSWS) (Driver, et al., 2014)	Not located on a SWSA
Geology and soil	
Geology	Rhyolite is a fine-grained, silica-rich volcanic rock that is typically light in colour. It is the extrusive equivalent of granite and is formed from high-viscosity lava that cools quickly at or near the Earth's surface. Rhyolite often contains small crystals of quartz and feldspar and may exhibit banding or flow textures due to its viscous nature. In terms of hydrology, rhyolite tends to be impermeable, contributing to surface runoff and limited infiltration, which can promote the formation of wetlands or seeps downslope.
Soil (ENPAT, 2024)	Ba4 - Plinthic catena: dystrophic and/or mesotrophic; red soils widespread, upland duplex and margalitic soils rare
Biodiversity Sector Plan	
Critical Aquatic Biodiversity Areas (Figure 5)	According to the Mpumalanga Biodiversity Sector Plan (MBSP), The proposed construction footprint (spillway and weir) is also surrounded by Moderately Modified and Heavily Modified areas associated with historical land use, ash disposal, and infrastructure. While the development is largely constrained to disturbed zones, care must be taken to avoid further encroachment into the intact CBA area, and any unavoidable impacts should be accompanied by appropriate mitigation measures.

Figure 3: Vegetation of the study site

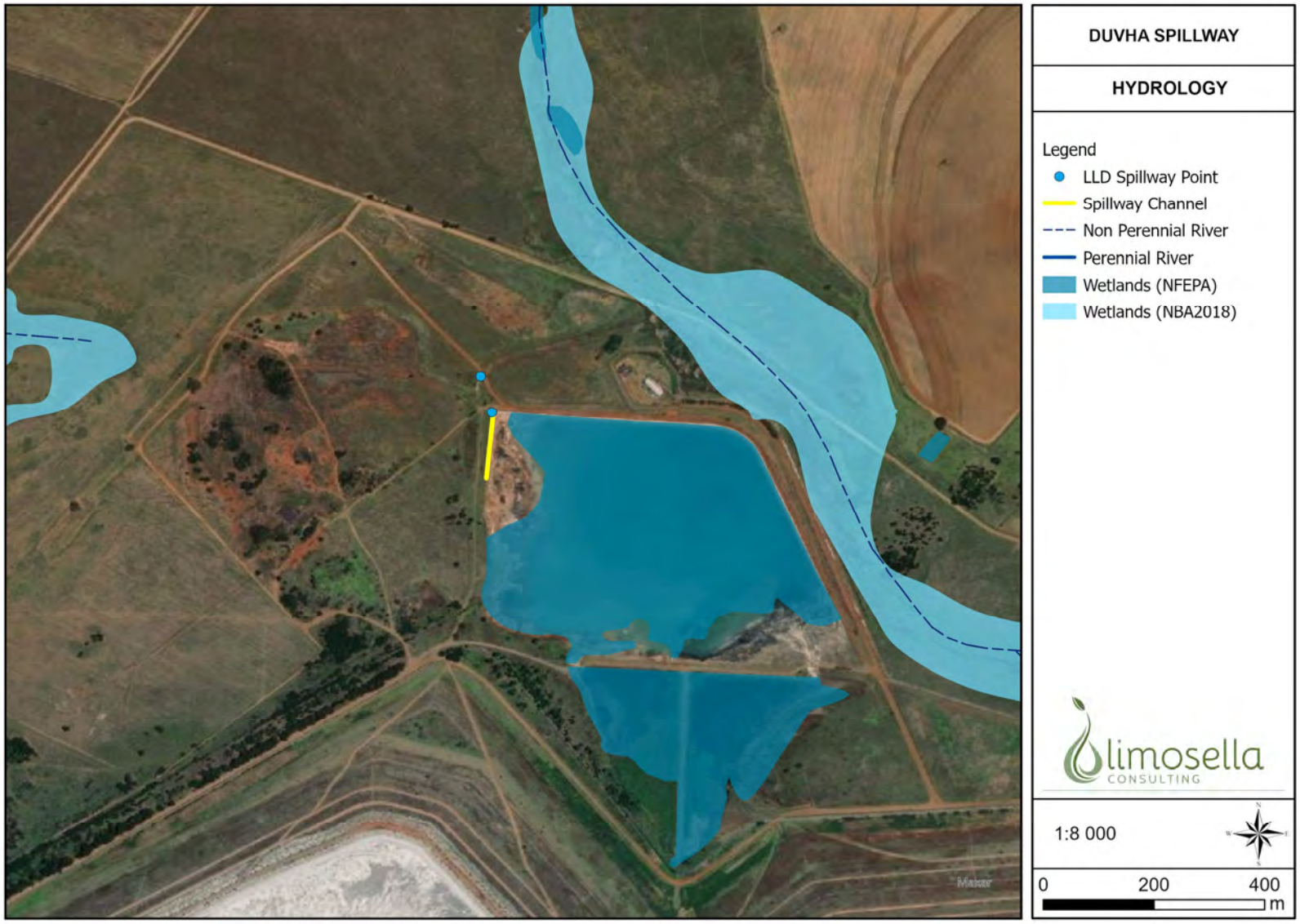

Figure 4: Regional hydrology relative to the study site

Figure 5: Critical Biodiversity Areas relevant to the study site

5 Methodology

The delineation method documented by the DWS in their document "**Updated manual for identification and delineation of wetlands and riparian areas**" (DWAF, 2008), as well as the **Classification System for Wetlands and other Aquatic Ecosystems in South Africa User Manual: Inland Systems** (Ollis, et al., 2013) was followed throughout the field survey.

These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas such as soil and vegetation forms, as well as the terrain unit indicator.

A smartphone was used to capture GPS co-ordinates in the field. 1:50 000 cadastral maps and available GIS data were used as reference material for the mapping of the preliminary watercourse boundaries. These were converted to digital image backdrops, and delineation lines and boundaries were imposed accordingly after the field survey. Applications used on the smartphone includes GPX Viewer Pro and Google Earth.

Following a desktop assessment highlighting wetland area to be groundtruthed in the field, soil and vegetation sampling on site informed a fine-scale delineation. In the current study, the wetland area was assessed using Wet-Health (Macfarlane , et al., 2020), EIS and WetEcoServices, (Kotze, et al., 2020). The assessment of potential impacts follows the 2014 NEMA regulations (as amended) and the DWS 2023 Risk Assessment.

In order to ease the legibility of the report, details regarding the methods used in each phase of the watercourse assessment are presented in a separate document, attached to this report as Appendix C, entitled (Bezuidenhoudt, 2024): R.Bezuidenhoudt (2024) . Appendix C: Aquatic Methodology. Limosella Consulting. Pretoria.

6 Results

The aquatic features (**Figure 6**) adjacent to the LLD spillway consist of a mixture of artificial and natural systems, shaped primarily by dam operations and historical land use. Directly west of the spillway, a seepage wetland has formed, likely as a result of sustained seepage from the dam wall (Green Polygon). Although it displays wetland characteristics such as saturated soils and hydrophytic vegetation, its artificial origin is suggested by its alignment with the dam wall and its absence from historical imagery.

To the north of the spillway, a man-made canal has been constructed (Red Line), where a breach in the dividing berm now allows water to flow toward a natural unchannelled valley-bottom wetland. This canal does not appear in the 1962 imagery, indicating it is a relatively recent intervention, likely to divert or manage overflow from the dam. The dividing berm itself (Blue Line) redirects flow westward into a large artificial wetland (Yellow Polygon), which overlays what appears to be an area of historical disturbance or excavation (possibly diggings). This wetland-like area is also not present in the 1962 imagery, confirming its artificial and operational nature.

Although the natural unchannelled valley-bottom wetland lies approximately 320 metres north of the LLD spillway, it is situated well beyond both the calculated 44 metre buffer and the more conservative 100 metre buffer applied in this assessment. As such, no direct impacts on this natural wetland are anticipated from the proposed construction activities, which are confined to the disturbed footprint of the LLD, spillway, and dividing berm. Furthermore, the project does not include any new or intensified discharges toward the natural system, and all spill-related events fall outside the scope of this assessment. While downstream impacts from future spill events may warrant separate operational consideration, they are not addressed herein. The current activities, focused on infrastructure reinstatement, are therefore unlikely to pose a risk to the ecological integrity of the natural wetland.

Figure 6:Characteristics of the Aquatic Environment

6.1 Historical Land Use, Cover and Aquatic Ecological State

The historical imagery from 1962 (**Figure 7** - Top) shows that the area surrounding the current Low-Level Dam (LLD) was largely rural and undeveloped, characterised by natural grasslands interspersed with limited patches of cultivated land. No evidence of dam infrastructure or major earthworks is visible in the imagery, indicating that the LLD and ash disposal facilities did not yet exist. The natural drainage patterns were intact, with well-defined valley-bottom wetland features present to the west and northwest of the current dam footprint. These wetlands appear to have been hydrologically connected and functioning within a largely unmodified landscape, suggesting that the aquatic ecological state at the time was predominantly unaltered, with good hydrological and ecological integrity.

In contrast, the 2025 imagery (**Figure 7** - Bottom) reveals significant landscape transformation. The construction of the LLD, along with extensive ash disposal facilities and associated roads, has introduced a high degree of surface disturbance. The LLD occupies the centre of the image, with clearly defined embankments and altered hydrological connectivity. Although the artificial dam is now mapped as a wetland in some datasets due to its standing water and surrounding vegetation, it is not a natural system. Some valley-bottom wetlands remain

visible to the north and west of the LLD, and while these appear structurally intact, they are likely subject to altered flow regimes due to upstream containment and runoff control infrastructure.

Figure 7: Historical aerial imagery (1962) (CDNGI, 2024) **compared to recent aerial imagery (2025)** (GoogleEarth, 2024) **comparing the land-use changes**

Notes on Artificial Wetlands

6.2 The National Climate Change Adaptation Strategy

South Africa's policy framework for climate resilience is guided by the **National Climate Change Adaptation Strategy (NCCAS)** and more recently formalised through the **Climate Change Act, 2024 (Act No. 22 of 2024)**. These frameworks aim to ensure that development projects account for climate-related risks, strengthen ecological resilience, and promote sustainable water resource management. In the context of this assessment, which involves the reinstatement of dam spillway infrastructure adjacent to regulated watercourses and wetland systems, alignment with climate adaptation objectives is essential to reduce vulnerability to extreme weather events and safeguard ecological infrastructure. The table below outlines key objectives from each policy and their relevance to the proposed abstraction activity (**Table 4**).

Table 4: Climate Change Adaptation Strategies and relation to the development.

Policy / Strategy	Relevant Objective / Requirement	Relevance to Proposed Project
National Climate Change Adaptation Strategy (NCCAS)	• Enhance adaptive capacity.	The project takes place within a regulated watercourse environment prone to hydrological variability. Infrastructure upgrades such as spillway reinstatement reduce flood risk and increase resilience to intense rainfall events.
	• Protect water resources	
	• Strengthen climate-resilient infrastructure	
Climate Change Act, 2024 (Act No. 22 of 2024)	• Institutionalise climate governance	The Act mandates that infrastructure projects consider potential climate risks and demonstrate how adaptation has been integrated into design and implementation.
	• Require climate risk consideration in development authorisations	
	• Promote ecosystem-based adaptation	

6.3 Buffer Zones

In line with national regulatory requirements and best-practice guidelines, all delineated wetlands and watercourses within and adjacent to the proposed development footprint have been assessed to determine appropriate buffer zones and whether the project triggers environmental authorisation thresholds under the National Environmental Management Act (NEMA) and the National Water Act (NWA).

The "regulated area of a watercourse" means:

a. The outer edge of the 1 in 100-year flood line or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, dams and lakes.
b. In the absence of a determined 1 in 100-year flood line or riparian area as contemplated in (a) above the area within 100m distance from the edge of a watercourse where the edge of the watercourse (excluding flood plains) is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the National Water Act 36 of 1998).
c. In respect of a wetland: a 500 m radius around the delineated boundary (extent) of any wetland (including pans).

Buffer zones are typically applied to natural wetlands and riparian areas to safeguard ecological functioning and reduce the risk of disturbance from adjacent activities. In this case, no buffer zones have been applied to the artificial wetlands identified near the LLD spillway, including the seepage wetland, canal, and the wetland overlying the historical diggings. These features are all of anthropogenic origin and do not qualify for formal buffer delineation under wetland policy guidelines.

For the natural unchannelled valley-bottom wetland located approximately 320 m north of the spillway, a buffer zone was calculated using the (Macfarlane & Bredin, 2017) methodology, In accordance with the requirements of GN509 of 2016 (and the revised GN4167 of 2022), yielding a site-specific buffer of 44 m. However, to ensure a conservative approach, a 100 m buffer was applied. The proposed construction activities occur well outside this buffer, and as discussed in the results section, no direct or indirect impacts are anticipated to the natural wetland.

Regarding the DWS 500 m regulated area, this radius is generally applied around natural wetlands to determine the need for a Water Use Licence in terms of Section 21(c) and (i) of the National Water Act. In this case, no natural wetlands occur within or adjacent to the LLD spillway footprint. Since the nearest natural wetland is more than 300 m away and the other water features are artificial, it is not appropriate or feasible to establish a 500 m regulated area around the project footprint for the purpose of licensing. The assessment thus focuses on activities directly associated with the spillway and dam wall, where regulatory triggers are based on proximity to and alteration of artificial and engineered watercourses.

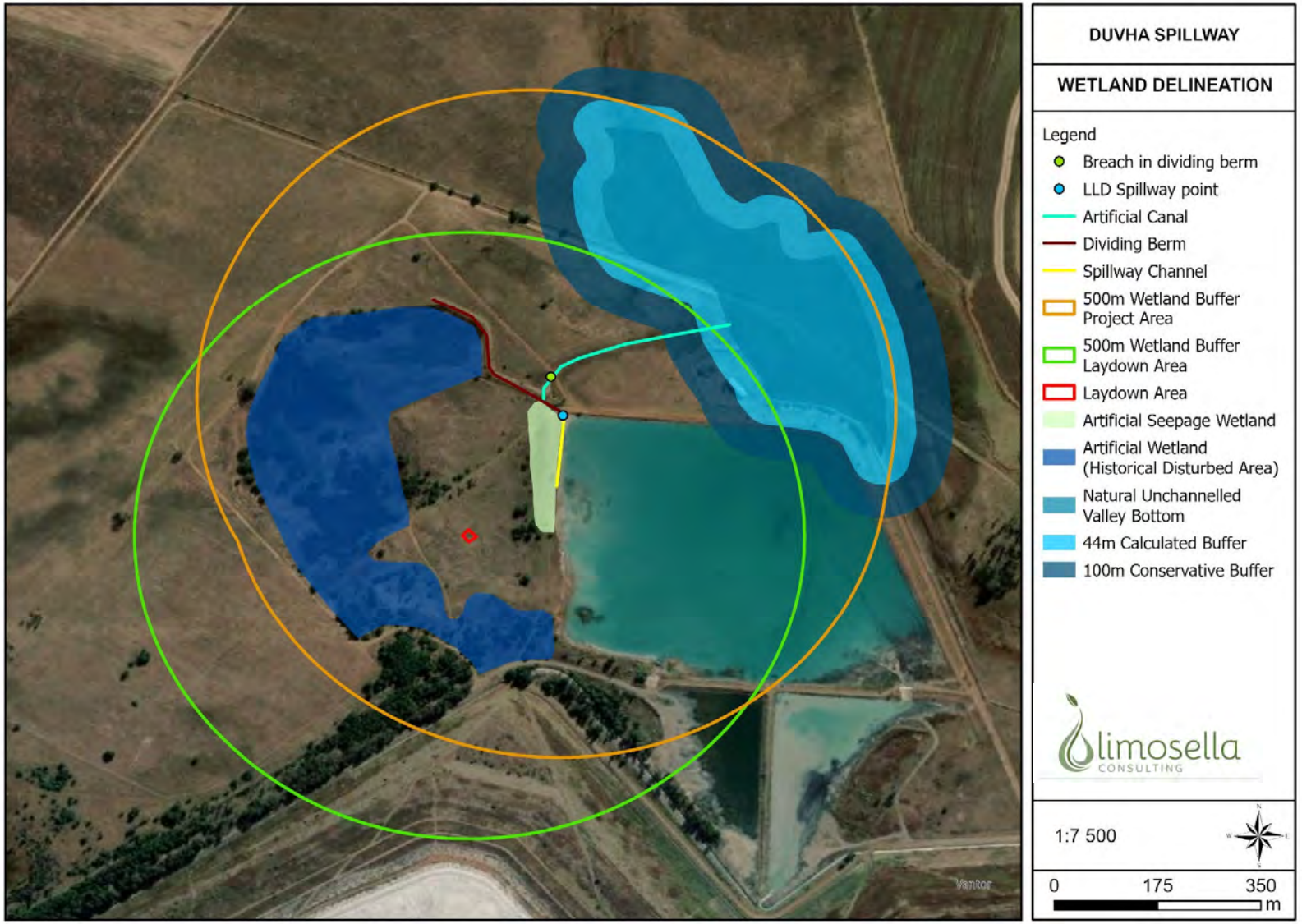

Figure 8: The watercourse delineation with calculated buffer zones

6.3.1 Wetland/Riparian Delineation

The Classification System for Wetlands and Other Aquatic Ecosystems (Ollis, et al., 2013) in South Africa is a hierarchical framework designed to standardise the identification and categorisation of aquatic ecosystems. The following table (**Table 5**) provides a detailed classification of the watercourse based on the six-tiered framework for aquatic ecosystem description. This framework considers biophysical, geomorphological, and hydrological factors, as well as specific site descriptors. The classification is essential for understanding the ecological character, functioning, and sensitivity of the system, and it informs appropriate management and mitigation measures related to the proposed dam wall rehabilitation activities.

Table 5: Classification System for Wetlands and Other Aquatic Ecosystems in South Africa *(Ollis, et al., 2013)*

Level	Name	Description	Purpose
1	System	Broadly categorises ecosystems as marine, estuarine, inland, or artificial systems.	Defines the overarching environment where the aquatic ecosystem is located.
2	Regional Setting	Places the system within a bioregional context (e.g., ecoregions, climatic zones).	Provides insight into the climatic and geographical influences shaping the ecosystem.
3	Landscape Unit	Defines the geomorphological context (e.g., valleys, plateaus, floodplains).	Establishes how the landscape influences hydrology and ecosystem structure.
4	Hydrogeomorphic (HGM) Unit	Categorises ecosystems based on hydrology, geomorphology, and water sources.	Differentiates systems like rivers, floodplains, depressions, or seepage wetlands.
5	Hydrological Regime	Focuses on the hydrology, including:	Provides detailed understanding of water movement and its influence on ecosystems.
		- 5A: Inundation Period - Frequency and duration of surface water presence.	
		- 5B: Saturation Period - Duration of soil saturation without surface water.	
6	Descriptors	Adds specific characteristics, such as: - Natural vs. Artificial systems - Salinity, pH, substratum type, vegetation cover, and geology	Offers detailed descriptions of physical and ecological attributes for site-specific management.

The watercourse is classified (Ollis, et al., 2013) from level 1 to 4 (**Table 6**)

Table 6: Summary of the result of the study area with application of Levels 1 to 4 of the Classification System for Wetlands and Other Aquatic Ecosystems in South Africa (Ollis, et al., 2013)

Level 1	Level 2	Level 3	Level 4: HGM unit
System	**NFEPA Wetland Vegetation Group**	**Landscape Unit**	**Level 4A**
Inland	Mesic Highveld Grassland Group 4	Slope and Valley Bottom	Artificial wetlands and Unchannelled Valley Bottom

6.4 Difficult to Delineate Wetlands

The guidance provided by Job (2009) is directly relevant to the current study area (Table 7), as the spillway surroundings include several artificial wetland-like features, namely the seepage wetland, the canal leading to the natural wetland, and the artificial wetland overlying the historical diggings. These areas display typical wetland indicators such as hydrophytic vegetation, saturated soils, and signs of surface water retention, yet they are clearly non-natural in origin, having formed due to dam seepage, excavation, or engineered water diversion.

Table 7: List of types of sites that are difficult to delineate. (Jobs, 2009)

Type of "difficult site"	Approach	Relevance to the Study Site and findings
Some or all, wetland indicators are present but is a non-natural wetland (e.g. some dams, road islands)	• Decide on the relative permanence of the change and whether the area can now be said to be functioning as a wetland. • Time field observations during the wet season, when natural hydrology is at its peak, to help to differentiate between naturally occurring versus human-induced wetland. • Decide appropriate policy/management i.e. can certainly land uses be allowed due to "low" wetland functional value, or does the wetland perform key functions despite being artificial.	• The relative permanence of these artificial wetlands suggests that although they now function as wetland systems, their origin and hydrology are entirely anthropogenic. They lack natural catchment processes and geomorphic setting. • Field observations, including current site verification, support the conclusion that these features formed post-construction and are not present in historical imagery (e.g., 1962). Therefore, their classification as natural wetlands is not supported. • From a management and policy perspective, these artificial wetlands are considered to have low ecological functional value. While they may perform limited roles such as water storage or vegetation support, they do not warrant the same level of regulatory protection as natural wetlands. Land use and infrastructure reinstatement within or near these features can proceed with appropriate mitigation, without invoking formal wetland buffers or DWS 500 m regulated areas.

6.5 Wetland Soil and Vegetation

6.5.1 Artificial Seepage Wetland

The artificial seepage wetland adjacent to the LLD spillway is characterised by soils that are persistently moist but do not display redoximorphic features, such as mottling or gleying, which are typical indicators of prolonged anaerobic conditions in natural wetlands. Instead, the soils are uniformly red (**Figure 9**)**,** suggesting a well-drained origin not typically associated with naturally hydromorphic conditions.

Despite the soil limitations, the vegetation is distinctly hydrophytic, with species such as *Juncus rigidus* dominating the permanent (central) zone of the wetland. The edge and temporary zones support a mix of facultative and upland species, including *Cyperus longus*, *Andropogon eucomus*, *Andropogon huilensis*, *Eragrostis gummiflua*, *Haplocarpha scaposa*, *Imperata cylindrica*, *Helichrysum mundtii*, and *Sporobolus africanus*. These species indicate temporary to seasonal saturation and are consistent with wetland fringe vegetation.

Several Alien invasive species (AIS) were recorded both within and adjacent to the wetland. Invasive woody species such as *Acacia mearnsii* and *Eucalyptus* sp. were noted throughout the wetland and surrounding areas. Other AIS included *Pennisetum clandestinum* (kikuyu), *Datura ferox*, and scattered individuals in adjacent upland areas. Terrestrial edge species observed outside the wetland included *Asclepias fruticosa* and *Seriphium plumosum*, indicating a transition into more typical grassland or old-field vegetation types. **Figure 9** gives a general overview of the vegetation and substrate composition.

Figure 9: General Vegetation and substrate composition of the artificial seepage wetland

6.5.2 Artificial Wetland – Previously Disturbed Area

The artificial wetland situated within the area of historical diggings is characterised by permanent standing water, with depths sufficient to submerge woody alien invasive species (AIS) such as *Eucalyptus* spp. and *Acacia mearnsii*. These species, which are not naturally adapted to prolonged inundation, are growing within the central zone of the wetland, indicating that the current water regime is likely more recent and not aligned with their ecological preferences. Despite this, hydrophytic species such as *Persicaria lapathifolia* thrive in these deeper areas, suggesting colonisation by wetland-adapted flora.

In the shallower margins, species such as *Phragmites australis* dominate, forming dense stands. The edges of the wetland include additional AIS such as *Cortaderia selloana* (pampas grass), which is known for its aggressive spread and habitat alteration. Other wetland species present in this artificial system are consistent with those found in the adjacent seepage wetland, including facultative hydrophytes that tolerate seasonal saturation.

The presence of standing water, wetland vegetation, and invasive species confirms that the area has developed wetland characteristics due to artificial modification of hydrology, likely through excavation and water diversion. However, as with the seepage wetland, its origin is clearly anthropogenic, and its functional value is considered limited in terms of natural wetland processes or biodiversity conservation.

Figure 10: General Vegetation and substrate composition of the artificial wetland -Previously Disturbed

6.5.3 Artificial Canal and Dividing Berm

The artificial canal and dividing berm, including the breached area, exhibit clear signs of anthropogenic origin. The canal is straight and engineered, with banks dominated by terrestrial vegetation, including grasses and scattered alien invasive species (AIS). Standing water was observed in both the canal and breached section during the site visit, likely the result of recent rainfall or a spill event. Hydrophytic vegetation was limited within the canal channel itself, with only sparse wetland species present until the point where the canal discharges into the natural unchannelled valley-bottom wetland. At this interface, the vegetation shifts noticeably, with indigenous wetland species such as *Typha capensis* becoming dominant.

The dividing berm was vegetated primarily by grasses and invasive species, similar in composition to the adjacent seepage wetland, and showed signs of trampling by livestock or wildlife, particularly in areas where water had pooled. The soil within the canal channel was dark red and clay-rich, consistent with the soils observed in the artificial seepage wetland, and lacked redoximorphic indicators typically associated with prolonged natural saturation.

These features further support the classification of the canal and berm as artificial and disturbed, functioning primarily as flow diversion structures rather than natural wetland systems. Their ecological integrity is low, although connectivity to the downstream natural wetland warrants attention for broader management purposes.

Figure 11: General Vegetation and substrate composition of the artificial canal and Dividing beam – including breached area

A summary of the dominant vegetation and soil characteristics for a level 6 assessment are described in the table below (**Table 8**).

Table 8: Summary of the Level 6 dominant soil and vegetation characteristics of the wetlands on the study site.

Dominant Descriptor Categories (Level 6)			
6A: Natural vs Artificial	**Vegetation Cover, Form and Status**		
	6A: Veg Cover	**6B, C & D Primary Form**	**6E: Veg Conditions**
Artificial	Vegetated	AIS and Grasses	Largely AIS

7 Watercourse Functional Assessment

In order to reflect a comprehensive suite of assessments appropriate for the watercourse type and characteristics, the following assessments are discussed in the sections below (**Given the** artificial nature of the wetland features associated with the LLD spillway, namely the seepage wetland, the historical diggings area, the artificial canal, and the dividing berm, a full WET-Health assessment is not appropriate. These systems have no natural reference condition, as they originated from anthropogenic activities such as dam seepage, excavation, or flow diversion. Applying WET-Health in this context would yield artificially low Present Ecological State (PES) scores and misrepresent their functional capacity.

Instead, the WET-EcoServices tool (Kotze et al., 2020) was applied to evaluate the combined functional value of these artificial wetlands. This approach focuses on the ecosystem services currently provided—such as flood attenuation, sediment trapping, and limited habitat provision—regardless of the wetland's origin. Grouping the artificial areas into a single functional unit for assessment reflects their shared hydrological influence and degraded, non-natural character.

In addition to EcoServices, the Ecological Importance and Sensitivity (EIS) framework was used to support interpretation of management value. While these systems may not be natural, some may perform limited regulatory or supporting functions in the broader landscape and could inform land-use decisions, particularly where erosion control or water retention is evident.

The Recommended Ecological Category (REC) (Rountree et al., 2013), however, was not applied to these artificial systems, as it is specifically intended for natural wetlands with a defined reference state. Applying the REC to anthropogenic systems would be inappropriate and potentially misleading. Instead, REC is only considered for the natural unchannelled valley-bottom wetland located approximately 320 m downstream of the LLD, which is of natural origin, visible in historical imagery, and ecologically intact enough to warrant formal assessment should future work include it.

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Table 9: Assessments undertaken in the current assessment

Watercourse Type	Assessment Method
Artificial Wetland Areas	• **Ecosystem Services:** WetEcosystem Services V2 (ES) (Kotze *et al*., 2020). • **Ecological Importance and Sensitivity (EIS) -** (Kotze *et al*., 2020) and.

7.1 WetEcoServices Kotze et al. (2020)

The total absence of Moderate or High importance scores confirms that these artificial systems are functionally limited, with no significant ecological, social, or economic value in their current state. While they may retain saturated conditions and support opportunistic wetland vegetation, they do not meaningfully contribute to biodiversity support, hydrological regulation, or ecosystem services typically expected from natural wetland systems (**Table *10***).

Table 10: Summary of the Ecosystem Services provided by the *Artificial Wetlands*

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.0	0.3	0.0	Very Low
	Stream flow regulation	0.0	0.3	0.0	Very Low
	Sediment trapping	1.0	0.5	0.0	Very Low
	Erosion control	0.5	1.0	0.0	Very Low
	Phosphate assimilation	0.8	0.8	0.0	Very Low
	Nitrate assimilation	0.5	0.8	0.0	Very Low
	Toxicant assimilation	0.8	0.8	0.0	Very Low
	Carbon storage	1.6	0.0	0.1	Very Low
	Biodiversity maintenance	0.3	1.0	0.0	Very Low
PROVISIONING SERVICES	Water for human use	0.0	1.3	0.0	Very Low
	Harvestable resources	2.0	0.3	0.7	Very Low
	Food for livestock	1.5	0.7	0.3	Very Low
	Cultivated foods	1.4	0.0	0.0	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.3	0.0	0.0	Very Low
	Education and Research	0.3	0.0	0.0	Very Low
	Cultural and Spiritual	2.0	0.0	0.5	Very Low

7.2 Ecological Importance and Sensitivity (EIS) (Rountree, et al., 2013)

The Ecological Importance and Sensitivity (EIS) score forms part of a larger assessment called the Importance and Sensitivity scoring system which also addresses hydrological importance and direct human benefits. Both EC and EIS form part of a larger reserve determination process documented by the Department of Water and Sanitation.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (Rountree, et al., 2013). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use.

The highest EIS score of 2.6 **falls in the Low Category** Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers.

- ***Biodiversity maintenance importance***: **0.7 (Very Low)**
- ***Regulating services importance*: 0.1 (Very Low)**
- ***Provisioning and cultural services importance:* 0.5 (Very Low)**

7.3 Summary of Findings

The Following table (**Table *11***) is a summary of the functional assessment for the wetlands within the study site.

Table 11: Summary of wetland functionality.

Classification	Artificial Wetland Areas
WetEcoServices	Very Low for all metrics
EIS (Kotze *et al.*, 2020)	**Low Category -** Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers.

8 General Principles of Watercourse Protection (SANBI & DWS, 2016)

1. **Avoid/Prevent:** This is the highest priority in the hierarchy and involves avoiding or preventing impacts to watercourses altogether. It focuses on identifying and selecting alternative actions or locations that do not pose a risk to watercourses. This may involve changing the design or selecting a different site altogether to avoid potential negative impacts.
2. **Minimise**: If avoidance is not possible, the next step is to minimize the potential impacts on watercourses. This involves employing measures and techniques to reduce the extent, magnitude, duration, or intensity of the impacts. Examples include implementing erosion and sediment control measures, using best management practices for stormwater management, and adopting sustainable water use practices.
3. **Rehabilitate**: If impacts occur despite avoidance and minimisation efforts, the next step is to rehabilitate or restore the affected watercourses. This involves taking actions to improve the ecological, hydrological, and geomorphological functions of the impacted areas. It may include restoring natural vegetation, improving water quality, stabilising banks, and enhancing habitat for aquatic species.
4. **Offset:** If complete avoidance, minimisation, or rehabilitation is not feasible or insufficient to mitigate the impacts, offsetting measures can be considered. Offset measures aim to compensate for the residual impacts by restoring or creating new watercourse features elsewhere. This may involve creating or enhancing watercourses, establishing buffer zones, or implementing other habitat restoration projects to achieve a net benefit for watercourses and their associated ecosystems. This should be discussed with the relevant authorities, and if deemed necessary an offset plan should be developed and approved.

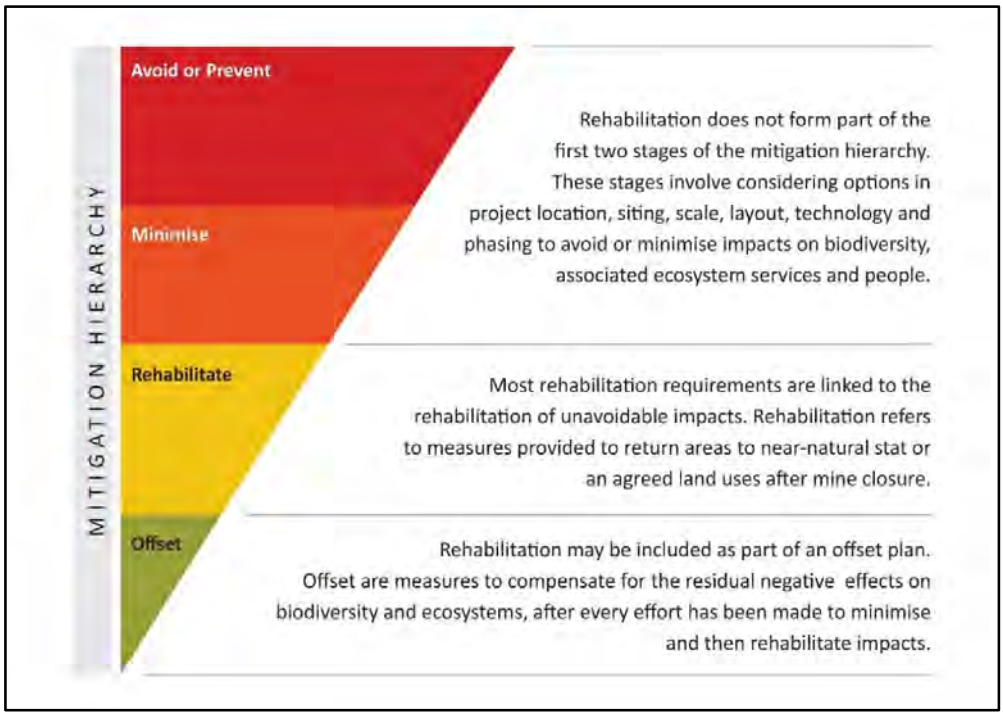

Figure 12: Mitigation Hierarchy (SANBI, 2016)

In terms of this project, which involves the reinstatement of the Low Level Dam (LLD) spillway and associated infrastructure at Duvha Power Station, the development aligns with the mitigation hierarchy as follows:

8.1 Avoidance

Where possible, the project has been designed to avoid direct impact on any natural wetland systems. All construction activities are restricted to a highly disturbed and artificial footprint, including the LLD spillway, canal, berm, and seepage wetland. The only natural wetland in proximity, the unchannelled valley-bottom wetland located ±320 m from the activity zone, falls outside the 100 m buffer and is not physically or hydrologically altered by the proposed works. No new infrastructure is placed within or directly adjacent to this natural feature.

8.2 Minimisation

Impacts within the artificial wetland areas should be limited through standard construction-phase controls, such as:

- Timing construction during the dry season to reduce soil disturbance and erosion risk;
- Stabilising exposed surfaces and stockpiles;
- Installing erosion protection (e.g., *Armorflex*, Reno mattresses) to reduce downstream sedimentation;
- Ensuring machinery remains within designated areas to prevent unnecessary trampling or vegetation removal.

The engineered design also improves the dam's resilience to high rainfall events, reducing the risk of uncontrolled spills that could affect downstream ecosystems.

8.3 Rehabilitation

Post-construction, any temporarily disturbed areas (e.g. berm realignments, access tracks) will be stabilised and re-vegetated using appropriate, preferably indigenous, grass species to reduce erosion risk. While the artificial wetlands themselves are not targeted for ecological rehabilitation, the surrounding disturbed soils will be shaped and compacted to promote stability and passive recovery.

8.4 Offsetting

No residual impact on natural aquatic ecosystems is anticipated; therefore, no biodiversity offsets are required. All construction occurs within artificial or heavily modified environments with very low ecological value, as confirmed by the WET-EcoServices assessment.

9 Impacts

The reinstatement of the Low Level Dam (LLD) spillway and associated infrastructure has the potential to result in several impacts on the surrounding environment if no mitigation measures are applied. While the development footprint is confined to disturbed and artificial areas, the nature of the works, particularly involving excavation, concrete placement, and vegetation clearance

9.1 Site Specific Impacts

The anticipated operational and construction impacts of the proposed project on watercourses are summarised in the table below (**Table *12***).

Table 12: Anticipated Construction and Operational Phase Impacts.

Impact	Description	Phase	Consequence
Soil disturbance and erosion	Excavation may expose soil, leading to erosion and sedimentation in adjacent wetlands	Construction	Increased sediment load, downstream siltation, and habitat smothering
Vegetation loss	Clearance of wetland and berm vegetation, including hydrophytes and terrestrial species	Construction	Loss of limited habitat and reduction in ecosystem services
Water quality degradation	Runoff may carry sediment, concrete residues, and hydrocarbons into surface water	Construction	Temporary deterioration in water quality affecting aquatic biota
Disturbance to wetland fauna	Noise, vibration, and habitat removal may displace amphibians, birds, or invertebrates	Construction	Temporary faunal displacement from artificial wetlands
Flow disruption during works	Incomplete or blocked spillway may alter flow paths during rain or overflow events	Construction	Increased risk of uncontrolled discharge into natural wetland
Spread of alien invasive species (AIS)	Soil disturbance may promote regrowth or spread of invasive species in and around the site	Construction & Post-construction	Increased AIS density, competition with indigenous vegetation

10 Opportunities and Constraints

The reinstatement of the LLD spillway and associated infrastructure presents both opportunities and limitations within the broader environmental and operational context. While the site is highly disturbed and largely artificial in nature, providing flexibility for construction without affecting natural wetlands, there are still ecological and operational considerations that must guide project planning. The table below outlines key aspects, associated opportunities, and constraints identified during the assessment (**Table 13**):

Table 13: Opportunities and Constraints

Aspect	Opportunities	Constraints
Site condition	Existing disturbance and artificial wetlands minimise ecological sensitivity of the construction area	Limited ecological value may lead to misunderstanding of functional roles of some features
Wetland origin	Artificial nature allows flexibility in design and management without contravening wetland regulations	Cannot be treated as natural systems for offset or rehabilitation obligations
Proximity to natural wetland	Natural wetland is located ~320 m away, outside the buffer—avoiding direct impact	Indirect impacts from future spills must still be carefully managed
Hydrology	Opportunity to restore spillway function and manage flood risk through controlled discharge	Temporary risk of flow disruption or erosion during construction
Alien invasive species (AIS)	Invasive vegetation can be cleared and managed as part of rehabilitation	High existing AIS load may promote re-establishment without follow-up management
Ecological service provision	Potential to enhance ecosystem services (e.g. erosion control) through design improvements	Current wetland services are very low—limited baseline for functional gain

11 Cumulative Impacts

As required by the Department of Forestry, Fisheries and the Environment (DFFE) under the **National Environmental Management Act (NEMA), 1998 (Act No 107 of 1998)** and its associated EIA Regulations (as amended), all proposed developments must consider not only direct project-specific impacts, but also cumulative impacts that may arise when added to other past, present, or reasonably foreseeable future activities in the area. The table below identifies key cumulative impacts relevant to this project, their potential ecological consequences, and mitigation strategies to ensure compliance with DFFE's cumulative assessment expectations. (**Table *14***).

The verified environmental sensitivities, including the distinction between highly sensitive natural wetlands and medium-sensitivity artificial wetland features, were used to spatially contextualise cumulative pressures within the broader catchment and downstream environment. Identified cumulative pressures such as hydrological alteration, sediment mobilisation, alien invasive species proliferation, and habitat fragmentation were evaluated against the ecological condition and sensitivity of these aquatic systems.

The specialist-recommended mitigation measures, including maintenance of controlled flow regimes, retention of buffer zones around natural wetlands, erosion and sediment control, and alien invasive species management, were then applied to the cumulative impact pathways to assess their effectiveness in limiting incremental degradation. These mitigation measures directly informed the post-mitigation cumulative impact significance ratings reflected in the risk assessment tables.

The conclusions drawn in the cumulative impact assessment therefore do not rely on generic assumptions, but are directly derived from verified site sensitivities, specialist impact findings, and the feasibility of mitigation within an already modified operational landscape.

11.1 Cumulative Impact Significance and Influence on Need and Desirability

The cumulative impact assessment indicates that, without mitigation, continued hydrological modification and physical disturbance would contribute incrementally to the degradation of downstream wetland functioning and ecosystem service delivery. However, when the specialist mitigation measures are implemented, cumulative impacts are assessed as low to moderate in significance, given that:

- The proposed works occur largely within an existing, modified aquatic and infrastructural footprint.
- No additional transformation of intact, highly sensitive natural wetlands is proposed.
- The development includes measures that stabilise flows and reduce uncontrolled erosion and sediment input relative to the existing condition.

As such, the post-mitigation cumulative impact significance does not preclude the proposed development and supports the need and desirability of the project, particularly where the intervention contributes to infrastructure safety, operational efficiency, and improved management of hydrological processes within an already transformed system.

11.2 Cumulative Impact Environmental Statement

Based on the cumulative impact assessment undertaken, and taking into account the verified environmental sensitivities, specialist recommendations, and proposed mitigation measures, it is concluded that the proposed development may proceed, provided that:

- No further encroachment into natural, highly sensitive wetland areas occurs;
- Specialist-recommended mitigation measures are fully implemented and maintained; and
- Ongoing monitoring is undertaken to identify and respond to cumulative downstream effects over time.

Under these conditions, the proposed development is not expected to result in unacceptable cumulative environmental impacts and is considered environmentally justifiable within the context of the existing modified landscape

Table 14: The cumulative impacts of the proposed development*

Cumulative Impact	Description of Impact	Cumulative Effect	Potential Result	Mitigation
Continued modification of hydrology	Ongoing dam operations, spillway modification, and artificial canals alter flow patterns	Incremental loss of natural hydrological function downstream	Degradation of downstream wetland functioning and ecological integrity	Maintain controlled flow regimes; monitor downstream impacts; avoid further channelisation
Increase in alien invasive species	Construction disturbance adds to existing AIS presence in berms and wetlands	Spread and dominance of invasive species across the broader wetland and grassland matrix	Loss of indigenous biodiversity; reduced habitat quality	Implement AIS control plan during and post-construction
Sediment and nutrient input	Combined runoff from infrastructure and spillways contributes to sediment/nutrient load	Long-term sedimentation and eutrophication in downstream systems	Decline in water quality; encroachment of aggressive wetland vegetation	Install erosion and sediment controls; maintain vegetation cover
Habitat simplification and fragmentation	Ongoing development fragments aquatic and terrestrial habitat	Cumulative reduction in faunal movement and habitat heterogeneity	Reduced ecological resilience and species richness	Retain buffer zones around natural wetlands; minimise further encroachment
Reduced ecosystem service delivery	Repeated alteration of natural features reduces wetland capacity for service provision	Decline in regional flood attenuation, water quality regulation, and biodiversity support	Increased vulnerability to climate extremes and land degradation	Restore functionality in natural systems where possible; prioritise no further transformation

*Notes

1. The cumulative impacts are based on activities within a 30 km radius, aligned with DFFE requirements

12 Mitigation Measures

Mitigation measures are essential to reduce or eliminate potential negative environmental impacts during the planning, construction, and operational phases of the proposed LLD spillway reinstatement. These measures are aligned with the principles of the mitigation hierarchy and aim to preserve downstream ecosystem integrity, manage erosion and invasive species, and ensure that artificial wetlands are not further degraded during the course of the project. The table below outlines the key objectives and corresponding measures for each project phase (**Table 15**):

Table 15: Mitigation plan.

Project Phase	Mitigation Objective	Mitigation Measures
Pre-construction	Minimise impact through effective planning	• Demarcate the construction footprint to avoid unnecessary disturbance • Clearly map artificial vs natural features- Prepare AIS control and monitoring plan
Construction	Prevent soil erosion and sedimentation	• Apply erosion controls (e.g., silt fences, straw bales) • Stabilise exposed soils promptly • Avoid working during heavy rainfall periods
	Maintain water quality	• Store fuels and chemicals in bunded areas • Prevent concrete runoff from entering wet areas • Regularly inspect vehicles for leaks
	Minimise vegetation and habitat loss	• Restrict machinery to defined access routes • Stockpile and re-use topsoil where feasible • Re-vegetate disturbed areas post-construction
	Control spread of alien invasive species	• Remove AIS manually or with approved herbicide methods- • Avoid transporting contaminated soil/materials between sites
	Avoid indirect impact on natural wetland	• Maintain 100 m buffer from natural wetland • Prevent unregulated water release during works
Post-construction	Restore stability and vegetation	• Shape and compact disturbed areas • Seed with indigenous grass species • Monitor erosion-prone areas
Operational	Long-term prevention of AIS resurgence	• Implement regular follow-up AIS control • Conduct inspections after seasonal rains • Include AIS monitoring in operational management plans

13 Rehabilitation

Rehabilitation in this document refers to the reinstatement of disturbed areas affected by the construction or due to construction and operational related activities, to a state that resemble the conditions prior to the disturbances. It therefore does not address the rehabilitation of the wetlands and riparian areas downstream of the study site from example a management category E to a D (Kleynhans, et al., 2007). The following table describes the rehabilitation suggested for the proposed abstraction (**Table 16**). Rehabilitation aims to restore the stability, functionality, and visual integrity of areas disturbed during construction. Given the project's location within artificial and already modified environments, rehabilitation will focus primarily on stabilising soils, preventing erosion, and managing alien invasive species (AIS). Ecological restoration is not required for the artificial wetlands, but basic functional rehabilitation will ensure that no further degradation occurs and that the area blends into the surrounding landscape post-construction.

Table 16: Rehabilitation plan.

Impact	Rehabilitation	Time Frame
Disturbed soils and embankments	Reshape and compact berms and spillway banks; apply erosion control (e.g., mulch, geo-fabric)	Immediate (within 2 weeks post-construction)
Vegetation clearance	Re-vegetate using indigenous grass species suited to disturbed soils (e.g., *Eragrostis* spp.)	Planting during the first suitable rainfall window after construction
Loss of topsoil	Replace stockpiled topsoil in disturbed zones; scarify and seed	Concurrent with re-vegetation
AIS colonisation post-disturbance	Remove regrowth of *Acacia mearnsii*, *Eucalyptus*, *Cortaderia selloana*, and *Pennisetum clandestinum*	Ongoing; first follow-up within 3 months, then seasonally for 2 years
Trampled or compacted areas	Loosen compacted soils and re-seed; restrict future access	Immediate; monitor quarterly until vegetation establishes
Visual and landscape impact	Blend reshaped surfaces with surrounding topography and vegetation cover	Within 1 month post-construction

14 GN320 Impacts on the Aquatic Environment

A discussion on impacts to the aquatic environment (as required in GN320 of March 2020) is summarised in **Table 17**The numbers (e.g., 2,5,3) refer to specific impact categories outlined in GN320 of March 2020, which guides the assessment of impacts on watercourses. These numbers correspond to predefined sections in the Government Notice that categorise different types of ecological impacts. In this context, they indicate that the impact assessment addresses:

- (2) Impacts on hydrological processes, including changes to flood regimes, floodplain connectivity, and groundwater interactions.
- (5) Impacts on ecosystem functioning and resilience, particularly how the proposed development may alter wetland or riparian dynamics.
- (3) Impacts related to sediment transport, erosion control, and other geomorphological changes.

Table 17: Impacts as per GN320 of March 2020.

Number	Impact question	Expected impact	Mitigation Measures
2,5,3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site?		
	a) Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding, or destruction of floodplain processes);	The development is located within an artificial, off-channel dam system and will not significantly alter the broader landscape-scale hydrological regime. However, during construction, temporary disruption of controlled overflow pathways could occur, potentially affecting downstream hydrology if unmanaged.	• Ensure controlled discharge remains operational during construction. • Schedule works outside peak rainfall season. • Monitor downstream flows to prevent unseasonal releases.
	b) Change in the sediment regime (e.g. sand movement, meandering river mouth /estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub -catchment;	Minimal long-term change is expected. Short-term increased sedimentation risk may arise from excavation of the spillway and berm removal. Sediment could be transported to artificial wetlands or, in extreme events, reach downstream natural wetlands.	Apply erosion control measures (e.g., silt fences, hay bales). - Stabilise excavated areas promptly. - Monitor turbidity during and after rain events.

Number	Impact question	Expected impact	Mitigation Measures
	c) The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary, seasonal, permanent zone, of a wetland, in the riparian zone, or within the channel of a watercourse, etc.).	All modifications are confined to artificial systems—seepage wetland, canal, berm, and diggings area. No work occurs within the natural wetland or its seasonal/permanent zones. Thus, the extent of modification is limited to degraded/artificial areas.	Maintain a 100 m buffer to the natural wetland. - Clearly demarcate construction zones. - Avoid any direct runoff pathways to the natural system.
	d) The extent to which the risk associated with water uses and related activities change.	There is a temporary increase in risk during construction due to possible sedimentation, uncontrolled spills, and pollutant mobilisation. However, the completed project will likely reduce long-term risk by restoring spillway capacity and preventing uncontrolled overflow events.	Maintain on-site environmental control measures. - Supervise handling of fuels, cement, and waste. - Ensure post-construction erosion protection (e.g., Reno mattresses, Armorflex) is implemented and maintained.
2,5,4	How will the proposed development impact on the functioning of the aquatic feature? This must include:		
	a) Base flows (e.g. too little/ too much water in terms of characteristics and requirements of system)	Negligible impact expected. The project does not alter the natural flow regime of any river or stream. The LLD is an artificial off-channel system, and the reinstatement of the spillway will maintain existing baseflow conditions.	N/A
	b) Quantity of water, including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or offstream impoundment of a wetland or river)	The reinstatement of the spillway is expected to restore controlled overflow and reduce risk of unregulated discharge. There is no change in hydroperiod or water abstraction proposed.	N/A

Number	Impact question	Expected impact	Mitigation Measures
	c) Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland)	No change in HGM type will occur. All work is within artificial features; the downstream natural wetland remains unaltered. The artificial canal will continue to discharge into the unchannelled valley-bottom wetland.	N/A
	d) Quality of water (e.g. due to increased sediment load, contamination by chemical and /or organic effluent, and/ or eutrophication)	Temporary deterioration in water quality may occur during construction due to sediment release or accidental pollution. Long-term, the restored spillway will reduce uncontrolled erosion	Implement best practice erosion and pollution controls during construction (e.g., bunded storage, silt fencing). - Prevent construction runoff from entering the canal or seepage wetland.
	e) Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal)	No additional fragmentation will occur. The site is already artificial and hydrologically modified. No new roads or linear infrastructure intersect natural features.	N/A
	f) The loss or degradation of all or part of any unique or important features (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.) associated with or within the aquatic ecosystem	No unique or important aquatic features (e.g. springs, peat, oxbows) are present within the construction area. The natural wetland is not modified and lies >300 m from the activity footprint.	N/A
2,5,5,	How will the proposed development impact on key ecosystem regulating and supporting services? In particular:		
	a) Flood attenuation	Neutral to positive. The reinstatement of the spillway will restore controlled overflow capacity, reducing the risk of unregulated overtopping. While the artificial wetlands provide minimal attenuation value, the project may slightly improve upstream flood management.	N/A
	b) Stream flow regulation	Negligible impact. The project does not influence stream baseflow, nor does it intersect a perennial or ephemeral	N/A

Number	Impact question	Expected impact	Mitigation Measures
		river. The artificial wetlands are not connected to long-term streamflow regulation processes.	
	c) Sediment trapping and g) Erosion Control	Short-term negative, long-term neutral to positive. Earthworks may mobilise sediments temporarily, but installation of erosion protection (Armorflex, Reno mattresses) will stabilise key areas, especially downstream of the weir.	Apply sediment and erosion control measures during construction. - Maintain vegetation on berms post-construction.
	d) Phosphate assimilation	Negligible to very low impact. Artificial wetlands currently show very limited capacity for nutrient assimilation. The development will not alter nutrient inputs or improve wetland function significantly	N/A
	e) Nitrate assimilation		
	f) Toxin assimilation		
	h) Carbon Storage	Negligible change. The project may temporarily disturb vegetated areas, but the biomass loss is minimal. The artificial wetlands have very low carbon storage capacity.	N/A

15 Government Notices (GN) 1150 of 2020 and 3717 of 2023

Additionally, the report was conducted in terms of the Government Notices (GN) 1150 of 2020 and 3717 of 2023 which outlines the protocols for specialist assessments and minimum report content requirements for environmental impacts on aquatic animal species in South Africa.

- GN 1150 of 2020: This notice establishes the initial protocols for conducting specialist assessments concerning aquatic animal species. It specifies the necessary qualifications for specialists, the methodologies to be employed during assessments, and the essential content that must be included in environmental reports. The aim is to ensure that assessments are thorough, standardized, and provide sufficient information for decision-making processes.

- GN 3717 of 2023: This notice serves as an amendment to the original protocols established in GN 1150 of 2020. The amendments may include updates to assessment methodologies, reporting requirements, or other relevant procedures to reflect current best practices and scientific understanding.

The following table indicated the impacts as per GN1150 of 2020 and GN3717 of 2023 (**Table *18***).

Table 18: Impacts as per GN1150 of 2020 and GN3717 of 2023

Number	Impact Question	Expected Impact	Mitigation Measures
2,5,3	**How will the development impact aquatic animal species and their habitat?**	The proposed development is confined to artificial aquatic systems—including the seepage wetland, canal, and historical diggings area—which have limited habitat value for aquatic fauna. These systems are largely disturbed, dominated by alien vegetation, and lack the structural complexity typical of natural wetland habitats. As such, the loss or alteration of habitat during construction is expected to have negligible ecological consequence. The natural unchannelled valley-bottom wetland, which could support a more diverse aquatic community, lies over 300 m away and will not be physically impacted by the project.	To minimise even these low-level impacts: • Vegetation clearing should be phased and preceded by a brief inspection for nesting birds, amphibians, or large invertebrate aggregations; • Where feasible, shallow pools with vegetation can be retained or reinstated post-construction; • Ensure construction runoff does not degrade water quality in adjacent areas that may serve as refuge habitat.
2,5,4	**How will the development impact aquatic animal species directly?**	Direct impacts to aquatic fauna—such as amphibians, aquatic invertebrates, and opportunistic wetland birds—are likely to be minimal and temporary, limited to: • Disturbance from noise and human activity; • Temporary loss of shallow water zones within the artificial wetlands during excavation; • Possible trampling or displacement of fauna during vegetation clearing. Given the degraded nature of the artificial systems, the fauna present are expected to be common, disturbance-tolerant species with high mobility or resilience. •	

16 Site Sensitivity Verification and Minimum Report Content Requirements

In accordance with the requirements of Government Notice No. 320 of 20 March 2020, a site sensitivity verification was undertaken prior to, and in support of, the aquatic specialist assessment. The purpose of this process was to verify the current land use and environmental sensitivities identified by the national environmental screening tool and to ensure that the specialist assessment is informed by confirmed site conditions. The site sensitivity verification process and outcomes are summarised in **Table *19*** below.

Table 19: Site Sensitivity Verification in accordance with GN 320 (20 March 2020)

GN 320 Requirement	Compliance Response
Requirement: Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site identified by the screening tool must be confirmed by undertaking a site sensitivity verification	A site sensitivity verification was undertaken prior to the aquatic biodiversity and wetland assessment to verify the land use and aquatic sensitivities identified by the environmental screening tool. The verification focused on aquatic features associated with the existing low-level dam, spillway, downstream channel, and associated wetland areas within the development footprint.
2.1 The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist	The site sensitivity verification was undertaken by a suitably qualified aquatic specialist registered with the South African Council for Natural Scientific Professions (SACNASP), with demonstrated experience in aquatic biodiversity assessments, wetland delineation, and regulatory compliance.
2.2(a) Desktop analysis using satellite imagery	A desktop verification was conducted using recent and historical aerial and satellite imagery, topographical mapping, and available spatial datasets. This analysis verified the spatial extent of natural wetland areas, artificial or modified wetland features associated with historical infrastructure, and the surrounding land use context.
2.2(b) Preliminary on-site inspection	A preliminary site inspection was undertaken to ground-truth the desktop findings and confirm current site conditions. The inspection verified the presence, condition, and degree of modification of both natural wetland areas and artificial wetland features, as well as the extent of instream and riparian disturbance associated with existing infrastructure.
2.2(c) Other available and relevant information	Additional relevant information reviewed included existing specialist studies, project documentation, regulatory guidance, and photographic records. These sources were used to contextualise the origin, function, and condition of natural versus artificial wetland components within the study area.
2.3(a) Confirmation or dispute of current land use and environmental sensitivity identified by the screening tool	The site sensitivity verification confirmed the presence of both natural and artificial wetland components within the study area. Natural wetland and their buffer areas were verified as highly sensitive due to their ecological functioning, hydrological connectivity, and biodiversity value. Artificial or engineered wetland areas associated with historical infrastructure were verified as having a medium sensitivity, reflecting their modified origin, reduced ecological integrity, and partial reliance on anthropogenic hydrological inputs.
2.3(b) Motivation and evidence (e.g. photographs) supporting the verified or revised sensitivity	The differentiation in sensitivity is supported by site observations, photographic evidence, and interpretation of satellite imagery, which collectively demonstrate intact hydrological and vegetative characteristics in natural wetland areas, contrasted with structural modification, altered flow regimes, and simplified vegetation assemblages in artificial wetland features.
2.3(c) Submission together with the relevant assessment report in accordance with the EIA Regulations	This site sensitivity verification is documented as part of the aquatic specialist assessment report and is submitted in support of the Basic Assessment Report in accordance with the Environmental Impact Assessment Regulations, 2014 (as amended). The verified sensitivity classifications directly inform the impact assessment and mitigation measures presented in subsequent sections of this report.

17 Shangoni Risk Assessment Criteria (Revision 2)

Table 20 indicates the impact scores for the potential impacts relevant to the proposed activities. These impacts include aspects of the aquatic environment as specified in GN350 of March 2022. The laydown area is not located close to any natural wetland and is thus unlikely to have an impact on any watercourse.

Table 20: Shangoni Risk Assessment for the proposed development.

No	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post-mitigation		
								Probability	Magnitude	Significance		Probability	Magnitude	Significance
1	Impacts to hydrological function at a landscape level	Operational phase.	The sources of this impact include the compaction of soil, the removal of vegetation, surface water redirection, changes to watercourse morphology or input of high energy surface water which could occur during construction and operation of the mining development.	Reversible	Low Degree	Construction, Operational	Local and Downstream	2	2	Low	Preventative,	1	1	Low

No	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post-mitigation		
								Probability	Magnitude	Significance		Probability	Magnitude	Significance
2	Sedimentation	All Activities	Construction and maintenance activities will result in earthworks and soil disturbance as well as the disturbance of natural vegetation. This could result in the loss of topsoil, sedimentation of the watercourses and pan and increase the turbidity of the water. Possible sources of the impacts include: • Earthwork activities during construction • Clearing of surface vegetation will expose the soils, which in rainy events would wash through the watercourse, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive trees can spread easily into these eroded soil. • Disturbance of soil surface • Disturbance of slopes through creation of roads and tracks adjacent to the watercourse • Erosion (e.g. gully formation, bank collapse)	Reversible	Low Degree	Construction and Operational	Local and Downstream	2	2	Low	Preventative	1	1	Low

No	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post-mitigation		
								Probability	Magnitude	Significance		Probability	Magnitude	Significance
3	Introduction and spread of alien vegetation.	All Activities	The moving of soil and vegetation resulting in opportunistic invasions after disturbance and the introduction of seed in building materials and on vehicles. Invasions of alien plants can impact on hydrology, by reducing the quantity of water entering a watercourse, and outcompete natural vegetation, decreasing the natural biodiversity. Once in a system alien invasive plants can spread through the catchment. If allowed to seed before control measures are implemented alien plans can easily colonise and impact on downstream users.	Reversible	Low Degree	Construction and Operational	Local Area	2	2	Low	Preventative	1	1	Low
4	Loss and disturbance of watercourse habitat and fringe vegetation.	Operational and maintenance activities	Loss and disturbance of watercourse habitat and fringe vegetation due to direct development on the watercourse as well as changes in management, fire regime and habitat fragmentation	Reversible	Low Degree	Construction and Operational	Local Area	2	2	Low	Preventative,	1	1	Low

No	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post-mitigation		
								Probability	Magnitude	Significance		Probability	Magnitude	Significance
5	Changes in water quality	Operational and maintenance activities	Changes in water quality due to input of foreign materials e.g. due to increased sediment load, contamination by chemical and /or organic effluent, and /or eutrophication. Construction and operational activities may result in the discharge of solvents and other industrial chemicals, leakage of fuel/oil from vehicles and the disposal of sewage resulting in the loss of sensitive biota in the wetlands/rivers and a reduction in watercourse function.	Reversible	Low Degree		Local and Downstream	2	2	Low	Preventative	1	1	Low

No	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post-mitigation		
								Probability	Magnitude	Significance		Probability	Magnitude	Significance
6	Loss of aquatic biota	Operational and maintenance activities	Loss of instream habitat, deposition of wind-blown sand, loss of fringing vegetation and erosion, alteration in base flow, natural fire regimes and subsequent loss of non-marginal and marginal vegetation. Increase in invasive species due to disturbance. Change in water quality. Changes in flow Loss and disturbance of biota due to direct development on the watercourse as well as changes in habitat including water quality, the water column, increased sediment, increased alien vegetation fire regime and habitat fragmentation	Reversible	Low Degree	Construction and Operational	Local and Downstream	2	2	Low	Preventative and Reduction	1	1	Low
Table 14	Cumulative Impacts	Operational and maintenance activities	Continued modification of flow regimes through dam operations, spillway infrastructure, and artificial channels contributes incrementally to the loss of natural hydrological functioning downstream, with associated degradation of wetland ecological integrity.	Reversible	Low Degree	Construction and Operational	The cumulative impacts are based on activities within a 30 km radius, aligned with DFFE requirements	2	2	Low	Preventative and Reduction	1	1	Low

18 DWS (2024) Risk Assessment

In accordance with the requirements of Government Notice 509 of 2016, as amended by GN 509 of 2023, a Risk Assessment Matrix (RAM) was completed to evaluate the level of risk associated with the proposed water use activities under Section 21 (a), (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998). The RAM assesses both the construction, operational, and decommissioning phases of the proposed abstraction infrastructure, including riverbed excavation, berm construction, pump installation, and the abstraction of water from the Hex River (**Table *21***). Although the proposed development is confined to artificial and highly disturbed aquatic features and lies more than 300 metres from any natural wetland, the DWS Risk Assessment Matrix (RAM) has been completed as a precautionary measure to support transparent decision-making and regulatory alignment. Strictly speaking, the DWS RAM is not required for artificial systems that do not constitute natural watercourses under the National Water Act (Act 36 of 1998).

Low Risk category: The risk and impact on watercourses are acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.

Table 21: The severity score derived from the DWS (2023) risk assessment matrix for the proposed development

Phase	Activity	Impact	Potentially affected watercourses		
			Name/s	PES	Overall Watercourse Importance
CONSTRUCTION	Earthworks and vegetation clearance (includes excavation of berm, spillway reshaping, and canal/breach work)	Soil disturbance and erosion	Artificial Wetland	F	Low / Very low
		Loss of vegetation and associated wetland habitat	Artificial Wetland	F	Low / Very low
		Temporary sedimentation in artificial wetlands	Artificial Wetland	F	Low / Very low
	Construction and installation of infrastructure (includes concrete works, weir, erosion control)	Localised water quality deterioration (e.g. cement residue)	Artificial Wetland	F	Low / Very low
		Alteration of wetland-like habitats	Artificial Wetland	F	Low / Very low
		Disturbance to opportunistic aquatic fauna	Artificial Wetland	F	Low / Very low
OPERATIONAL	Functioning of the reinstated spillway and weir	Improved control of overflow, reducing uncontrolled discharges	Artificial Wetland	F	Low / Very low
	Maintenance and access post-construction	Periodic disturbance from vehicles or machinery	Artificial Wetland	F	Low / Very low
		Possible regrowth of AIS if unmanaged	Artificial Wetland	F	Low / Very low
Cumulative Impacts	Cumulative Impacts	Cumulative Impacts as per table 14	Artificial Wetland	F	Low / Very low

Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
Abiotic Habitat (Drivers)			Biota (Responses)											
Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
1	1	1	1	1	2	1	2	5	2	10	80%	8	L	Medium
1	1	1	1	1	2	1	2	5	2	10	80%	8	L	Medium
1	1	1	1	1	2	1	2	5	2	10	80%	8	L	Medium
1	1	1	1	1	2	1	2	5	2	10	80%	8	L	Medium
1	1	1	1	1	2	1	2	5	2	10	80%	8	L	Medium
1	1	1	1	1	2	1	2	5	2	10	80%	8	L	Medium
-2	-2	0	-1	-2	0	1	2	3	2	6	60%	3.6	L	Medium
1	1	1	1	1	2	1	2	5	2	10	60%	6	L	Medium
1	1	1	1	1	2	1	2	5	2	10	60%	6	L	Medium
1	1	1	1	1	2	1	2	5	2	10	40%	4	L	Medium

19 Conclusion

The proposed reinstatement of the Low Level Dam (LLD) spillway and associated infrastructure at Duvha Power Station is a necessary intervention to restore safe discharge capacity, ensure compliance with dam safety regulations, and reduce the long-term risk of uncontrolled overflow. The development footprint is entirely confined to artificial or heavily modified features, including the seepage wetland, canal, dividing berm, and the disturbed wetland overlying historical diggings. These features, while exhibiting wetland-like characteristics, are of anthropogenic origin and were confirmed to have very low ecological and functional value based on the WET-EcoServices assessment.

No direct impacts on natural wetlands or watercourses are anticipated. The nearest natural unchannelled valley-bottom wetland lies approximately 320 m from the activity footprint and remains outside both the calculated and conservative buffer zones. As such, no triggers under Section 21(f) or (g) of the National Water Act apply, and Section 21(c) and (i) are considered only as a precaution due to the proximity of engineered water features. The natural wetlands are confirmed to be highly sensitive as indicated in the screening report, the artificial wetlands are less sensitive but does contribute to some extent to ecosystem services.

All potential impacts are limited, localised, and temporary, and can be effectively mitigated through standard best-practice construction and rehabilitation measures. Long-term, the project is expected to reduce operational risk, enhance flow control, and prevent further degradation of surrounding artificial wetlands. As such, the development is considered environmentally acceptable and aligned with national policies on sustainable water resource management and climate adaptation.The important factors, relevant to Environmental Authorisation for the proposed project, are summarised in **Table *22*** below:

Table 22: Summary of the findings.

Quaternary Catchment and WMA areas	B11G Limpopo-Olifants (LOCMA) #2 - Olifants: Major rivers include Elands, Wilge, Steelpoort, Olifants and Letaba Rivers
Watercourse	The primary watercourse feature is the Low Level Dam (LLD), an artificial off-channel ash return dam. Although mapped as a wetland in the NFEPA and NBA2018 datasets, it does not represent a natural wetland system but rather an engineered containment structure with wetland-like characteristics. Downstream of the LLD, the spillway channel connects to a valley-bottom wetland associated with a non-perennial river. This wetland drains into the Witbak Dam. • NBA (2018) list the watercourses as **Vulnerable** • NFEPA (2011) list the watercourses as **Vulnerable**
Classification (SANBI, 2013)	Artificial Wetland Areas
WetEcoServices	Very Low for all metrics
EIS (Kotze, et al., 2020)	**Low Category -** Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers
Coj Generic Buffer and Calculated Buffer Zone (Macfarlane *et al,* 2015)	**Calculated Buffer Zone: 44 m** **Conservative Buffer: 100 m** **Artificial Wetland Areas: No Buffer**
DWS 2024 Risk Assessment	Risk scores fall in the **Low category**
National Screening Tool Findings	This study confirms that the natural wetlands are highly sensitive as indicated on the screening report, the artificial wetlands are less sensitive.

APPENDIX A: Requirements for Aquatic Biodiversity Assessments

The NEMA regulations of 2014 (as amended) specify required information to be included in specialist reports. **Table 23** presents a summary of these requirements, in accordance with GNR982, as amended by GN326. In March 2020, the Department of Environmental Affairs issued General Notice 320 which set out requirements of the EIA Screening Tool Protocols for the Assessment and Reporting of Environmental Themes, including Aquatic Biodiversity. These specifications overlap somewhat with the 2014 EIA regulations, as amended (GN 982 as amended by GN326). **Table 24** presents a summary of the requirements of this protocol, with notes on sections of this report applicable to each aspect. Additionally, Protocols to Follow as per GN 1150 of 2020, as Amended by GN 3717 of 2023 is indicated in **Table *25***.

Table 23: Legislative report requirements GNR982

GNR982 as amended by GN326	Report Section
(1) A specialist report prepared in terms of these Regulations must contain—	
(a) details of—	
(i) the specialist who prepared the report; and	Page 3
(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix B
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 1
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	**Table *3***
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2 and Appendix E (Separate Document)

(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	**Figure *8***
(g) an identification of any areas to be avoided, including buffers;	**Figure *8***
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	**Figure *8***
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 8
(k) any mitigation measures for inclusion in the EMPr;	Section 8
(l) any conditions for inclusion in the environmental authorisation;	Section 8
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 8
(n) a reasoned opinion—	
(i) whether the proposed activity, activities or portions thereof should be authorised;	Conclusion
(iA) regarding the acceptability of the proposed activity or activities; and	Conclusion
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Conclusion
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not Applicable
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not Applicable
(q) any other information requested by the competent authority.	Not Applicable
(2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Not Applicable

Table 24: Content of Specialist report GN320

Requirement	Section
2.3.1. a description of the aquatic biodiversity and ecosystems on the site, including; (a) aquatic ecosystem types; and (b) presence of aquatic species, and composition of aquatic species communities, their habitat, distribution and movement patterns;	Section 6.3
2.3.2. the threat status of the ecosystem and species as identified by the screening tool;	**Table *3***
2.3.3. an indication of the national and provincial priority status of the aquatic ecosystem, including a description of the criteria for the given status (i.e. if the site includes a wetland or a river freshwater ecosystem priority area or sub catchment, a strategic water source area, a priority estuary, whether or not they are free-flowing rivers, wetland clusters, a critical biodiversity or ecologically sensitivity area); and	**Table *3***
2.3.4. a description of the ecological importance and sensitivity of the aquatic ecosystem including:	**Table *3***
(a) the description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); and	**Figure *8***
(b) the historic ecological condition (reference) as well as present ecological state of rivers (in- stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel and flow regime (surface and groundwater).	**Figure 7**
2.4. The assessment must identify alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification and which were not considered appropriate.	No alternatives were available during the writing of the report.
2.5. Related to impacts, a detailed assessment of the potential impacts of the proposed development on the following aspects must be undertaken to answer the following questions:	Section 8

2.5.1. Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Section 8
2.5.2. is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?	Section 8
2.5.3. how will the proposed development impact on fixed and dynamic ecological processes that operate within or across the site? This must include:	Section 8
(a) impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g., suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes);	Section 8
(b) will the proposed development change the sediment regime of the aquatic ecosystem and its sub -catchment (e.g. sand movement, meandering river mouth or estuary, flooding or sedimentation patterns);	Section 8
(c) what will the extent of the modification in relation to the overall aquatic ecosystem be (e.g. at the source, upstream or downstream portion, in the temporary I seasonal I permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.); and	Section 8
(d) to what extent will the risks associated with water uses and related activities change;	Section 8
2.5.4. how will the proposed development impact on the functioning of the aquatic feature? This must include:	Section 8
(a) base flows (e.g., too little or too much water in terms of characteristics and requirements of the system);	Section 8
(b) quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g., seasonal to temporary or permanent; impact of over -abstraction or instream or off stream impoundment of a wetland or river);	Section 8
(c) change in the hydrogeomorphic typing of the aquatic ecosystem (e.g., change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland);	Section 8
(d) quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication);	Section 8

(e) fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and	Section 8
(f) the loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.);	Section 8
2.5.5. how will the proposed development impact on key ecosystems regulating and supporting services especially: (a) flood attenuation; (b) streamflow regulation; (c) sediment trapping; (d) phosphate assimilation; (e) nitrate assimilation; (f) toxicant assimilation; (g) erosion control; and (h) carbon storage?	Section 8
2.5.6. how will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator - prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 8
2.6. In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: (a) size of the estuary; (b) availability of sediment; (c) wave action in the mouth; (d) protection of the mouth; (e) beach slope; (f) volume of mean annual runoff; and (g) extent of saline intrusion (especially relevant to permanently open systems).	Not applicable

Table 25: Protocols to Follow as per GN 1150 of 2020, as Amended by GN 3717 of 2023

Protocol Requirement	Details	Report Section
Specialist Requirements	The assessment must be conducted by a qualified aquatic ecologist or aquatic biodiversity specialist.	Page 3
	The specialist must have proven expertise in South African aquatic ecosystems and species identification.	
	The specialist should hold a postgraduate qualification in aquatic ecology, conservation biology, or a related field.	
	Field experience in freshwater, estuarine, or marine ecology is required.	
Assessment Methodology	Desktop Study: Review of existing aquatic biodiversity databases, including SANBI, NFEPA, and National Wetland Map.	**Table 3**
	Historical data analysis on species occurrences, water quality, and habitat conditions.	Section 6.1
	Identification of threatened, endemic, or indicator species.	Not recorded
	Field Surveys: Aquatic species sampling using standardised methodologies.	No flowing water to conduct these test
	Use of SASS 5 protocol for macroinvertebrates.	
	Electrofishing, seine netting, or fyke netting for fish species.	
	Dip-netting and visual observation for amphibians.	
	Habitat assessment including water quality, aquatic habitat integrity, and flow conditions.	
	Impact Assessment: Evaluation of direct and indirect impacts on aquatic habitats and species.	Section 8.1

Protocol Requirement	Details	Report Section
	Assessment of potential risks from habitat loss, fragmentation, water quality degradation, and hydrological changes.	**Table *17***
	Cumulative impact assessment within 30 km radius.	Section 12.1
Minimum Report Content	Introduction & Background: Project description and objectives.	Section1
	Legal & Policy Framework: Compliance with NEMA, NWA, Biodiversity Acts.	Section 2.2 and 2.3
	Study Area Description: Hydrological, geomorphological, and ecological features of aquatic ecosystems.	**Table *3***
	Survey Methodology: Description of sampling techniques and site selection.	Appendix E and separate document
	Findings & Discussion: Presence and status of threatened, protected, or endemic aquatic species.	Section 6
	Ecological Importance and Sensitivity (EIS) scores.	***Section 6.4.2***
	Present Ecological State (PES) of watercourses.	***Section 6.4.2***
	Water quality and hydrological changes.	***Section 9***
	Impact Assessment: Impacts during pre-construction, construction, and operation phases.	Section 16 and 17
	Cumulative impacts with other developments.	
	Mitigation & Management Measures: Avoidance, minimisation, rehabilitation, and offset strategies.	Tabel 15
	Buffer zones, erosion control, stormwater management, and pollution prevention.	Tabel 15
	Monitoring & Compliance: Long-term monitoring plan for aquatic species and habitats.	N/a

Protocol Requirement	Details	Report Section
	Adaptive management strategies for ongoing ecological changes.	Table *14*
Compliance & Approval	The report must be submitted to DFFE, DWS, and relevant provincial authorities.	Responsibility of the client.
	The assessment should be peer-reviewed before submission.	
	Findings must be incorporated into the EIA and WULA.	

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Appendix A: CVs of Specialists

RUDI BEZUIDENHOUDT

ECOLOGIST

Ecologist / Botanist / Aquatic Specialist
SACNASP STATUS: Pr. Sci Nat (Reg. No. 008867)

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LANGUAGES
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MEMBERSHIPS IN SOCIETIES

- **SACNASP** (South African Council for Natural Scientific Professions) (Professional Natural Scientist Reg. No. 008867)
- **SAWS** (South African Wetland Society) Founding member
- **FEN** (Freshwater Ecosystem Network)

PERSONAL INTERESTS
Active CrossFit Member
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ABOUT ME

I am a skilled Scientific Professional with more than 10 years experience in various ecological fields with a specialisation in aquatic ecology and anthropogenic interactions.

EDUCATIONAL QUALIFICATIONS

FORMAL QUALIFICATIONS

- **B.Sc. (Botany & Zoology)**, University of South Africa (2008 - 2012)
- **B.Sc. (Hons) Botany**, University of South Africa (2014 – 2016)

OTHER QUALIFICATIONS

- **Introduction to wetlands**, Gauteng Wetland Forum (2010)
- **Biomimicry and Constructed Wetlands**, Golder Associates and Water Research Commission (2011)
- **Tools for Wetland Assessment**, Rhodes University (2011)
- **Understanding Environmental Impact Assessment**, WESSA (2011)
- **Wetland Seminar**, ARC-ISCW & IMCG (2011)
- **SASS 5**, Groundtruth (2012)
- **Wetland Rehabilitation Principles**, University of the Free State (2012)
- **Wetland Legislation**, University of Free-State (2013)
- **Wetland Plant Identification Course**, SANBI (2015)
- **Wetland Operations and Diversity Management Master Class**, Secolo Consulting Training Services (2015)
- **Tree Identification**, Braam van Wyk – University of Pretoria (2015)
- **Wetland Buffer Legislation** – Eco-Pulse & Water Research Commission (2015)
- **Venomous Snake Handling Course** – African Reptiles and Venom (2015)
- **Invasive Species Training**, SAGIC (2016)
- **Aquatic & Wetland Plant identification**, Cripsis Environment (2019)
- **Hydropedology Course.** Department of Water and Sanitation (2019)
- **Tropical Coastal Ecosystems**, edX (2020)
- **The Science of Hydropedology** – Department of Water and Sanitation (2020)
- **Hydropedological Grouping of SA Soil Forms** - Department of Water and Sanitation (2020)
- **Hydropedological Classification of South Africa Soil Forms** - Department of Water and Sanitation (2020)
- **Contribution of Hydropedological Assessments to the Availability and Sustainable Management of water for all** - Department of Water and Sanitation (2020)
- **Ecosystem Restoration** - United Nations Development Programme (2022)
- **Green Entrepreneurship** - United Nations Development Programme (2022)
- **Fundamentals on Reducing emissions from deforestation and forest degradation** - United Nations Development Programme (2022)
- **Using Spatial Data for Biodiversity** - United Nations Development Programme (2022)
- **Communicating the Value of Biodiversity** - United Nations Development Programme (2022)
- **Protected Areas and Sustainable Development** - United Nations Development Programme (2022)
- **Applying Resilience Thinking to National Biodiversity Plans** - United Nations Development Programme (2022)
- **New Zealand Landscape as Culture: Wai (Water).** EDx & Victoria University of Wellington (2022)
- **New Zealand Landscape as Culture: Motu (Island).** EDx & Victoria University of Wellington (2022)
- **New Zealand Landscape as Culture: Maunga (Mountains).** EDx & Victoria University of Wellington (2022)
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APPENDIX B: GLOSSARY OF TERMS

Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Hydrophyte	Any plant that grows in water, or on a substratum, that is at least periodically deficient in oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Hydromorphic soil	Soil that, in its undrained condition, is saturated or flooded long enough during the growing season to develop anaerobic conditions, favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Seepage	A type of wetland occurring on slopes, usually characterised by diffuse (i.e. unchannelled, and often subsurface) flows.
Sedges	Grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family.
Soil profile	The vertically-sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991).
Wetland	"*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*." (National Water Act; Act 36 of 1998)
Wetland delineation	The determination and marking of the boundary of a wetland on a map using the DWAF (2005) methodology. This assessment includes identification of suggested buffer zones and is usually done in conjunction with a wetland functional assessment. The impact of the proposed development, together with appropriate mitigation measures, are included in impact assessment tables.

PROJECT: **Duvha Spillway - Artificial Wetland Areas**

RISK ASSESSMENT MATRIX for Section 21 (c) and (i) Water Use activities - Version 2.1.1

Name of Assessor: R Bezuidenhoudt **Signature:** 

SACNASP Registration Number: 8867

Date of assessment: 2025.06.17

Risk to be scored for all relevant phases of the project (**factoring in specified control measures**). MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
CONSTRUCTION	Earthworks and vegetation clearance (includes excavation of berm, spillway reshaping, and canal/breach work)	Soil disturbance and erosion	Artificial Wetland	F	Low / Very low	1	1	1	1	1	**2**	1	2	**5**	**2**	**10**	80%	**8**	L	Medium
		Loss of vegetation and associated wetland habitat	Artificial Wetland	F	Low / Very low	1	1	1	1	1	**2**	1	2	**5**	**2**	**10**	80%	**8**	L	Medium
		Temporary sedimentation in artificial wetlands	Artificial Wetland	F	Low / Very low	1	1	1	1	1	**2**	1	2	**5**	**2**	**10**	80%	**8**	L	Medium
	Construction and installation of infrastructure (includes concrete works, weir, erosion control)	Localised water quality deterioration (e.g. cement residue)	Artificial Wetland	F	Low / Very low	1	1	1	1	1	**2**	1	2	**5**	**2**	**10**	80%	**8**	L	Medium
		Alteration of wetland-like habitats	Artificial Wetland	F	Low / Very low	1	1	1	1	1	**2**	1	2	**5**	**2**	**10**	80%	**8**	L	Medium
		Disturbance to opportunistic aquatic fauna	Artificial Wetland	F	Low / Very low	1	1	1	1	1	**2**	1	2	**5**	**2**	**10**	80%	**8**	L	Medium
OPERATIONAL	Functioning of the reinstated spillway and weir	Improved control of overflow, reducing uncontrolled discharges	Artificial Wetland	F	Low / Very low	-2	-2	0	-1	-2	**0**	1	2	**3**	**2**	**6**	60%	**3.6**	L	Medium
	Maintenance and access post-construction	Periodic disturbance from vehicles or machinery	Artificial Wetland	F	Low / Very low	1	1	1	1	1	**2**	1	2	**5**	**2**	**10**	60%	**6**	L	Medium
		Possible regrowth of AIS if unmanaged	Artificial Wetland	F	Low / Very low	1	1	1	1	1	**2**	1	2	**5**	**2**	**10**	60%	**6**	L	Medium

Appendix E: Aquatic Methodology

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Table of Contents

Figures

Tables

1 Wetland and Riparian Delineation

Wetlands are delineated based on scientifically sound methods and utilizes a tool from the DWS 'A practical field procedure for identification and delineation of wetlands and riparian areas' (DWAF, 2005) as well as the "Updated manual for identification and delineation of wetlands and riparian areas" (DWAF, 2008) The delineation of the watercourses presented in this report is based on both desktop delineation and groundtruthing.

1.1 Desktop Delineation

A desktop assessment was conducted with wetland and riparian units potentially affected by the proposed activities identified using a range of tools, including:

- 1: 50 000 topographical maps.
- Recent, relevant aerial and satellite imagery, including Google Earth.
- NFEPA wetlands and Rivers (CDNGI, 2024)
- Municipal and DWS spatial datasets.

All areas suspected of being wetland and riparian habitat based on the visual signatures on the digital base maps were mapped using google earth.

1.2 Ground Truthing

Field investigations confirmed fine-scale wetland and riparian boundaries where possible, Scenarios exist where some areas are inaccessible due to unforeseen circumstances. Extrapolation together with high resolution aerial imagery will be sued here.

1.3 Wetland Indicators

Wetlands were identified based on one or more of the following characteristic attributes (DWAF, 2005):

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur (Figure 1).
- The presence of plants adapted to or tolerant of saturated soils (hydrophytes).
- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation; and
- A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing within 50cm of the soil surface (Figure 2).

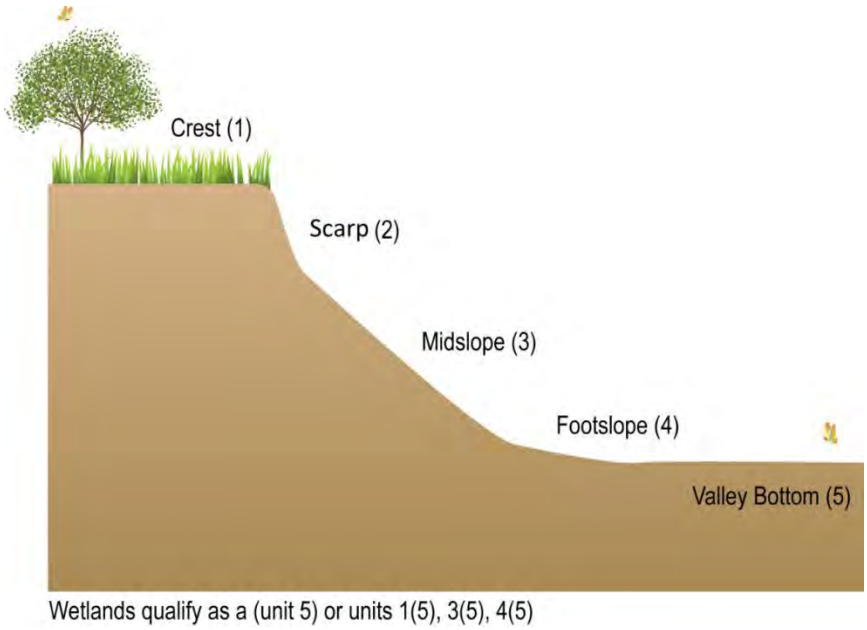


Figure 1: Terrain units *(DWAF, 2005)* **(© Artist rendition done by Limosella)**

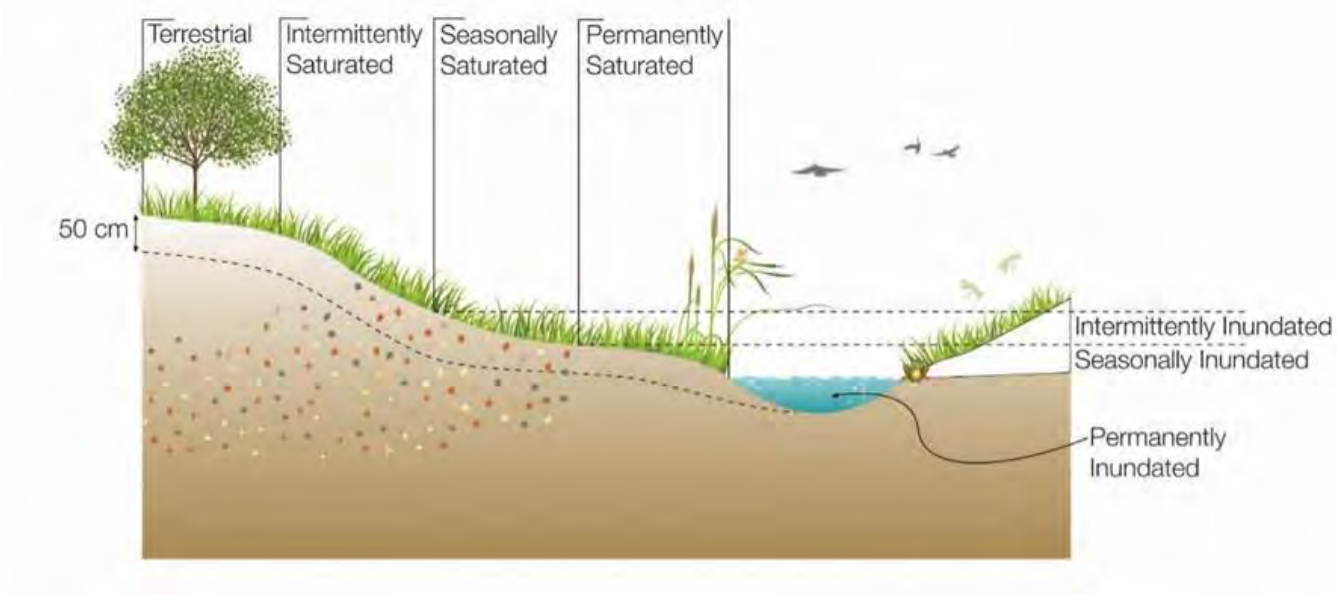


Figure 2: Typical cross section of a wetland *(Ollis, et al., 2013)* **(© Artist rendition done by Limosella)**

1.3.1 Terrain Unit Indicator

The terrain unit indicator is an important guide for identifying the parts of the landscape where wetlands might possibly occur and is relevant to the hydropedological setting of a wetland. For example, some wetlands occur on slopes higher up in the catchment where groundwater discharge is taking place through seeps. The type of wetland which occurs on a specific topographical area in the landscape is described using the Hydrogeomorphic classification which separates wetlands into 'HGM' units. The classification of (Ollis, et al., 2013) is used, where wetlands are classified on Level 4 as either Rivers, Floodplain wetlands, Valley-bottom wetlands, Depressions, Seeps, or Flats (Figure 3).

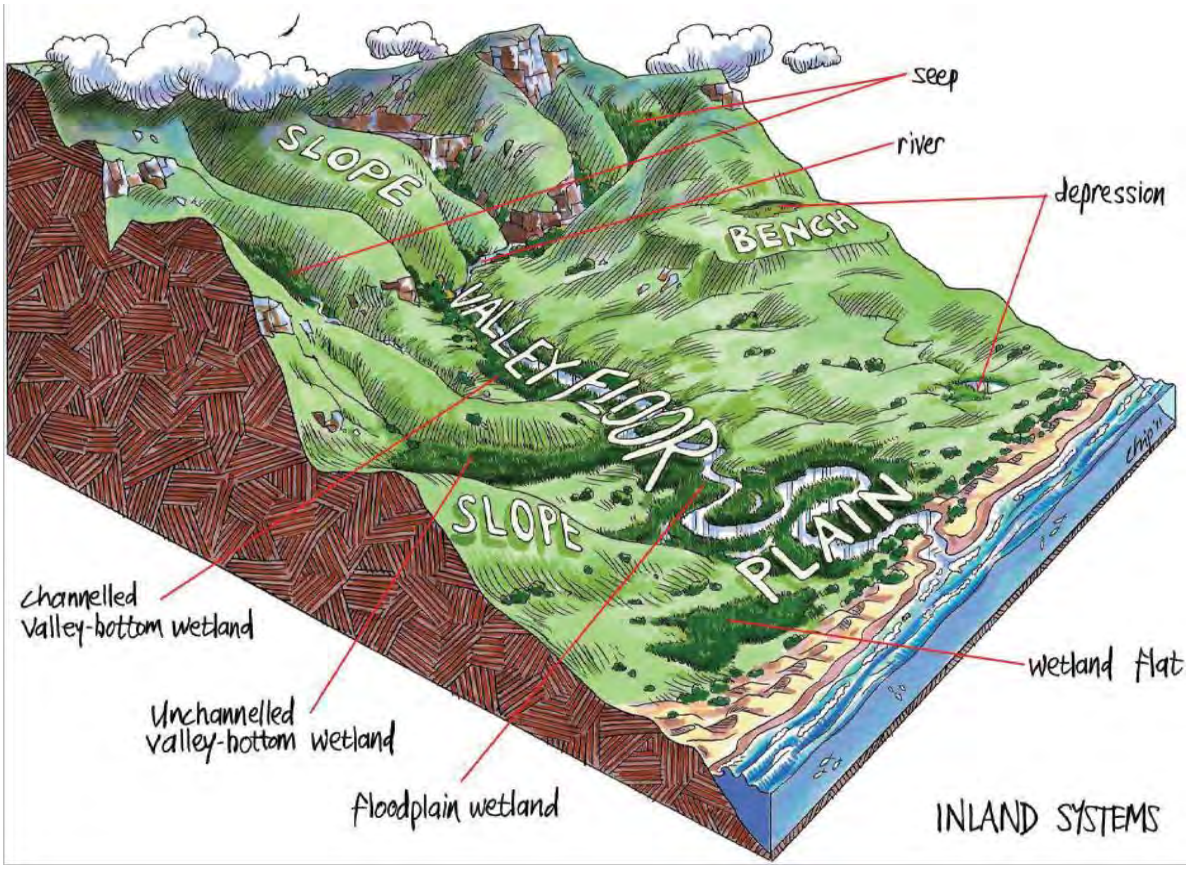


Figure 3: Terrain units *(Ollis, et al., 2013)* **(Artwork copyright – Clip Snaddon).**

1.3.2 Hydromorphic Soils (DWAF, 2008)

- Mottling – Formation of clumps of iron oxide within the soil matrix in the form of orange, yellow, black, or reddish-brown speckling. Mottling occurs in most soils and reaches maximum density in the centre of the seasonal zone with sparse mottling in the temporary zone and no mottling in the permanent zone.
- Gleying – Shift in soil colour from the terrestrial baseline towards a blue, green, or grey colour and an overall reduction in soil chroma. This phenomenon is normally difficult to identify in the temporary zone, noticeable in the seasonal zone and most significant in the permanent zone.
- Organic Surface Layers – surface layers with very high organic content that typically occur in the wetland seasonal and permanent zones.
- Organic Streaking – Streaks of organic matter within the soil column which may be present in all zones, but particularly the temporary and seasonal zones.

1.3.3 Hydrophytic Vegetation (Ginkel & Cilliers, 2017)

- Obligate Species: These species occur in wetlands more than 99% of the time, usually found in the permanent or seasonal zones.
- Facultative Positive Species: These species have 67 to 99% of their population occurring within wetlands, typically in the seasonal and temporary zones, with the remaining 1 to 33% found in the adjacent area on the wetland periphery.
- Facultative Species: These species have 33 to 67% of their population occurring within wetlands, usually in seasonal or temporary zones, with the remaining 33 to 67% found in the adjacent area on the wetland periphery.
- Facultative Negative Species: These species have 1 to 33% of their population occurring within wetlands, usually in the temporary zone, with the remaining 67 to 99% found in the adjacent area on the wetland periphery.
- Wetland Cosmopolitan Species: These species have no specific affinity for wetlands and colonise both wetland and terrestrial areas.

1.4 Riparian Indicators

A riparian area can be defined as a linear fluvial, eroded landform which carries channelized flow on a permanent, seasonal, or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone (Kleynhans, et al., 2007)

Riparian habitat is classified primarily by identifying riparian vegetation along the edge of the macro stream channel. The macro stream channel is defined as the outer bank of a compound channel and should not be confused with the active riverbank. The macro channel bank often represents a dramatic change in the energy with which water passes through the system. Rich alluvial soils deposit nutrients making the riparian area a highly productive zone. This causes a very distinct change in vegetation structure and composition along the edges of the riparian area (DWAF, 2008). The marginal zone includes the area from the water level at low flow, to those

features that are hydrologically activated for the greater part of the year. The non-marginal zone is the combination of the upper and lower zones (Figure 4).

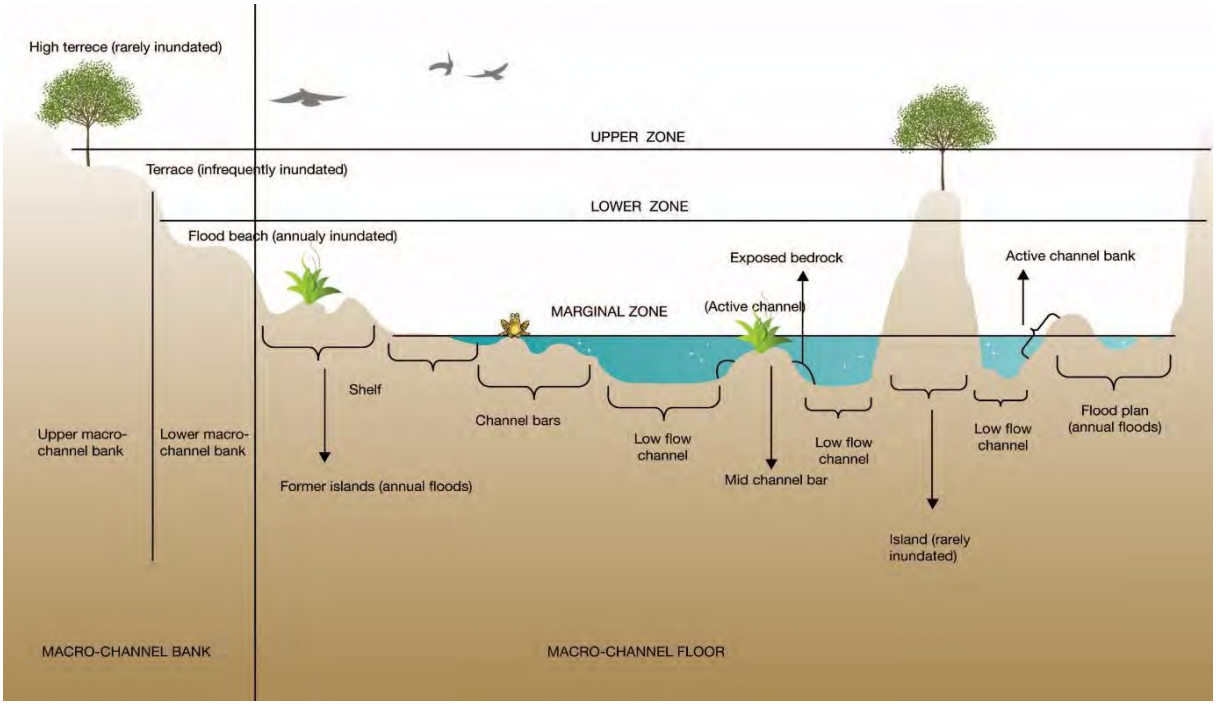


Figure 4: Schematic diagram illustrating an example of where the 3 zones would be placed relative to geomorphic diversity (Kleynhans et al., 2007) (© Artist rendition done by Limosella)

Riparian areas can be grouped into different categories based on their inundation period per year. Perennial rivers are rivers with continuous surface water flow, intermittent rivers are rivers where surface flow disappears, but some surface flow remains, temporary rivers are rivers where surface flow disappears for most of the channel Figure 5. Two types of temporary rivers are recognized, namely “ephemeral” rivers that flow for less time than they are dry and support a series of pools in parts of the channel, and “episodic” rivers that only flow in response to extreme rainfall events, usually high in their catchments (Seaman, et al., 2010)

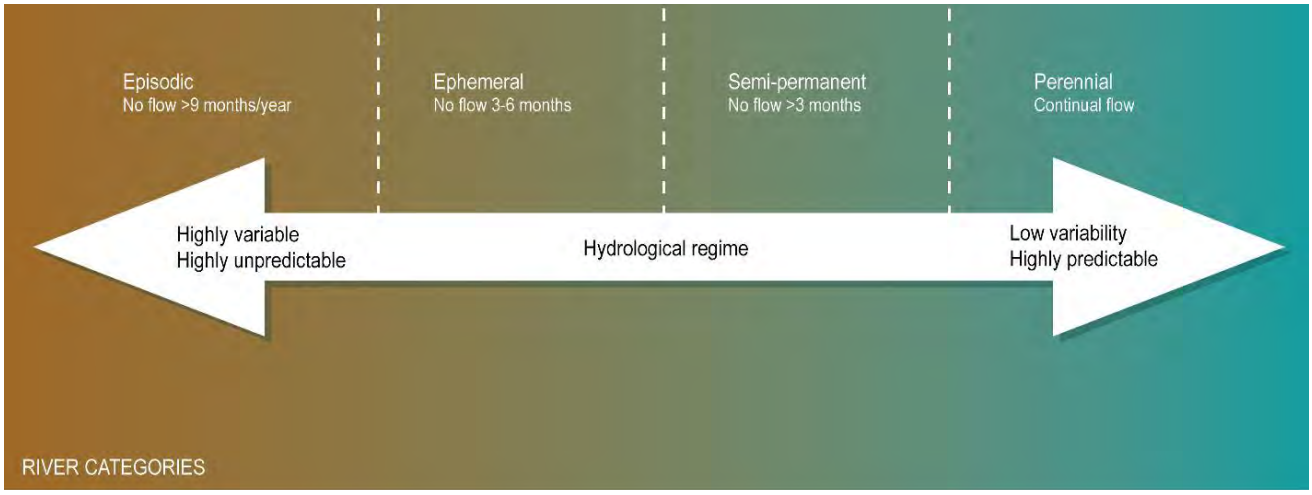


Figure 5: The four categories associated with rivers and the hydrological continuum. Dashed lines indicate that boundaries are not fixed *(Seaman, et al., 2010)*. **(© Artist rendition done by Limosella)**

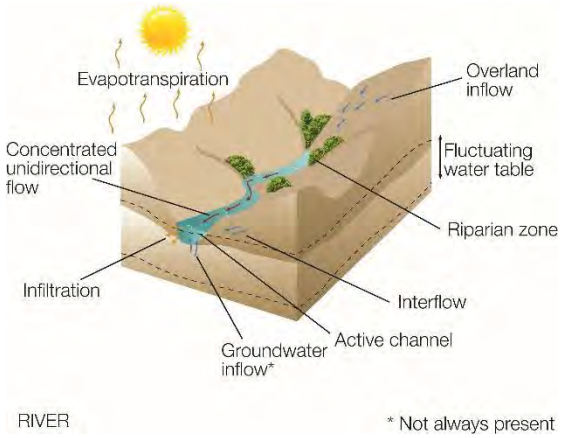
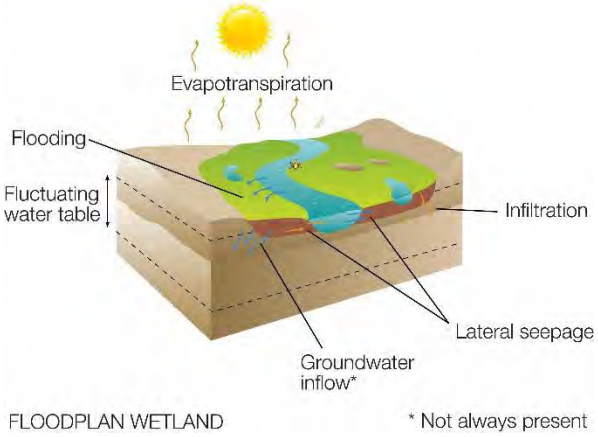
2 Wetland/Riparian Classification

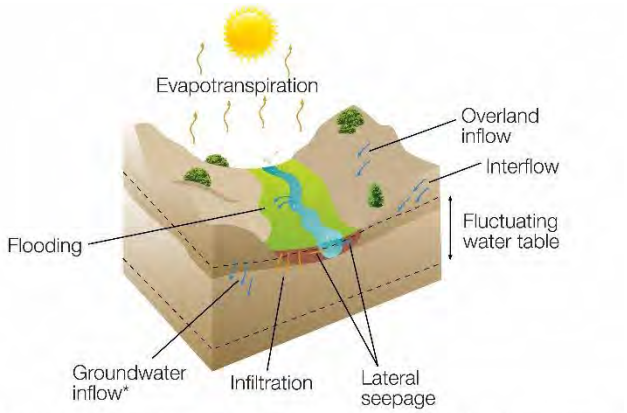
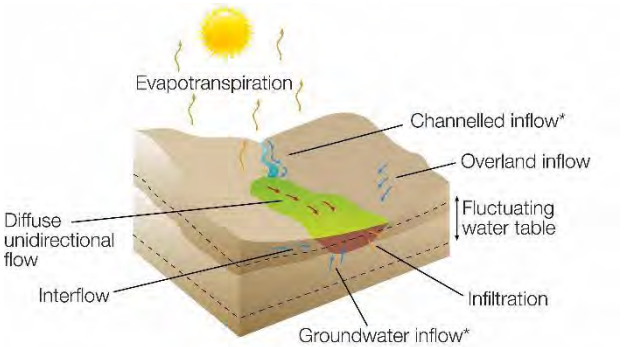
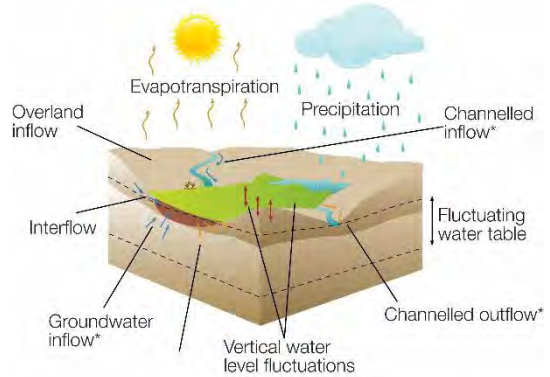
The classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification The current watercourse assessment follows the same approach by classifying watercourses in terms of a functional unit recognised in the classification system proposed in (Ollis, et al., 2013) HGM units take into consideration factors that determine the nature of water movement into, through and out of the watercourse system. In general, HGM units encompass three key elements (Kotze, et al., 2020)

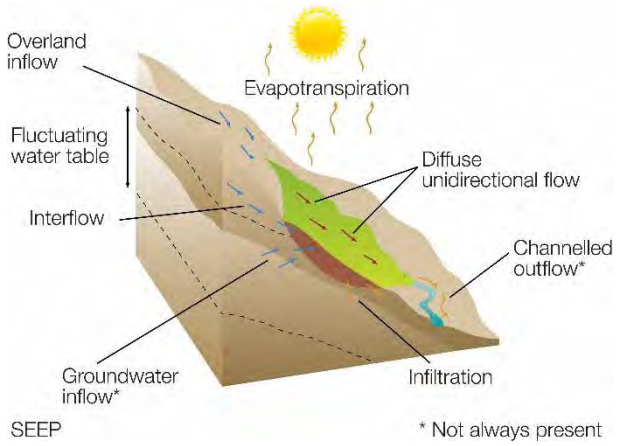
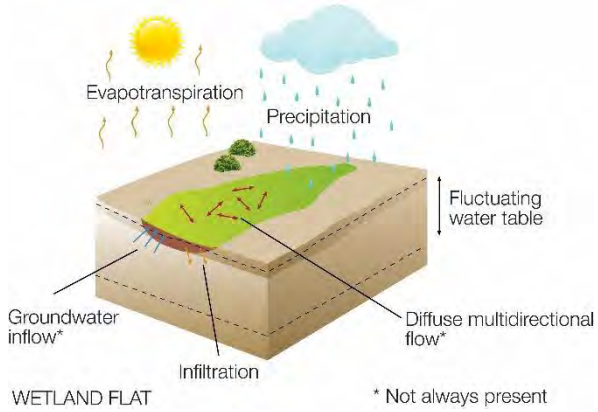
- Geomorphic setting - This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment).
- Water source - There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
- Hydrodynamics - This refers to how water moves through the wetland.

The classification of watercourse areas found within the study site and/or within 500 m of the study site are as follows (Table 1).

Table 1: Watercourse Types and descriptions *(Ollis, et al., 2013)*. **(© Artist rendition done by Limosella)**

Hydro-geomorphic types	**Description**
Riparian habitat 	Linear fluvial, eroded landforms which carry channelized flow on a permanent, seasonal, or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone.
Meandering Floodplain 	Linear fluvial, net depositional valley bottom surfaces which have a meandering channel which develop upstream of a local (e.g. resistant dyke) base level, or close to the mouth of the river (upstream of the ultimate base level, the sea). The meandering channel flows within an unconfined depositional valley, and oxbows or cut-off meanders evidence of meandering – are usually visible at the 1:10 000 scale (i.e. observable from 1:10 000 orthomaps). The floodplain surface usually slopes away from the channel margins due to preferential sediment deposition along the channel edges and areas closest to the channel. This can result in the formation of backwater swamps at the edges of the floodplain margins.

Hydro-geomorphic types	Description
Valley bottom with a channel  CHANNELLED VALEY-BOTTOM WETLAND * Not always present	Linear fluvial, net depositional valley bottom surfaces which have a straight channel with flow on a permanent or seasonal basis. Episodic flow is thought to be unlikely in this wetland setting. The straight channel tends to flow parallel with the direction of the valley (i.e. there is no meandering), and no oxbows or cut-off meanders are present in these wetland systems. The valley floor is, however, a depositional environment such that the channel flows through fluvially-deposited sediment. These systems tend to be found in the upper catchment areas.
Valley bottom without a channel  UNCHANNELLED VALLEY-BOTTOM WETLAND * Not always present	Linear fluvial, net depositional valley bottom surfaces which do not have a channel. The valley floor is a depositional environment composed of fluvial or colluvial deposited sediment. These systems tend to be found in the upper catchment areas, or at tributary junctions where the sediment from the tributary smothers the main drainage line.
Depressional pans  DEPRESSION * Not always present	Small (deflationary) depressions which are circular or oval in shape; usually found on the crest positions in the landscape. The topographic catchment area can usually be well-defined (i.e. a small catchment area following the surrounding watershed). Although often apparently endorheic (inward draining), many pans are “leaky” in the sense that they are hydrologically connected to adjacent valley bottoms through subsurface diffuse flow paths.

Hydro-geomorphic types	Description
Seepage Wetlands 	Seepage wetlands are the most common type of wetland (in number), but probably also the most overlooked. These wetlands can be located on the mid- and footslopes of hillsides; either as isolated systems or connected to downslope valley bottom weltands. They may also occur fringing depressional pans. Seepages occur where springs are decanting into the soil profile near the surface, causing hydric conditions to develop; or where through flow in the soil profile is forced close to the surface due to impervious layers (such as plinthite layers; or where large outcrops of impervious rock force subsurface water to the surface).
Flat Wetland 	In areas with weakly developed drainage patterns and flat topography, rainfall may not drain off the landscape very quickly, if at all, due to the low relief. In such areas (commonly characterized by aeolian deposits or recent sea floor exposures) the wet season water table may rise close to, or above, the soil surface, creating extensive areas of shallow inundation or saturated soils. In these circumstances the seasonal or permanently high groundwater table creates the conditions for wetland formation.

3 Buffer Zones and Regulated Areas

A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted (DWAF, 2005). A development has several impacts on the surrounding environment and on a watercourse. The development changes habitats, the ecological environment, infiltration rate, amount of runoff and runoff intensity of the site, and therefore the water regime of the entire site. An increased volume of stormwater runoff, peak discharges, and frequency and severity of flooding is, therefore, often characteristic of

transformed catchments. The buffer zone identified in this report serves to highlight an ecologically sensitive area in which activities should be conducted with this sensitivity in mind.

Buffer zones have been shown to perform a wide range of functions and have therefore been widely proposed as a standard measure to protect water resources and their associated biodiversity. These include (i) maintaining basic hydrological processes; (ii) reducing impacts on water resources from upstream activities and adjoining landuses; (iii) providing habitat for various aspects of biodiversity. Buffer zones are therefore proposed as a standard mitigation measure to reduce impacts of land uses / activities planned adjacent to water resources. Although buffer zones can be effective in addressing diffuse source pollution in storm water run-off, they should typically be seen as part of a treatment train designed to address storm water impacts.

Authorisation from the DWS requires calculation of a site-specific buffer zone (GN267 of 24 March 2017), following (Macfarlane, et al., 2010). This Excel-based tool calculates the best suited buffer for each wetland or section of a wetland based on numerous on-site observations. The resulting buffer zone can thus have large differences depending on the current state of the wetland as well as the nature of the proposed development. Developments with a high-risk factor such as mining are likely to have a larger buffer area compared to a residential development with a lower risk factor. Figure 6 represents the buffer zone setback for the watercourse types discussed in this report.

It should be noted that the buffer calculation tool does not take into account the effects of climate change or cumulative impacts to floodflows resulting from transformed catchments. Therefore, a conservative approach to the application of buffer zones is encouraged.

Regulated areas are zones within which authorisation is required. The DWS specifies a 500 m regulated area around all wetlands and 100 m around all riparian zones within which development must be authorised from their department (unless a fine scale riparian delineation has been done in which case the calculated buffer zone is used as the regulated area). Development within 32 m of the edge of the watercourse triggers the requirement for authorisation under the National Environmental Management Act (NEMA): Environmental Impact Assessment (EIA) Regulations of 2014 (GN326) as amended.

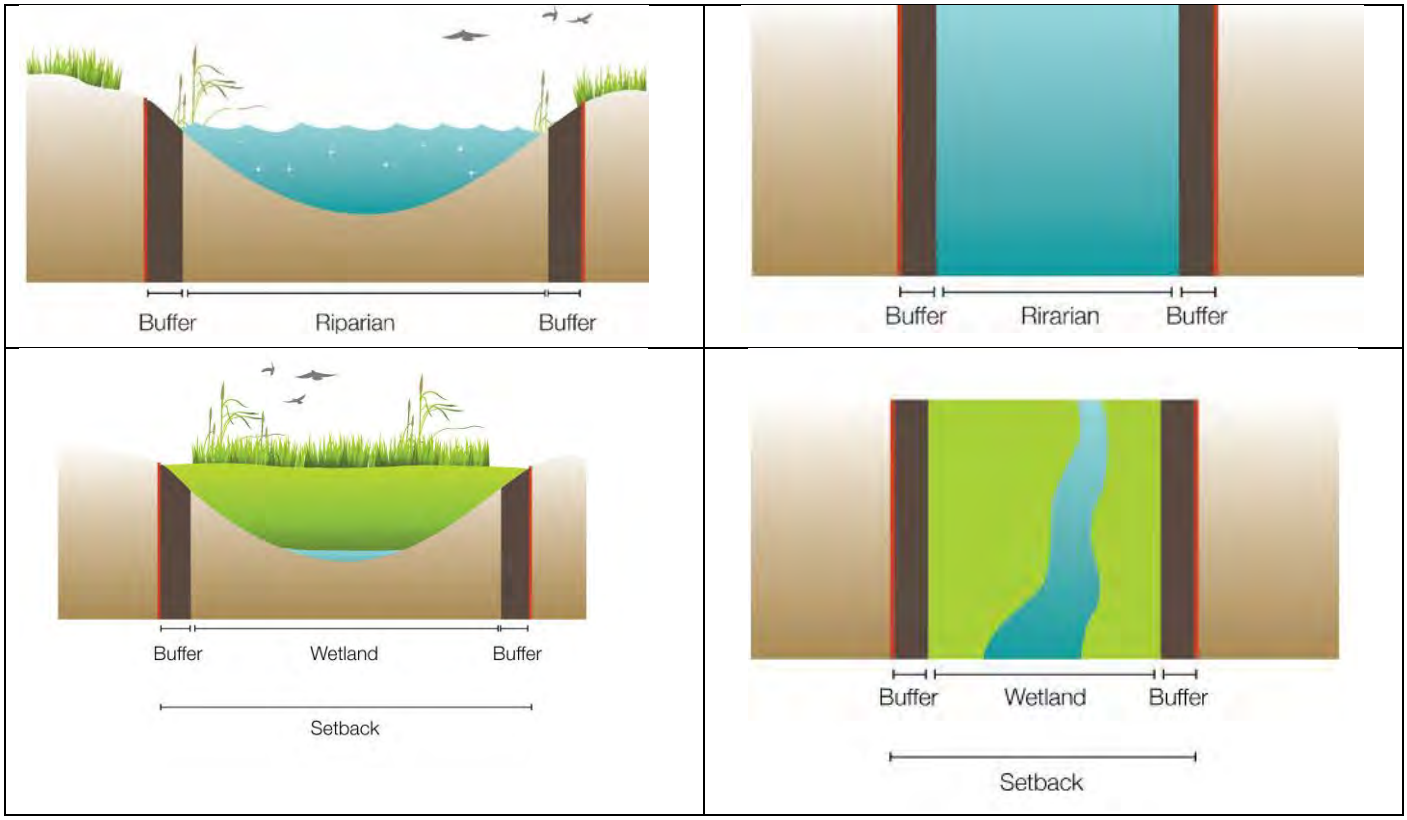


Figure 6: A represent the buffer zone setback for the watercourse discussed in the accompanying report. (© Artist rendition done by Limosella).

4 Watercourse Functionality, Status and Sensitivity

Watercourse functionality is defined as a measure of the deviation of structure and function from its natural reference condition. The natural reference condition is based on a theoretical undisturbed state extrapolated from an understanding of undisturbed regional vegetation and hydrological conditions.

The allocations of scores in the functional and integrity assessment are somewhat subjective and are thus vulnerable to the interpretation of the specialist. With the exception of the assessment of water quality and invertebrates, collection of empirical data is precluded at this level of investigation due to project constraints including time and budget. Water quality values, species richness and abundance indices, surface and groundwater volumes, amongst others, should ideally be used rather than a subjective scoring system such as is presented here.

The functional assessment methodologies presented below take into consideration subjective recorded impacts to determine the scores attributed to each functional Hydrogeomorphic (HGM) unit. Following the calculation of PES and EC scores, a Recommended Ecological Category can be obtained. This score reflects an auditable management or rehabilitation target to be achieved by the proposed project. The sections below provide a brief description of each method.

4.1 Present Ecological Status (PES) – WET-Health (Macfarlane , et al., 2020)

A summary of the four components of the WET-Health (2.0) namely Hydrological; Geomorphological, water quality and Vegetation Health assessment for the wetlands found on site is described in **Table 2**. For this assessment, WET-Health Version 2.0 was used. This method builds on the WET-Health Version 2.0 (Macfarlane , et al., 2020). The WET-Health Version 2 considers four (4) components to assess the PES of wetland ecosystems. Geology, climate, and topographic position determines the ecological setting of a wetland. Three (3) core interrelated drivers broadly influence all wetlands, namely Hydrology, Geomorphology and Water Quality (i.e. physico-chemical attributes). Wetland biology, and more specifically vegetation, responds to the changes in these drivers and to the surrounding environment.

Table 2: The three levels of assessment to cater for application of the WET-Health Version 2 Tool across different spatial scales and for different purposes *(Macfarlane , et al., 2020)*.

Level of Assessment	Spatial Scale	Description
Level 1A	Desktop-based, low resolution	Entirely desktop-based and only uses pre-existing landcover data. Landcover types within a buffer / "pseudo catchment" around a wetland is used to determine the impacts on the wetland arising from the upslope catchment. Impacts arising from within individual wetlands are inferred from landcover types occurring within desktop-delineated wetlands.
Level 1B	Desktop-based, high resolution	Largely desktop-based using pre-existing landcover data but makes a few finer distinctions than Level 1A in terms of landcover types and usually requires "heads-up" interpretation of the best available aerial imagery to do so. Upslope catchment of each wetland can be individually delineated at this level, and landcover in this area is used as a proxy of the impacts on a wetland arising from its upslope catchment. Impacts arising from within individual wetlands are inferred from landcover types occurring within desktop-delineated wetlands. In terms of water quality PES, the option is provided to factor in point-source pollution inputs in a Level 1B assessment.
Level 2	Rapid field-based assessment	Strongly informed by desktop landcover mapping; refined by assessing a range of catchment and wetland-related indicators known to affect wetland condition. Impacts arising from the upslope catchment of a wetland are inferred from landcover mapping but are refined based on additional information. Landcover types occurring within the wetland are used as the starting point for assessing human impacts arising from within the wetland but are refined through the assessment of additional indicators as part of a rapid field-based assessment. This involves sub-dividing the wetland into relatively homogenous "disturbance units" and assessing a suite of site-based wetland questions that provide a more direct assessment of change. Determination of water quality PES in a Level 2 assessment requires the identification and characterisation of point-source pollution inputs.

A summary of the change class, description and symbols used to evaluate wetland health are summarised in Table 3. The trajectory of change is summarised in Table 4.

Table 3: Health categories used by WET-Health for describing the integrity of wetlands *(Macfarlane , et al., 2020)*

Ecological Category	Description	Impact Score	PES Score (%)
A	Unmodified, natural	0 to 0.9	90-00
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.	1.0 to 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.	2.0 to 3.9	60-79
D	Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 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.	6.0 to 7.9	20-39
F	Critical Modification. The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10	0-19

Table 4: Trajectory class, change scores and symbols used to evaluate Trajectory of Change to wetland health *(Macfarlane , et al., 2020)*

Change Class	Description	Symbol
Improve	Condition is likely to improve over the over the next 5 years	(↑)
Remain stable	Condition is likely to remain stable over the next 5 years	(→)
Slowly deteriorate	Condition is likely to deteriorate slightly over the next 5 years	(↓)
Rapidly deteriorate	Substantial deterioration of condition is expected over the next 5 years	(↓↓)

4.2 Ecological Importance and Sensitivity (EIS) (Rountree, et al., 2013)

The Ecological Importance and Sensitivity (EIS) score forms part of a larger assessment called the Wetland Importance and Sensitivity scoring system which also addresses hydrological importance and direct human benefits relevant to a HGM unit. Both PES and EIS form part of a larger reserve determination process documented by the Department of Water and Sanitation.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (Rountree, et al., 2013). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use.

The Ecological Importance and Sensitivity of the wetlands is represented are described in the results section. Explanations of the scores are given in Table 5.

Table 5: Environmental Importance and Sensitivity rating scale used for the estimation of EIS scores *(Rountree, et al., 2013)*

Ecological Importance and Sensitivity Categories	Rating
Very High Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in major rivers.	>3 and <=4
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers.	>1 and <=2
Low/Marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers.	>0 and <=1

4.3 Ecosystem Services (ES)

The Department of Water and Sanitation authorisations related to wetlands are regulated by Government Notice 267 published in the Government Gazette 40713 of 24 March 2017 regarding Section 21(c) and (i). Page 196 of this notice provides a detailed terms of reference for wetland assessment reports and includes the requirement that the ecological integrity and function of wetlands be addressed.

WET-EcoServices Version 2 (Kotze, et al., 2020) includes 16 different ecosystem services, which were selected for their specific relevance to the South African situation:

- Flood attenuation.
- Streamflow regulation.
- Sediment trapping.
- Phosphate assimilation.
- Nitrate assimilation.
- Toxicant assimilation.
- Erosion control.
- Carbon storage.
- Biodiversity maintenance.
- Provision of water for human use.
- Provision of harvestable resources.
- Food for livestock.
- Provision of cultivated foods.
- Cultural and spiritual experience.
- Tourism and recreation.
- Education and research.

Table 5 and Table 6***Table 6*** describe the categories for integrating scores for supply and demand of ecosystem services and their overall importance.

Table 6: Integrating the scores for ecosystem supply and demand into an overall importance score.

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0.0	0.0	0.5	1.5	2.5
Low	1	0.0	0.0	1.0	2.0	3.0
Moderate	2	0.0	0.5	1.5	2.5	3.5
High	3	0.0	1.0	2.0	3.0	4.0
Very High	4	0.5	1.5	2.5	3.5	4.0

Table 7: Categories used for reporting the overall importance of ecosystem services.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

4.4 Use of WET-EcoServices for assessing the Ecological Importance and Sensitivity (EIS) of wetlands.

The term Ecological Importance and Sensitivity (EIS) is well entrenched in water resource management in South Africa. Ecological Importance (EI) is the expression of the importance of wetlands and rivers in terms of the maintenance of biological diversity and ecological functioning at a local and landscape level. Ecological Sensitivity (S) refers to ecosystem fragility or the ability to resist or recover from disturbance (Rountree, et al., 2013) (Kotze, et al., 2020). The purpose of assessing ecological importance and sensitivity of water resources like wetlands, and rivers is to be able to identify those systems that provide valuable biodiversity support functions, regulating ecosystem services, or are especially sensitive to impacts. Knowing what ecosystems are valuable enables the appropriate setting of management objectives (i.e. recommended ecological category - REC) and the prioritization of management actions and interventions to promote effective water resource management.

The tool currently used for assessing wetland EIS (Rountree, et al., 2013) (Kotze, et al., 2020) is somewhat outdated but is typically informed by a WET-EcoServices assessment. The implication is that practitioners involved in wetland assessments typically have to complete both a WET-EcoServices assessment and a stand-alone EIS assessment to inform decision-making processes. Recommendations to refine the wetland EIS tool have been documented (Macfarlane , et al., 2020) and includes the need to revise and update the wetland EIS assessment framework to simply integrate the key outputs of the WET-EcoServices tool to produce an overall ecological importance (EI) score.

Specific recommendations for integrating the WET-EcoServices outputs into the wetland EIS assessment have also been documented. These include grouping of ecosystem service scores into broad categories which would then be integrated into an overall ecological importance (EI) score:

- • ***Biodiversity maintenance importance***: This is the importance score derived from the biodiversity maintenance component of WET-EcoServices.
- • ***Regulating services importance***: This would be calculated as the maximum score of all the importance scores for regulating services considered in WET-EcoServices.
- • ***Provisioning and cultural services importance***: This would be calculated as the maximum score of all the importance scores for provisioning and cultural services considered in WET-EcoServices.

The EI would be simply derived based on the maximum of these scores and could then be integrated with the ecological sensitivity (ES) score to produce an overall EIS score. A simple schematic of the proposed Wetland EIS framework is shown in Figure 7***Figure 7*** below.

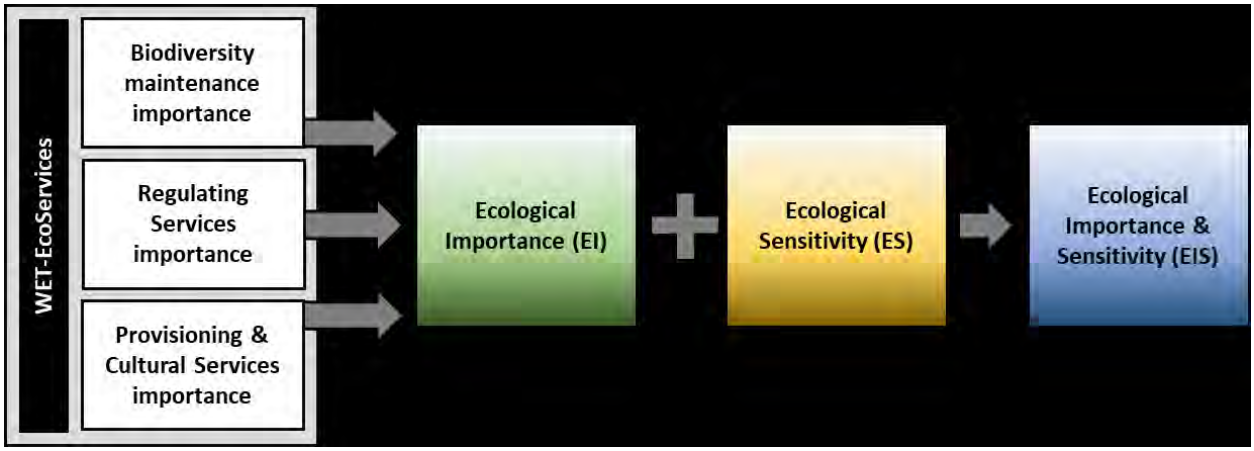


Figure 7: Schematic of the recommended Wetland EIS framework.

4.5 Present Ecological Category (EC): Riparian

In the current study, the Ecological Category of the riparian areas was assessed using a level 3 VEGRAI (Riparian Vegetation Response Assessment Index) (Kleynhans, et al., 2007) (***Table 8***).

Table 8: Generic ecological categories for EcoStatus components *(Kleynhans, et al., 2007)*.

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

4.6 Physical Habitat Assessment: Integrated Habitat Assessment System (IHAS) method.

The quality of the instream and riparian habitat has a direct influence on the aquatic community. Evaluating the structure and functioning of an aquatic ecosystem must therefore take into account the physical habitat to assess the ecological integrity. The IHAS sampling protocol, of which version 2 is currently used, was developed by (McMillan, 1998) for use in conjunction with the SASS5 protocol to determine which habitats are present for aquatic macroinvertebrates.

IHAS consists of a scoring sheet that assists to determine the extent of each of the instream habitats, together with the physical parameter of the stream. For example, the proportion of stones in current and stones out of current will be compared with the presence of instream vegetation. This sampling protocol assists with the interpretation of the SASS5 data.

Data recorded during the site visit concerning sampling habitat and stream condition is uploaded into an excel spreadsheet. The results are then interpreted according to the categories supplied by (McMillan, 1998) (Table 9).

Table 9: IHAS score interpretation table.

IHAS Score	Interpretation
<65%	Insufficient for supporting a diverse aquatic macro invertebrate community
65%-75%	Acceptable for supporting a diverse aquatic macroinvertebrate community
75%	Highly suitable for supporting a diverse aquatic macroinvertebrate community

4.7 SASS5

SASS5 is a rapid bioassessment method used to identify changes in species composition of aquatic invertebrates to indicate relative water quality (Dickens & Graham, 2002). SASS5 requires the identification of invertebrates to a family level in the field.

SASS5 is based on the principle that some invertebrate taxa are more sensitive than others to alterations in ecological drivers such as pollutants or flooding events. Macroinvertebrate assemblages are good indicators of localized conditions in rivers. Many macroinvertebrates have limited migration patterns or are not free moving, which makes them well-suited for assessing site specific impacts with upstream/downstream studies. Benthic macroinvertebrates are abundant in most streams. Even small streams (1st and 2nd order) which may have a limited fish population will support a diverse macroinvertebrate fauna. These groups of species constitute a broad range of trophic levels and pollution tolerances. Thus, SASS5 is a useful method for interpreting the cumulative effects of impacts on aquatic environments.

Using a 'kick net', the SASS5 sampling method entails prescribed time-periods and spatial areas for the kicking of in-current and out-current stones and bedrock; sweeping of in-current and out-current marginal and aquatic vegetation, as well as of gravel, stones, and mud (GSM); followed by visual observations and hand-picking. The results of each biotope are kept separate, until all observations are noted. The entire sample is then returned to the river, retained alive, or preserved for further identification.

In SASS5 analysis, species abundance is recorded on an SASS5 data sheet which weighs the different taxons common to South African rivers from 1 (pollutant tolerant) to 15 (pollution sensitive). The SASS5 score will be high at a particular site if the taxa are pollution sensitive and low if they are mostly pollution tolerant.

The SASS5 Score, the number of taxa observed, and the average score per taxon (ASPT) are calculated for all the biotopes combined. Dallas (2007) used available SASS5 Score and ASPT values for each eco-region in South Africa to generate biological bands on standardised graphs that are used as a guideline for interpreting any data obtained during the study. The meaning of each SASS5 Ecological Category is as follows Table 10.

Table 10: SASS categories *(Dallas, 2007)*.

EC	Ecological Category	Description
A	Natural	Unmodified natural
B	Good	Largely natural with few modifications
C	Fair	Moderately modified
D	Poor	Largely modified
E	Seriously modified	Seriously modified
F	Critically modified	Critically or extremely modified

4.8 Physical properties of water

The physical properties of water are based on the temperature, Electrical Conductivity (EC), pH, and oxygen content of the water- using physical methods. The physical properties of water influence the aesthetical – as well as the chemical qualities of water. Relevance of the indicators of the physical properties of water include pH, which affects the corrosiveness of water, and EC, an indication of the "freshness" of water (indicates the presence of dissolved salts and other dissolved particles). Included in the physical properties of water is the suspendoids' effects on water quality. This includes turbidity, and total suspended solids. Turbidity is measured in Nephelometric Turbidity Units (NTU's) and is the indication of the ability of light to pass through water. See Table 11 for a list of physical properties of water and comparative results.

Table 11: Table for comparative results of physical properties of water.

pH Values	
pH > 8.5	Alkaline
pH 6.0-8.5	Circumneutral
pH < 6.0	Acidic
Total Hardness (in **mg CaCO3/l)**	
Hardness < 50 mg/l	Soft
Hardness 50-100 mg/l	Moderately soft
Hardness 100- 150 mg/l	Slightly hard
Hardness 150-200 mg/l	Moderately hard
Hardness 200-300 mg/l	Hard
Hardness 300-600 mg/l	Very hard
Total Dissolved Solids as indicator of salinity of water	
TDS <450 mg/l	Non saline
TDS 450-1000 mg/l	Saline
TDS 1000-2400 mg/l	Very saline
TDS 2400-3400 mg/l	Extremely saline
Total suspended solids (TSS)	
Background TSS concentrations are < 100 mg/l	Any increase in TSS concentrations must be limited to < 10 % of the background TSS concentrations at a specific site and time.

4.9 Recommended Ecological Category (REC).

The REC is determined by the Present Ecological State of the water resource and the importance and/or sensitivity of the water resource. Water resources which have Present Ecological State categories in an E or F ecological category are deemed unsustainable by the DWS. In such cases the REC must automatically be increased to a D.

Where the PES is in the A, B, C, D or E the EIS components must be checked to determine if any of the aspects of importance and sensitivity (Ecological Importance; Hydrological Functions and Direct Human Benefits) are high or very high. If this is the case, the feasibility of increasing the PES (particularly if the PES is in a low C or D category) should be evaluated. This is recommended to enable important and/or sensitive wetland water resources to maintain their functionality and continue to provide the goods and services for the environment and society (Table 12).

If:

- PES is in an E or F category:
  The REC should be set at at least a D, since E and F EC's are considered unsustainable.
    - The PES category is in a A, B, C or D category, AND the EIS criteria are low or moderate OR the EIS criteria are high or even very high, but it is not feasible or practicable for the PES to be improved:
- The REC is set at the current PES.
    - The PES category is in a B, C or D category, AND the EIS criteria are high or very high AND it is feasible or practicable for the PES to be improved:
- The REC is set at least one Ecological Category higher than the current PES." (Rountree, et al., 2013)

Table 12: Generic Matrix for the determination of REC and (Recommended Management Objective) 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

5 Impact Assessments

5.1 DWS (2023) Risk Ratings

Risk-based management has value in providing an indication of the potential for delegating certain categories of water use "risks" to DWS regional offices (RO) or Catchment Management Agencies (CMA). Risk categories obtained through this assessment serve as a guideline to establish the appropriate channel of authorisation of these water uses.

The DWS has therefore developed a risk assessment matrix to assist in quantifying expected impacts. The scores obtained in this assessment are useful in evaluating how the proposed activities should be authorised.

The formula used to derive a risk score is as follows:

RISK = CONSEQUENCE x LIKELIHOOD

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

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

Table 13 below provides a description of the classes into which scores are sorted, and their implication for authorisation.

Table 13: An extract from DWS (2023) indicating the risk scores and classes as well as the implication for the appropriate authorization process.

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 29	(L) Low Risk OR (+) Positive (+ +) Highly positive	Acceptable as is or or with proposed mitigation measures. Impact to watercourses and resource quality small and easily mitigated, or positive.
30 – 60	(M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
61 – 100	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

5.2 NEMA (2014) Impact Ratings with reference to aquatic aspects specified in GN320 of March 2020

As required by the 2014 NEMA regulations (as amended), impact assessment should provide quantified scores indicating the expected impact, including the cumulative impact of a proposed activity. Specific aspects of the aquatic environment that should be assessed are set out in GN 320. These are listed in Appendix A. The impact assessment should follow the format presented below (Table 14, Table 15 and Table 16). Impact scores are calculated using the following parameters:

Table 14: Step 1: Determine the PROBABILITY of the impact by calculating the average between the Frequency of the Aspect, the Availability of a pathway to the receptor and the availability of the receptor (thus: Sum of the three column scores below ÷ 3)

Frequency of Aspect / Unwanted Event	Score	Availability of pathway from the source to the receptor	Score	Availability of receptor	Score
Never known to have happened, but may happen	1	A pathway to allow for the impact to occur is never available	1	The receptor is never available	1
Known to happen in industry	2	A pathway to allow for the impact to occur is almost never available	2	The receptor is almost never available	2
< once a year	3	A pathway to allow for the impact to occur is sometimes available	3	The receptor is sometimes available	3
Once per year to up to once per month	4	A pathway to allow for the impact to occur is almost always available	4	The receptor is almost always available	4
Once a month - Continuous	5	A pathway to allow for the impact to occur is always available	5	The receptor is always available	5

Table 15: Step 2: Determine the MAGNITUDE of the impact by calculating the average of the factors below (thus: Sum of all six column ratings below ÷ 6)

Source						Receptor					
Duration of impact	**Score**	**Extent**	**Score**	**Volume / Quantity / Intensity**	**Score**	**Toxicity / Destruction Effect**	**Score**	**Reversibility**	**Score**	**Sensitivity of environmental component**	**Score**
Lasting days to a month	1	Effect limited to the site. (metres);	1	Very small quantities / volumes / intensity (e.g. < 50L or < 1Ha)	1	Non toxic (e.g. water) / Very low potential to create damage or destruction to the environment	1	Bio-physical and/or social functions and/or processes will remain unaltered.	1	Current environmental component(s) are largely disturbed from the natural state. Receptor of low significance / sensitivity	1
Lasting 1 month to 1 year	2	Effect limited to the activity and its immediate surroundings. (tens of metres)	2	Small quantities / volumes / intensity (e.g. 50L to 210L or 1Ha to 5Ha)	2	Slightly toxic / Harmful (e.g. diluted brine) / Low potential to create damage or destruction to the environment	2	Bio-physical and/or social functions and/or processes might be negligibly altered or enhanced / Still reversible	2	Current environmental component(s) are moderately disturbed from the natural state. No environmentally sensitive components.	2
Lasting 1 – 5 years	3	Impacts on extended area beyond site boundary (hundreds of metres)	3	Moderate quantities / volumes / intensity (e.g. > 210 L < 5000L or 5 – 8Ha)	3	Moderately toxic (e.g. slimes) Potential to create damage or destruction to the environment	3	Bio-physical and/or social functions and/or processes might be notably altered or enhanced / Partially reversible	3	Current environmental component(s) are a mix of disturbed and undisturbed areas. Area with some environmental sensitivity (scarce / valuable environment etc.).	3
Lasting 5 years to Life of Organisation	4	Impact on local scale / adjacent sites (km's)	4	Very large quantities / volumes / intensity (e.g. 5000 L – 10 000L	4	Toxic (e.g. diesel & Sodium Hydroxide)	4	Bio-physical and/or social functions and/or processes might be considerably altered or enhanced / potentially irreversible	4	Current environmental component(s) are in a natural state. Environmentally sensitive environment / receptor (endangered	4

Source								Receptor			
				or 8Ha–12Ha)						species / habitats etc.).	
Beyond life of Organization / Permanent impacts	5	Extends widely (nationally or globally)	5	Very large quantities / volumes / intensity (e.g. > 10 000 L or > 12Ha)	5	Highly toxic (e.g. arsenic or TCE)	5	Bio-physical and/or social functions and/or processes might be severely/substantially altered or enhanced / Irreversible	5	Current environmental component(s) are in a pristine natural state. Highly Sensitive area (endangered species, wetlands, protected habitats etc.)	5

Table 16: Step 3: Determine the SEVERITY of the impact by plotting the averages that were obtained above for Probability and Magnitude in the table below.

ENVIRONMENTAL IMPACT RATING / PRIORITY					
	MAGNITUDE				
PROBABILITY	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Low	Medium	High	High	High
4 Likely	Low	Medium	High	High	High
3 Possible	Low	Medium	Medium	High	High
2 Unlikely	Low	Low	Medium	Medium	High
1 Rare	Low	Low	Low	Medium	Medium

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2026.02.23

The Competent Authority
Department of Forestry, Fisheries and the Environment

Cc:
DFFE: Biodiversity and Conservation Section, Mpumalanga (MDARDLEA)
Mpumalanga Tourism and Parks Agency (MTPA)

RE: Confirmation of Correction – Mpumalanga Biodiversity Sector Plan (MBSP) CBA Status
Project: Eskom Duvha Power Station – Reinstatement of the Low-Level Dam Spillway and Construction of a Weir

Dear Sir/Madam,

I, Rudi Bezuidenhoudt, a registered Professional Natural Scientist (SACNASP Reg. No. 008867) and appointed Wetland and Aquatic Biodiversity Specialist for the above-mentioned project, hereby provide formal confirmation regarding the Critical Biodiversity Area (CBA) status of the project site.

During the initial drafting of the Wetland Biodiversity Assessment, reference was made to the Mpumalanga Biodiversity Sector Plan (MBSP), indicating that the project area intersects a **CBA: Optimal** zone. Upon further spatial verification and review of the most current MBSP spatial dataset, it was confirmed that this statement was incorrect.

The corrected spatial analysis confirms that:

• The development footprint associated with the reinstatement of the low-level dam spillway and construction of the weir **does not intersect a CBA: Optimal zone**.
• The project area falls outside the mapped CBA Optimal areas as reflected in the most recent MBSP spatial layer.
• The Wetland Biodiversity Assessment has been amended accordingly, and the corrected spatial representation is included in the updated Annexure E of the amended Draft Basic Assessment Report.

The correction was made following detailed GIS verification using the official MBSP dataset and overlay of the confirmed development footprint coordinates. The updated assessment accurately reflects the biodiversity planning context of the site.

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This letter serves as formal confirmation that the project area is **not situated within a Critical Biodiversity Area (CBA) Optimal zone**, and that the previous reference to such intersection was an error that has since been rectified in the amended Wetland Biodiversity Assessment.

Please find attached supporting spatial evidence reflecting the confirmed development footprint relative to the MBSP CBA layer.

Should you require any additional clarification, I remain available to provide further supporting information.

Yours sincerely,

Rudi Bezuidenhoudt
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Signed:

Rudi Bezuidenhoudt
2026.02.23

Annexure E5: Heritage Phase 1 study

1st phase H I A
for the
Construction of a spillway & weir at the Low Level Ash Water Return Dam (LLAWRD), Duvha Power Station,
in
Emalahleni Municipality, Mpumalanga Province
for
Eskom Holdings (SOC) Ltd.

Figure 1. Study area for the heritage impact assessment at the proposed upgrading of the spillway and weir at the Duvha Power Station LLAWRD. ***(Google Earth 2026.)***

Report prepared by: -

Sidney Miller

DATE: April 2026

Project coordinator: -

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"Of the earth, for the earth"
SHANGONI
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Contact Details.

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Heritage Conservation Consultant.	Sidney Miller.	082 939 6536. sidneymears@gmail.com

Declaration of independence.

I, Mr. Sidney Mears Miller, declare that as an independent consultant I have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which the appointment was made other than fair remuneration for the Shangoni **APPOINTMENT LETTER: -** ***SIDNEY MILLER: HERITAGE SPECIALIST ASSESSMENT FOR THE ESKOM DUVHA RE-INSTATMENT OF THE SPILLWAY*****, Dated 8th April 2026,** and work performed in connection with the activity or application.

Provisional indemnity.

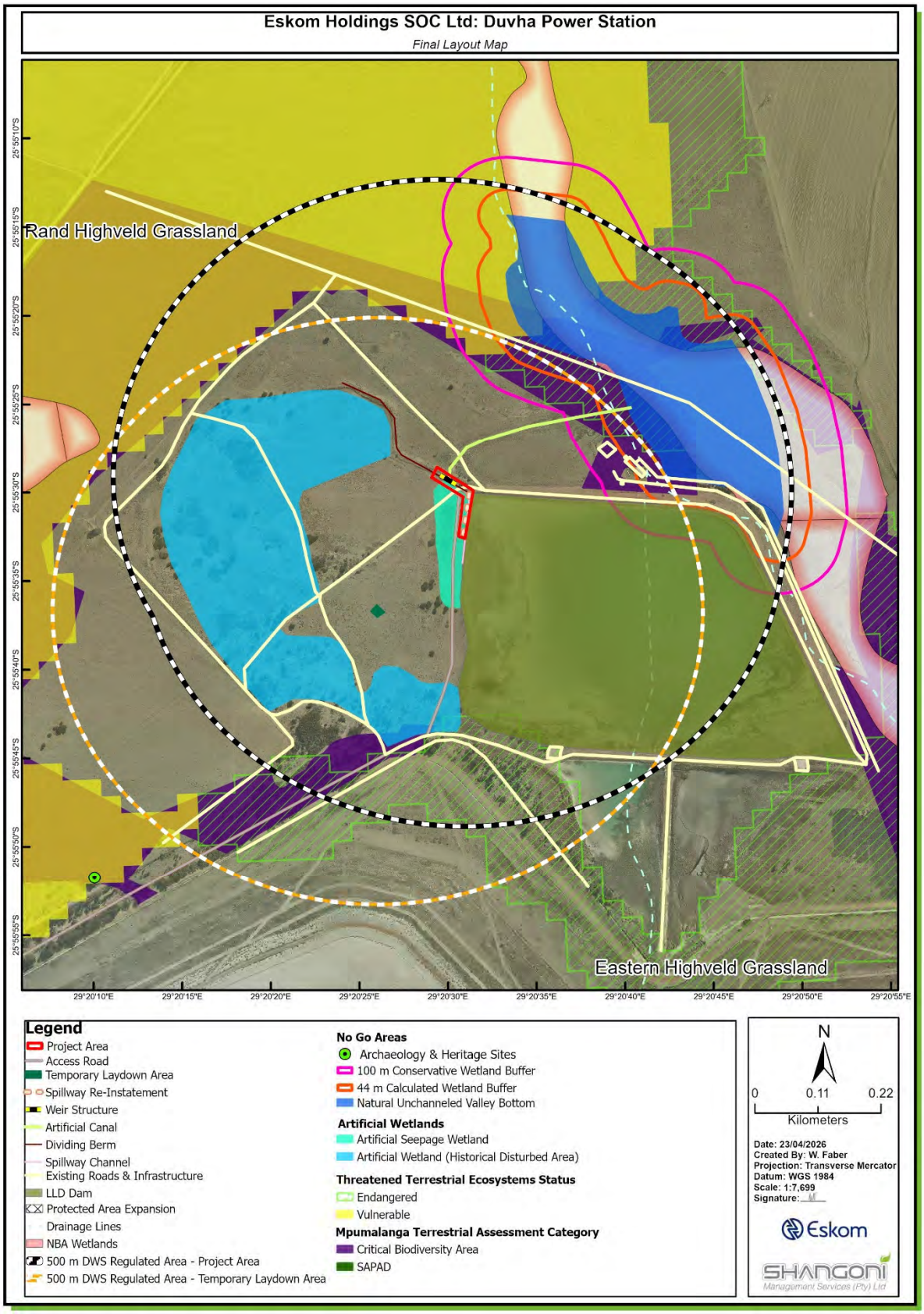
I, Sidney Mears Miller hereby declare that all reasonable steps were taken to identify all the heritage resources on the property under investigation. For obvious reasons heritage remains that occurs/occurred underground cannot be vouched for. In the event of such remains being uncovered during the construction operations, work should be stopped and a heritage practitioner or the heritage authorities must be informed. The cost of such new investigation will be for the account of the client.

Sidney Mears Miller

BSc (Engineering) Civil. *(TUKS.)*
MA (Architecture) Conservation. *(WITS.)*

Accredited Professional Archaeologist for the SADC Region
Member No. 087.

Note that a copy of the report must be lodged by the client with SAHRA to be vetted, and to be placed on SAHRIS as stipulated by the NHRA (Act No. 25 of 1999), Section 38 (particularly subsection 4).



 April 2026. *. Eskom Holdings (SOC) Ltd.*

Contents

List of acronyms.

AIA	Archaeological Impact Assessment.	GPS	Global Positioning System.
ASAPA	Association of Southern African Professional Archaeologists.	HIA	Heritage Impact Assessment.
BAR	Basic Assessment Report.	HMF	Heritage Management Framework.
BP	Before Present.	HMP	Heritage Management Plan.
BIF	Banded iron formation.	ICOMOS	International Council on Monuments and Sites.
BMS	Berlin Mission Society.	LIA	Late Iron Age.
CE	Current Era.	LMS	London Mission Society.
CFP	Chance Finds Procedure.	LOM	Life of Mine.
CRM	Cultural Resources Management.	LSA	Later Stone Age.
DEA	Department of Environmental Affairs.	MPRDA	Mineral and Petroleum Resources Development Act (No. 28 of 2002)
EAA	Environmental Authorisation Application.	MSA	Middle Stone Age.
EAP	Environmental Assessment Practitioner.	YA	Years Ago.
EIA	Early Iron Age.	NEMA	National Environmental Management Act (No. 107 of 1998)
ESA	Early Stone Age.	NHRA	National Heritage Resources Act (No. 25 of 1999)
ECO	Environmental Control Officer.	PHRA	Provincial Heritage Resources Authority.
EMPr	Environmental Management Programme.	SAHRA	South African Heritage Resources Agency.
EIA	Environmental Impact Assessment.	SAHRIS	South African Heritage Resources Information System.
FLS	Fellow of the Linnaean Society.	TOR	Terms of Reference.
GIS	Geographic Information System.	Shangoni = Shangoni Management Services (Pty) Ltd)	

Archaeological remains can be defined as any features or objects resulting from human activities, which have been deposited on or in the ground, reflecting past ways of life, and are older than 100 years.

Conservation as used in this report, in relation to heritage resources, "includes protection, maintenance, preservation and sustainable use of places or objects so as to safeguard their cultural significance" ***(National Heritage Resources Act (NHRA) 1999: Act 25: 2 iii).***

Cultural significance means "aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance" ***(NHRA 1999: Act 25:2(vi).)***

Development means "any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of a heritage authority, in any way, result in a change to the nature, appearance or physical nature of a place, or influence its stability and future well-being" ***(NHRA 1999: Act 25:2(viii).)***

Heritage: Heritage resources have lasting value in their own right and provide evidence of the origins of South African society. They are limited and non-renewable. The National Heritage Resources Act (Act 25 of 1999) section 32, p. 55 defines these as "An object or collection of objects, or a type of object or list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object".

1. Executive summary. [1]

1.1. Introduction.

Eskom Holdings (SOC) Ltd., has appointed Shangoni Management Services as environmental consultant, for their application for the proposed upgrading of the spillway and weir at the Low Level Ash Water Return Dam (LLAWRD) at Duvha Power Station. Duvha Power Station has been in operation for a period of over 40 years. Duvha Power Station produces wet ash that gets pumped to the ash dam which is located 1.7km east of the Witbank Dam. The settled water is then decanted to the LLAWRD, from where it gets pumped back to the station to produce more wet ash slurry. The LLAWRD spillway and weir is experiencing trauma and is in need of upgrading.

1.2. Research target/s. ***(See Figure 3 below.)***

To identify any heritage estate remains in the research area.

1.3. Desktop Research results.

1.3.1. Archaeological and historical. ***(See Addendum 3.)***

Due to environmental conditions, the region was generally unsuited for long-term settlement for both Stone- and Iron Age communities owing mainly to lack of suitable shelter and harsh winter conditions. (Especially sustainable fuel and timber availability.) Furthermore, original low population densities and far better environmental conditions in the Middle- and Lowveld regions, gravitated early human settlement towards those areas.

1.3.2. Previous Heritage Impact Assessments. ***(See Addendum 8.)***

1.3.2.1. General.

These sources establish an ephemeral cultural landscape with no or little Stone Age, no or little Iron Age saturation and mainly recent European farm-yards as permanent settlement. These though, were always associated with small cemeteries. One small and badly preserved LIA stone-walled site on the farm Middelkraal was reported in the HIA's of *Van Vollenhoven* ***(2021)****, & Pelser* ***(2024).***

1.3.2.2. Specific.

The existing 2019 PGS HERITAGE study *has already cleared the present site*. (*See Figure 19 page 32.*)

1.4. Previous Impact.

During the last hundred years the whole of the study area has been heavily impacted by dry-land maize farming, an ash-dump from the Duvha Power Station, plus the development of the Witbank mining town and associated suburbs. Multiple roads have added to the overall influence of the coal mining industry in the region since the early 1960's.

1.5. Field Research results.

1.**5**.1. No heritage remains were encountered in the research area.

1.5.2. The two heritage remains identified in the 2019 study by PGS HERITAGE nearby, Duv 001 and Duv 002, were also inspected and were found to be intact and unchanged.

1.5.2. Potential Environmental Impact are rated LOW*. (See Addendum 7.3.)*

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[1] ***1. The reader is reminded that according to section 38 (particularly subsection 1) of Act 25 of 1999, the National Heritage Act, there was no need for this Impact Assessment owing to the small footprint of the proposed work.***

2. The reader is also reminded that a previous HIA has already cleared the present study area. I.E the available 2019 PGS HERITAGE study. (See Figure 19 page 32 for track logs and heritage sites identified from the fieldwork undertaken by the PGS HERITAGE team in 2019.

1.6. Declaration.

This Phase 1 HIA was conducted for the construction of the spillway and weir at Duvha Power Station LLAWRD, for Eskom Holdings (SOC) Ltd. The author of this report is confident that the heritage resources, of the property under review, were adequately investigated, assessed and documented during this Phase 1 HIA. ***Therefore there is no reason that the proposed work could not be executed***.

Sidney M Miller .

2. Study Area *([2]).*

Figure 2. Duvha Power Station Site Layout, showing the location of the LLAWRD in relation to the Ash Dam ***(Map provided by Eskom, taken from the 2019 PGS HIA.)***

Figure 3 Study area for the heritage impact assessment at the proposed upgrading of the spillway and weir of the LAWRD. ***(Google Earth 2026.)***

[2] ***See Addendum 4 for detailed description of the specific study areas to be impacted. It is derived and compiled from KMZ images supplied by Shangoni on the 10th March 2026.***

3. Terms of Reference.

Shangoni Management Services (Pty) Ltd (Shangoni) appointed Mr Sidney Miller as independent specialist to conduct a Phase 1 HIA for Eskom Holdings (SOC) Ltd. This HIA is conducted for their application for the refurbishment of the spillway & weir at the LLAWRD, at Duvha Power Station.

3.1. The study area is minute in extent as demonstrated in ***Figure 3***.

3.2. It comprise an eighty meter spillway and a 30 meter weir.

3.3. Both structures are located on disturbed land as can be seen in ***Figure 3.***

3.4. Compared to the existing environmental impact of the Greater Duvha Power Station, the proposed new work is insignificant. ***(See Figure 2.)***

4. Assessment Methodology.

4.1. Desktop evaluation.

Prior to conducting the physical site assessment, a desktop survey of existing literature on the wider region was conducted to assess the known heritage context. These included published research articles, unpublished reports, and other online information. The SAHRIS data base was also accessed for previous heritage reports that relate to the general region of the survey. The relevant topographical and historical maps were traced, and consulted for pointers to possible heritage resources. The study area is covered by a series of historical photo data sets that can be used to assess the occupations of this particular landscape. Historical articles were also systematically scrutinised to identify potential sites, areas of disturbance and vegetation or geological anomalies, and for any evidence of structural remains, or likely areas for archaeological features.

Of the twenty HIA's consulted, there emerges a pattern of heritage finds that closely overlaps the known history of the region[3].

4.1.1. Ephemeral LSA stone tool surface finds occur around pans.

4.1.2. A few farm buildings of generally low heritage value are described.

4.1.3. One badly preserved LIA stone-walled site on the farm Middelkraal was reported in the HIA's of *Van Vollenhoven* ***(2021)*** *& Pelser* ***(2024)*** for the extension of the mine there. Mitigation was advised by SAHRA ***(Enquiries: John Pakwe Tel: (063) 894-1979 Email: jpakwe@sahra.org.za Case ID: 24025)***

4.1.4. The reader is also reminded that the existing* 2019 PGS HERITAGE study *has already cleared the present study area.

4.2 Surveyed area evaluation *([4]).*

4.2.1. Affected areas.

4.2.1.1. The following is known: -

> *"…The Duvha Power Station is a coal-fired thermal power plant situated near eMalahleni in Mpumalanga province, operated by the state-owned utility Eskom Holdings SOC Ltd. With six generating units each rated at 600 megawatts, it provides an installed capacity of 3,600 megawatts, making it one of Eskom's largest facilities and a key contributor to baseload electricity supply. Construction of the station commenced in November 1975, with the first unit entering commercial operation in 1980 and the final unit in 1984, establishing Duvha as a cornerstone of Eskom's expansion during the late apartheid era to meet growing industrial demand. The plant's design efficiency stands at 37.6% at rated turbine maximum continuous rating, utilizing dry-cooled technology adapted to the region's water-scarce environment, and it draws coal primarily from nearby collieries. Despite its technical specifications enabling reliable output under optimal conditions, Duvha has faced recurrent operational challenges, including multiple equipment failures and maintenance delays that have exacerbated national power shortages.*

[3] See Addendums 2, 3, 8 & 9.

[4] See Addendum 4.

Figure 4. Study area with survey track in magenta. ***(Annotation S.Miller 2026.)***

4.2.1.2. The total study area comprise 80meters for the spillway and 30meters for the weir.

4.2.1.3. Compared to the existing environmental impact of the Greater Duvha Power Station, the proposed new work is insignificant. ***(See Figures 2 & 3).***

4.2.2. Site Visit.
4.2.2.1. The project site was visited on the 21th of April 2026 by ***Mr S Miller*** and ***Mr Z Nel***[5] in the company of ***Mr Benson Mahlangu*** the representative from ***Eskom Holdings (SOC) Ltd.***

4.2.2.2. The study area and immediate surrounds were systematically searched and inspected on foot to identify any potential areas that could contain heritage resources. Prior to the field work all maps and diagrams of the proposed mine infrastructure provided by the Client were mapped and plotted on Google Earth and high-resolution aerial imagery, and converted to .gpx format.

4.3. Heritage issues identified.

4.3.1. Research Finds.
No heritage remains were encountered or observed.

4.3.2. Potential Environmental Impact
Rated as LOW. (See Addendum 7.3.)

5. Legislative Framework.

5.1 National Heritage Resource Act (NHRA).[6]

The National Heritage Resources Act (NHRA) ***(Act No. 25 of 1999)*** is the primary legislative act dealing with the conservation and management of heritage resources. In brief the Act aims to promote good

[5] ***Mr. Nel is an Archaeology Student in Heritage Impact Assessment training.***
[6] ***The reader is reminded that according to section 38 of the National Heritage Act, Act 25 of 1999 there was no need for this Impact Assessment.***

management of the national estate, and to enable and encourage communities to nurture and conserve their legacy so that this may be bequeathed to future generations.

The NHRA clearly defines the national estate and sets out principles for the management of heritage resources, determines the constitution, powers, functions, and duties of heritage authorities and provides a framework for the enforcement of the Act. All sites, heritage resources and archaeological remains are protected in terms of the National Heritage Resources Act (NHRA) Act No. 25 of 1999: -

> • *All archaeological remains, artefactual features, and structures older than 100 years and historical structures older than 60 years are protected by the National Heritage Resources Act (NHRA)* ***(Act No. 25 of 1999, section 35).*** *No archaeological artefact, assemblage, or settlement (site) may be moved or destroyed without the necessary approval from SAHRA.*
>
> • *Human remains older than 60 years are protected by the National Heritage Resources Act Section 36. Human remains that are less than 60 years old are protected by the Human Tissue Act* ***(Act 65 of 1983 as amended).***

The following sections of the South African Heritage Resources Act, 1999 ***(Act 25 of 1999)*** must be noted: -

> *In terms of section 3 (1 & 2) of the NHRA, heritage resources of South Africa that are of cultural significance or other special value for the present community and for future generations and are considered part of the national estate and fall within the sphere of operations of heritage resources authorities include: -*
>
> *(a) Places, buildings, structures and equipment of cultural significance;*
> *(b) Places to which oral traditions are attached or which are associated with living heritage;*
> *(c) Historical settlements and townscapes;*
> *(d) Landscapes and natural features of cultural significance;*
> *(e) Geological sites of scientific or cultural importance;*
> *(f) Archaeological and palaeontological sites;*
> *(g) Graves and burial grounds, including: -*
> *(i) Ancestral graves;*
> *(ii) Royal graves and graves of traditional leaders;*
> *(iii) Graves of victims of conflict;*
> *(iv) Graves of individuals designated by the Minister by notice in the Gazette;*
> *(v) Historical graves and cemeteries; and*
> *(vi) Other human remains which are not covered in terms of the Human Tissue Act, 1983* ***(Act No. 65 of 1983);***
>
> *(h) Sites of significance relating to the history of slavery in South Africa;*
> *(i) Movable objects, including: -*
> *(i) Objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;*
> *(ii) Objects to which oral traditions are attached or which are associated with living heritage;*

(iii) Ethnographic art and objects;
(iv) Military objects;
(v) objects of decorative or fine art;
(vi) Objects of scientific or technological interest; and
(vii) books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1 (xiv) of the National Archives of South Africa Act, 1996 ***(Act No. 43 of 1996).***

Without limiting the generality of subsections (1) and (2), a place or object is to be considered part of the national estate if it has cultural significance or other special value because of: -

(a) Its importance in the community, or pattern of South Africa's history;
(b) Its possession of uncommon, rare or endangered aspects of South Africa's natural or Cultural heritage;
(c) Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
(d) Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
(e) Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
(f) Its importance in demonstrating a high degree of creative or technical achievement at a particular period;
(g) Its strong or special association with a particular community or cultural group for social, Cultural or spiritual reasons;
(h) Its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
(i) Sites of significance relating to the history of slavery in South Africa.

5.2. National Environmental Management Act, 1998 ***(Act 107 of 1998).***[7]

The NEMA and subsequent regulations provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state; and all matters connected therewith.

The content of the Specialist Report must be in accordance with the specifications of NEMA EIA Regulations ***(GNR 982 of 4 December 2014),*** with specific reference to ***Appendix 6: Specialist Reports*** and must contain the following: -

(a) Details of: -
(i) The specialist who prepared the report; and
(ii) The expertise of that specialist to compile a specialist report including a curriculum vitae;

(b) A declaration that the specialist is independent in a form as may be specified by the competent authority;

(c) An indication of the scope of, and the purpose for which, the report was prepared;

[7] ***Generally known as NEMA.***

(d) The date and season of the site investigation and the relevance of the season to the outcome of the assessment;
(e) A description of the methodology adopted in preparing the report or carrying out the specialised process;

(f) The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;

(g) An identification of any areas to be avoided, including buffers;

(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;

(i) A description of any assumptions made and any uncertainties or gaps in knowledge;

(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;

(k) Any mitigation measures for inclusion in the EMPr;

(l) Any conditions for inclusion in the environmental authorisation;

(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation;

(n) A reasoned opinion: -
(i) As to whether the proposed activity or portions thereof should be authorised;
(ii) If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;

(o) A description of any consultation process that was undertaken during the course of preparing the specialist report;

(p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and

(q) Any other information requested by the competent authority.

5.3. Grading and field rating *([8]).*
Section 7 of the NHRA distinguishes between three grades of declared (formally protected) heritage resources.

• **National (Grade I):** Heritage resources with qualities so exceptional that they are of special national significance.

[8] See Addendum 8, Grading and impact, for results of grading evaluation.

• **Provincial (Grade II):** Heritage resources which, although forming part of the national estate, can be considered to have special qualities that make them significant within the context of a province or a region. All other heritage resources in the province are by default Grade II.
• **Local (Grade III):** Other heritage resources worthy of conservation. The Grade III tier is further split into three sub-categories, with **IIIa** = high, **IIIb** = medium and **IIIc** = low local significance. ***(SAHRA 2005/2007, 2016; Wiltshire 2013: 325).*** Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade I resources are intended to be managed by the national heritage authority. Provincial heritage resources authorities would manage Grade II sites. Grade III resources would be managed by the relevant local planning authority ***(Wiltshire 2013: 325).*** These bodies are responsible for grading, but anyone may make recommendations for grading. ***Unfortunately, only a few Provincial Heritage Resources Authorities (PHRA's) are fully functional.***

While grading is actually the responsibility of the heritage resources authorities, all reports must include Field Ratings for the site(s) discussed (proposals for grading), to comply with section 38 of the national legislation ***(SAHRA Draft Minimum Standards 2016: 25–26): -***

a) Proposed Field Rating/Grade 1 National Resource: This site is considered to be of Field Rating/Grade I and must be nominated as such (mention must be made of any relevant international ranking), a protected buffer zone must be proposed, these sites must be maintained in situ and a CMP must be recommended for the in-situ conservation of the site;

b) Proposed Field Rating/Grade II Provincial Resource: This site is considered to be of Field Rating/Grade II and must be nominated as such, a protected buffer zone must be considered, these sites must be maintained in situ and a CMP must be recommended for the in-situ conservation of the site;

c) Proposed Field Rating/Grade IIIA Local Resource: The site must be retained as a heritage register site **(High significance)** and so mitigation as part of the development process is not advised, a protected buffer zone must be considered, these sites must be maintained in-situ and a CMP must be recommended for the in-situ conservation of the site;

d) Proposed Field Rating/Grade IIIB Local Resource: This site could be mitigated and (part) retained as a heritage register site **(High/Medium significance).** Mitigation of these sites must be subject to a formal permit application process lodged with the relevant heritage resources authority;

e) Proposed Field Rating/Grade IIIC Local Resource: These are sites have been assigned a **Low field rating** which, once adequately described in the Phase I Assessment, may be granted destruction authorisation at the discretion of the relevant heritage authority outside of the formal permitting process, ***(with regard to section 38(8)*** cases. This will be subject to the granting of the Environmental Authorisation.

5.4. International treaties, conventions and charters.
South Africa is signatory to a number of international agreements, which have implications for heritage conservation and management including the World Heritage Convention that places certain obligation on the state and civil society for the management of heritage resources.

South Africa as a member of the United Nations Organization for Education, Science and Culture **(UNESCO)** subscribes to and takes part in a number of the subsidiary programs including the International Council of Museums **(ICOM),** International Committee for Monuments and Sites **(ICOMOS)** and various other international conservation bodies under the umbrella of **UNESCO.**

Of these the most important and pertinent is the ICOMOS Charter for the Conservation of Places of Cultural Significance, commonly known as the Burra Charter **(2009, 2013).** Although first adopted in 1979, the Charter remains current with the latest version adopted in October 2013. The Charter is considered to be the international blueprint on the conservation of places of cultural significance. The Burra Charter accordingly sets the international standard for standard of practice for those who provide advice, make decisions about, or undertake works to places of cultural significance, including owners, managers and custodians. ***(Australian ICOMOS Charter for places of Cultural Significance 2013).***

6. Archaeological and Historical Context.[9]

6.1. The Stone Age archaeology.

Unfortunately, as far a known, the harsh environment of the Eastern Transvaal inhibited long term permanent habitation to hunter-gatherer societies throughout the entire Stone Age. During the last two millennia though, the influx of Agro-Pastoralist peoples and European pioneers marginalised the potential hunting grounds of *the first peoples* encountered by them.

Although it is known, through amongst other resources farm names in the region, that there was a noticeable presence of Hunter-Gatherers in the early 19th century in the area. This owing to the prefix ***Boschman[10]***-, coupled to -fountain, -stream, -hill and similar natural phenomena to compile farm names. Owing to the very late Hunter-Gatherers' ephemeral lifestyle of seasonal and regional migration very few traces can be found of their passing through the present study area.

No Stone Age heritage remains were encountered during the fieldwork.

6.2. The Iron Age.

Agro-pastoral farmers moved into the Southern African region during the period since circa 2000 YA. The term Iron Age is widely used to describe the Agro-pastoral (mixed farming) way of life associated with speakers of Bantu languages that contrasted with the Stone Age hunter-gatherer lifestyle ***(Huffman 2007).*** The Iron Age within sub-Saharan Africa has been divided into the Early Iron Age (200–900 CE), Middle Iron Age (900–1300 CE) and Late Iron Age (1300–1840 CE) ***(Huffman 2007).***

Early Iron Age sites mainly occur in northern and eastern Limpopo Province, as well as along the Kwa-Zulu Natal coastal region sited on soils compatible to early farming practices.

Middle Iron Age sites mainly occur in northern and eastern Limpopo Province, also on soils compatible to early farming practices including large cattle assemblages. During this period trade with and trade routes to the eastern coast on the Indian Ocean becomes prominent in South Africa.

Later Iron Age sites occur in the Northern-, Gauteng-, Free State-, Gauteng-, Kwa-Zulu Natal-, and Limpopo Provinces, as well as in Swaziland, Lesotho and Mozambique. This rapid population expansion can partially be contributed to the introduction of maize through the expanding east coast trade structure and a long period of civil peace. Owing to this, from the mid 18th century onwards, sites can comprise from a handful of villages, to the *mega-cities* of Celonskraal, Khaditswene and the large residences of the Ama-Zulu Kings.

[9] For full description see Addendums 2 & 3.
[10] Bushman

Apart from normal environmental conditions for their farming practises, vegetation in the form of timber become very important for construction and energy. This then limits settlement in areas of low tree density, such as the Eastern Highveld in Mpumalanga. Added to this is the extremely cold winters that occur there. From this reality one find LIA occupation mainly north and west of Middelburg, north and east of Belfast, south and west of Heidelberg and south and east of Ermelo. No known LIA sites occur in the region of the study area.

One small, badly preserved LIA site was found on the farm *Middelkraal* as mentioned in the two HIA's *(Van Vollenhoven* ***2021*** *& Pelser* ***2024)*** for the extension of the mine there. Mitigation was advised by SAHRA ***(Enquiries: John Pakwe Tel: (063) 894-1979 Email: jpakwe@sahra.org.za Case ID: 24025)***

No Iron Age heritage remains were encountered during the fieldwork.

6.3.1. Historical Period. ***([11])***

Mzilikazi was originally a lieutenant of Shaka but had a quarrel with him in 1823 and rebelled. Rather than face ritual execution, he fled northwards with his followers. He first travelled to Mozambique but in 1826 he moved west into the Transvaal and continued the period known as the *Mfecane* initiated by the Ndwandwe under Zwide. In the Transvaal his army easily overpowered the large peaceful Tswana, Sotho and other communities, which have over several centuries inhabited and populated this region of abundance. His raiding soldiers may have traversed the study area but no evidence exist.

After his expulsion from the Transvaal the Voortrekkers annexed it and in a succession of punitive expeditions subdued the rest of the indigenous peoples. They then subdivided the Transvaal into farms and a number of reserves for the indigenous peoples. In the early 19th century the Boors also avoided the study area region owing to the cold, the lack of firewood and the difficulty of ploughing for larger scale crop production. Some turned to successful beef and milk production despite the cold. Eventually farming with horses were attempted, but is was always expensive and risky. With the advent of modern farming equipment post WWII, the region saw large scale dry-land maize farming emerging.

6.3.2. The missionary endeavour.

Missionary work in the region was mainly undertaken by the Berlin Missionary Society at Botshabelo to the northwest of Middleburg and Gerlacheshoop further to the north-east. The absence of mission stations in the study region then also confirms low volume utilisation of the area by later Iron Age peoples.

6.3.3. The mining history.

The recent mining history and current mining operations are not discussed for the purpose of this report as the large scale impact is well known. Early mention of coal can be seen in the 1899 Jeppe Map, sheet 5. This was known early in the 19th century by the Boor farmers before the advent of steam trains, when the sources along the new railway lines were developed. But even before that the 1870's Kimberly Diamond Mines and the 1880's Johannesburg Gold Mines sponsored the general development of fossil fuel mines such as at Vereeniging. With the growth of towns and the advent of inexpensive cast-iron stoves early in the 20th century, more and more coal were extracted for local use. Similarly the arrival of electricity prompted the building of power-stations which from the pre-WWII years exponentially demanded the mining of coal. From the 1970's onwards the export of coal to Japan became an important earner of foreign currency for an embattled Apartheid Government. It is then during the last two phases that the Mpumalanga Coal Mining Industry grew to its modern capacity. This supplies mainly to ESCOM for the national grid, while export is still an ongoing concern.

[11] ***For fuller details see Addendum 3***

No Historical Period heritage remains were encountered during the fieldwork.

7. Previous HIA's and literature sources.[12]

Archaeological Impact Assessments (AIA's), Heritage Impact Assessments (HIA's) and academic publications on the prehistory and historical period generated a data base for the general area. These sources demonstrate an ephemeral cultural landscape with no or little Stone Age, no or little Iron Age saturation and mainly European farm-yards as permanent historical settlement through utilization of the local natural resources

A desktop study of existing literature on the wider region was conducted to assess the heritage context. The SAHRIS data base was also accessed for previous heritage reports that relate to the general region of the survey, especially for coal mining licence applications. No Iron Age and few historical era sites have been recorded but none occur on the site under investigation. On the other hand, a few disturbed Later Stone Age open-air sites have been found around the numerus pans that exist. One small, badly preserved LIA site was found on the farm Middelkraal as mentioned in the two HIA's *(Van Vollenhoven **2021** & Pelser **2024)*** for the extension of the mine there. Mitigation was advised by SAHRA ***(Enquiries: John Pakwe Tel: (063) 894-1979 Email: jpakwe@sahra.org.za Case ID: 24025)***

The reader is also reminded that the existing* 2019 PGS HERITAGE study *has already cleared the present study area.

8. Finds and impact.[13]

8.1. There were No finds observed during the present HIA field work.

8.2. The present HIA field work implies a LOW ENVIRONMENTAL IMPACT

ENVIRONMENTAL IMPACT RATING/PRIORITY					
PROBABILITY	**MAGNITUDE**				
	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Low	Medium	High	High	High
4 Likely	Low	Medium	High	High	High
3 Possible	Low	Medium	Medium	High	High
2 Unlikely	Low	Low	Medium	Medium	High
1 Rare	Low	Low	Low	Medium	Medium

Figure 5. From the Zero heritage remains encountered the ENVIRONMENTAL IMPACT form can be completed as above. ***(Compiled S.M. Miller 2026.)***

[12] ***See Addendum 8.***
[13] ***See Addendum 7.***

8.2.2. Risk assessment and mitigation measures table.

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post-mitigation		
								Probability	Magnitude	Significance		Probability	Magnitude	Significance
1	Sites, artefacts and fossils of Archaeological and Cultural Importance.	Re-instatement of the LLAWRD spillway and weir	No heritage remains were encountered in the research area. The two heritage remains identified in the 2019 study by PGS HERITAGE nearby, Duv 001 and Duv 002, were also inspected and were found to be intact and unchanged.	Reversible	Low Degree.	Construction, Operational	62 m spillway and 34 m weir.	1	2	LOW	Avoid	1	1	LOW

Aspect affected	Activity	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
Sites, artefacts and fossils of Archaeological and Cultural Importance.	Re-instatement of the LLAWRD spillway and weir	Construction, Operational	62 m spillway and 34 m weir.	None proposed as no impacts were identified.	In compliance with the National Heritage Resources Act (Act No. 25 of 1999)	Construction and operation.

From the assessment table above, it is evident that the impact of the proposed Re-instatement of the *LLAWRD* spillway and weir at Duvha Power Station, may be considered to be of LOW ENVIRONMENTAL IMPACT.

Addendum 1. Natural Environment, Geology and Vegetation.

This Addendum is not supposed to be a scientific description of the natural environment of the study area. It is rather to be seen as a canvas or milieu that supports environmental factors that influenced Human habitation in the research area over time. This then assist to determine resources that were present for fruitful living conditions for a variety of populations that developed, peaked and eventually disappeared from existence over time.

It also sets the parameters for the purpose of the heritage impact study, such as mineral deposits proposed to be reclaimed and expected development ideas envisioned by a client. These proposed effects then has to be assessed in terms of legislation regulating impact on general past human life.

1. Geology.

1.1.1. General Southern African Geology.

In our present study area, the Kaapvaal Craton had formed and the Transvaal Super-group had been deposited. The Bushveld Complex had appeared and the Vredefort meteorite impact had occurred. P in the figure marks Pretoria (Tshwane), west of the study area.

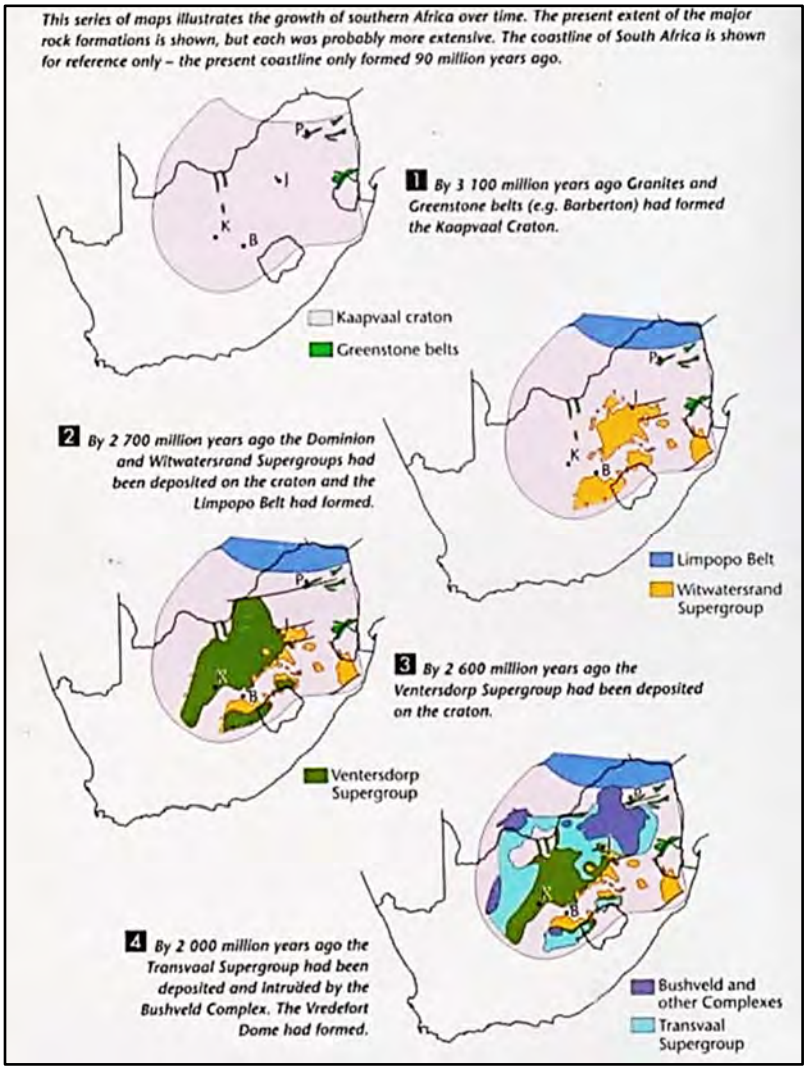


Figure 6. Left is illustrated the formation of the South African geological substructure between 3100 million years ago and 2000 million years ago. ***(McCarthy & Rubidge: p 334.).***

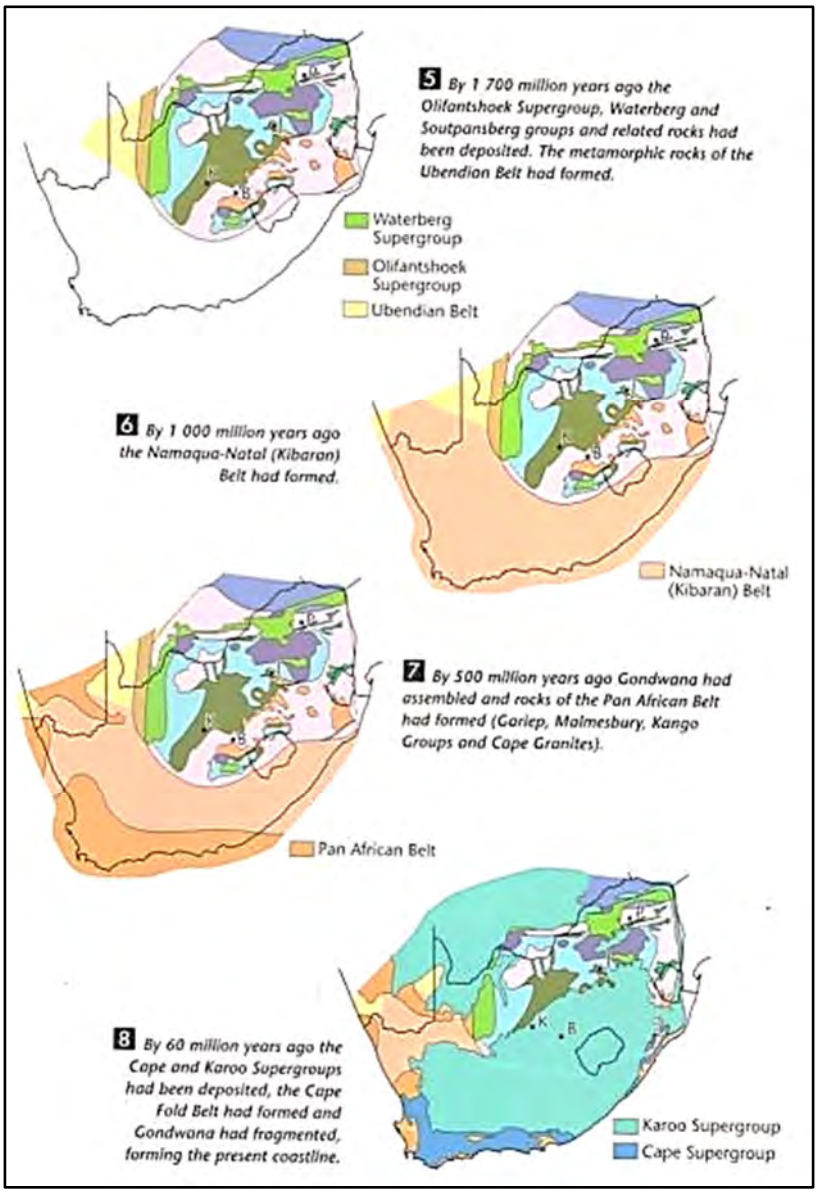
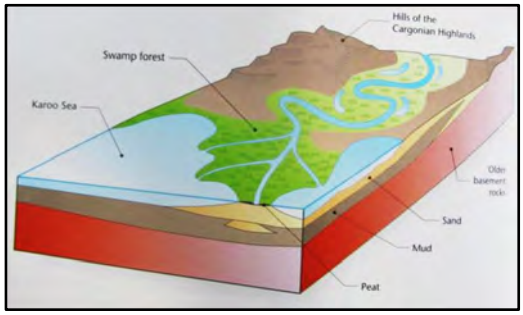


Figure 7. Left is illustrated the formation of the South African geological substructure between 2000 million years ago and 60 million years ago. ***(McCarthy& Rubidge: p 335.)***

As can be seen above it is only the Karoo Super-group that had any further significant impact on the study area. P, in the illustrations, marks Pretoria, (Tshwane) west of the study area. Africa in general and Southern Africa in particular is fortunate to contain evidence of almost all of the geological information regarding the alterations in earth geology over nearly 3 500 million years including the oldest known oceanic crust, consisting of komatiite in the lower Onverwacht Group in Barberton. The only two older rock groups known today can be found in Canada (Granites circa 4100 million years?) and in Iceland (Sedimentary material circa 3 900 million years) as these early periods the earth's crust has been in a continuous process of reshaping owing to plate tectonic movement.

Geologists' uses terms such as the Kaapvaal Craton, the Pangean continent and Gondwanaland that encompasses hundreds of millions of years, but for our present study the geological under-build is fortunately less complex. Apparently within the last 600 million years, as Gondwana drifted from the Antarctic region northwards, and as the ice covering continued to melt, an inland sea was formed between the Cargonian Highlands in the north and the Falkland Plateau in the south, and became linked to the open sea apparently similar to the Black sea. Deposits from the higher areas filled up the Karoo Sea over time forming what is formally known as the Ecca Group sedimentary deposits.

During the time of the formation of the Cape Super group though, it appears as if land plants were tentatively establishing themselves out of the primeval seas. It therefore followed that by the time of the emergence of the Southern Gondwana from underneath the ice sheets, several large tree-like plants had already evolved, and terrestrial life were firmly on its way to utilize the new environment. A great number of plants were to quickly colonise the extensive swamp-like deltas that were feeding into the Karoo Sea from the north



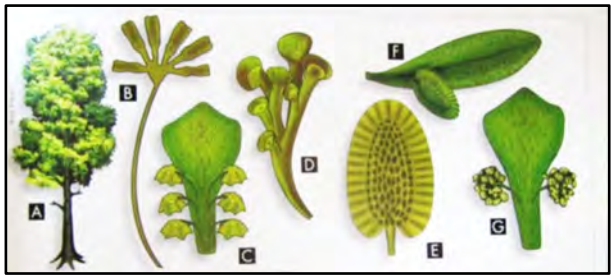


Figure 8 Reconstruction of Glossopteris. ***(McCarthy and Rubidge, p 219.)***

Figure 9. Schematic explanation of the formation of peat deposits on the shores of the Karoo Sea according ***(McCarthy and Rubidge, p 200.)***

In Figure 8 above, Glossopteris (A) and its diversity of seed-bearing organs (B to F) and pollen producing organs comprising clusters of sacs attached to scale leaves. (G) *Glossopteris* as the dominant tree species, with a large number of other plants were soon so prolific and abundant in these extensive swamps that dead vegetation accumulated faster than it could decay, and thick accumulations of peat were formed, which ultimately converted into coal. ***(McCarthy and Rubidge, 219)***

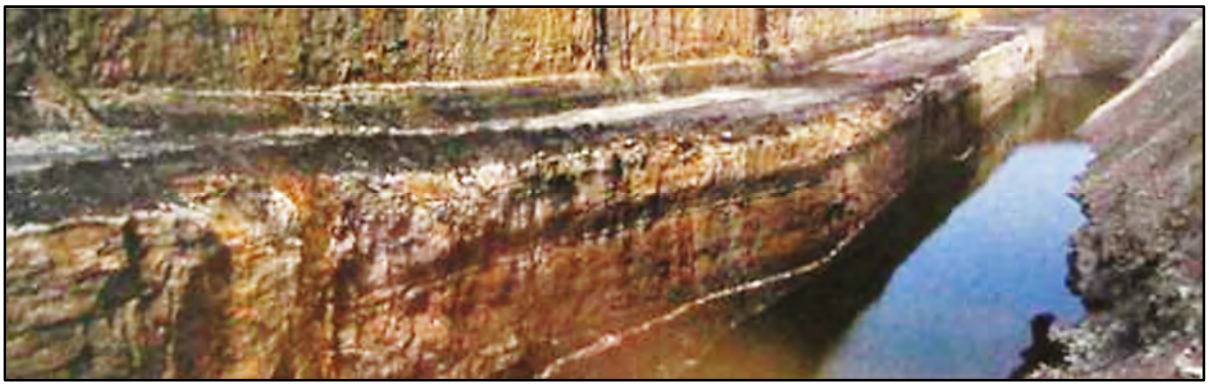


Figure 10. This mining pit illustrates the separation of coal seams by pale-coloured sedimentary rock as described in the text. (McCarthy and Rubidge, 201)

1.1. The formation of coal.

When recycling of vegetation does not occur, which usually happens if it is growing in water, the organic material accumulates to form peat layers. Over time these layers can be buried under sediments. In the case of the Karoo Basin, rivers draining into the basin along its northern margin formed a series of channels and deltas with well-vegetated margins, which formed extensive swamps.

These swamps were periodically drowned by subsidence, and the peat layers were buried beneath sediment, only to reform as the water again became shallower. In this way multiple peat layers were deposited. Peat contains about 50% carbon, the rest being made-up mainly of oxygen and hydrogen. Once peat is buried beneath sediment, it is compressed and slowly heated. Oxygen and hydrogen are expelled as water, and carbon content increases. Ultimately the process leads to the conversion of peat into coal. Low heat and pressure results in brown coal or lignite**.** With higher temperatures and pressures bituminous coal and anthracite may also be formed which contains much higher percentages of carbon. During formation, peat contains a certain percentage of fine sediment generally referred to as 'mud'. This is retained in the carbonisation process and when coal is burnt

is a leftover in the form of ash. Coal in a mine often appears to have a multi-coloured banded and or layered structure. This is often the result of a variety of plant types that contributed to the peat layers owing to climatic changes.

The Coal deposits of the eastern Transvaal Highveld is a very complex geological structure that originated during the Carboniferous Era. However is has been and still is a very large National Energy Resource for South Africa. It is not only the dynamo that generates vast quantities of Southern Africa's electricity requirements, but is also a supply of an export product that produce valuable revenue for the country.

To understand some of the local geology we quote from the *Bamford, 2025,* Palaeontological Impact Assessment for the Goedehoop 498 JS Prospecting Permit application report.[14]

> *…"A Palaeontological Impact Assessment was requested for the Goedehoop 498 JS Prospecting Permit application, Magisterial district of Carolina, Mpumalanga Province (Project reference: 25-3626-AUTH (Goedehoop 19280 PR). The prospecting is for Coal on Portions 4, 6, 7, 11, 19 and a portion of Portion 27. The applicant is Argopart resources (Pty) Ltd. The site is undeveloped but has been under agriculture previously. In this part of the Ermelo coalfield the uppermost coal seam is at least 18 m below the ground surface. To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development. The proposed site lies on the potentially very highly sensitive Vryheid Formation (Ecca Group, Karoo Supergroup) that could preserve fossil plants of the Glossopteris flora in carbonaceous shales associated with the coal seams, but not in the coal itself. The soil cover would not preserve any fossils. Therefore, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, environmental officer or other designated responsible person once excavations, drilling or mining activities have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised"…*

1.2. Flora.

It is important to note that Acocks's original study dates back to the 1950's predating the commencement of really large scale maize production, as well as the extensive coal mining operations of the last 60 odd years that effectively altered much of the original specie-diversification. However, in combination with height-above sea-level, precipitation and temperature brackets, it created a very specific environment that dictated specific zones for specific Flora and Fauna to be present.

Veld zone Type 61 is described by Acocks on page 112 as the *BANKENVELD* which he also classifies loosely as a FALSE GRASSLAND type. This Bankenveld appears to have been an open savannah type of *Acacia caffra* character, and still is along its northern boundary. Sour bushveld regularly occurs on rocky outcrops and hills. It is a sparse and tall tufted type with the forbs playing an important part, and is extremely sour. Generally there are three variations, 61(a) the Western variation, 61(b) the Central variation and, the present study area 61(c), the Eastern Variation, on sandy plains, but wetter than the Western and Central Variations.

This is described as a very flat sandy country. On the rocky outcrops the veld resembles the Central Variation as it does along the northern margin, being transitional to Sour Bushveld. Rainfall varies from 600 to 750 mm in the summer and altitudes vary from 1350 to 1700 m above sea level. The

[14] ***For full report see Bamford, 2025.***

dominant six grass species are *Tristachya leucothrix, Eragrostis racemosa, Heterpogon contortus, Trachypogon spicatus, Digitaria tricholaenoides* and *Themeda triandra.*

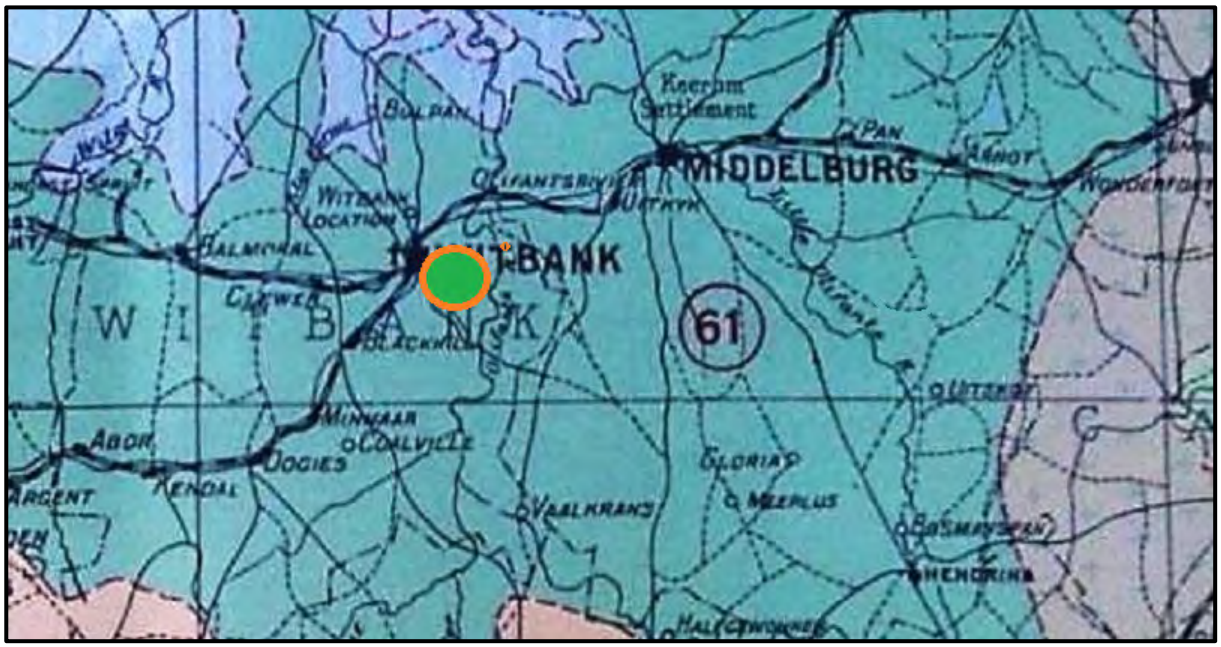


Figure 11. A portion of Acocks's map of the Veldt Types of South Africa produced by the Botanical Research Institute and the Department of Agricultural Technical Service of the Republic of South Africa.[15] The study area is indicated by the orange and green circle in veld zone 61.

The general lack of wooded plants is reflected by the absence of farms associated with tree names ***(Figure 12),*** and even in the names Enkeldebosch (Single bush) and Boschkranz (The edifice with trees) implies low floral density. The environmental factors of geology, vegetation, precipitation, temperature and elevation above sea level crated a rather bleak setting of open, cold in winter and wet in summer, plains with very little wooded vegetation that could support large Iron Age communities for basic firewood requirements. The soil was also not conducive to traditional Iron Age crop production with small hand-held hoes. All this inhibited permanent or even semi-permanent settlement of larger family or community groups. Also there were large tracks of land surrounding the Eastern Highveld that offered/supplied soils and firewood with more compatible temperature zones for Iron Age communities.

As a matter of fact, this Veld zone Type 61 environment was more suitable for small bands of mobile Hunter-Gatherers, which could evade the cold winters by seasonal migration. This is then also reflected in many farms in the area that contains the prefix Boesman-(Bushman-), linked to –Fontein (-Fountain), -Krans (-edifice), -Spruit (-rivulet), and –Pan (-small lake). ***(See Figure 12.)***

1.3. Fauna.

An excerpt from sheet 5 of Jeppe's Map of 1899 ***(Figure 12),*** shows the **farm names illustrate** the environmental character of the area surrounding the study area. It is a rather wet and cold environment and the Fauna represented illustrate the opportunities for a Stone Age hunting society. **(Hartebeest, Wildebeest, Eland, Lion, Hyena, Rhino, Elephant, Hippos and Bees.)**

[15] ***The present author is well aware of the 2006 publication of Mucina, L. & Rutherford, M.C. (eds). "The vegetation map of South Africa, Lesotho and Swaziland." Strelitzia 19, South African National Biodiversity Institute. But Acocks's work was* completed *75 years ago, since when much has changed in environmental matters, and relates more appropriately in heritage studies.***

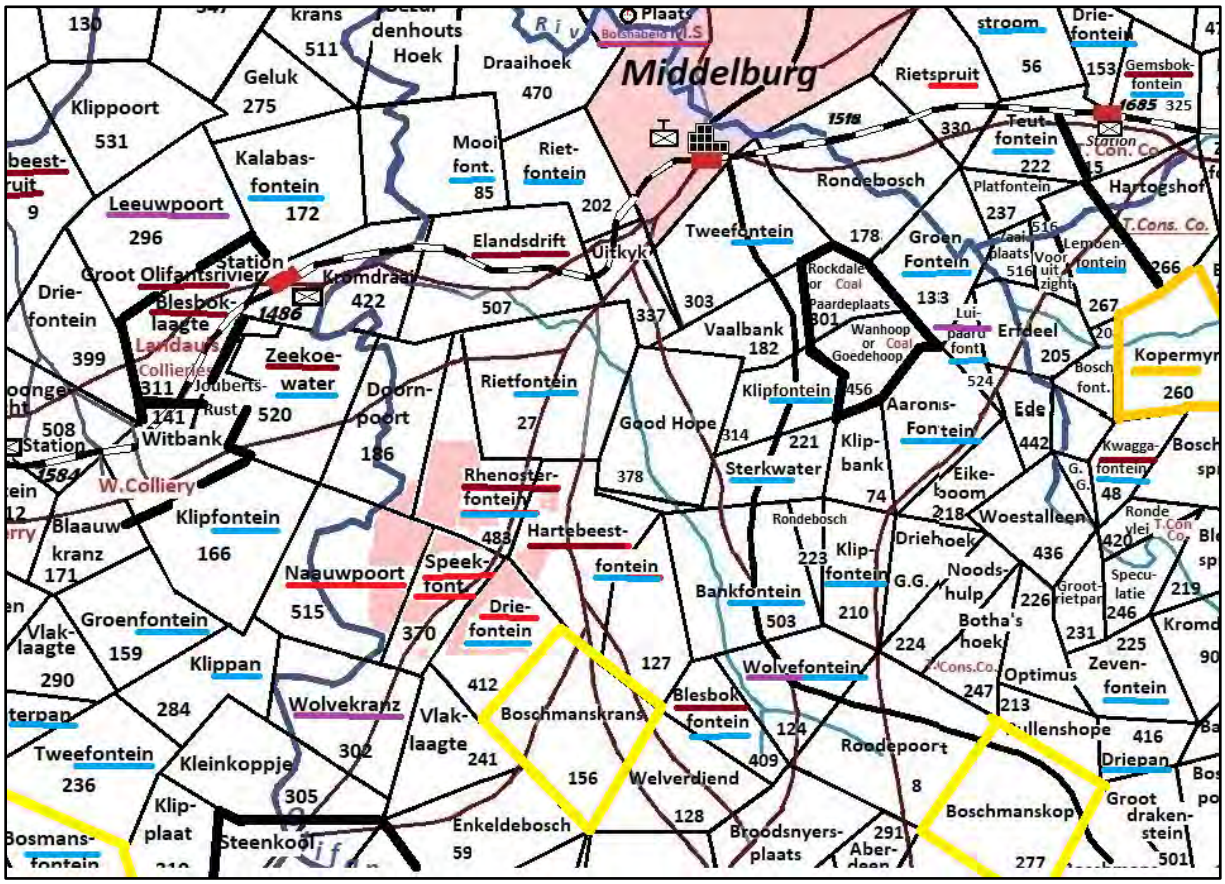


*Figure 12. Excerpt from sheet 5 of Jeppe's Map of 1899. The **farm names illustrate** the environmental character of the area surrounding the study area shaded in pink. It is a rather wet and cold environment and the Flora & Fauna represented illustrate the opportunities for a Stone Age hunting society. Note the presence of coal highlighted in black.*

1.4. Impact of geology and vegetation on fieldwork.

Environmental factors of geology and vegetation had a low or little impact on field-work observation and quality. The high precipitation of 2025/2026 resulted in inhibiting muddy road conditions, possibly obscuring small finds visibility.

The real impact on preservation of heritage remains were the long and ongoing maize production by farmers with modern farming machinery, modern coal mining operations and infrastructure related to coal mining.

Addendum 2. The synthesis of cultural succession of the southern African chronological sequence

The following table provides an overview of the southern African chronological sequence, the main attributes associated with a particular period, and cultural groups associated with each of the periods.

The southern African chronological sequence		
Cultural period and ages	Cultural groups	Technological attributes and tool types
Earlier Stone Age (ESA) >2 m—>200 000 YA	Early hominins Australopithecines Homo Habilis Homo erectus archaic Homo sapiens	Large cutting tools (LCTs), scrapers and flaked forms. Some use of flaked bone as tools
Middle Stone Age (MSA) 20 000 YA	Archaic and fully modern Homo sapiens	A reduction in tool size. Blades, convergent points and awls made on prepared core types to produce uniform tool forms, also scrapers and other tool types. Flaked products were often further shaped through secondary retouch to produce a range of formal tool types. Decorative items, body ornaments and ochre use become apparent. Rare engravings and rock art.
Later Stone Age (LSA)	Homo sapiens San hunter-gatherers Khoekhoe herders	An extended range of microlithic tool types, often used as inserts for bow-and arrow hunting. Characteristic tools include scrapers, borers, and arrow heads. Ostrich eggshell (OES) beads and flasks — sometimes decorated— are prolific. Trade/barter items include glass, iron and copper beads, and pigments. Leather working, basketry, bone implements and armatures for arrows are common. Bow and-arrow hunting and snaring. San and herder ceramics. Domestic animals: sheep, goats, cattle and dogs. Rock art. Polished stone tools and grooved stones used to shape different bone implements
Early Iron Age (EIA) c. AD 200—c. AD 900	Bantu-speaking African farming communities	Distinct pottery styles for the various pottery expressions, metal working, subsistence agriculture, domestic animals, trade and barter. Upper and lower grinding stones.
Middle Iron Age c. AD 900—c. AD 1300	Bantu-speaking African farming communities	Distinct pottery for the various ethnic groups, metal working, subsistence agriculture, domestic animals, trade and barter
Late Iron Age (LIA) c. AD 1300 – c. AD 1840 Stone-walled LIA sites: c. AD 1640—c. AD 1840	Bantu-speaking African farming groups and Europeans	Characteristic pottery traditions associated with each of the main divisions, metal working, subsistence agriculture, domestic animals, trade and barter. Upper and lower grinding stones and other stone implements. Farmer rock art. Stone-walled settlements.
Colonial Period c. 1650	Bantu-speaking African farming groups and Europeans	Historical structures, industrial metals, glass, porcelain and ceramics
Historical Period c. 1850	Various African groups, groups of mixed origin and Europeans	Historical structures, industrial metals, glass, porcelain and ceramics

Addendum 3. Archaeological and Historical context of the study area.

3.1 The Stone Age archaeology.

Early Stone Age (ESA), Middle Stone Age (MSA) and Later Stone Age (LSA) Lithics occur widely within the greater region of the Northwest-, Limpopo-, Mpumalanga- and Gauteng Provinces. The materials used for the stone tools derived from a variety of geological materials. Important sites include the Sterkfontein complex, the Wonderboom Acheulean site, the Makapaan Caves complex, The Pietersburg complex, the Echo Caves complex and similar. Several rock art and engraving sites that date to the LSA are present in the wider region. These include engravings along the Vaal River and a multitude, complex and divers painted heritage sites along the Oliphant's- and Limpopo Rivers and into the Pilgrims Rest area.

Unfortunately, as far a known, the harsh environment of the Eastern Transvaal inhibited long term habitation to hunter-gatherer societies. During the last two millennia though, the influx of Agro-Pastoralist peoples and European pioneers marginalised the potential hunting grounds of *the first peoples.*

These areas include the desert areas of Namibia and Botswana, the inhospitable Drakensberg mountain range and finally the cold Eastern Transvaal Highveld. Owing to the very late Hunter-Gatherers' ephemeral lifestyle of seasonal and regional migration very little physical traces can generally be found of their passing through the present study area. A number of farm names do however capture their presence even into the middle nineteenth century.

3.2 The Iron Age.

Agro-pastoral farmers moved into the Southern African region during the period circa 2000 YA. The term Iron Age is widely used to describe the Agro-pastoral (mixed farming) way of life associated with speakers of Bantu languages that contrasted with the Stone Age hunter-gatherer lifestyle ***(Huffman 2007).*** The Iron Age within sub-Saharan Africa has been divided into the Early Iron Age (AD 200–900), Middle Iron Age (AD 900–1300) and Late Iron Age (AD 1300–1840) ***(Huffman 2007; Küsel 2009).***

Although these divisions are somewhat arbitrary, they are useful in defining broad-based cultures, changing world views and technological advances. The term Iron Age is widely used in the South African context to describe the agro-pastoral (mixed farming) way of life associated with speakers of Bantu languages that contrasted with the Stone Age hunter-gatherer lifestyle ***(Huffman 1980, 1989, 2007, 2017, 2020).***

Agro-pastoral lifestyles are characterized by the production of both crops and retaining domestic herds and may be implicit in a lifestyle that occasionally included annual or seasonal migration to compensate for depletion of local resources.

Broadly speaking, the Iron Age can be separated from the preceding Stone Age in terms of distinguishing characteristics that included a reliance on food production through agriculture or animal husbandry, a settled village life, the manufacture of large quantities of pottery in distinct styles and, in particular, metal-working ***(Mitchell 2002).***

The evidence accumulated to date strongly suggests that the Iron Age and the associated settlement of farming communities in the sub-continent can most convincingly be explained in terms of population movement from further north. Within the South African context this model is largely

based on ceramic typology, with the most widely used approach being the model developed by Tom Huffman ***(Mitchell 2002).***

Most important though is the availability of suitable soils for crop production and sufficient and constant yearly precipitation to allow farming independent of irrigation

3.2.1 The Early Iron Age.

There are several Early Iron Age (EIA) settlements, where ceramics diagnostic of the Doornkop facies, exist in the Eastern Lowveld, especially in the Steelpoort Valley. ***(Van Schalkwyk 2007 a; Huffman & Schoeman 2002).*** Archaeologists' knowledge of EIA sites and cultural remains in Southern Africa is based on a relatively small statistical sample from a handful of sites, located mainly in the Eastern bushveld of South Africa, and by no means comprehensive. The current body of archaeological data demonstrates that EIA communities were essentially subsistence farmers with the dominant crops being millets and sorghums, although cucurbits, groundnuts and beans were also produced. There is no known Early Iron Age site near the present study area.

3.2.2 The Middle to Late Iron Age.

Around a 1000 YA the Mapungubwe State, that dominated large portions of the Northern Transvaal, Eastern Botswana, Southern Zimbabwe and limited portions of present-day Mozambique regulated life in the larger region until its final demise around 800 YA. From then on various Sotho, Tswana and Ndebele African farming communities inhabited the land to the east of the dry Kalahari. These included the Bahurutsi, Northern Sotho, Venda and Ndzundza Ndebele. ***(Mönnig 1963, 1978; Bergh 1990; Van der Ryst & Meyer 1999). Küsel (2006 a, 2006 b, 2008, 2012)*** provides detail on the origin of the first Sotho–Tswana groups and on the rise of the Pedi Empire during the reign of successively Thulare, Sekwati and Sekhukhune in the Eastern Transvaal. From the end of the eighteenth century and the early nineteenth century the area directly east of the present research area is also highly impacted upon by the raids from the south-east, most notably by the notorious Mzilikazi. This rebellious general of Chaka was finally expelled from the region by the Boer forces of Potgieter circa 1836-1838. Although some of the local indigenous peoples accepted this change of occupiers, Many Tshwane peoples, especially Sechele, eventually decided to seek the protection of the British Crown to the north of the study area, to eventually form what is today known as Botswana

3.3 The Historical Period. ***([16])***

The Historical Period in this region took a vastly different road than what happened to the areas to the east. European (Boer) Settlers were in fact no different in need for land than the indigenous peoples they forcibly ejected from the higher rainfall bushveld and Highveld regions to the north, north-east, east and south-east.

Therefore, the first interest by Europeans (especially the British) became apparent after the discovery of diamonds along the Orange and Vaal Rivers in the 1870's, and the eventual discovery of the Kimberly mines ***(In Roberts 1984, Kimberly Turbulent City),*** that led to the first South African War and the establishment of the Bechuanaland Protectorate. ***(Sir Charles Rey, 1988.)***

Before this the only first historical event that impacted on the region was the formation of the Gruiqua peoples loosely called ***"Nation"***, from an array of mixed peoples between the later 18th century and middle 19th century. The original highly mobile Khoi or Khoe-Khoe or rather, first nation peoples, that lived nomadic lifestyles centred on animal husbandry were supplemented by escaped slaves of

[16] ***For fuller details see Addendum 6, Historical cameos from the greater region.***

mixed race from the Cape Colony. This combination easily slipped into a simplified "European/Dutch/Boer" lifestyle outside the borders and control of the Cape Colony.

But over time they acquired valuable assets such as wagons, oxen, horses and "modern" rifles and an insatiable want for cattle that was available from their Agro-pastoralist neighbours to the east in the higher rainfall areas. From the Dutch and British they learnt the value of "cavalry warfare" and frequently raided eastwards until the arrival of Mzilikazi.

Mzilikazi was originally a **lieutenant of Shaka** but had a quarrel with him in 1823 and rebelled. Rather than face ritual execution, he fled northwards with his followers. He first travelled to Mozambique but in 1826 he moved west into the Transvaal and initiated the period known as the *Mfecane.* In the Transvaal his army easily overpowered the large peaceful Tswana, Sotho and other communities, which have over several centuries inhabited and populated this region of abundance.

During his reign of a decade or more, his only enemies were his own people from Natal, now, after the death of Chaka under Dingaan, and the Griqua to the west. After the arrival of the Potgieter trek in 1836, and his first defeat at Vegkop south of the Vaal River, the end of his struggle-hold was not long to come about. Both the earlier diaries of Moffat and the Smith expedition of 1836 gives us a clear view of his harassment by the Griqua and the Boers and by 1836 he was finally expelled from the Transvaal.

3.4 The missionary endeavour.
Missionary work in the region was mainly undertaken by the Berlin Missionary Society, at Botshabelo northwest of Middelburg. No mission station/s occur on or near the study area.

3.5 The early European towns.
Middelburg is one of the oldest towns that were established by the Voortrekkers in the previous Transvaal. The original town was established on the farms of Klipfontein and Keerom on the banks of the Klein Oliphant's River in 1859. It is generally accepted that Middelburg's name is derived from the fact that the Transvaal Republic established the town midway between Pretoria and Lydenburg. The original choice for Middelburg's location was not well accepted by the inhabitants and it was moved to the farm Sterkfontein. Here, a town was established and named Nasaret (Nazareth). However, the name did not appeal to the local community and its original name was reinstated. Middelburg temporary served as the seat of the Transvaal Republic after the siege of Pretoria during the Second Anglo Boer War.

Belfast was founded on 30 June 1890. Farmer Richard O' Neil bought the farm Tweefontein near where the expected railway line between Pretoria and Lourenço Marques in Mozambique would run. He set up a store and applied for permission to lay out a village. He named it Belfast in honour of the city in Ireland from where his father had immigrated. The railway reached the village in 1894 and the first village council took office in 1902.

3.6 The mining history. ***([17])***
The recent mining history and current mining operations are not discussed for the purpose of this report as the large scale impact is well known. Early mention of coal can be seen in the 1899 Jeppe Map. This was known early in the 19th century by the Boor farmers before the advent of steam trains, when the sources along the new railway lines were developed. But even before that the 1870's Kimberly Diamond Mines and the 1880's Johannesburg Gold Mines sponsored the general development of

[17] ***For fuller details see Addendum 8, Ecological milieu including Geology and Vegetation.***

fossil fuel mines such as at Vereeniging. With the growth of towns and the advent of inexpensive cast-iron stoves early in the 20th century, more and more coal were extracted for local use. Similarly the arrival of electricity prompted the building of power-stations which from the pre-WWII years exponentially demanded the mining of coal. From the 1970's onwards the export of coal to Japan became an important earner of foreign currency for an embattled Apartheid Government. It is then during the last two phases that the Mpumalanga Coal Mining Industry grew to its modern capacity. This supplies mainly to ESCOM for the national grid, while export is still an ongoing concern. *(See Figures 18 & 19.)*

Addendum 4. Location of the research areas.

4.1. Google Earth.

Figure 13. Duvha Power Station is located some 10 km southeast of Witbank within the area known for its vast coal reserves. ***(Google Earth 2025.)***

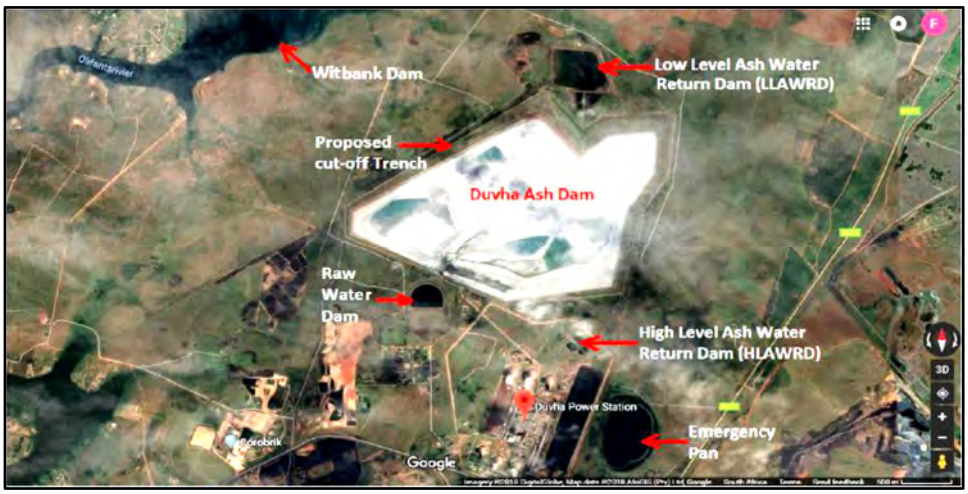


Figure 14. Site layout of the Duvha Power Station with the present study area, the LLAWRD located in the top of the image. ***(Map provided by Eskom taken from the 2019 PGS HIA.)***

Figure 15. The study area as provided by Shangoni. As can be seen the spillway is only 80 m long and the weir only 30m. This places the site outside the legal requirements of Act 25 of 1999. See section 38. ***(Google Earth 2025.)***

4.2. Jeppe's 1899 Map of the Transvaal.

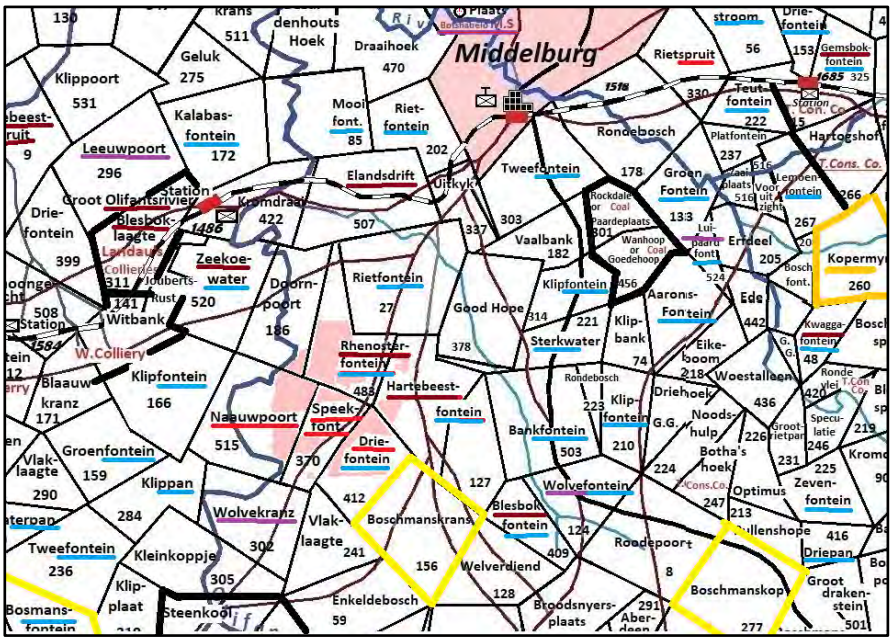


Figure 16. Extract from sheet 5 of Jeppe's 1899 Map of the Transvaal showing the region around Duvha Power Station (In pink), and where Witbank will later be located. Even 1899 it was known that there was coal in the area. Note the farms Steenkoolspruit Blesboklaagte Rockdale Wanhoop and Hartoghof owned by the Transvaal Consolidated Company and Landau Coal. ***(Annotation S.M. Miller. 2023.)***

4.3. The typical 1: 50000 Topographical map/s of the area.

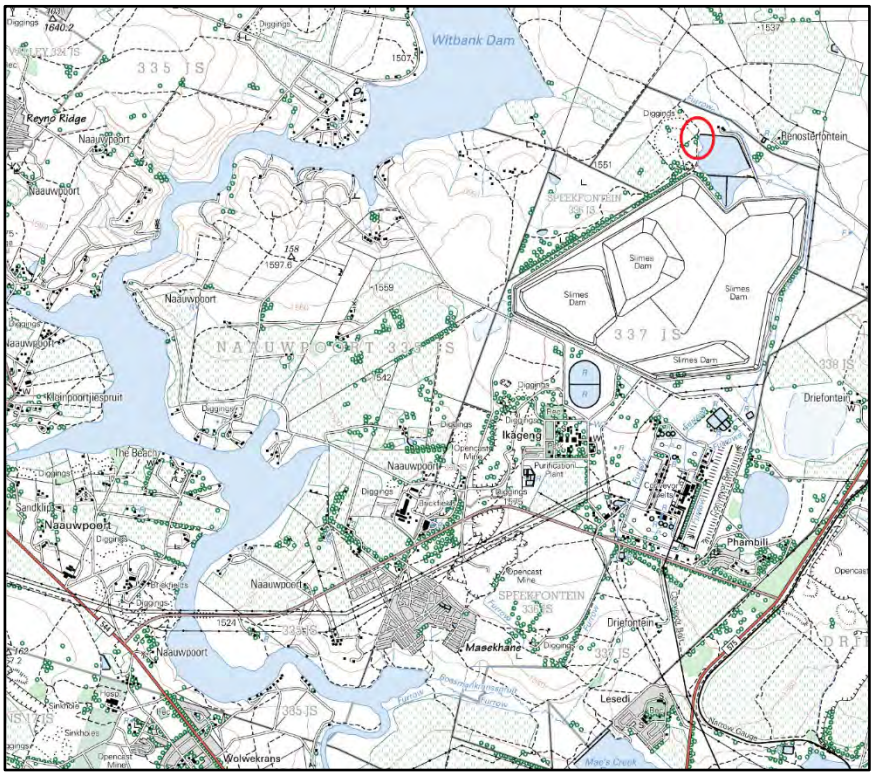


Figure 17. The 2009 topographical map of the region around Duvha Power Station where the study area (red circle) is located. The study area is circled in red.
(2529 CD 2010 MIDDELBURG)

4.4. Files provided by the Client through Shangoni.

4.4.1. Provided on the 10th March 2026.

Duvha Project.kmz

Weir Structure.shp.kmz

Spillway Re-Instatement.kmz

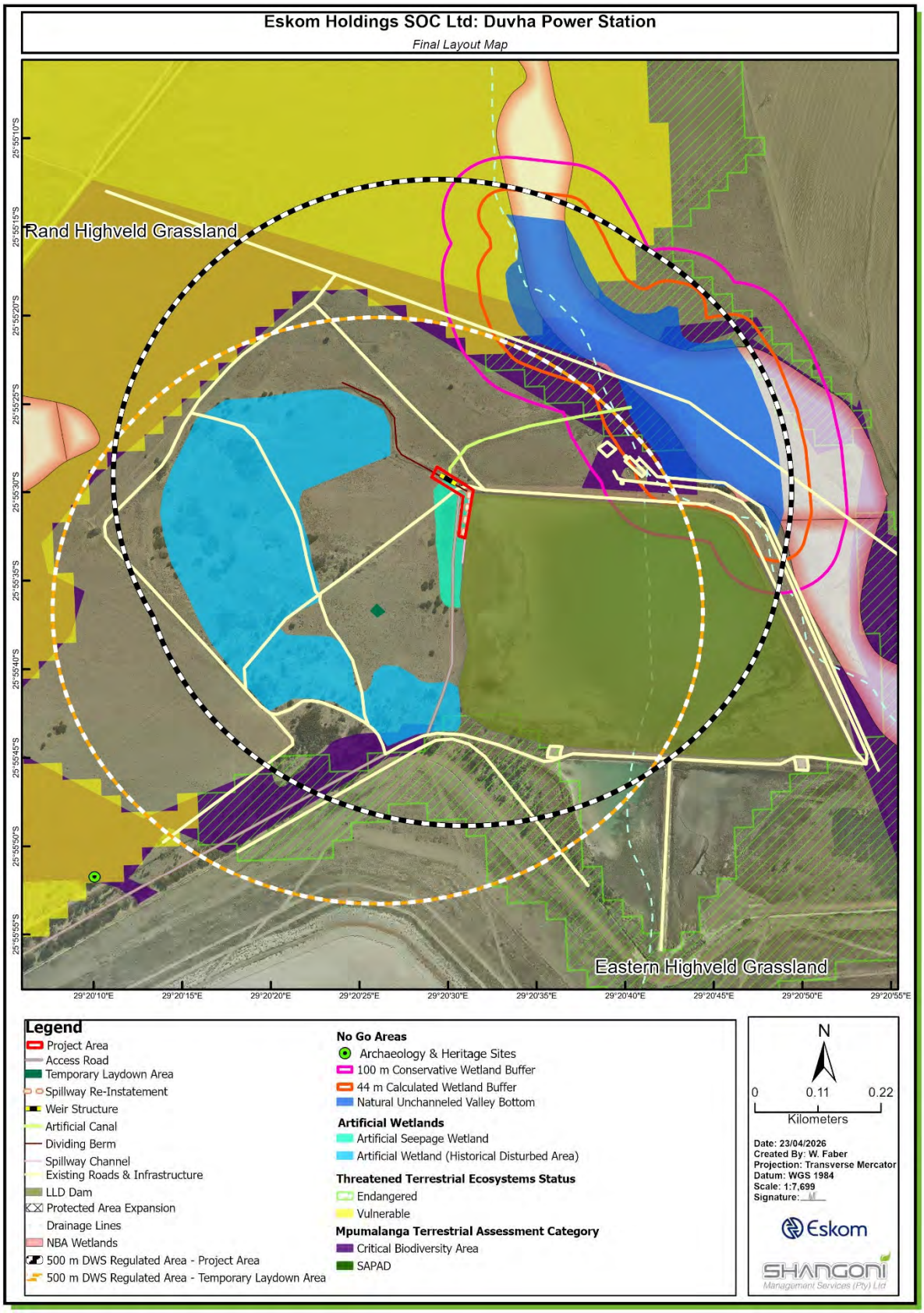


Figure 18. ***Artificial and natural wetlands surrounding the Low Level Ash Water Return Dam.***

Addendum 5. Methodology and Track logging data.

5.1. Methodology.

Prior to conducting the site assessment, a desktop survey of existing literature on the wider region was conducted to assess the heritage context. These included published research articles, unpublished reports, and other online information. The SAHRIS data base was also accessed for previous heritage reports that relate to the general region of the survey. The relevant topographical and historical maps were sourced, and consulted for pointers to possible heritage resources. The study area is covered by a series of aerial photography data sets that can be used to assess the occupations of this particular landscape. Historical articles were also systematically scrutinised to identify potential sites, areas of disturbance and vegetation or geological anomalies, and for any evidence of structural remains, or likely areas for archaeological features. Of the twenty HIA's consulted, there emerges a pattern of heritage finds that closely overlaps the known history of the region. Ephemeral LSA stone tool surface finds occur around pans, and a few European farm buildings of generally low heritage value are reported. One badly preserved LIA stone-walled site on the farm Middelkraal was found in the HIA's *(Van Vollenhoven 2021 & Pelser 2024)* for the extension of the mine there. Mitigation was advised by SAHRA *(Enquiries: John Pakwe Tel: (063) 894-1979 Email: jpakwe@sahra.org.za Case ID: 24025)*

The 2019 HIA by PGS HERITAGE stands out though, as it has already cleared the present study area from containing any heritage residue. (See figure 18 below that comes from the 2019 PGS HERITAGE report page 31.)

Figure 19. General Map indicating track logs and heritage sites identified from the fieldwork undertaken by the PGS HERITAGE team in 2019.

5.2 Surveyed area.

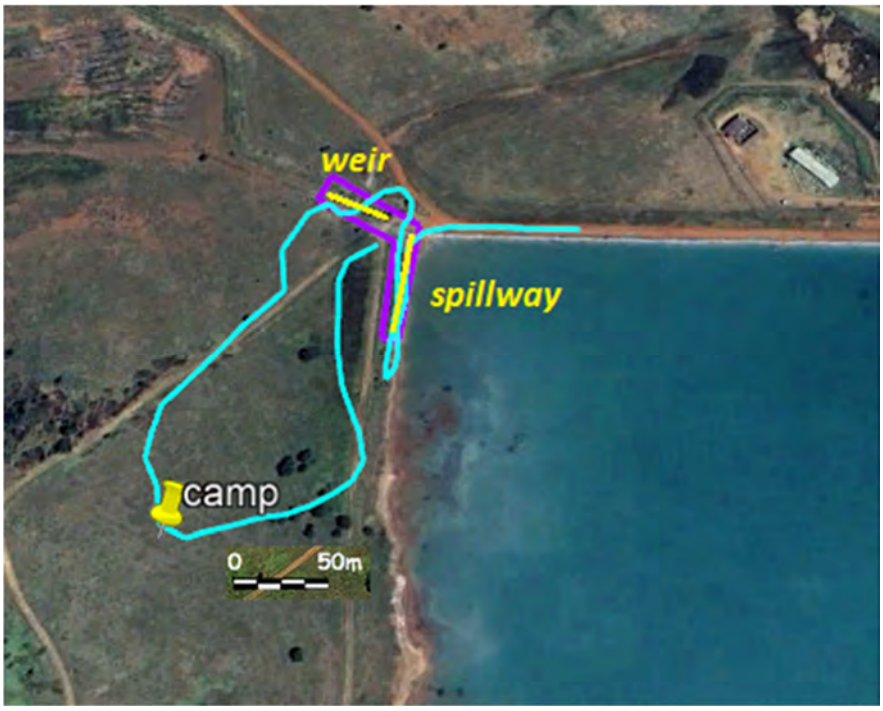


Figure 20. Study area with survey track in magenta. ***(Annotation S.Miller 2026.)***

5.2.1. Affected areas.
5.2.1.1 The total study area comprise approximately a half of a hectare in extent, all of which, is disturbed.

5.2.1.2. It comprise a section of dam wall and a section of dirt road none of which contains heritage residue.

5.2.2. Site Visit.
5.2.2.1. The project site was visited on the 21th of April 2026 by ***Mr S Miller*** and ***Mr Z Nel***[18] in the company of ***Mr Benson Mahlangu*** the representative from ***Eskom Holdings (SOC) Ltd.,***

5.2.2.2. The study area and immediate surrounds were systematically searched and inspected by vehicle and on foot to identify any potential areas that could contain heritage resources. Prior to the field work all maps and diagrams of the proposed mine infrastructure provided by the Client were mapped and plotted on Google Earth and high-resolution aerial imagery, and converted to .gpx format.

5.3. Previous Impacts.
The LLAWRD is a structure originally built for the circulation of water within the Duvha Power Station. As the structure in itself is not older than 60 years it does not qualify for protection under Act 25 of 1999.

RESEARCH FINDS	Degrees south	Degrees east
NO HERITAGE REMAINS	N/A	N/A

Figure 21. Heritage finds. ***(Composed by Miller April 2026.)***

[18] ***Mr. Nel is an Archaeological student in training.***

Addendum 6. Photo recording.

6.1. Spillway.

Figure 22. Detail of existing Spillway construction site looking west, southwest and south. Existing structure and retaining wall. ***(Photos S.M. Miller.)***

Figure 23. Detail of weir construction site (trench) looking northwest. ***(Photos S.M. Miller.)***

Figure 24. Detail of "cloth" covering broken ground around "campsite". ***(Photos S.M. Miller.)***

Addendum 7. Grading and impact.

7.1. Appropriate process to be followed prescribed by Shangoni.

7.1.1. Step 1: Determine the PROBABILITY of the impact. Calculate the average of the frequency of the aspect, the availability of a pathway to the receptor, and the availability of the receptor.

Frequency of aspect/ impact	Score	Availability of pathway from the source to the receptor	Score	Availability of receptor	Score
Never known to have happened, but may occur	1	A pathway to allow for the impact to occur is never available	1	The receptor is never available	1
Known to happen in industry	2	A pathway to allow for the impact to occur is almost never available	2	The receptor is almost never available	2
Smaller than once a year	3	A pathway to allow for the impact to occur is sometimes available	3	The receptor is sometimes available	3
Once per year to up to once per month	4	A pathway to allow for the impact to occur is almost always available	4	The receptor is almost always available	4
Once a month to Continuous.	5	A pathway to allow for the impact to occur is always available.	5	The receptor is always available.	5
	Sum A		Sum B		Sum C
(A + B + C) ÷ 3 = X which is the PROBABILITY of the impact					

7.1.2. Step 2: Determine the MAGNITUDE of the impact by calculating the average of the factors below. **(Thus: Sum of all six column ratings below ÷ 6.)**

Source.								**Receptor.**			
Duration of Impact.	**Score.**	**Extent.**	**Score.**	**Intensity.**	**Score.**	**Destruction Effect.**	**Score.**	**Reversible.**	**Score.**	**Significance of heritage.**	**Score.**
From days to a month	1	Limited to the site.	1	Very small.	1	No loss.	1	Reversible	1	No/low significance **Grade IIIC.**	1
Lasting 1 month to 1 year.	2	Limited to site and immediate surroundings	2	Small.	2	Small loss at local level.	2	Local impact but still reversible	2	Medium local significance **Grade IIIB.**	2
Lasting 1 to 5 years.	3	Impacts ex-tend beyond site boundary	3	Mod-erate.	3	Moderate loss at local level	3	Partially Reversible.	3	High local significance **Grade IIIA.**	3
Lasting 5 years to Life of Orga-nization	4	Impact on Regional scale/ adjacent sites	4	Large	4	Regional loss	4	Potentially irreversible	4	High regional significance **Grade II (Provincial)**	4
Beyond life of Organization / Permanent impacts	5	Extends nationally or globally	5	Very large	5	National loss	5	Irreversible	5	High National significance **Grade II (National)**	5
Sum A		**Sum** B		**Sum** C		**Sum** D		**Sum** E		**Sum** F	
(A + B + C + D + E + F) ÷ 6 = X which is the MAGNITUDE of the impact											

7.1.3. Step 3: Determine the SEVERITY of the impact by plotting the ***averages*** that were obtained above for ***Probability*** and ***Magnitude*** in the table below.

ENVIRONMENTAL IMPACT RATING/PRIORITY					
PROBABILITY	**MAGNITUDE**				
	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Low	Medium	High	High	**High**
4 Likely	Low	Medium	High	High	High
3 Possible	Low	Medium	**Medium**	High	High
2 Unlikely	Low	Low	Medium	Medium	High
1 Rare	**Low**	Low	Low	Medium	Medium

Figure 25. The result will automatically calculate the severity of the environmental impact of the proposed new works in a variety of magnitudes varying from LOW to MEDIUM to HIGH, as illustrated above.

7.2. Impact of the finds during the present HIA field work.
7.2.1. No heritage remains.
7.2.2. **No grading.**

7.3. Calculating the ENVIRONMENTAL IMPACT RATING.[19]
7.3.3. Probability

Frequency of aspect/ impact	**Score**	**Availability of pathway from the source to the receptor**	**Score**	**Availability of receptor**	**Score**
Never known to have happened, but may occur	1	A pathway to allow for the impact to occur is never available	1	The receptor is never available	1
Known to happen in industry	2	A pathway to allow for the impact to occur is almost never available	2	The receptor is almost never available	2
Smaller than once a year	3	A pathway to allow for the impact to occur is sometimes available	3	The receptor is sometimes available	3
Once per year to up to once per month	4	A pathway to allow for the impact to occur is almost always available	4	The receptor is almost always available	4
Once a month to Continuous.	5	A pathway to allow for the impact to occur is always available.	5	The receptor is always available.	5
	2		3		3
(1 + 1 + 1) ÷ 3 = 1 which is the PROBABILITY of the impact					

[19] ***For a spillway & weir at Duvha Power Station.***

7.3.4. Magnitude.

Source.								Receptor.			
Duration of Impact.	Score.	Extent.	Score.	Intensity.	Score.	Destruction Effect.	Score.	Reversible.	Score.	Significance of heritage.	Score.
From days to a month	1	Limited to the site	1	Very small.	1	No loss.	1	Reversible	1	No/low significance **Grade IIIC.**	1
Lasting 1 month to 1 year.	2	Limited to site and immediate surroundings	2	Small.	2	Small loss at local level.	2	Local impact but still reversible	2	Medium local significance **Grade IIIB.**	2
Lasting 1 to 5 years.	3	Impacts extend beyond site boundary	3	Moderate.	3	Moderate loss at local level	3	Partially Reversible.	3	High local significance **Grade IIIA.**	3
Lasting 5 years to Life of Organization	4	Impact on Regional scale/ adjacent sites	4	Large	4	Regional loss	4	Potentially irreversible	4	High regional significance **Grade II (Provincial)**	4
Beyond life of Organization / Permanent impacts	5	Extends nationally or globally	5	Very large	5	National loss	5	Irreversible	5	High National significance **Grade II (National)**	5
3		**2**		**3**		**3**		**4**		**3**	
(1 + 1 + 1+ 1 + 1 + 1) ÷ 6 = 1 which is the MAGNITUDE of the impact											

7.3.5. Environmental Impact.

ENVIRONMENTAL IMPACT RATING/PRIORITY					
PROBABILITY	**MAGNITUDE**				
	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Low	Medium	High	High	High
4 Likely	Low	Medium	High	High	High
3 Possible	Low	Medium	Medium	High	High
2 Unlikely	Low	Low	Medium	Medium	High
1 Rare	Low	Low	Low	Medium	Medium

7.3.5 Risk assessment and mitigation measures table.

No.	Aspect affected	Activity	Potential Impact	Reversibility	Irreplaceable loss	Phase	Size and scale of disturbance	Significance pre-mitigation			Mitigation Type	Significance post-mitigation		
								Probability	Magnitude	Significance		Probability	Magnitude	Significance
1	Sites, artefacts and fossils of Archaeological and Cultural Importance.	Re-instatement of the LLAWRD spillway and weir	No heritage remains were encountered in the research area. The two heritage remains identified in the 2019 study by PGS HERITAGE nearby, Duv 001 and Duv 002, were also inspected and were found to be intact and unchanged.	Reversible	Low Degree.	Construction, Operational	62 m spillway and 34 m weir.	1	2	LOW	Avoid	1	1	LOW

Aspect affected	Activity	Phase	Size and scale of disturbance	Mitigation Measures	Compliance with standards	Time period for implementation
Sites, artefacts and fossils of Archaeological and Cultural Importance.	Re-instatement of the LLAWRD spillway and weir	Construction, Operational	62 m spillway and 34 m weir.	None proposed as no impacts were identified.	In compliance with the National Heritage Resources Act (Act No. 25 of 1999)	Construction and operation.

From the assessment table above, it is evident that the impact of the proposed mining activities on the grave sites may be considered of LOW ENVIRONMENTAL CONSEQUENCE.

7.4. Risk Mitigation.

7.4.1. General.

SAHRA (2007: 4) defines mitigation as: -

''[t]he act or effort by a qualified heritage specialist appointed by a developer to lessen the impact of a development on heritage resources within or near the development footprint'.

The authors of this report are confident that the heritage occurrences of the property under review were adequately documented and assessed during the HIA.

The HIA field study surveyed the surface only, a procedure than cannot locate buried archaeological and/or palaeontological sites. While not detracting by any means from the extensiveness of the fieldwork undertaken by the authors, it is necessary to point out that heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors may account for this, such as ephemeral indications of graves, dense vegetation cover in some parts of the surveyed area, and the subterranean nature of certain archaeological sites that are buried through sediment accumulations.

7.4.2. Specific.

7.4.1. No mitigation required

Addendum 8. Heritage study/s prior to 2026.

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6. V Vollenhoven A. 2012. A report on a heritage impact assessment for the Schurvekop Coal Mine Project near Bethal in the Mpumalanga Province. (Unpublished Report Archaetnos Groenkloof.)

7. J van Schalkwyk 2009. HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED COAL MINING ACTIVITIES ON THE FARM VLAKFONTEIN 569JR, WITBANK MAGISTERIAL DISTRICT, MPUMALANGA PROVINCE Report prepared for SRK Consulting.

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Addendum 10. CV of the author.

S M Miller (Abbreviated C V.)

A. Academic.

ASAPA member 087.		2005.
M. (Architecture) Conservation.	WITS.	1990.
Archaeology I and II.	UNISA.	1988.
At this stage Archaeology III did not exist as a subject at UNISA.		
Both Archaeology I and Archaeology II was completed in one year.		
BSc. (Engineering). Civil.	University of Pretoria.	1980.
Military.		1977 to 1979.
Matriculated		1971.

B. Work Experience.

1. Civil Engineer. 1980 to 1986.

2. Archaeology/museums/self-employed.

Technical Assistant development Schoemansdal Museum.	1986 to 1988.
Archaeologist Schoemansdal Museum.	1988 to 1993.
Yearly reports submitted to the National Monuments Council.	1988 to 1993.
Archaeologist/site contractor Thulamela project.	1993 to 1997.
Modjadji project. (Lebjene site.)	1998 to 1999.
Contract lecturer at UNISA archaeology dept.	2000 to 2001.
Self employed heritage assessor consultant.	2001 to 2026.

3. Archaeology on-site experience in excavation work.

3.1. As student.

Mapungubwe, Masurini, and Bushman Rock Shelter, Ohrigstad.	7 weeks 1974.
Mapungubwe, Letaba River and Bushman Rock Shelter, Ohrigstad.	7 weeks 1975.
Kruger park River Survey.	14 weeks 1976 to 1982.
Mapungubwe and Kruger park projects.	4 weeks 1977.
Happy Rest, Klein Afrika.	5 weeks 1978.
Northern Kruger Park, Makahane, Makuleke.	8 weeks 1982.
Mamba site, Tugela Natal.	8 weeks 1983.
Schoemansdal.	8 weeks 1984.

3.2. As professional.

Schoemansdal.	7 years	1986 to 1993.
Northern Kruger Park, Thulamela.	4 years	1993 to 1997.
Modjadji.	1 year	1997 to 1998.

4. Surveying of archaeological site maps 2002 to 2012.

Melora.	(Waterberg)	7 ha	Ndebele type.
Muisvogelskraal.	(Waterberg)	4 ha	Ndebele type.
Kaditshwene.	(Zeerust)	4 ha	Ba-Hurutse.
Rooiberg Tin Mines.	(Waterberg)	4 ha	Later Iron Age.
Eight Goedehoop dam sites.	(Steelpoort)		
Two Doornkop type-sites.		4 ha	Early Iron Age.
Five 19th to 20th century type-sites.		2 ha	Pedi.
One early 20th century bridge.		20 m	European.

Elandsfontein, 10 sites.	(Brits)	10 ha	Sotho/Tswana.
Zeerust. (J.C. Boeyens Doctoral Thesis).	(Variety in size and period)		Iron Age.
Kruger Park Letaba River.	(Variety in size and period)		Iron Age.
Thulamela.		2 ha	Later Iron Age.
Van Kollerskop.	(Balfor)	2 ha	Sotho type site.
Jakkalskop.	(Marikana)	2 ha	Tswana type site.
Frampton.	(Masisi)	2 ha	Venda type site.
Kumba Mine.			
5 prehistoric type-sites.	(Thabazimbi)	14 ha	Later Iron Age.
Songozwi.	(Louis Trichardt)	2 ha	Venda Royal Burial.
Schoemansdal.	(Louis Trichardt)	50 ha	White Pioneer.
Gumeni hill.	(Machado)	3 ha	Later Iron Age Nguni.
Kudu Ranch.	(Lydenburg)	13 ha	Later Iron Age occupation and engraving sites.
Redan.	(Vereeniging)	0.5 ha	Engraving site.
Muisvogelskraal.	(Waterberg)	2 ha	Pedi Initiation sites.

5. Rock Art.

Initiation of the Soutpansberg Rock art conservation group 1995. Publication/co-author of "The Rooi Olifant", a newsletter on the rock art in the Soutpansberg. 1986 to 1993.

6. Architecture conservation work.

IDASA Democracy wall.		1999 to 2000.
Eshowe town historical documentation.		2001 to 2002.
Utungulu Regional Council regional heritage estate.		2002.
Fort Merensky, Middleburg restoration assessment.		2003.
Megawatt Park. Khami Wall project.		2003.
Freedompark	(1st phase heritage survey.)	2005.
Lunnon road, Suburban development.	(2nd phase assessment.)	2005.
Simmer and Jack Mine.	(2nd phase assessment.)	2005.
Clan Chattan private house.	(2nd phase study.)	2005.
Rustenburg Regional Council.	(Regional heritage estate study.)	2005 to 2006.
Premier Mine compounds.	(2nd phase assessment.)	2006.
Vredefort dome.	(Regional heritage study.)	2006.
Kimberley mines & historical buildings.	(Regional documentation project.)	2006.
Gautrain. 8 houses & Shed.	(2nd phase assessment.)	2006.
Mears Street, Walker Street and Hatfield stations.	(2nd phase assessment.)	2006.
Blaaubank gold mine & farm.	(Regional documentation project.)	2007.
DACST/ Theatre Pretoria.	(1st phase heritage survey.)	2007.
ERPM Southwest Rockshaft Compound.	(2nd phase heritage survey.)	2008.
Donkerhoek Rondavelhuis.	(2nd phase heritage survey.)	2008.
Thomo cultural village project.		2008.
Gautrain Pretoria Shed.	(2nd phase heritage survey.)	2008.
Standerton Airfield.	(1st phase heritage survey.)	2008.
Tshate, Sekhukhune mapping and excavation project.		2009.
Springs, no 3 Shaft Compound.	(2nd phase heritage survey.)	2009.
Lobenthal mission station.	(1st phase heritage survey.)	2009.
Stenekoppies historical farm.	(2nd phase heritage survey.)	2009.
Mogale alloys, 6 houses.	(2nd phase heritage survey.)	2010.
De Witt building & neighbouring house.	(1st phase heritage survey.)	2010.

Jachtlust.	(2nd phase heritage survey.)	2011.
Witrand.	(2nd phase heritage survey.)	2011.
Patatafontein.	(2nd phase heritage survey.)	2011.
Panplaas.	(2nd phase heritage survey.)	2011.
Zonnebloem.	(2nd phase heritage survey.)	2011.
Gemsbokfontein.	(2nd phase heritage survey.)	2011.
Smith farm.	(2nd phase heritage survey.)	2011.
Agrivaal building.	(2nd phase heritage survey.)	2011.
Lakenvlei historical farm.	(2nd phase heritage survey.)	2010.
Kumba mine heritage management plan.		2007 to 2012.
Jakkalskop, Lonmin.	(2nd phase heritage survey.)	2011.
Van Kolderskop, RWB.	(2nd phase heritage survey.)	2011.
Rhovan. UPDATED	(1st phase heritage assessment.)	2011.
Gumeni Escom Line.	(2nd phase heritage survey.)	2012.
Wonderfontein Colliery.	(2nd phase heritage survey.)	2013.
Areheng Rapid Bus Transport.	(2nd phase heritage survey.)	2014.
Melville two houses.	(2nd phase heritage survey.)	2017.
Olando Power station.	(2nd phase heritage survey.)	2018.

7. CRM Impact assessment work. (General)
2013 - 2020.

Atterbury Road extension.	(1st phase heritage assessment.)
Blue-Hills Suburban development.	(1st phase heritage assessment.)
Boekenhoutkloof sand mines.	(1st phase heritage assessment)
Boskop Smelter.	(1st phase heritage assessment.)
Blesbokfontein mine re application.	(1st phase heritage assessment.)
Capm Gold.	(1st phase heritage assessment.)
Carnarvon SKA telescope.	(1st phase heritage assessment.)
Crosa Sand mine re application	(1st phase heritage assessment.)
Doornhoek farm development.	(1st phase heritage assessment.)
Deelkraal mine re application.	(1st phase heritage assessment.)
Delmas coal mine.	(1st phase heritage assessment.)
Doornkop Harmony mine re application.	(1st phase heritage assessment.)
Dwaalboom Cattle processing farm.	(1st phase heritage assessment.)
Ellisras Lala Salama game farm.	(1st phase heritage assessment.)
Ecco sand mine re application.	(1st phase heritage assessment.)
Evander Harmony Gold mine re application.	(1st phase heritage assessment.)
Elandsfontein granite mine.	(2nd phase archaeological evaluation.)
Ermelo Nootgedachters farm.	(1st phase heritage assessment.)
Ermelo coal mine.	(1st phase heritage assessment.)
Fountains/Pretoria development heritage study.	
Groenfontein coal mine rehabilitation.	(1st phase heritage assessment.)
Hendrina to Gumeni power line.	(1st phase heritage assessment.)
Hartebeesfontein town development.	(1st phase heritage assessment.)
Jakkalskop.	(2nd phase archaeological evaluation.)
Kalgold.	(1st phase heritage assessment.)
Kruger Park new gates.	(1st phase heritage assessment.)
Klerksdorp five town development sites.	(1st phase heritage assessment.)
Krugerspost Andalusite mine re application.	(1st phase heritage assessment.)
Krosa mine.	(1st phase heritage assessment.)
Klipfontein 505 IQ town development.	(1st phase heritage assessment.)

Liebenberg Slate Quarry. (1st phase heritage assessment.)
Lakenvlei historical farm. (1st phase heritage assessment.)
Marico Chrome mine re application. (1st phase heritage assessment.)
Maroelasfontein new mine. (1st phase heritage assessment.)
Mooinooi Golf development. (1st phase heritage assessment.)
Mooiplaats, Suburban development. (1st phase heritage assessment.)
Monnakato. (1st phase heritage assessment.)
Mareletwane. (1st phase heritage assessment.)
Maloneys Eye. (1st phase heritage assessment.)
Nooitgedacht farm town development. (2nd phase archaeological evaluation)
Olifantspoortjie farm development. (1st phase heritage assessment.)
Orkney Police station. (1st phase heritage assessment.)
Paardekraal farm development. (1st phase heritage assessment.)
Pilanesberg Platinum. (2nd phase archaeological evaluation)
Prt.4 Rietfontein. (1st phase heritage assessment.)
Prt.128 Doornhoek. (1st phase heritage assessment.)
Paardefontein Poultry farm extension. (1st phase heritage assessment.)
Parys Eiland development. (1st phase heritage assessment.)
Putfontein farm development. (1st phase heritage assessment.)
Randstephne new iron mine. (1st phase heritage assessment.)
Renosterspruit flow meter. (1st phase heritage assessment.)
Sedibeng Diamond mine re application. (1st phase heritage assessment.)
Summerset ext, 31, Kyalami. (1st phase heritage assessment.)
Stenekoppie. (1st phase heritage assessment.)
Skurweberg. (1st phase heritage assessment.)
Transnet gas pipeline survey. (1st phase heritage assessment.)
Tshwane Rapid Bus Transit System. (1st phase heritage assessment.)
Tsakane, town development (1st phase heritage assessment.)
Vankolderskop (2nd phase archaeological evaluation)
VERRYBRICK re application. (1st phase heritage assessment.)
Voorspoed mine. (1st phase heritage assessment.)
Welkom Harmoney mine. (1st phase heritage assessment.)
Westewood poultry farm extension. (1st phase heritage assessment.)
Wachteenbietjiedraai farm development. (1st phase heritage assessment.)
Kumba mine heritage closure plan.
Storemill Compound Paardekraal 226IQ, Gauteng. (1st phase heritage assessment.)
Proteadal farm house. (2nd phase heritage assessment)
Prospecting drill site Farm 21, Reivilo Northwest Province. (1st phase heritage assessment.)
Rooifontein 1722. (1st phase heritage assessment.)
Ulco mine new farm Bergville. (1st phase heritage assessment.)
Rietfontein, Rustenberg. (1st phase heritage assessment.)
Rondebult new sewerage line. (1st phase heritage assessment.)
Dal Fouche Impala Plats new sewerage line. (1st phase heritage assessment.)
JRA three bridges. (1st phase heritage assessment.)
Sebokeng extension. (1st phase heritage assessment.)
Bronkhorstspruit Biogas. (1st phase heritage assessment.)
Sishen dumping ground extension. (1st phase heritage assessment.)
Cullinan mine recording by drone video.

2021.
Sprinkell Sanatorium mediation. (2nd phase heritage assessment.)

Sishen Mine. (1st phase heritage assessment.)
Venetia mine. (1st phase heritage assessment.)
18 and 19 Park Street Oaklands, Johannesburg. (1st phase heritage assessment.)
18 and 19 Park Street Oaklands, Johannesburg. (2nd phase heritage assessment.)
18 and 19 Park Street Oaklands, Johannesburg. (Demolition application.)
Ukupha chicken farm. (1st phase heritage assessment.)

2022.
Cullinan Mine Heritage Management Plan.
ZP properties: - 14th and 16th 6th Avenue, Houghton. (1st phase heritage assessment.)
New extensions at Sishen Mine, Northern Cape. (1st phase heritage assessment.)

2023.
Sereti Coal Mine. (1st phase heritage assessment.)

2024.
Sereti Coal Mine. (2nd phase heritage assessment.)

2025.
Goedehoop South Coal Mine. (1st phase heritage assessment.)

8. Publications.
1990. Adaptation of Traditional Building methods, The Venda. Unpublished Masters Degree.
1992. "Die Grond Vertel" Unpublished report on excavations and rebuilding on Schoemansdal.
1997. Thulamela. Unpublished report on excavations on Thulamela. SAN Parks.
1999. *Archaeological Bulletin*. Report on Thulamela with Steyn and others.
2000. *NCHM Annals. Special edition for Prof. Eloff*. From Schoemansdal to Thulamela.
2003. *Historical Buildings of Eshowe*, Eshowe Town Council.
2007. Contribution to *Neem uit die Verlede* by U.de V Pienaar. Protea Boekhuis.
2012. Contribution to *A Cameo from the Past* by U.de V Pienaar. Protea Boekhuis.
2018. *A Frontier town*. 1848 to 1867. Published by Amazon and Kindle.
2018. *Thulamela.* Published by Amazon and Kindle.

9. Exhibitions.
Schoemansdal and Rock Art Exhibition Pietersburg Show. 1991-1992
Mapungubwe and Thulamela Gold exhibition background,
Melck Huis, Cape Town 2003

10. General heritage surveys for private farm owners.
Farms Malmanieshoek, Hermanusdorns, Tambotispruit, Welgefonden, Lindani, Slangfontein, Muisvogelkraal, Kwarriehoek, Cattle-lands, Waterberg Game Ranch and Kudu Ranch

11. Tours and courses presented.
11. 1. SAN Parks Heritage courses I and II for Honorary Rangers and Kruger Park Students, including a yearly field trip, from **2002 to 2009**.

11. 2. St Olafs Collage, Minnesota U.S.A. Post Graduates History Students South African trip, northern leg, Including Soweto & Pretoria historical sites and museums, Sterkfontein, Goudrivier, Melora, Blouberg deep rural, Schoemansdal, Afrikaner/ Muslim church denominations, Venda Ceramicists, Mapungubwe, Thulamela, Makuleke, Masorini, Lydenberg, Heads, Fort Merensky. **2005 and 2006.**

Addendum 11. List of Figures.

List of Figures.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Construction of a spillway & weir at the Low Level Ash Water Return Dam (LLAWRD), Duvha Power Station,

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

Page 1 of 3

Declaration of Independence
General declaration:

▪ I, Sidney Mears Miller, declare that –

▪ I act as the independent Palaeontologist in this application

▪ I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant

▪ I declare that there are no circumstances that may compromise my objectivity in performing such work;

▪ I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;

▪ I will comply with the Act, Regulations and all other applicable legislation;

▪ I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;

▪ I have no, and will not engage in, conflicting interests in the undertaking of the activity;

▪ I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;

▪ I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;

▪ I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not

▪ All the particulars furnished by me in this form are true and correct;

▪ I will perform all other obligations as expected from a heritage practitioner in terms of the Act and the constitutions of my affiliated professional bodies; and

▪ I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Sidney Mears Miller

Annexure E6: Palaeontological letter of recommendation

Palaeosciences Centre, East Campus, 1 Jan Smuts Avenue, Braamfontein, Johannesburg
Private Bag 3, WITS 2050, Johannesburg, SOUTH AFRICA Tel: 011 717 6682

Marion.bamford@wits.ac.za
10 April 2026

Dr Ragna Redelstorff
Heritage Officer Archaeology, Palaeontology & Meteorites Unit
South African Heritage Resources Agency
111 Harrington Street
Cape Town 8001

Dear Dr Redelstorff

RE: Request for Exemption of any Palaeontological Impact Assessment for the proposed re-instatement of the Duvha Power Station low-level dam spillway, southeast of Emalahleni, Mpumalanga Province
SAHRIS Case Id: 26348

In my capacity as a professional palaeontologist, I am requesting exemption for palaeontological impact assessment in terms of the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) which requires that the proposed development must be preceded by the relevant impact assessment, in this case for palaeontology.

Project Description
Shangoni Management Services (Pty) Ltd was appointed by Eskom Holdings (SOC) Ltd to undertake an Environmental Authorisation (EA) application for the proposed Reinstatement of the Low-Level Dam Spillway at the Duvha Power Station, eMalahleni Local Municipality, Mpumalanga Province (Fig. 1).

The spillway requires refurbishment to make the dam functional. This is an existing structure.

Geology and Palaeontology
The project is on a dyke of non-fossiliferous intrusive diabase and on the Schrikkloof Formation that is composed of rhyolite and other volcanic rocks that have also been metamorphosed (Nazari-Dehkordi and Robb, 2022). The Schrikkloof Formation and the

diabase, therefore, do not have any fossils. (Fig. 2). In addition, at the time of their emplacement, the only living organisms were microbes.

Figure 1: Google Earth map of the project area with the spillway for the Duvha Power Station dam shown by the purple lines and pins.

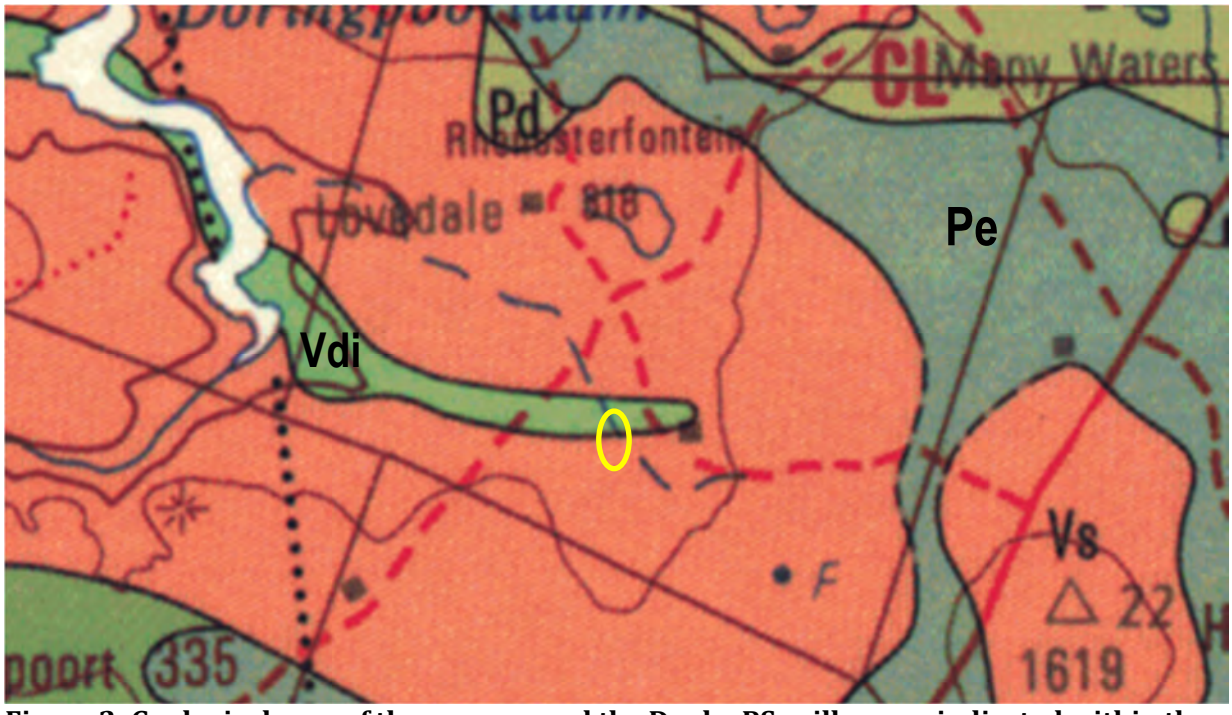


Figure 2: Geological map of the area around the Duvha PS spillway as indicated within the yellow polygon. Abbreviations of the rock types are in the table below. Map enlarged from the Geological Survey 1: 250 000 map 2528 Pretoria.

Table 1: List of abbreviations for the geology map.

Symbol	Group/Formation	Lithology	Approximate Age
Pe	Ecca Group, Karoo SG	Shales, siltstone, sandstone, coal	Early Permian
Pd	Dwyka Group, Karoo SG	Tillite, diamictite, shale, mudstone	Late Carboniferou to early Permian
Vdi	Diabase	Diabase	Post Transvaal SG
Vs	Schrikkloof Fm, (formerly Selons River Fm), Rooiberg Group (upper Transvaal SG)	Volcanic rocks, conglomerate, sandstone, quartzite	Palaeoproterozoic Ca 2089 – 2056 Ma

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/ YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 3: SAHRIS palaeosensitivity map for the site for the spillway for the Duvha Power Station is shown by the yellow outline.

Palaeosensitivity and Recommendation

The diabase is correctly indicated as non-fossiliferous (grey, in Fig. 3) and the Schrikkloof Formation is indicated as having a low palaeosensitivity (blue, in Fig. 3),

however as explained above there is no chance of fossils occurring on the volcanic rocks, that furthermore, are already disturbed. It is recommended that the project can be authorised.

Yours faithfully

Prof Marion Bamford
Palaeobotanist; PhD (Wits 1990)

Fossil Chance Find Protocol

Monitoring Programme for Palaeontology – to commence in the event that any other activities take place on the site.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, stromatolites, plants, insects, bone or bone fragments) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Lists of possible fossils can be provided to the developer to assist in recognizing them.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any important fossil material found by the developer/environmental officer/miners, according to the preliminary assessment by a palaeontologist, then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Reference cited:

Burne, R.V., Moore, L.S., 1987. Microbialites; organosedimentary deposits of benthic microbial communities. Palaios 2(3), 241-254.

Davies, N.S., Liu, A.G., Gibling, M.R., Miller, R.F., 2016. Resolving MISS conceptions and misconceptions: A geological approach to sedimentary surface textures generated by microbial and abiotic processes Earth-Science Reviews 154, 210–246.

Nazari-Dehkordi, T., Robb, L., 2022. Geochemical constraints on the origin and evolution of the volcanic Rooiberg Group, Bushveld Large Igneous Province, South Africa Precambrian Research 369: 106509.
https://doi.org/10.1016/j.precamres.2021.106509

Palaeosensitivity map:
https://sahris.sahra.org.za/map/palaeo

Declaration of Independence

This letter has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Shangoni Management Services (Pty) Ltd, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision-making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Annexure E3: Motivation from engineers from assessing design and layout alternatives

Eskom	EXEMPTION FROM DESIGN PHASE(S)TEMPLATE	Template Identifier	240-77476531 (Rev 6)
		Document Identifier	xxx-xxx
		Document Revision	x.x
		Effective Date	October 2017
		ENGINEERING	

STATION NAME:	Duvha Power Station		
ECN NO:	25450210	WBS/CC:	
REQUESTED BY:	Netshia Takalani	PROJECT CODE:	
ENGINEERING DESIGN WORK LEAD:	Netshia Takalani	CLASSIFICATION:	L2,
SYSTEM ENGINEER:	Netshia Takalani	PROJECT VALUE:	R3M

PROJECT TITLE AND DESCRIPTION

Project title: Upgrading of LLD spillway system

Description:
The Low Level Dam (LLD) is an off-channel storage dam used to store ash water. The dam is also used to collect all contaminated storm water from the ash dam, station and the surrounding area. The LLD has a capacity of 811 240m³ at the spillway level of 7.2m. The LLD spillway Currently have a width of 10m as opposed to the original design width of 110m, this is due to a berm constructed along the spillway in the past.

In 2013 the station constructed another earth berm on the downstream of the LLD spillway as a preventative measure in an event where the LLD overflow and since then it has been Duvha Power Station's practice to contain ash water in a bund along the LLD spillway to prevent contamination of the natural stream.

In 2019 Duvha had a risk of LLD overtopping when the level was at 7.7m and freeboard on the dam wall was approximately 300mm due to inadequate discharge capability caused by constructed berms. LLD is classified as a category II by The Department of Water and Sanitation as part of dam safety regulation dam and according to the same regulation it is a requirement that the dam should have adequate spillway system to prevent dam failures. In order to comply with the regulation Duvha need to remove the earth berm and reshape the spillway channel to its original capacity based on the SED (safety evaluation discharge) for a Category II-dam

The original design of the spillway and the downstream path was all earthworks, it has been recommended by the Approved Professional Person (APP) that as part of reinstating process the area be upgraded and minor concrete works together with slope protection be constructed to prevent further scouring of the soil

MOTIVATION

As part of Reinstating the LLD spillway to its original Design the APP has recommended that the station should install concrete beam, concrete weir and install Reno Mattress protection to prevent scouring soil downstream of the LLD spillway. The details of the above recommendation have been provided by the APP on the spillway reinstating scope of work together with detail drawing

The request to the committee is to skip the Concept design and Basic design, to proceed into environmental studies then compile detail design after the recommendation from the Environmental studies.

The proposed upgrade of the LLD spillway doesn't impact any operations of the current system but just improves the plant physics and prevent future environmental contravention. There will be no safety or cost impact that will be incurred by bypassing of theses phases.

Eskom	EXEMPTION FROM DESIGN PHASE(S)TEMPLATE	Template Identifier	240-77476531 (Rev 6)
		Document Identifier	xxx-xxx
		Document Revision	x.x
		Effective Date	October 2017
		ENGINEERING	

I declare that the exemption for not completing the phases above does not contravene compliance to the ECM Process, impact the safeguarding of the Design Base and that the relevant stakeholders have been consulted in making this decision.

	Date	Signature
Site Line Engineering Manager Nelly Hlophe	2021/02/19	
GMR2 Manager: Malis Mamoleka **Note: Signing for confirmation that all present law requirements have been met**	2021-02-23	
Site Change Control Committee Chairperson (L1, L2, L3): Oloff Nel	2021-02-23	

Annexure E2: Technical Design Report

REPORT: DUVHA POWER STATION LOW LEVEL ASH WATER RETURN DAM SPILLWAY UPGRADING DESIGN REPORT

DATE: 04 MAY 2020

REPORT NUMBER: P047-R0030

SAWE / PG CONSULTING

BUILDING 24, SUNNUNGHILL OFFICE PARK, 20 PELTIER ROAD, SUNNINGHILL, JOHANNESBURG, 2157

REPORT NUMBER: P047-R0030

REPORT TITLE: DUVHA POWER STATION LOW LEVEL ASH WATER RETURN DAM SPILLWAY UPGRADING DESIGN REPORT

REPORT VERSION: V3

CONTRACT NUMBER: 4600064796

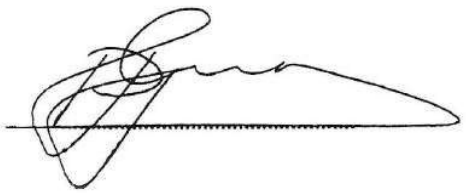
CLIENT: DUVHA POWER STATION

DEPARTMENT: AUXILIARY ENGINEERING

SYSTEMS ENGINEER/ PROJECT MANAGER: TAKALANI NETHSIA

REPORT AUTHORS: FRANCOIS JOUBERT, Pr Tech Eng

AUTHORISED BY:



PIETER GOUWS, Pr Eng (Civil), APP
DATE: 04 MAY 2020

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LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

APP	Approved Professional Person
CL	Contour Level
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
EPP	Emergency Preparedness Plan
EWR	Ecological Water Reserve
FSL	Full Supply Level
HRU	Hydrological Research Unit
IFR	Instream Flow Requirements
Ke	Regional coefficient
MAP	Mean annual precipitation
MAR	Mean sea run-off
masl	Meters above sea level
NOC	Non-overspill crest
NWA	National Water Act
OMM	Operation and maintenance manual
PMF	Probable maximum flood
PMP	Probable maximum precipitation
RDD	Recommended design discharge
RDF	Recommended design flood
RI	Recurrence interval
RL	Relative level
RMF	Regional maximum flood
SANCOLD	South African National Committee on Large Dams
SCS	Soil Conservation Service
SED	Safety evaluation discharge
SEF	Safety evaluation flood

LIST OF REFERENCES

	Document Title	Preparer / Author	Document Number	Revision or Date of Issue
1. Legislative Requirements				
[1]	The National Water Act	NWA	Act of 36	1998
[2]	The National Environmental Management Act	NEMA	Act of 107	1998
[3]	Regulation Gazette No. 20119 *Mining and Related Activities Regulations*	NWA	Government Notice (GN) R704	1999
[4]	Regulation Gazette No. 35062 *Dam Safety Regulations*	NWA	Government Notice (GN) R139	2012
2. National Standards and Information				
[5]	Guidelines on Safety in Relation to Floods	SANCOLD	Report no 4	1991
[6]	GIS information: WRC2012	WRC		2012
[7]	Software: Design Rainfall Estimation in South Africa	Smithers and Schulze	K5/1060	2002
[8]	Regional Maximum Flood Peaks in Southern Africa, Department of Water Affairs	DWA	TR137	1988
3. Technical Guidelines				
[9]	Drainage Manual 6th Edition	SANRAL		2012
[10]	Best Practice Guideline A4 Pollution Control Dams	DWAF	BPG 1	2007
4. Other Documentation and Information				
[11]	Lidar Survey Data & Settlement Beacons and Piezometer Positions Report	SAWE / PGC	P047-R0012	2019
[12]	First Dam Safety Evaluation Report	Darling De Lange & Van Tonder		2006
[13]	Ash Dam Operations and Maintenance Manual	ESKOM	ENM0003	2018

1. INTRODUCTION

1.1 Background

At an inspection on 11 December 2020, an instruction was given by Mr. Pieter Gouws, the Approved Professional Person, to breach the berm that had been constructed downstream of the Low-Level Ash Water Return Dam (LLAWRD) to prevent imminent overtopping of the LLAWRD. The berm had been constructed to mitigate the risk of spilling water to the clean natural water system that leads into Witbank Dam. This breach led to a spill into the clean natural water system.

SAWE Engineering Solutions (Pty) Ltd was appointed by Eskom Holdings SOC Ltd to re-evaluate the current situation at the Low-Level Ash Water Return Dam (LLAWRD) in respect of the following:

1. Operating level and spillway capacity,
2. Formalizing of the spillway design.

The LLAWRD is situated at the Eskom Duvha Power Station just north of the Ash tailings facility, about 13 kilometres south-east of Emalahleni in the Nkangala District, Mpumalanga Province. The centre co-ordinates (WGS 84) for the LLAWR Dam are latitude 25° 55' 37.31'' S and longitude 29° 20' 40.96'' E.

The location is illustrated in Figure 1 below.

Figure 1: Google Earth Image showing the dam position

1.2 Scope of Work

The scope of work can be summarised as follows.

a) Estimate the current LLAWR Dam's spillway capacity, before overtopping of the dam wall crest will occur (as reduced by an earth berm placed by Eskom within the original spillway channel).
b) Reinstate spillway capacity to comply with acceptable dam safety standards.
c) Address the man-made breached section in the dividing berm and propose a more formalised structure which will allow for spillage into the clean water system only during a flood storm which exceeds a 1:50-year recurrence interval.
d) Calculate the wetland potential storage capacity, which is located within the dirty water area, to the western side of the LLAWR Dam.
e) Re-evaluate the optimum operating level within the LLAWR Dam in order to allow for enough buffer capacity to safely accommodate the 1:100-year 24-hour flood storm volume (as recommended in the Ash Dam Operations and Maintenance Manual, ENM003-2018).
f) Provide a specification for gravel topping on the dam wall crest.

2. OPERATION OF LOW-LEVEL ASH WATER RETURN DAM

With reference to the Ash Dam Operations and Maintenance Manual, page 59 (ENM0003 – 2018), the LLAWR Dam is to be operated within a water level range of between 1354 and 1352 masl. The levels shown in this graph is based on the old level system, before the Lidar and RTK surveys were conducted during 2019, which provides a more accurate elevation.

The higher limit is to ensure adequate storage capacity during any major storm, including a 1:100-year 24-hour storm. The lower limit is to prevent cavitation on the pumps.

With the above in mind, the maximum operation level should not exceed 1354m (which equals the 4m level marker). Unfortunately, it was found that in recent times, the dam was operated at 1356m and even higher (6m+ level marker). The graph in Figure 2 below illustrates these operating parameters.

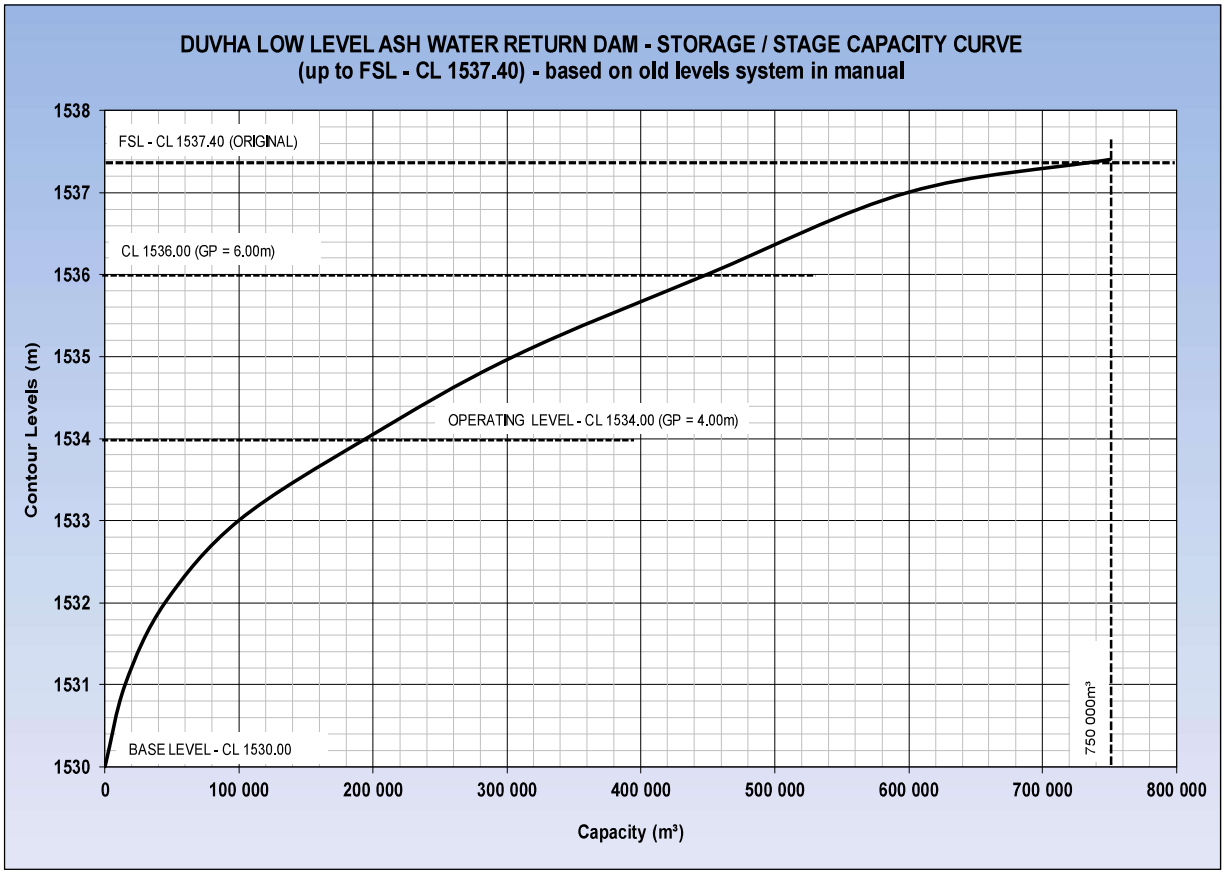


Figure 2: Storage / stage capacity curve (based on old levels system)

The graph in Figure 3 below, although like the graph above, gives the adjusted levels (meters above mean sea level) based on the Lidar and RTK surveys conducted during 2019. In future, this level set will be used as the reference points. The Operations and Maintenance Manual must be updated to reflect this change.

The graph below in Figure 3 below provides the above in the revised survey parameters.

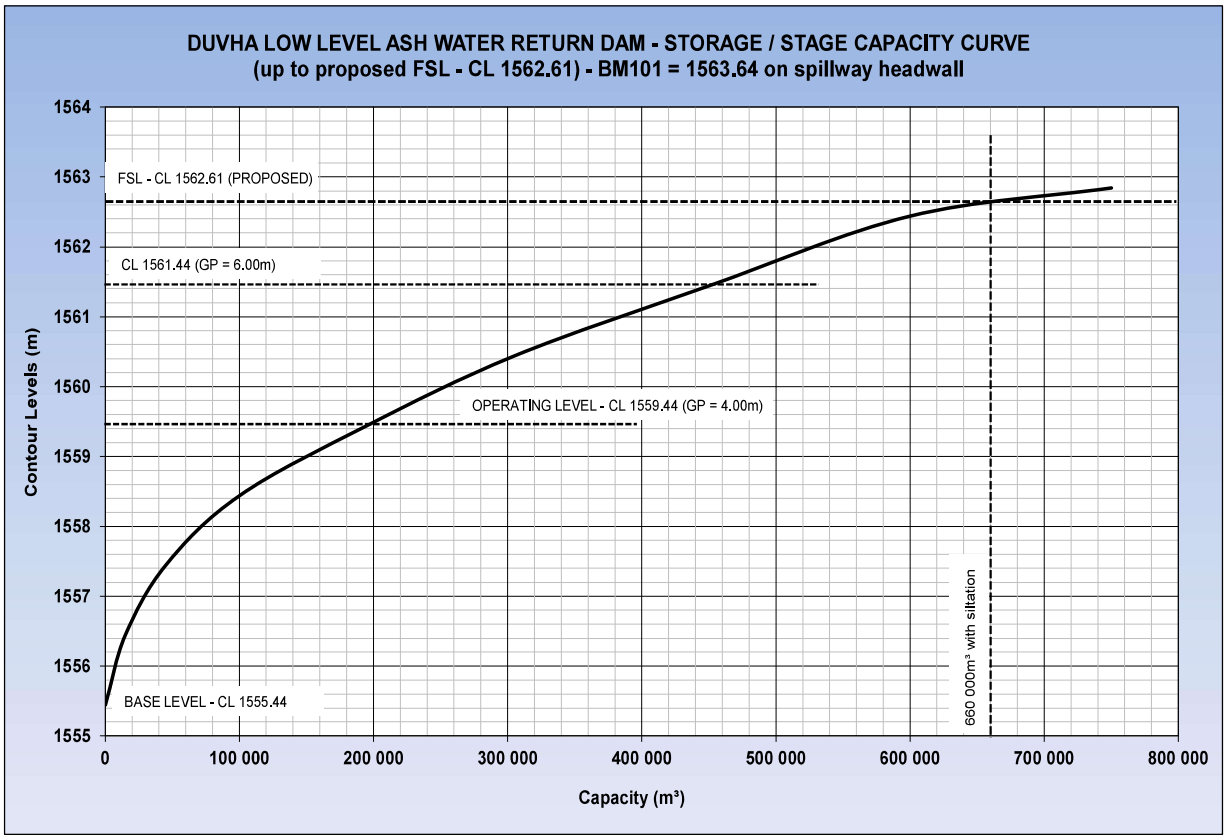


Figure 3: Storage / stage capacity curve (based on new levels system)

The LLAWRD also receives both stormwater and process water from the power station terrace. This is directed to the LLAWRD through the stormwater channels and the solution trench that emanate from the power station and surround the ash tailings facility.

NOTE: The above storage / stage capacity curves are based on the graph given in the Ash Dam Operations and Maintenance Manual which differs from the initial as-build graph. See Figure 4 below for comparison based on old levels system. As such it is recommended to conduct a new dam basin survey (bathometric survey) on the LLAWRD to establish the exact present storage capability (with new graph), since the dam has recently been desilted.

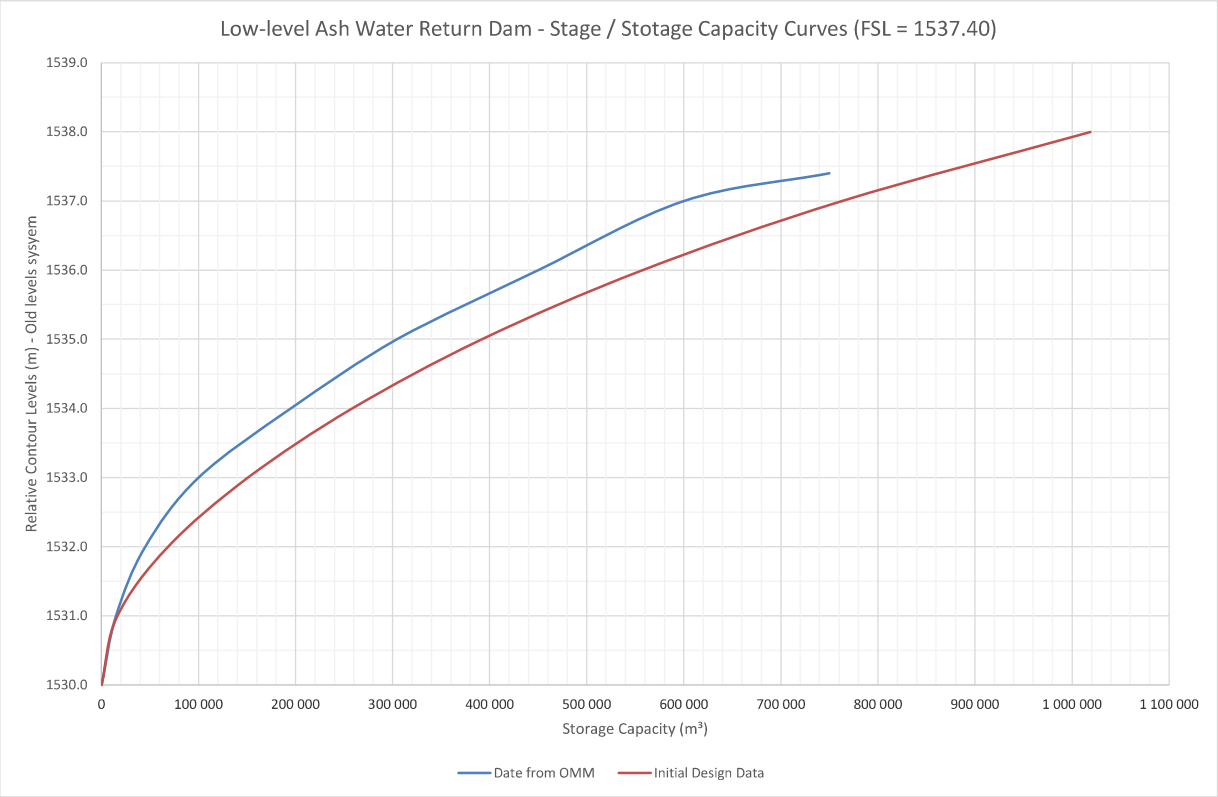


Figure 4: Storage / stage capacity curves comparison

3. LEGISLATION REQUIREMENTS

3.1 Government Notice (GN139) – Dam Safety Regulations

In regulating dams, the government has developed a legislative framework that is set out in Chapter 12 Sections 117-123 of the National Water Act (Act 36 of 1998). Dam Safety regulations are set out in Government Notice 139 (GN 139) and this indicates the criteria that are required to be considered when classifying a dam. Furthermore, Government Notice 704 (GN 704) provides additional criteria for clean and dirty water systems, which would be applicable in this case.

A dam with a maximum wall height of more than 5 (five) meters and a capacity which exceeds 50 000 cubic meters, is defined as a dam with a safety hazard. Such a dam must be formally classified and registered for dam safety purposes with the Department of Water and Sanitation (Dam Safety Office - Pretoria). In addition, the regulations also prescribe the following relevant information, which is to be read in conjunction with the that stipulated by SANCOLD, namely:

1. Dam use,
2. Flood spillway hydraulic capabilities;
3. Flood attenuation capabilities;
4. The need to undertake periodic dam safety assessments, and for,
5. Oversight of an Approved Professional Person to provide guidance on the operation of the dam.

NOTE: In view of the above, the LLAWR Dam was classified on 8 June 2006 as a **small size**, **Category II-dam** with a **significant hazard potential** rating and was formally registered on 22 June 2006. DSO reference number 12/2/B102/83. Refer to Dam Safety Registration Certificate attached as ***Appendix C***.

The SANCOLD guidelines provide more specific requirements.

3.2 Guidelines on Safety in Relation to Floods (SANCOLD Report N0. 4 – 1991)

Based on the SANCOLD Guidelines (1991), for a Category II-dam, with a significant hazard potential, the flood spillway design needs to safely allow for a discharge of a 1:100-year flood with adequate safety "dry" freeboard applied. In addition to this, the spillways with no safety freeboards, should also allow for the recommended SEF before overtopping of the NOC (embankment crest) occur.

The Guidelines state that the SEF shall be set equal to the routed RMF-Δ flood peak.

3.3 Government Notice (GN704) – Regulations on Use of Water for Mining and Related Activities Aimed at the Protection of Water Resources

Section 6 of GN 704 states the following in relation to capacity requirements of clean and dirty water systems, namely (relevant sections quoted):

d) design, construct, maintain and operate any dirty water system at the mine or activity so that it is not likely to spill into any clean water system more than once in 50 years; and;
e) design, construct, maintain and operate any dam or tailings dam that forms part of a dirty water system to have a minimum freeboard of 0.8 m above full supply level, unless otherwise specified in terms of Chapter 12 of the Act.

It basically states that any dirty water system (i.e. dam) must be designed, constructed, and maintained in such a way that it is not likely to spill into any clean water system more than once in 50 years. Subsequently, the flood volume of the 1:50-year flood storm must be contained within the defined dirty water area. Flood water in excess of the 1:50-year may spill into the clean water system.

Currently the dam does not adhere to the above requirements as it being operated in a manner that is above the set operational level, with less free-board. In Section 8 in this report we review and optimise the operating level.

4. FLOOD HYDROLOGY

4.1 Calculation Methodology

Methods which were adopted and applied to calculate the expected run-off peaks with variance in the return periods are summarised below.

a) **Rational Method Implementation #1 –** Based on the regional DDF-equations representing the HRU 1/78 DDF-relationships ("Op ten Noort & Stephenson" -1982),

b) **Rational Method Implementation #2 –** Based on the DDF-tables of TR102 for an n-day storm depths in Southern Africa ("Adamson" -1981),

c) **Empirical Method (TR137) –** Regional maximum floods based on "Francou-Rodier" K-values ("Kovacs" – 1988) – Commonly used by DWS. However, this method tends to give over conservative values for catchments >10km² but had to be applied in order to obtain the RMF value.

4.2 Catchment Parameters

The catchments identified and delineated for the dam forms part of quaternary catchment **B11G**. (Refer to Google image below, Figure 5).

The mean annual rainfall of the catchment, based on the nearest rainfall station (0515382W), is given as **773 mm**. The Mean Annual Precipitation (MAP) for the quaternary catchment is given as **693 mm**. Rainfall data and design rainfall depths from the table below (highlighted) were incorporated in the hydrology calculations.

Ash Dam Complex catchment area (km²)	**5.38km²**
Duvha Power Station terrace catchment area (km²)	**1.22km²**
Total catchment area (km²)	**6.60km²**
Flow length of longest watercourse (km)	**5.0km**
Vertical difference in catchment (m)	**90m**
Average watercourse / river slope (10/85)	**1.80%**
Time of concentration (Tc)	**1.08 hour**

DESIGN RAINFALL DEPTHS AT SELECTED STATIONS IN SOUTH AFRICA

SAWB NUMBER	Station Name	Latitude		Longitude		MAP	Altitude	Years	Duration	Return Period (years)																	
										2			5			10			20			50			100			200		
		(°)	(')	(°)	(')	(mm)	(m)		(days)	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U
0515382AW	WITBANK-1	25	52	29	13	773	1583	42	1	52	52	52	69	69	70	81	81	82	92	93	95	108	110	112	120	123	127	132	137	143
									2	71	71	71	92	92	93	106	107	107	120	121	122	137	140	142	151	154	157	165	168	174
									3	79	79	80	102	102	103	117	118	118	132	133	133	151	152	153	165	167	168	180	181	183
									4	87	88	88	113	113	114	129	130	131	145	146	147	165	167	168	179	182	185	194	197	201
									5	95	96	96	123	123	124	140	141	142	157	159	160	178	181	183	193	197	201	208	213	219
									6	101	102	102	130	131	131	148	149	150	165	167	169	186	189	192	201	205	209	215	221	228
									7	107	108	108	137	138	139	157	157	158	174	176	177	196	199	201	212	215	219	227	232	236
0515382 W	WITBANK - MAG	25	52	29	13	773	1583	62	1	52	53	53	69	70	70	81	82	83	93	94	95	109	111	113	121	124	128	133	138	144
									2	66	67	67	86	87	87	100	100	101	113	114	115	129	131	133	142	145	148	155	158	163
									3	75	75	76	97	97	98	112	112	113	126	126	127	144	145	146	157	159	160	171	172	174
									4	82	82	83	106	106	107	122	122	123	136	137	138	155	157	158	168	171	174	182	185	189
									5	88	88	88	113	113	114	129	130	131	145	146	147	164	166	169	178	181	185	192	196	202
									6	93	93	94	119	119	120	135	136	137	151	152	154	170	173	175	184	187	191	197	202	208
									7	97	98	98	125	126	126	143	143	144	159	160	161	179	181	183	193	196	199	207	211	215
0515383 W	WITBANK (POW)	25	53	29	13	729	1598	44	1	48	48	48	64	64	65	75	76	77	86	88	90	101	105	108	113	118	123	126	132	139
									2	62	62	62	82	82	82	96	96	97	109	110	111	128	129	131	142	144	146	157	160	163
									3	71	71	72	93	94	94	108	110	111	123	125	127	142	146	150	156	162	169	171	179	189
									4	78	78	79	102	103	103	118	120	121	134	136	139	154	159	163	169	176	183	185	194	204
									5	85	85	85	110	111	112	128	129	130	144	146	148	166	169	173	182	187	193	197	205	213
									6	90	90	91	117	117	118	135	136	136	153	153	154	175	177	179	193	195	198	210	214	217
									7	95	95	95	122	123	123	141	142	142	158	160	161	181	184	186	198	202	205	215	220	225
0515412 W	WITBANK (MUN)	25	52	29	14	698	1610	43	1	51	52	52	69	69	70	81	82	83	93	95	97	109	113	116	122	127	133	135	142	150
									2	64	65	65	85	86	86	100	100	101	114	115	116	133	135	136	148	150	153	164	166	170
									3	72	73	73	95	96	96	111	112	113	126	128	130	145	149	154	160	166	173	174	183	193
									4	80	80	81	104	105	106	121	122	124	137	139	142	158	162	167	173	180	187	189	198	208
									5	87	88	88	114	114	115	131	132	133	148	150	152	170	174	178	187	192	198	203	211	219
									6	91	92	92	118	119	119	137	137	138	155	156	157	178	180	181	195	198	200	213	216	220
									7	98	98	98	126	127	127	146	146	147	164	165	166	187	190	192	204	208	212	222	227	232
0515528 W	OLIFANTSRIVIER (SAR)	25	48	29	18	656	1410	72	1	51	51	51	68	69	69	80	81	82	92	94	95	108	111	115	120	125	131	134	140	148
									2	63	63	64	84	84	84	98	98	99	112	113	113	131	132	134	146	148	150	161	163	166
									3	72	72	72	94	95	95	109	111	112	124	126	129	143	147	152	158	164	170	172	181	190
									4	79	79	80	104	104	105	120	121	123	136	138	141	156	161	165	172	178	185	187	197	207
									5	85	86	86	111	112	112	128	129	131	145	147	149	167	170	174	183	188	194	199	206	215
									6	89	90	90	116	117	117	134	135	135	151	152	153	174	176	177	191	194	196	209	212	215
									7	95	96	96	123	124	124	142	143	143	160	161	162	182	185	187	199	203	207	216	221	226
0515732 W	BOTSABELO (SKL)	25	42	29	24	697	1410	67	1	54	54	54	71	72	72	83	84	85	96	97	98	112	114	116	124	128	132	137	142	148
									2	68	68	69	89	89	89	102	103	103	115	116	118	133	135	137	145	148	151	159	162	167
									3	76	76	77	98	99	99	113	114	114	128	128	129	146	147	148	160	161	162	173	175	177
									4	85	85	85	109	110	110	125	126	127	140	142	143	160	162	163	174	176	179	188	191	193
									5	90	91	91	117	117	118	133	134	135	149	151	152	169	172	174	184	187	191	198	203	208
									6	95	96	96	122	123	123	139	140	141	155	157	158	175	178	180	189	193	197	202	207	214
									7	101	101	102	129	130	131	148	148	149	164	165	167	185	187	190	199	203	206	214	218	223
0515826 W	MIDDELBURG (TNK)	25	46	29	28	689	1459	96	1	44	44	45	59	60	60	69	70	71	80	81	83	94	97	100	105	109	114	116	122	129
									2	59	59	59	78	78	79	91	92	92	104	105	106	122	123	124	135	137	139	149	152	155
									3	66	67	67	87	88	88	101	103	104	115	117	119	133	137	141	146	152	158	160	168	177
									4	73	74	74	96	96	97	111	112	113	126	128	130	144	149	153	159	165	172	173	182	191
									5	79	80	80	104	104	105	120	121	122	135	137	139	155	159	162	170	175	181	185	192	200
									6	85	85	85	110	110	111	127	127	128	143	144	145	165	166	168	181	183	186	198	201	204
									7	90	90	91	116	117	117	134	135	135	151	152	153	172	174	177	188	191	195	204	209	213

188 L=lower 90% error bound (mm); D=design rainfall depth (mm); U=upper 90% error bound (mm)

Table 1: Design rainfall depths (Adamson 1981)

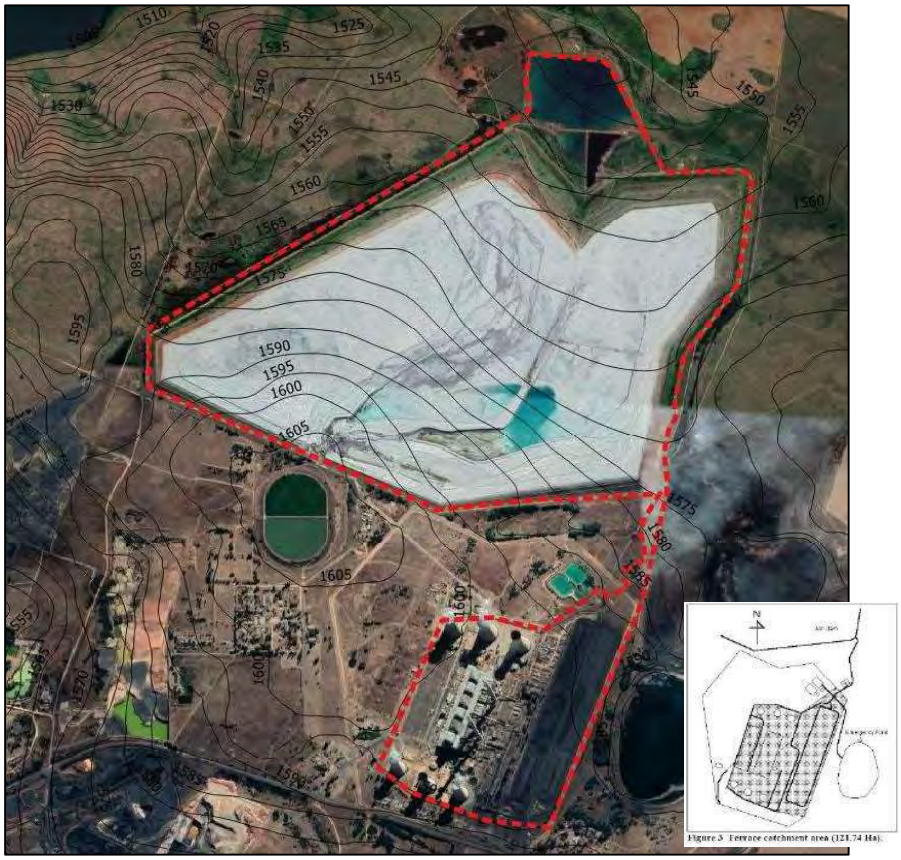


Figure 5: Google image showing LLAWR dam catchment

4.3 Summary of Hydrology

During the final hydrology calculations, following various considerations, it was decided to adopt the average flood values derived by the two deterministic Rational methods applied. This allows for the inclusion of specific conditions as the catchment size is <10km².

The values derived by the TR137 empirical method were found to be too conservative as it is based on general regional assumptions. However, because this is a Category II-dam, the method had to be applied in order to derive the RMF peak for SEF purposes. Refer to the flood graphs included below and calculation sheets ***Appendix A***.

Flood peaks derived			
Values in m³/s	Q_{50}	Q_{100} (RDF)	Q_{200}
Rational Method (Implementation #1)	51.2	76.0	112.2
Rational Method (Implementation #2)	40.2	54.9	74.1
Empirical TR137 Method (K_e region 5.2)	*85.2*	*107.3*	*128.8*
Average of two Rational Methods applied	**45.7**	**65.5**	**93.2**

Table 2: Summary of calculated flood peaks with three applied methods

Regional maximum flood (RMF) – calculated for K_e - region 4,6: 205m³/s
Regional maximum flood (RMF-Δ) – calculated for K_e - region 4,0: 133m³/s
Probable maximum flood (PMF) 1:10 000 years – $K_{e\,max}$ – region 5,6: 361m³/s

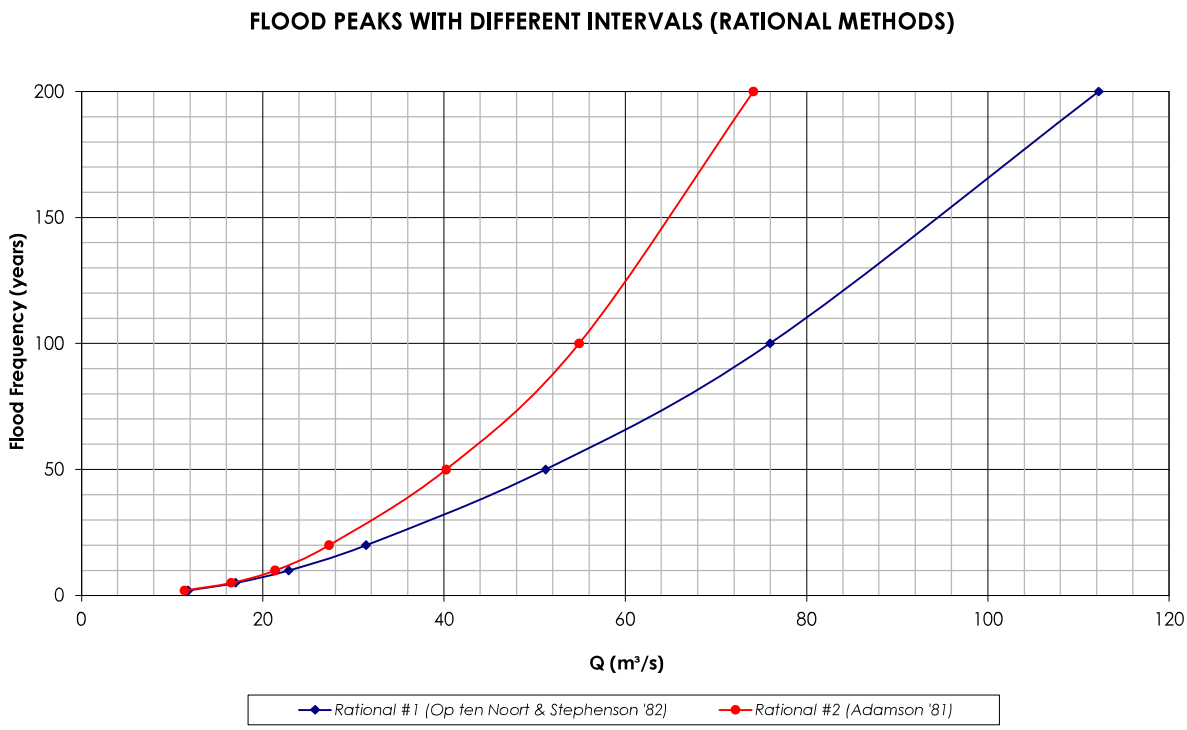


Figure 6: Flood graphs derived by the two Rational Method implementations applied

The re-evaluated flood peak values above compare favourably with the flood values presented in the First Dam Safety Evaluation Report (2006) compiled by Darling De Lange & Van Tonder. Refer to abstract in Figure 7 below.

SECTION 7: FLOOD ESTIMATES

Catchment area:	538 ha
Catchment slope:	0,5%
Weather station:	Witbank 515382
Mean annual rainfall:	615 mm
Combined run-off factor:	0,38 to 0,57
Time of concentration:	1,13 hr
Region:	4,6

Flood estimates

1:20 year:	$26 m^3/s$
1:50 year:	$39 m^3/s$
1:100 year:	$52 m^3/s$
1:200 year:	$57 m^3/s$
Regional maximum flood:	$190 m^3/s$
Recommended design flood: ...	$52 m^3/s$
Safety evaluation flood:	$124 m^3/s$ (RMF_{-delta})

Figure 7: Hydrology summary abstract from the 1st Dam Safety Evaluation Report (2006)

5. METHODOLOGY FOR SCOPE OF WORK

The following methodology was adopted to address the scope of work.

a) To establish the current spillway discharge capacity, the Lidar survey data and RTK survey data from 2019 were used to compile a representative profile alignment at the spillway control section (i.e. where the earth berm was placed). A sectional spillway calculation was then applied. See calculation sheets attached as ***Appendix A***.

b) To reinstate the spillway capacity to prescribed standards, the SANCOLD Guidelines were consulted by applying acceptable spillway hydraulic calculations. See calculation sheets ***Appendix A*** and drawings ***Appendix B*** attached.

c) In order to address the man-made breached section in the dividing berm and to propose a more formal structure to allow for spillage only at a recurrence interval of 1:50-years and larger, the detention capacity of the wetland within the dirty area, as well as the buffer retention capacity of the LLAWR Dam had to be established. This was then used to establish the overspill level of the proposed structure at the dividing berm. See drawings attached for illustration.

d) With the re-evaluation of the optimum operating level in the LLAWR Dam, a re-evaluation of the flood hydrology was done in order to establish the expected 1:100-year 24-hour storm event runoff volume that needs to be retained. This was then balanced to an existing dam storage / stage curve to allow for sufficient buffer capacity during such a storm event.

6. RETENTION / DETENTION STORAGE CAPACITY CALCULATIONS

Based on the flood hydrology calculation under Section 4, the following Table 3, provides a summary and averages of the expected flood runoff volumes at the different flood recurrence intervals based on a 1:2 ratio flood hydrograph. Rational Method Implementation #1 gives the flood volume for a 1:100-year 24-hour flood storm as 441 254m³ while Rational Method Implementation #2 gives it as 318 981m³. Subsequently, as with the flood peak values, the average was adopted which gives a more realistic volume of approximately **380 000m³** which is used for buffer capacity estimation. For the 1:50-year 24-hour flood storm the average is given as approximately **265 000m³**.

DUVHA P/S LOW LEVEL ASH WATER RETURN DAM

Rational (Implementation #1)									
Flood Frequency (Years)		2	5	10	20	50	100	200	PMF
V (m³)	0.5 tc	108 922	157 721	211 830	291 219	474 902	704 426	1 040 700	4 067 407
	1.0 tc	**68 229**	**98 797**	**132 690**	**182 420**	**297 480**	**441 254**	**651 897**	**2 547 832**
	2.0 tc	40 089	58 049	77 964	107 183	174 787	259 263	383 029	1 497 006
	3.0 tc	28 804	41 709	56 018	77 012	125 586	186 283	275 209	1 075 611

Rational (Implementation #2)									
Flood Frequency (Years)		2	5	10	20	50	100	200	PMF
V (m³)	0.5 tc	105 250	152 910	197 790	252 798	372 505	508 376	686 308	1 215 458
	1.0 tc	**66 039**	**95 944**	**124 104**	**158 618**	**233 728**	**318 981**	**430 625**	**762 640**
	2.0 tc	38 953	56 592	73 202	93 560	137 863	188 149	254 001	449 839
	3.0 tc	27 860	40 476	52 356	66 917	98 604	134 570	181 670	321 739

Average									
Flood Frequency (Years)		2	5	10	20	50	100	200	PMF
V (m³)	0.5 tc	107 086	155 315	204 810	272 008	423 704	606 401	863 504	2 641 432
	1.0 tc	**67 134**	**97 370**	**128 397**	**170 519**	**265 604**	**380 117**	**541 261**	**1 655 236**
	2.0 tc	39 521	57 320	75 583	100 371	156 325	223 706	318 515	973 422
	3.0 tc	28 332	41 092	54 187	71 964	112 095	160 427	228 440	698 675

Table 3: Summary of expected flood volumes at different recurrence intervals

The detention storage capacity of the wetland area, located next to the dam on the western side, was also calculated based on the latest Lidar survey data of 2019. Calculations had revealed that the area has a possible storage capacity of approximately **53 000m³** up to the lowest section on the dividing berm, which is at 1563.00 masl. Refer to the graph in Figure 8 below.

Based on the proposed new concrete weir spillway design under Section 7, the weir will have an overflow spill level at CL 1562.86 masl. With reference to the graph, Figure 8, the corresponding storage capacity is given as approximately **46 500m³** at this level.

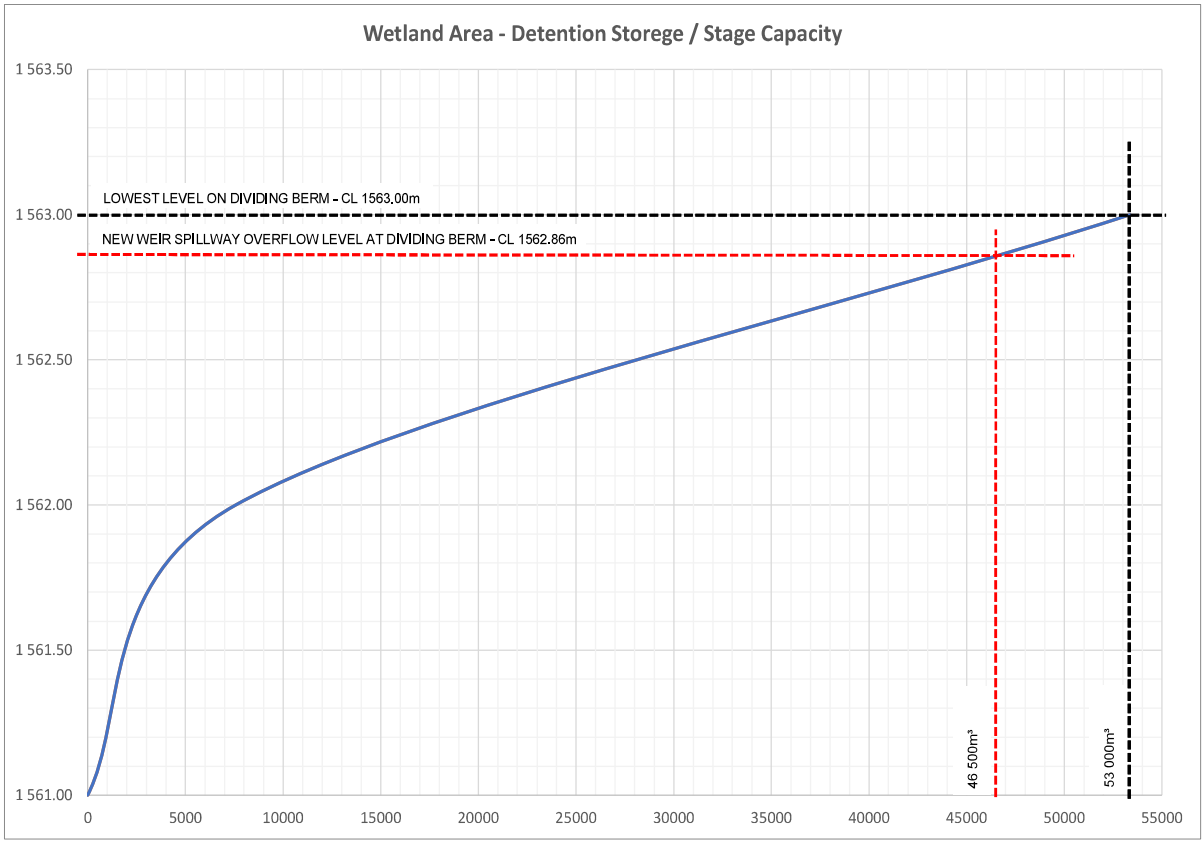


Figure 8: Storage / stage capacity curve of wetland area next to the LLAWR Dam

7. SPILLWAY UPGRADING (DESIGNS)

Because of an earth berm which was placed in the spillway channel control section of the LLAWR Dam, the flood discharge capacity and capability of the dam was drastically reduced. This led to non-compliance in terms of the Dam Safety Regulations which must be rectified. Initially the dam was constructed with a 110m-wide spillway channel with an 800mm freeboard, which was enough to accommodate the SEF as previously discussed. Below, in Figure 9, is a section through the spillway, as present, derived from the Lidar survey. The black line represents the lowest level on the dam wall crest.

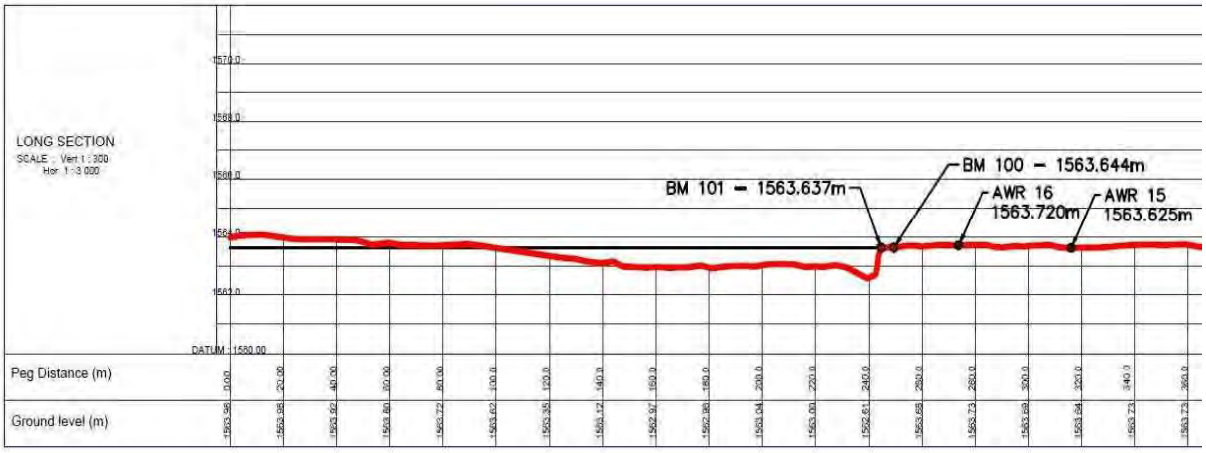


Figure 9: Image showing current spillway profile at the control section (dam wall on right)

Hydraulic calculations were performed on the flow section of the spillway channel which had revealed that the current spillway geometry is only capable of discharging approximately **44m³/s** before overtopping of the dam wall crest will occur. Refer to calculation sheets attached as ***Appendix A***.

In order to rectify the non-compliance, it is proposed to remove the earth berm and to reshape the spillway channel. The proposed upgraded channel will have a control width of **60m-wide** and in addition, a freeboard of **1.25m** will be implemented. The freeboard will be achieved by excavating and forming the base of the spillway channel at CL 1562.61masl. In addition, a gravel topping will be placed on the existing dam wall crest section, as described under Section 9.

Note that with regard to the regulation of GN 704, which only allows flood water to spill into clean water systems every 50 years or above, provision for the 50-year storm volume subsequently will have to be contained within the dam basin, referred to as the “buffer” capacity (i.e. storage capacity between the operating level and the FSL). Fortunately, to augment this buffer capacity, it is recommended that the wetland area, also situated within the dirty water area, shall be utilized. An additional capacity of **46 500m³** is available, as described under Section 6.

Due to recent high-water levels within the LLAWRD it was necessary to breach a section within the dividing berm in order to prevent overtopping of the dam wall, and subsequent damage and inundation of the pump station. As part of the LLAWRD spillway upgrading, it

was also decided to design and construct a formal concrete weir spillway structure at the man-made breach section, for future spillage capability (>50-year flood peak). Refer to the image in Figure 10 below, for illustration purposes.

Figure 10: Google Image showing dam's spillway section and dividing berm

Calculations had revealed that by constructing a weir spillway with an overflow width of **24m** and a freeboard of **1m**, the discharge capacity will safely accommodate the "routed" 1:50-year flood peak before the berm will overtop. Refer to calculation sheets, ***Appendix A*** and concept design details on attached drawings, ***Appendix B***. The overflow level of the weir spillway will be at CL 1562.86 (250mm higher than the LLAWRD FSL).

Note that some low sections on the existing dividing berm will also have to be raised and compacted with earth-fill in order to provide the 1m freeboard throughout. The earth berm material within the LLAWRD can be utilised for this purpose.

Images below, in Figures 11 and 12, show the earth berm placed in the existing spillway channel of the LLAWR Dam and the manmade bridge section within the dividing berm between the dirty and clean water systems.

Figure 11: Image of earth berm placed within the original spillway channel

Figure 12: Image of manmade breached section at dividing berm which was necessitates because of high water levels in the LLAWRD (proposed weir position indicated with red line)

8. OPTIMIZING OF OPERATING LEVEL

In view of the proposed and recommended designs and operational changes above, the initial recommended maximum operating level of the LLAWR Dam (i.e. level depth marker 4m) was revisited and re-evaluated accordingly.

With reference to the recommendation of the Ash Dam Operating and Maintenance Manual, stating that; "*the maximum operating level is to ensure that adequate storage capacity is available during any major storm, including a* ***1:100-year 24-hour storm***", the required buffer capacity was re-evaluated. It was found that a buffer capacity of approximately **380 000m³** is required (Section 6).

In view of the above, this capacity needs to be provided for especially during the summer months (during the rainfall season). For the winter months the required capacity can be based on the ***1:50-year 24-hour storm*** which requires a buffer capacity of approximately **265 000m³**. Subsequently the maximum operating level will fluctuate between two maximum allowable operation levels (i.e. summer and winter months).

This, in effect, means that there must be buffer capacity of 380 000 m³ between the maximum operating level and the FSL of the dam during the summer months. This was applied, as can be seen on the graph in Figure 13 below, which results in a revised maximum operation level of **CL 1560.24 masl** which corresponds with level depth marker **4.80m**.

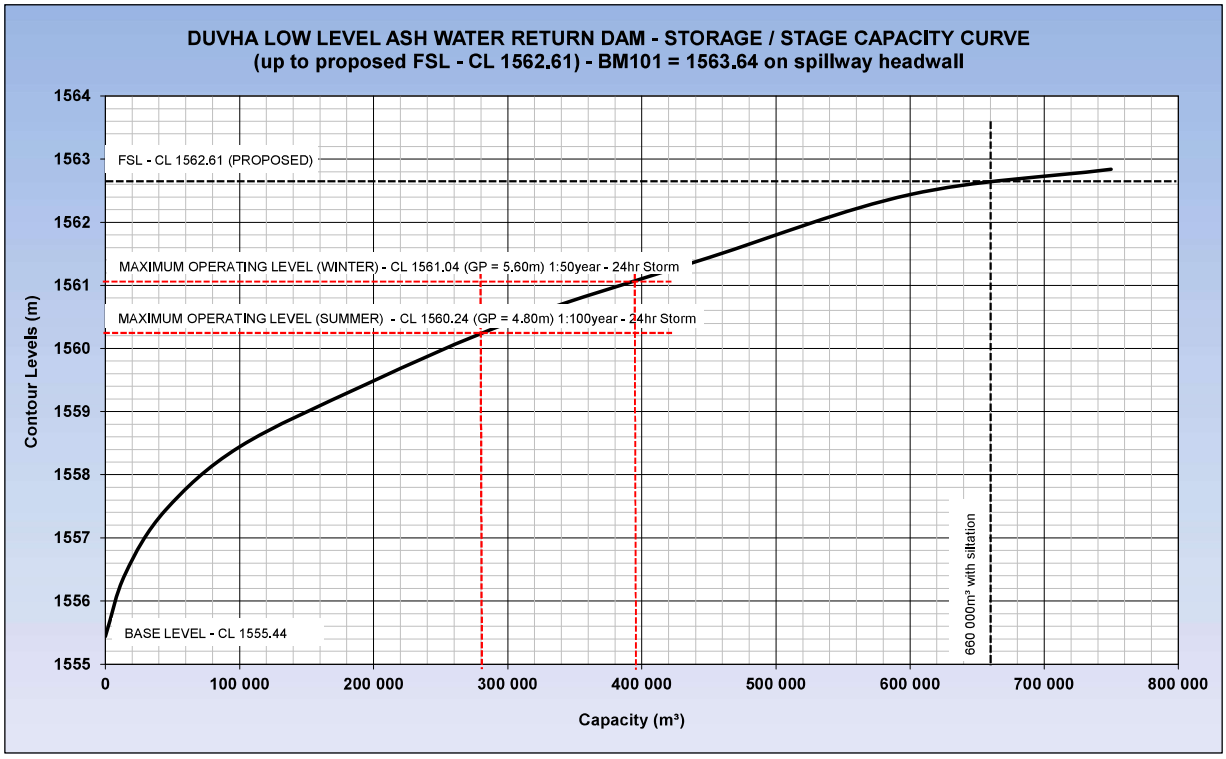


Figure 13: Storage / stage capacity curve with revised operating level

During the winter months there must be buffer capacity of 265 000 m³ between the maximum operating level and the FSL of the dam. This was also applied, as can be seen on the graph in Figure 13, which results in a revised maximum operation level of **CL 1561.04 masl** which corresponds with level depth marker **5.60m**.

9. GRAVEL TOPPING ON DAM WALL CREST

Following the Lidar and RTK surveys during 2019, it was found that minor settlement had occurred on the embankment crest section. Another defect is the fact that the crest section, after rainfall, becomes very slippery and inaccessible for vehicle traffic.

Subsequently, it is recommended to apply a 300mm thick gravel topping on the entire crest section to correct both concerns. The gravel topping shall be compacted to at least 92% Mod AASHTO with a 2% crossfall towards the upstream (water) side, to prevent standing and ponding water on the crest, after rainfall. Refer to drawing 047/AWR/006 for detail, attached as ***Appendix B***.

The dam safety settlement beacons, recently placed on the crest of the embankment, will have to be re-placed after the placement of the gravel topping and re-shaping of the crest.

10. CONCLUSIONS

Currently the Low-Level Ash Water Return Dam is being operated outside of the safe operations requirements prescribed for the dam. A number of factors have led to this, these being amongst others:

a) The process water make from the power station operations is higher than expected and not in sync with the water withdrawn from the dam for lower level water services such as ashing.
b) In the recent past, the dam / pan south of the coal stockyard has been removed from the power station water management system, resulting in more storm water being directed to the LLAWRD.
c) The current status of the ash tailings facility makes it difficult to temporarily store water on the dam. This ability makes the operation of the LLAWRD acutely prone to potential spills.
d) The current operational and maintenance status of the LLAWRD return pumps and the pipelines providing suction to these could potentially be causing the pumps to cavitate at lower LLAWRD operational level than designed.

In order to rectify non-compliance in terms of legal requirements, the following upgrading works need to be implemented at the Low-Level Ash Water Return Dam. The works as described in the report can be briefly summarised as follows.

a) Remove earth berm in existing spillway channel and form and reshape channel to specifications. A concrete sill needs to be constructed as well to act as a definite control point.
b) Construct new concrete weir spillway and spillway channel at dividing berm to allow for the 1:50-year flood storm to spill.
c) Apply gravel topping to the existing dam wall crest section in order to provide sufficient freeboard and to prevent rainwater from accumulating on the crest during rain events.

A re-evaluation on the flood hydrology and maximum operating level of the dam was conducted, which needs to be instated and adhered to at all times. The revised maximum operating levels are subsequently set as CL 1560.24masl (GP = 4.80m) during the summer months and CL 1561.06masl (GP = 5.60m) during the winter months. The present level marker systems need to be repaired / upgraded so that the operator can easily read and manage levels accurately.

The old levels system had been adjusted to the current standards based on a Lidar survey conducted during 2019. The new level system needs to be updated in the Ash Dam Operations and Maintenance Manual. We recommend that the manual be revised accordingly.

The present standard and state of operation of the ash dam and low-level dam needs to be rectified as a matter of urgency. It is imperative that this is done whilst the current dry season we are going into is taken advantage of before the next rainy season. Other aspects that need to be addressed are:

a) The water management process at the power station to ensure that the dirty water make is in sync with the operation of the LLAWRD.
b) Review the storm water management on the power station in light of the capacities needed to comply to the various regulations in particular GN 704.
c) Ensure the operations and maintenance of the return pumping facility is in good health to meet the requirements of the water management process at the power station.
d) Conduct a new dam basin survey (bathometric survey) on the LLAWRD to establish the exact present storage capability, since the dam has recently been desilted.

It is our opinion that a concerted effort in terms of the repair, re-instatement, and upgrade of various infrastructure at the LLAWRD dam as well as implementing operationally disciplines will ensure that the dam can be operated safely. Failing this, the dam is likely to be at high risk and will spill on any sustained rainfall event, even those within the design parameters for the dam.

Appendix A – Hydrology and Spillway Calculation Sheets

Appendix B – Drawings x6

Appendix C – Dam Safety Registration Certificate

APPENDIX A
Hydrology and Spillway Calculation Sheets

RATIONAL METHOD # 1

Based on the Regional DDF-Equations representing the HRU 1/78 DDF-relationships *(Op ten Noort & Stephenson, 1982)*

PROJECT	DUVHA P/S LOW LEVEL ASH WATER RETURN DAM

CATCHMENT CHARACTERISTICS

Catchment Area	Total (A)	6.600 km²
Areal Weighting Factors: x + y + z = 1		
x (Rural)	y (Urban)	z (Lakes)
1.00		

Effective (Ae)	6.6000	km²
Dolomitic (Ad)		km²
Ratio of Ad / A		%
Channelised Flow (Y/N)		Y
Overland Flow (Y/N)		N

Longest Watercourse (L)	5.000	km
Height Difference (H) "10/85"	90	m
Maen Slope (S)	1.80	%
Mean Annual Rainfall (MAP)	773	mm
Time of Concentration (tc)	1.08	hour
	64.5	min

Inland (Y/N)	Y
Coastal (Y/N)	N

C1

Steepness %		%A	Factor	Avg	Soil Permeability	%A	Factor	Avg	Vegetation	%A	Factor	Avg
10/85 Slope	< 1				Very Permeable				Forest Plantation			
	1 - 3	100	0.03	0.030	Permeable	70	0.08	0.056	Dense Bush, Wood			
	3 - 10				Semi-Permeable	30	0.16	0.048	Thin Bush			
	10 - 30				Impermeable				Cultivated Land			
	30 - 50								Grassland	30	0.21	0.063
	> 50				Total %	100	Cp	0.104	Bare Surface	70	0.28	0.196
Total %		100	Cs	0.030	Total C1 Value		0.393		Total %	100	Cv	0.259

C2

Urban for T < 21 Years			
Occupation	%A	Factor	Avg
Lawns, Parks			
Sandy flat < 2%			
Sandy 2 - 7%			
Sandy steep > 7%			
Heavy soil flat < 2%			
Heavy soil 2 - 7%			
Heavy soil > 7%			
Residential			
Single family area			
Apartment dwelling			
Industrial			
Light areas			
Heavy areas			
Business			
Downtown			
Neighbourhood			
Streets			
Total %			

Urban for T 21 to 50 Years			
Occupation	%A	Factor	Avg
Lawns			
Other			
Total %			
Urban for T > 50 Years			
All included			
Total C2 for T < 21			
Total C2 for T 21 - 50			
Total C2 for T > 50			

Surface Condition Factor (r)	

STORM RAINFALL

Flood Frequency in Years	STORM DURATION (AS MULTIPLES OF tc) IN HOURS											
	0.5	tc (h) =	0.54	1.0	tc (h) =	1.08	2.0	tc (h) =	2.15	3.0	tc (h) =	3.23
	D (mm)	ARF	I (mm/h)	D (mm)	ARF	I (mm/h)	D (mm)	ARF	I (mm/h)	D (mm)	ARF	I (mm/h)
2	28	1.000	52.01	35	1.000	32.58	41	1.000	19.14	44	1.000	13.76
5	37	1.000	68.47	46	1.000	42.89	54	1.000	25.20	58	1.000	18.11
10	45	1.000	84.30	57	1.000	52.80	67	1.000	31.03	72	1.000	22.29
20	56	1.000	103.78	70	1.000	65.01	82	1.000	38.20	89	1.000	27.45
50	73	1.000	136.62	92	1.000	85.58	108	1.000	50.28	117	1.000	36.13
100	90	1.000	168.20	113	1.000	105.36	133	1.000	61.90	144	1.000	44.48
200	111	1.000	207.07	140	1.000	129.71	164	1.000	76.21	177	1.000	54.76
PMF	360	1.000	669.60	451	1.000	419.44	530	1.000	246.45	571	1.000	177.07

RUN-OFF COEFFICIENT

Flood Frequency (Years)		2	5	10	20	50	**100**	200	PMF*
Rural	C1	0.197	0.216	0.236	0.263	0.326	**0.393**	0.472	0.570
Urban	C2								
Combined	C	0.197	0.216	0.236	0.263	0.326	**0.393**	0.472	0.570
C1 adjusted for Ad									
Final adjusted C		0.197	0.216	0.236	0.263	0.326	**0.393**	0.472	0.570

** PMF = Cs + Cp max + Cv max*

PEAK DISCHARGE

Flood Frequency (Years)		2	5	10	20	50	100	200	PMF*
Q (m³/s)	0.5 tc	18.75	27.16	36.47	50.14	81.77	121.28	179.18	700.30
	1.0 tc	**11.75**	**17.01**	**22.85**	**31.41**	**51.22**	**75.97**	**112.24**	**438.67**
	2.0 tc	6.90	9.99	13.42	18.45	30.09	44.64	65.95	257.74
	3.0 tc	4.96	7.18	9.64	13.26	21.62	32.07	47.38	185.19

FLOOD VOLUMES

Flood Frequency (Years)		2	5	10	20	50	100	200	PMF*
V (m³)	0.5 tc	108 922	157 721	211 830	291 219	474 902	704 426	1 040 700	4 067 407
	1.0 tc	**68 229**	**98 797**	**132 690**	**182 420**	**297 480**	**441 254**	**651 897**	**2 547 832**
	2.0 tc	40 089	58 049	77 964	107 183	174 787	259 263	383 029	1 497 006
	3.0 tc	28 804	41 709	56 018	77 012	125 586	186 283	275 209	1 075 611

RATIONAL METHOD # 2

Based on the DDF-Tables of TR102 for an n-day storm depths in Southern Africa *(Adamson, 1981)*

PROJECT	DUVHA P/S LOW LEVEL ASH WATER RETURN DAM

CATCHMENT CHARACTERISTICS

Catchment Area	Tatal (A)	6.600 km²	Effective (Ae)	6.6000	km²	Longest Watercourse (L)	5.000	km
Areal Weighting Factors: x + y + z = 1			Dolomitic (Ad)		km²	Height Difference (H) "10/85"	90	m
x (Rural)	y (Urban)	z (Lakes)	Ratio of Ad / A		%	Maen Slope (S)	1.80	%
1.00			Channelised Flow (Y/N)		Y	Mean Annual Rainfall (MAP)	773	mm
			Overland Flow (Y/N)		N	Time of Concentration (tc)	1.08	hour
							64.5	min

Rainfall Station Name	WITBANK			Number		515382	
Recurrence Interval (Years)	2	5	10	20	50	100	200
1-day Storm Depths (mm)	53	70	83	95	113	128	144
7-day Storm Depth for Recurrence Interval of 200 years (mm) - (* For PMF Calculation)							211

Rainfall Region	
Summer Rainfall	Y
Winter Rainfall	N

C1											
Steepness %		%A	Factor	Avg	Soil Permeability	%A	Factor	Avg	Vegetation	%A	Factor	Avg
10/85 Slope	< 1				Very Permeable				Forest Plantation			
	1 - 3	100	0.03	0.030	Permeable	70	0.08	0.056	Dense Bush, Wood			
	3 - 10				Semi-Permeable	30	0.16	0.048	Thin Bush			
	10 - 30				Impermeable				Cultivated Land			
	30 - 50								Grassland	30	0.21	0.063
	> 50				Total %	100	Cp	0.104	Bare Surface	70	0.28	0.196
Total %		100	Cs	0.030	Total C1 Value		0.393		Total %	100	Cv	0.259

C2			
Urban for T < 21 Years			
Occupation	%A	Factor	Avg
Lawns, Parks			
Sandy flat < 2%			
Sandy 2 - 7%			
Sandy steep > 7%			
Heavy soil flat < 2%			
Heavy soil 2 - 7%			
Heavy soil > 7%			
Residential			
Single family area			
Apartment dwelling			
Industrial			
Light areas			
Heavy areas			
Business			
Downtown			
Neighbourhood			
Streets			
Total %			

Urban for T 21 to 50 Years			
Occupation	%A	Factor	Avg
Lawns			
Other			
Total %			
Urban for T > 50 Years			
All included			
Total C2 for T < 21			
Total C2 for T 21 - 50			
Total C2 for T > 50			

Surface Condition Factor (r)	

STORM RAINFALL

Flood Frequency in Years	STORM DURATION (AS MULTIPLES OF tc) IN HOURS											
	0.5	tc (h) =	0.54	1.0	tc (h) =	1.08	2.0	tc (h) =	2.15	3.0	tc (h) =	3.23
	Ratio from Graph		0.510	Ratio from Graph		0.640	Ratio from Graph		0.755	Ratio from Graph		0.810
	D (mm)	ARF	I (mm/h)	D (mm)	ARF	I (mm/h)	D (mm)	ARF	I (mm/h)	D (mm)	ARF	I (mm/h)
2	27	1.000	50.26	34	1.000	31.54	40	1.000	18.60	43	1.000	13.30
5	36	1.000	66.38	45	1.000	41.65	53	1.000	24.57	57	1.000	17.57
10	42	1.000	78.71	53	1.000	49.39	63	1.000	29.13	67	1.000	20.84
20	48	1.000	90.09	61	1.000	56.53	72	1.000	33.34	77	1.000	23.85
50	58	1.000	107.16	72	1.000	67.24	85	1.000	39.66	92	1.000	28.37
100	65	1.000	121.39	82	1.000	76.16	97	1.000	44.92	104	1.000	32.13
200	73	1.000	136.56	92	1.000	85.68	109	1.000	50.54	117	1.000	36.15
PMF	108	1.000	200.10	135	1.000	125.55	159	1.000	74.06	171	1.000	52.97

RUN-OFF COEFFICIENT

Flood Frequency (Years)		2	5	10	20	50	**100**	200	PMF*
Rural	C1	0.197	0.216	0.236	0.263	0.326	**0.393**	0.472	0.570
Urban	C2								
Combined	C	0.197	0.216	0.236	0.263	0.326	**0.393**	0.472	0.570
C1 adjusted for Ad									
Final adjusted C		0.197	0.216	0.236	0.263	0.326	**0.393**	0.472	0.570

PEAK DISCHARGE

Flood Frequency (Years)		2	5	10	20	50	100	200	PMF*
Q (m³/s)	0.5 tc	18.12	26.33	34.05	43.52	64.14	87.53	118.16	209.27
	1.0 tc	**11.37**	**16.52**	**21.37**	**27.31**	**40.24**	**54.92**	**74.14**	**131.31**
	2.0 tc	6.71	9.74	12.60	16.11	23.74	32.39	43.73	77.45
	3.0 tc	4.80	6.97	9.01	11.52	16.98	23.17	31.28	55.39

FLOOD VOLUMES

Flood Frequency (Years)		2	5	10	20	50	100	200	PMF*
V (m³)	0.5 tc	105 250	152 910	197 790	252 798	372 505	508 376	686 308	1 215 458
	1.0 tc	**66 039**	**95 944**	**124 104**	**158 618**	**233 728**	**318 981**	**430 625**	**762 640**
	2.0 tc	38 953	56 592	73 202	93 560	137 863	188 149	254 001	449 839
	3.0 tc	27 860	40 476	52 356	66 917	98 604	134 570	181 670	321 739

Duvha P/S Low Level Ash Water Return Dam

CALCULATION OF (RMF) REGIONAL MAXIMUM FLOOD AND THE RECOMMENDED (SEF) SAFETY EVALUATION FLOOD

(TR 137 "DWAF" KOVACS - BASED ON THE FRANCOU-RODIER MODEL)

EMPIRICAL METHOD

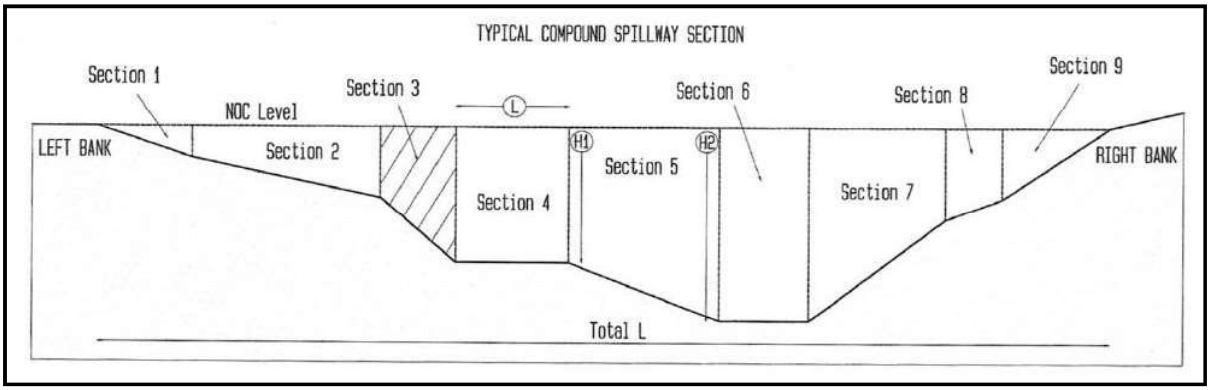
Size of dam (S/M/L)	S	Small / Medium / Large
Hazard rating (L/S/H)	S	Low / Significant / High
Category (1/2/3)	2	Category
Ke - determined value if applicable	0.0	Ke - value if determine otherwise "0"
Ke - envelope value	4.6	2.8 / 3.4 / 4 / 4.6 / 5 / 5.2 / 5.4 / 5.6
Watersurface at FSL (ha.)	N/A	In hectare
Areal catchment area (sq. km.)	6.600	Smaller than 10 use other methods
Is the dam in the Southwest-Cape (Y/N) ?	N	Important for region 5

Zone	Transition zone
RMF	**204.8**
Q200	128.8
Q100	107.3
Q50	85.2
Q20*	41.0
RDF	**107.3**
** RMF - Δ	133.0
** RMF + Δ	256.9

PMF (Grafic)	**553.2**
PMF (K-max)	**360.8**
PMF (Avg)	**457.0**
Q175	123.5
Q150	118.1
Q125	112.7
Q75	99.6
Q25	49.8

	Recommended SEF
PMF based	228.5
RMF based	133.0
Average SEF	**180.7**
SEF (Cat. I) < 10km² = Q_{175}	N/A

CALCULATION OF THE MAXIMUM DISCHARGE CAPACITY OF DUVHA P/S LLAWR DAM (CURRENT) SPILLWAY DISCHARGE IN m³/s



equation applied: Q = C.L.H^1.5

C = discharge coefficient L = section length (m) H = height (m)

A = cross-sectional area (m²) V = discharge velocity (m/s) Q = discharge capacity (m³/s)

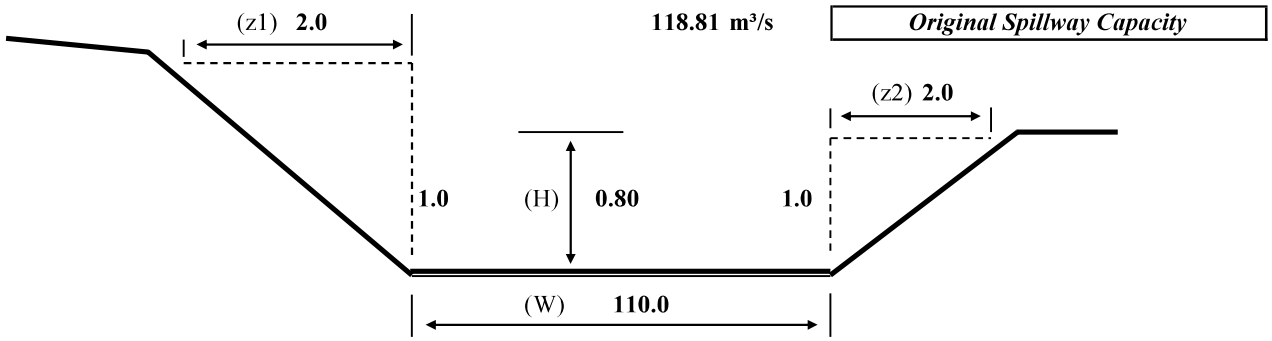
Main Spillway

Section	*C*	*L*	*H1*	*H2*	*H*	*Q*	*A*	*V*
(LB) 1	1.47	31.79	-	0.41	0.21	4.34	13.03	0.33
2	1.47	36.69	0.41	0.42	0.42	14.42	15.23	0.95
3	1.47	18.62	0.42	0.33	0.38	6.29	6.98	0.90
4	1.47	24.13	0.33	0.37	0.35	7.34	8.45	0.87
5	1.47	12.35	0.37	0.82	0.60	8.33	7.35	1.13
6	1.47	3.13	0.82	0.68	0.75	2.99	2.35	1.27
7	1.47	2.01	0.68		0.34	0.59	0.68	0.86
8								
9								
10								
11								
Total top width		**128.72**	Average velocity		**0.82**	Discharge capacity		**44.29**
Sectional area		**54.07**	Maximum depth		**0.82**			

Emergency Spillway (if applicable)

Section	*C*	*L*	*H1*	*H2*	*H*	*Q*	*A*	*V*
(LB) 1			-					
2								
3								
4								
5								
6								
7								
8								
9								
(RB) 10								
Total top width			Average velocity			Discharge capacity		
Sectional area			Maximum depth			Combined capacity		

CALCULATION OF THE MAXIMUM DISCHARGE CAPACITY OF LLAWR DAM (ORIGINAL) SPILLWAY IN m³/s (USING THREE (3) METHODS)



MEASUREMENTS:

z1 - side slope to 1	2.00	Section area (m²)	89.6
z2 - side slope to 1	2.00	Velocity (m/s)	**1.33**
H - total freeboard available (m)	**0.80**		
W - width of spillway control point (m)	110.0		

Q - CALCULATIONS:

equation: Q1 = 4.43k (h^0.5) (H - h) ((B + z (H - h)) *where k = 0.90*

equation: h = (3 (2zH + B) - (16z^2.H^2 + 16zBH + 9B^2)^0.5) / 10z

with: h (in meter) = 0.26

with: **Q1** (in cub.m./sec.) = **121.96**

equation: Q2 = a.L.H^1.5 + 1.35z.H^2.5 *where a = 1.47*

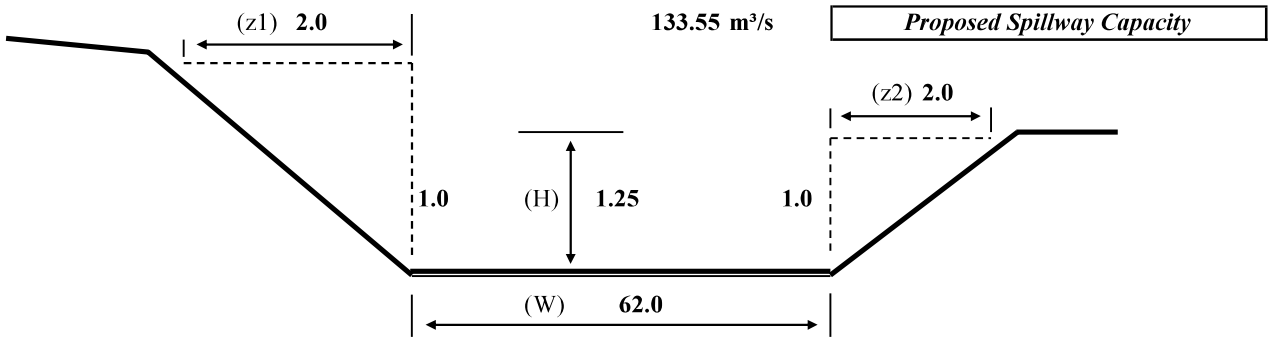
with: **Q2** (in cub.m./sec.) = **117.25**

equation: Q3 = C.Le.H^1.5 *where Le = L + 0.9zH* *and C = 1.47*

with: **Q3** (in cub.m./sec.) = **117.22**

Average Q ((Q1+Q2+Q3)/3) in cub.m./sec. = **118.81**

CALCULATION OF THE MAXIMUM DISCHARGE CAPACITY OF LLAWR DAM (UPGRADED) SPILLWAY IN m³/s (USING THREE (3) METHODS)



MEASUREMENTS:

z1 - side slope to 1	2.00	Section area (m²)	80.0
z2 - side slope to 1	2.00	Velocity (m/s)	**1.67**
H - total freeboard available (m)	**1.25**		
W - width of spillway control point (m)	62.0		

Q - CALCULATIONS:

equation: Q1 = 4.43k (h^0.5) (H - h) ((B + z (H - h)) *where k = 0.90*

equation: h = (3 (2zH + B) - (16z^2.H^2 + 16zBH + 9B^2)^0.5) / 10z

with: h (in meter) = 0.41

with: **Q1** (in cub.m./sec.) = **136.56**

equation: Q2 = a.L.H^1.5 + 1.35z.H^2.5 *where a = 1.47*

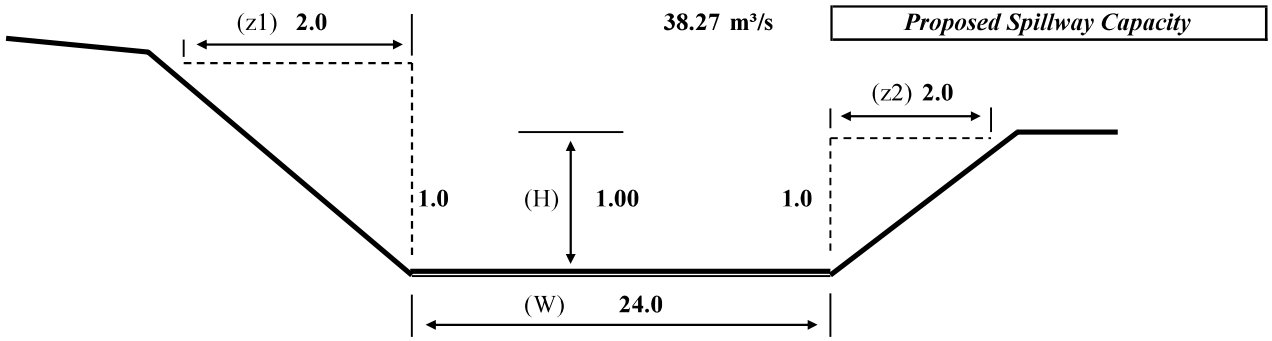
with: **Q2** (in cub.m./sec.) = **132.09**

equation: Q3 = C.Le.H^1.5 *where Le = L + 0.9zH* *and C = 1.47*

with: **Q3** (in cub.m./sec.) = **131.99**

Average Q ((Q1+Q2+Q3)/3) in cub.m./sec. = **133.55**

CALCULATION OF THE MAXIMUM DISCHARGE CAPACITY OF DIVIDING BERM WEIR SPILLWAY IN m³/s (USING THREE (3) METHODS)



MEASUREMENTS:

z1 - side slope to 1	2.00	Section area (m²)	26.0
z2 - side slope to 1	2.00	Velocity (m/s)	**1.47**
H - total freeboard available (m)	**1.00**		
W - width of spillway control point (m)	24.0		

Q - CALCULATIONS:

equation: Q1 = 4.43k (h^0.5) (H - h) ((B + z (H - h)) *where k = 0.90*

equation: h = (3 (2zH + B) - (16z^2.H^2 + 16zBH + 9B^2)^0.5) / 10z

with: h (in meter) = 0.32

with: **Q1** (in cub.m./sec.) = **38.89**

equation: Q2 = a.L.H^1.5 + 1.35z.H^2.5 *where a = 1.47*

with: **Q2** (in cub.m./sec.) = **37.98**

equation: Q3 = C.Le.H^1.5 *where Le = L + 0.9zH* *and C = 1.47*

with: **Q3** (in cub.m./sec.) = **37.93**

Average Q ((Q1+Q2+Q3)/3) in cub.m./sec. = **38.27**

APPENDIX B
Drawings

BASED ON LIDAR SURVEY CONDUCTED DURING 2019

GOOGLE AREAL IMAGE - NOT TO SCALE

CONCEPT DESIGN DRAWING

ORIGINAL SIZE A3

AMENDMENTS

NO.	DATE	APPROVED	DESCRIPTION

NOTES:

GENERAL NOTES:
1. ALL WORK MUST COMPLY WITH THE BY-LAWS AND SPECIFICATIONS OF THE LOCAL AUTHORITY, NATIONAL BUILDING REGULATIONS AND SANS 1200
2. ALL DIMENSIONS AND LEVELS SHALL BE CHECKED ON SITE BEFORE WORK COMMENCES AND ANY DISCREPANCIES SHOULD BE REPORTED TO THE ENGINEER IN WRITING
3. THE ENGINEER WILL ASSIST THE CONTRACTOR IN STAKING LINES WHERE AFTER THE CONTRACTOR SHALL TAKE OVER ALL SETTING OUT PEGS AND SURVEY BEACONS AND MAINTAIN THEM DURING THE CONSTRUCTION PERIOD

CLIENT

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Tel: 013 690 0221
Cell: 072 787 4772

Eskom

CONSULTANTS

SAWE Engineering Solutions

PG Group Engineers

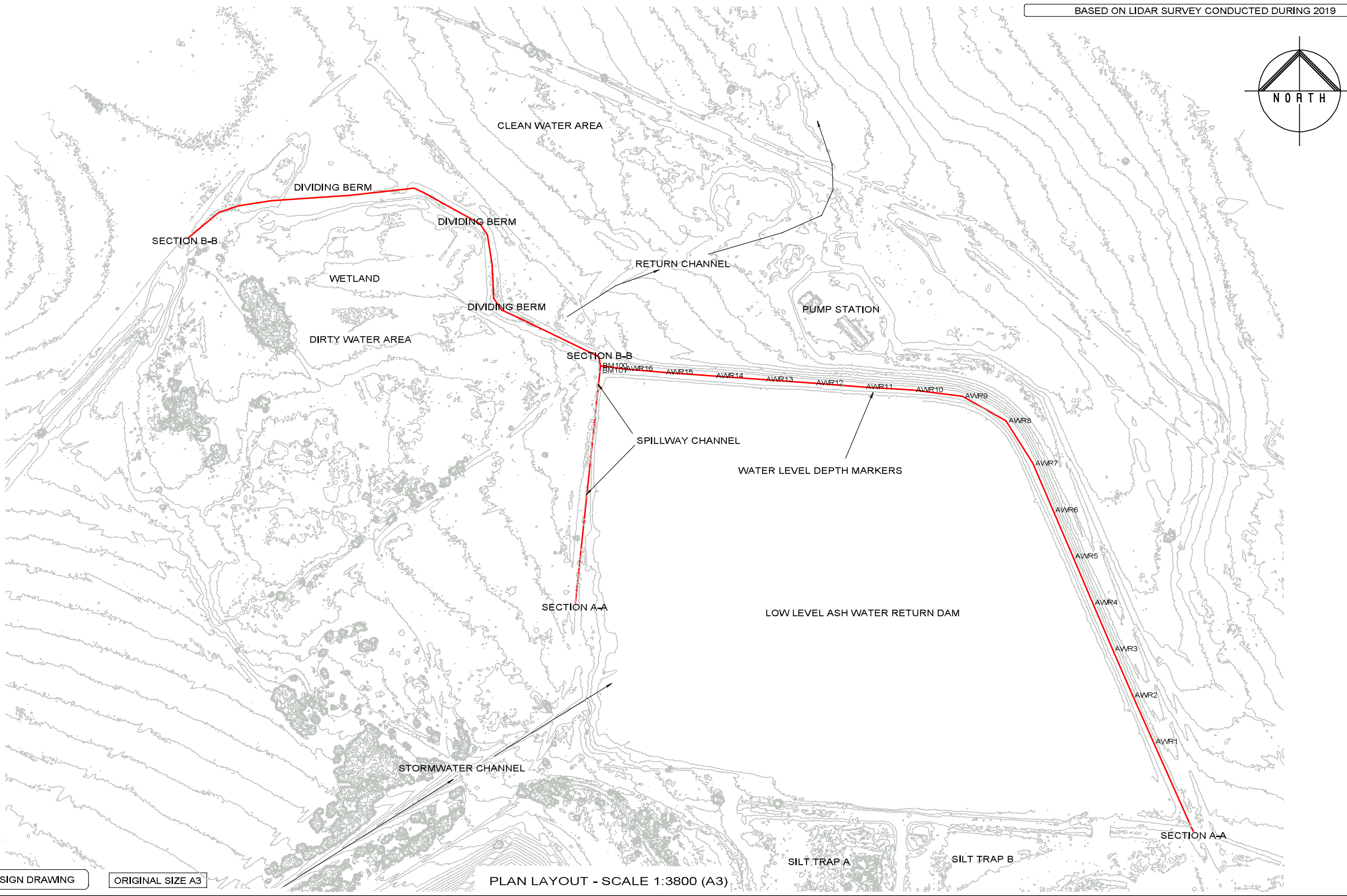
SURVEYED	LIDAR & RTK 2019
DRAWN	MF JOUBERT Pr Tech Eng
DESIGNED	MF JOUBERT Pr Tech Eng
APPROVED PR. NO.	PJ GOUWS Pr Eng (APP) 880061
SIGNATURE	

Project
LOW LEVEL ASH WATER RETURN DAM

Plan Description
GOOGLE AERIAL IMAGE
DAM & WETLAND AREA

DATE	2020-04-28
SCALE	AS SHOWN
DRAWING NUMBER	047/AWR/001
REVISION NUMBER	0
PROJECT NUMBER	4600054796

BASED ON LIDAR SURVEY CONDUCTED DURING 2019



CONCEPT DESIGN DRAWING

ORIGINAL SIZE A3

PLAN LAYOUT - SCALE 1:3800 (A3)

AMENDMENTS			
NO.	DATE	APPROVED	DESCRIPTION

NOTES:

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DRAWN	MF JOUBERT Pr Tech Eng
DESIGNED	MF JOUBERT Pr Tech Eng
APPROVED PR. NO.	PJ GOUWS Pr Eng (APP) 880061
SIGNATURE	

Project

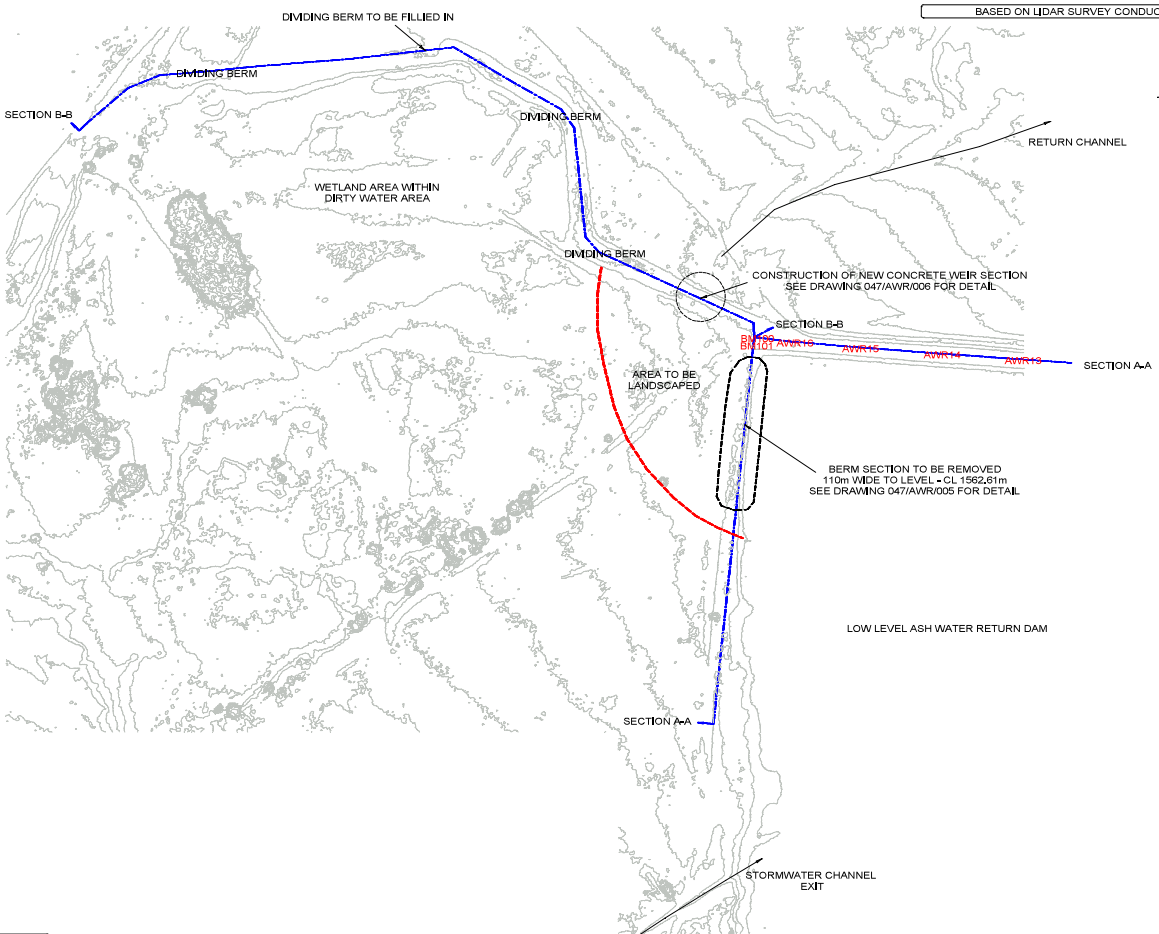
LOW LEVEL ASH WATER RETURN DAM

Plan Description

CONTOUR PLAN LAYOUT
DAM BASIN, SPILLWAY & WETLAND AREA

DATE 2020-04-28	SCALE AS SHOWN
DRAWING NUMBER	047/AWR/002
REVISION NUMBER	0
PROJECT NUMBER	4600064796

BASED ON LIDAR SURVEY CONDUCTED DURING 2019



CONCEPT DESIGN DRAWING

ORIGINAL SIZE A3

PLAN LAYOUT - SCALE 1:3800 (A3)

AMENDMENTS

NO.	DATE	APPROVED	DESCRIPTION

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PG CONSULTING ENGINEERS

SURVEYED	LIDAR & RTK 2019
DRAWN	MF JOUBERT Pr Tech Eng
DESIGNED	MF JOUBERT Pr Tech Eng
APPROVED PR. NO.	PJ GOUWS Pr Eng (APP) 880061
SIGNATURE	

Project: LOW LEVEL ASH WATER RETURN DAM

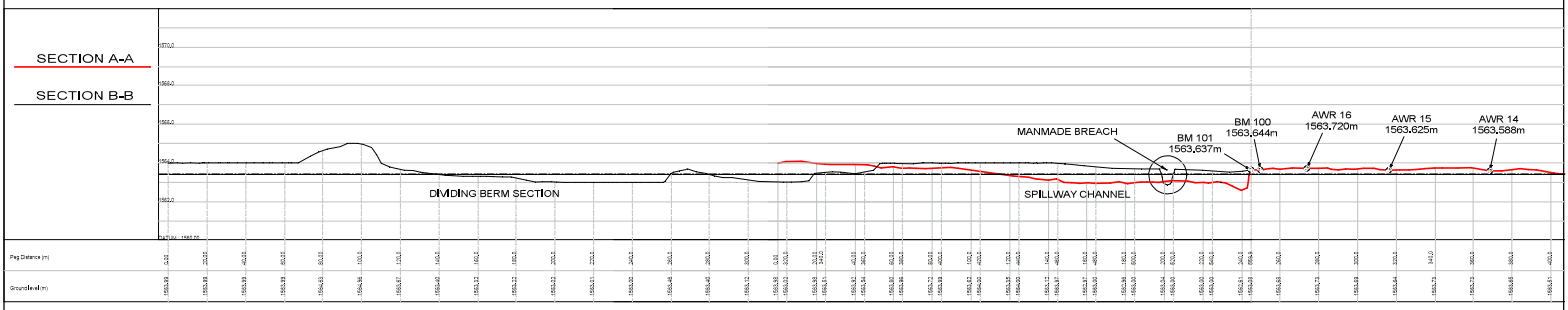
Plan Description: PLAN LAYOUT SPILLWAY UPGRADING

DATE	2020-04-28
SCALE	AS SHOWN
DRAWING NUMBER	047/AWR/003
REVISION NUMBER	0
PROJECT NUMBER	4600064796

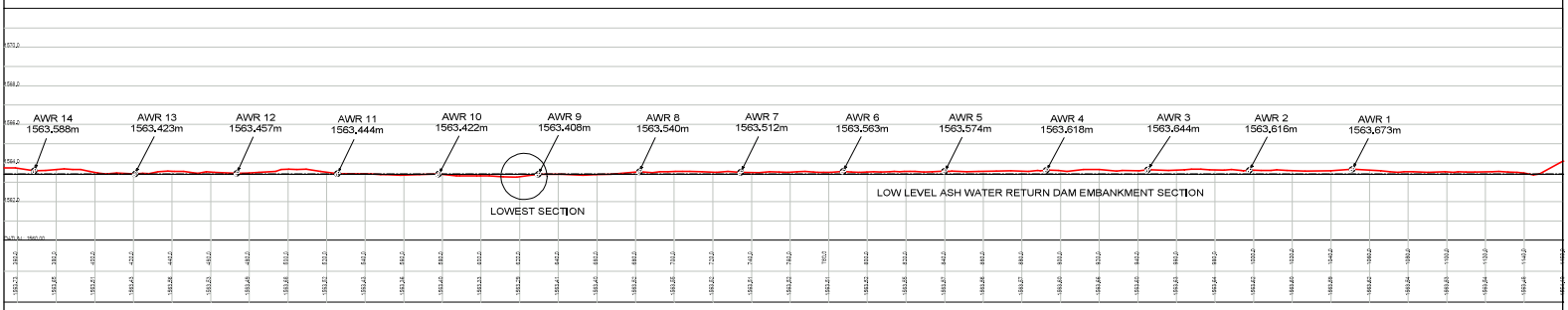
BASED ON LIDAR SURVEY CONDUCTED DURING 2019

AS-BUILT SECTIONS DERIVED FROM LIDAR & RTK SURVETS

SECTIONS PROFILES A-A & B-B (NOT TO SCALE)



SECTIONS PROFILES A-A & B-B - SCALE (V) 1:200 (H) 1:2000 (A3)



SECTIONS PROFILES A-A & B-B - SCALE (V) 1:200 (H) 1:2000 (A3)

CONCEPT DESIGN DRAWING

ORIGINAL SIZE A3

AMENDMENTS

NO.	DATE	APPROVED	DESCRIPTION

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SAWE Engineering Solutions

PG CONSULTING ENGINEERS

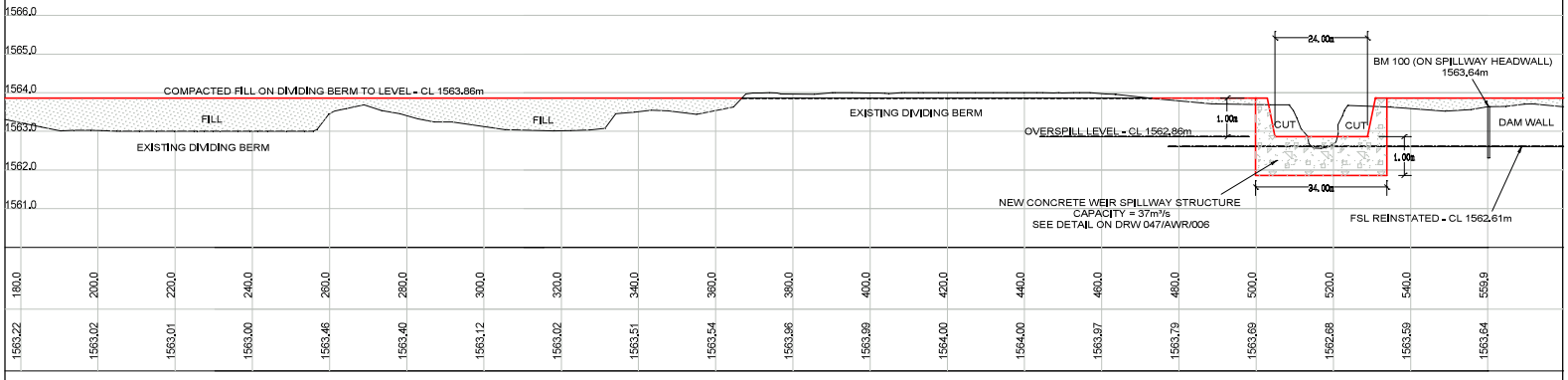
SURVEYED	LIDAR & RTK 2019
DRAWN	MF JOUBERT Pr Tech Eng
DESIGNED	MF JOUBERT Pr Tech Eng
APPROVED PR. NO.	PJ GOUWS Pr Eng (APP) 880061
SIGNATURE	

Project: LOW LEVEL ASH WATER RETURN DAM

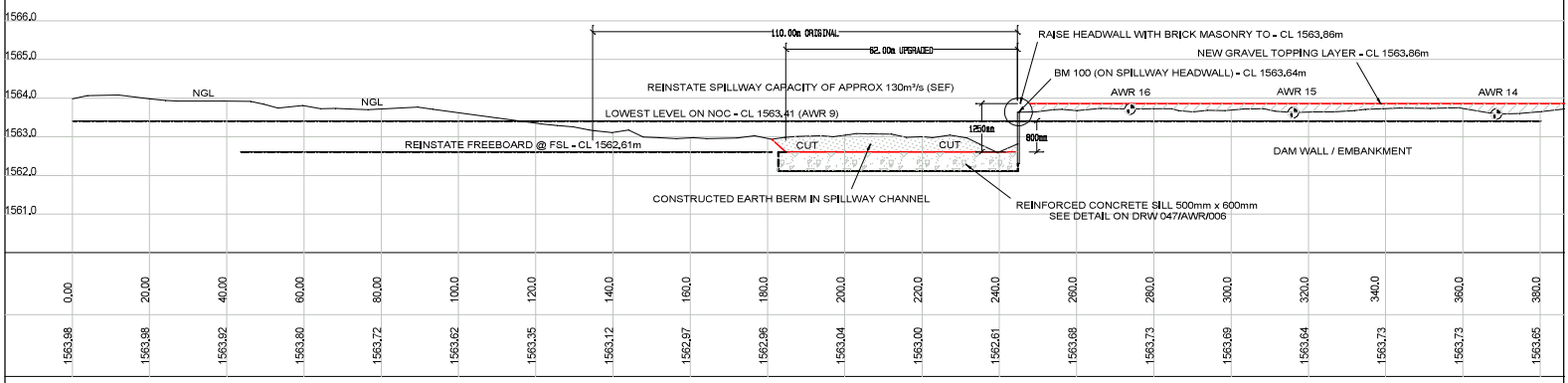
Plan Description: SECTIONS (AS-BUILT)

DATE	2020-04-28
SCALE	AS SHOWN
DRAWING NUMBER	047/AWR/004
REVISION NUMBER	0
PROJECT NUMBER	4600064796

BASED ON LIDAR SURVEY CONDUCTED DURING 2019



DIVIDING BERM WEIR SPILLWAY SECTION - SCALE (V) 1:100 (H) 1:1000 (A3)



LLAWRD SPILLWAY SECTION - SCALE (V) 1:100 (H) 1:1000 (A3)

CONCEPT DESIGN DRAWING

ORIGINAL SIZE A3

AMENDMENTS

NO.	DATE	APPROVED	DESCRIPTION

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SAWE Engineering Solutions

PG Consulting Engineers

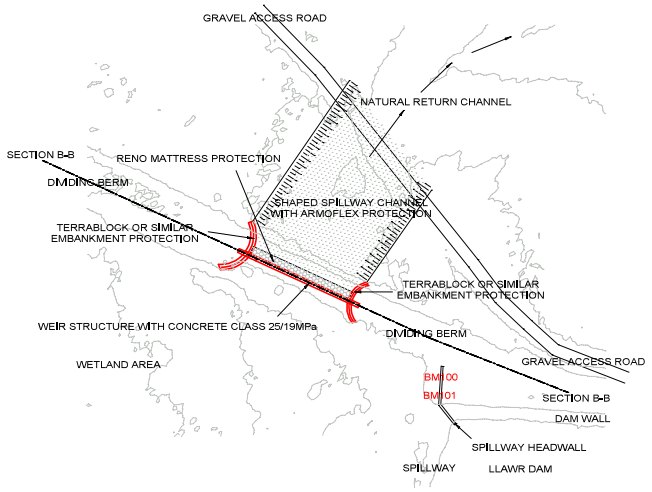
SURVEYED	LIDAR & RTK 2019
DRAWN	MF JOUBERT Pr Tech Eng
DESIGNED	MF JOUBERT Pr Tech Eng
APPROVED PR. NO.	PJ GOUWS Pr Eng (APP) 880061
SIGNATURE	

Project: LOW LEVEL ASH WATER RETURN DAM

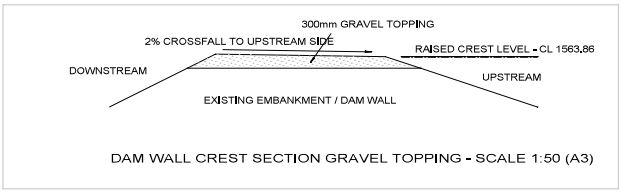
Plan Description: SPILLWAY UPGRADING SECTIONS

DATE	2020-04-28
SCALE	AS SHOWN
DRAWING NUMBER	047/AWR/005
REVISION NUMBER	0
PROJECT NUMBER	4600064796

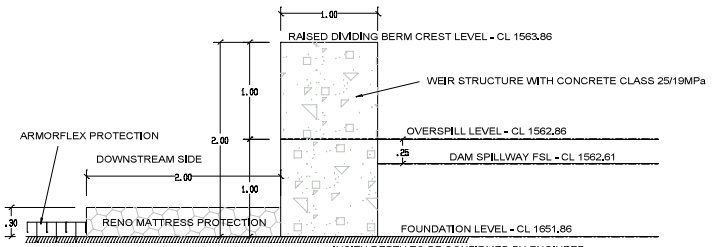
BASED ON LIDAR SURVEY CONDUCTED DURING 2019



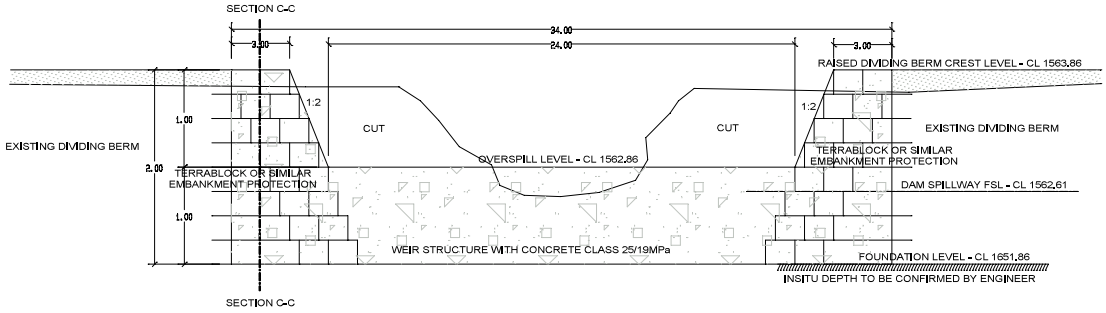
PLAN LAYOUT OF CONCRETE SPILLWAY WEIR STRUCTURE
SCALE 1:1000 (A3)



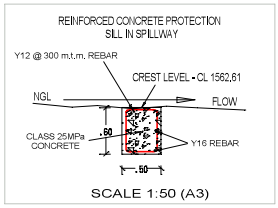
DAM WALL CREST SECTION GRAVEL TOPPING - SCALE 1:50 (A3)



SECTION C-C - SCALE (V) 1:40 (H) 1:40 (A3)



UPSTREAM ELEVATION SECTION B-B - SCALE (V) 1:40 (H) 1:200 (A3)



SCALE 1:50 (A3)

CONCEPT DESIGN DRAWING

ORIGINAL SIZE A3

AMENDMENTS			
NO.	DATE	APPROVED	DESCRIPTION

NOTES:

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Eskom

CONSULTANTS

SAWE Engineering Solutions

PG CONSULTING ENGINEERS

SURVEYED	LIDAR & RTK 2019
DRAWN	MF JOUBERT Pr Tech Eng
DESIGNED	MF JOUBERT Pr Tech Eng
APPROVED PR. NO.	PJ GOUWS Pr Eng (APP) 880061
SIGNATURE	

Project: LOW LEVEL ASH WATER RETURN DAM

Plan Description: PROPOSED CONCRETE WEIR PLAN AND SECTIONS, DAM WALL CREST TOPPING & OTHER DETAILS

DATE	2020-04-28
SCALE	AS SHOWN
DRAWING NUMBER	047/AWR/006
REVISION NUMBER	0
PROJECT NUMBER	4600064796

APPENDIX C
Dam Safety Registration Certificate

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Registration Details of a Dam Registered in terms of Dam Safety Legislation in terms of Chapter 12 of the National Water Act (Act 36 of 1998)

(Please note that registration for dam safety legislation is not an entitlement for water use in terms of Chapter 4 of the National Water Act)

Enter No of dam	B102/83	Column
No of dam	B102/83	1
WARMS Dam ID	0	2
Name of dam	DUVHA POWER STATION LOW LEVEL ASH WATER RETURN	3
Water management area	2	4
Quaternary Drainage Area	B11G	5
Latitude deg	25	6
Lat min	55	7
Lat sec	30	8
Longitude deg	29	9
Long min	20	10
Long sec	40	11
Town nearest	WITBANK	12
Distance from Town	10	13
Name of farm	RHENOSTERFONTEIN 318 JS	14
District	WITBANK	15
Province	MPUMALANGA	16
DWS Provincial Office / Region	MPUMALANGA	17
Completion date	1979	18
Completion date raised	0	19
River or Watercourse	OFF-CHANNEL	20
Wall type	EARTHFILL	21
Wall height	8	22
Crest Length (m)	930	23
Spillway Type	SIDE CANAL	24
Capacity (1000 cub m)	850	25
Surface area (ha)	25.25	26
Catchment area (sq km))	5.38	27
Purpose	ASH TRANSPORT	28
Owner Name	ESKOM: DUVHA POWER STATION	29
Designer	OVE ARUP & PARTNERS	30
Contractor	UNKNOWN	31
Registration date	2006/06/22	32
Size	Small	33
Hazard Potential	Significant	34
Category	2	35
Classification date	2006/06/08	36
Sector	O	37
Date Last DSE	2012/08/14	38
Number Last DSE	2	39
Target date next DSE	2018/10/30	40

Annexure E4: Site Sensitivity Verification Report

Eskom Holdings SOC Ltd: Duvha Power Station

Site Sensitivity Verification Report for the Reinstatement of the low-level dam spillway at Duvha Power Station

Date: 29 April 2026

Reference: ESK-DUV-23-11-01

SHANGONI
Management Services (Pty) Ltd

Stewards | Problem Solvers | Team Players

Influencing decisions since 2000 through identification, quantification and mitigation of environmental, safety, health and compliance risks

Table of Content

Abbreviations

CBA	Critical Biodiversity Areas
DFFE	Department of Forestry, Fisheries, and the Environment
DWS	Department of Water and Sanitation
EMPr	Environmental Management Programme Report
ESA	Ecological Support Area
EA	Environmental Authorisation
GIS	Geographic Information Systems
IDP	Integrated Development Plan
I&APs	Interested and Affected Parties
MAP	Mean Annual Precipitation
MASL	meters above sea level
MDARDLEA	Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs
MPHRA	Mpumalanga Heritage Resources Authority
NDM	Nkangala District Municipality
NDP	National Development Plan
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMWA	National Environmental Management: Waste Act, 2008 (Act No. 28 of 2008)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
SAHRA	South African Heritage Resources Association
TLM	Steve Tshwete Local Municipality
WMA	Water Management Area
WUL	Water Use License
WULA	Water Use License Application

1 Details of Project Applicant and Environmental Assessment Practitioner

1.1 Details of Project Applicant

Table 1: Details of the applicant

Name of operation	Eskom Holdings SOC Ltd: Duvha Power Station
Applicant	Eskom Holdings SOC Ltd: Duvha Power Station
Postal address	Eskom Holdings SOC Ltd: Duvha Power station PO Box 2199 Witbank 1035
Responsible person	Lourence Chauke
Telephone no.	(013) 691 6300
e-mail address	ChaukeTL@eskom.co.za
Company registration no.	2002/015527/30

1.1. Details and Expertise of Environmental Assessment Practitioner

Table 2: Details of the environmental assessment practitioner

EAP	Shangoni Management Services (Pty) Ltd.: Lee-Anne Fellowes
Tel No	(012) 807 7036
Fax No	(012) 807 1014
e-mail Address	leeanne@shangoni.co.za

Table 3: Expertise of the environmental assessment practitioner

Name and Surname	Qualifications and summary of experience
Lee-Anne Fellowes	Lee-Anne is a Principal Consultant who has a B-tech degree in Nature Conservation from the Tshwane University of Technology and holds a National Diploma in Nature Conservation. She gained valuable experience in the conservation and the environmental field through her employment at Gauteng's Department of Agriculture, Conservation and Environment for a period of 5 years. Her areas of expertise include alien invasive surveys, biodiversity action & conservation plans, Environmental Impact Assessments ("EIA"), Environmental Management Programmes ("EMP"), Section 24G Rectification

Name and Surname	Qualifications and summary of experience
	Applications, Basic Assessments, Water Use Licenses and Project Management. Lee-Anne has 20 years' experience at Shangoni. Lee-Anne has been registered as a Professional Natural Scientist in the field of Conservation Science Registration number: 115574 and is registered as an environmental impact assessment practitioner Registration number: 2019/850. Lee-Anne served on the Gauteng's Department of Agriculture and Rural Development Appeals Panel Committee for a period of 36 months (2020 – 2023) and gained valuable experience with the appeals procedure.

2 Introduction

2.1 Introduction and Background

Shangoni Management Services ("Shangoni") has been appointed by Eskom Holdings SOC Ltd: Duvha Power station ("Duvha Power Station") to conduct Basic Assessment ("BA") and General Authorisation ("GA") Processes as part of the application for the reinstatement of the low-level dam spillway at Duvha power station. As part of the project, Shangoni has reviewed available information to compile this screening report. This screening report has identified the following:

- Environmental sensitivities of the study area; and
- Licences / authorisations required for each activity / infrastructure.

The Duvha Power Station is located at approximately 15 km east of Witbank under the Jurisdiction of Emalahleni Local Municipality ("ELM") and the Nkangala District Municipality ("NDM") within the Mpumalanga Province. The Station has been operational for over 40 years and consists of six 600 MW units with a total installed capacity of 3,600 MW operating with a turbine Maximum Continuous Rating of 37.6%. The station is a twin sister to Tutuka Power Station. The Duvha Power Station produces wet ash which is pumped into an Ash Dam. The settled water is then decanted into the Low-Level Dam ("LLD") before it is pumped back to the station for reuse. The LLD is an off-channel storage dam used to store ash water. Additionally, the LLD is also used to collect all contaminated storm water from the ash dam, station and the surrounding area with a capacity of 811 240 m³ at the spillway level of 7.2 m.

The LLD spillway currently has a width of 10 m as opposed to the design width of 110 m, this is due to a berm constructed along the spillway in the past. The spillway size needs to be reinstated to its original capacity which was based on the Safety Evaluation Discharge ("SED") for a Category II dam.

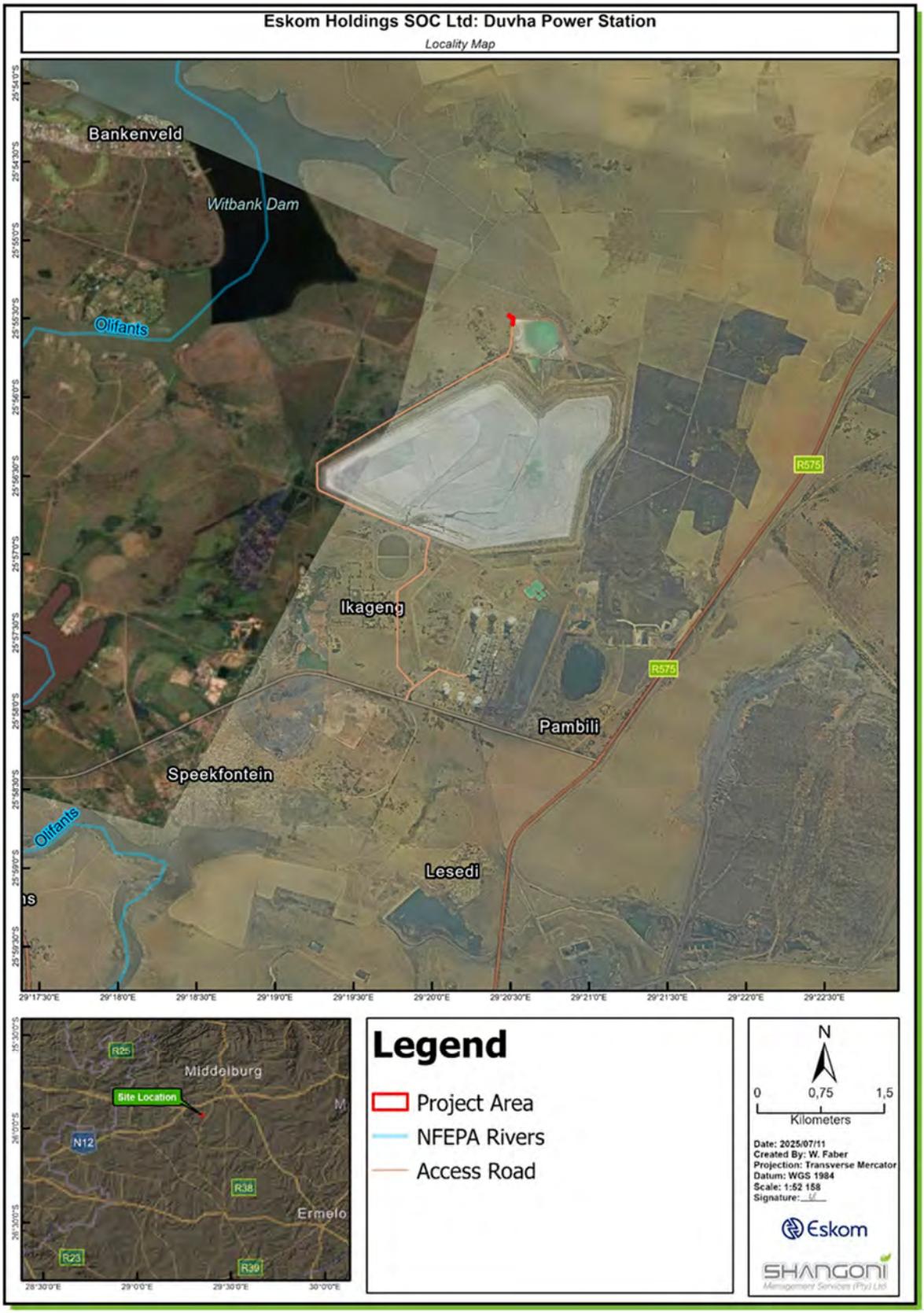


Figure 1: Locality Map

2.2 Assumptions and limitations

The following assumptions and limitations have bearing on this environmental screening report:

1. The environmental screening report is based on information provided by Eskom Holdings: Duvha Power Station.
2. The report includes environmental sensitivities identified using the Department of Forestry, Fisheries and Environment ("DFFE") Screening Tool.
3. The DFFE Screening Tool was used specifically for the proposed reinstatement of the low-level dam spillway (as per the project area kmz file) at Duvha Power Station.
4. The site was screened to determine potential environmental authorisation and water use licence requirements that may be triggered by the proposed project.
5. The report includes the outcomes of the *Wetland Biodiversity Assessment and Aquatic Site Sensitivity Verification Report* dated June 2025 compiled by Limosella Consulting.

3 Project Description

The following activities will be undertaken as part of the reinstatement of the LLD spillway:

3.1.1.1 Construction of the weir structure:

A man-made breach section has been created at the diving berm (between dirty and clean water areas) to allow water to flow downstream in an event of a high storm. A concrete weir structure must be constructed at the position of man-made breach for proper management of flow when the dam spill in the event of floods >1:50-years and to prevent soil erosion by engaging in the following activities:

- Excavate the existing diving berm for a width of 34 m up to counter level 1561.86.
- Rip and compact the in-situ material to at least 95% Mod AASHTO to a depth of 150 mm.
- Construction of a new concrete weir structure.
- Construction of a new retaining walls for embankment protection using terra block or similar.
- Backfill all low sections of the dividing berm as indicated on long section using material excavated from the LLD spillway section.
- Install Reno mattress protection downstream of the weir structure for a width of 2 m.
- Shape the downstream channel of the weir structure by installing (laying) the Armoflex protection.

3.1.1.2 Re-instate the Spillway

The original spillway width was 110 m; however, an earth berm was constructed which reduced the size of the spillway to current width of 10 m. The design of the spillway has been optimized and upgraded and will now have a width of 62 m to accommodate a maximum capacity of approximately 130 m^3/s which is equivalent to the SED:

- Excavate the berm up to invert level 1562.61 over a length of 62 m toward the southern direction referencing from the existing spillway headwall. The excavated material will be used as backfill for area on section 3.1.2 of the scope.
- Rip and compact the in-situ material to at least 95% Mod AASHTO to a depth of 150 mm.
- Cast in reinforced concrete sill up to a finish floor level (FFL) of 1562.61, The concrete sill should be 500 mm x 600 mm x 62 m.
- Raise the spillway headwall with brick masonry to contour level 1563.86. A double brick masonry (230 mm) wall – 3 layers of bricks built on top of existing headwall.

3.1.1.3 LLD dam crest

The LLD crest was surveyed and settlement of about 3% has occurred which is currently resulting in an uneven surface profile, reducing the dam's freeboard. In order to rectify the settlement and to reinstate adequate freeboard a new wearing course of approximately 300mm gravel topping must be applied. The layer must be compacted to at least 92% Mod AASHTO with a 2% cross fall towards the upstream (water) side, to prevent standing and ponding water on the crest, after rainfall, refer to drawing

047/AWR/006 for details. The lay out map below as indicated in

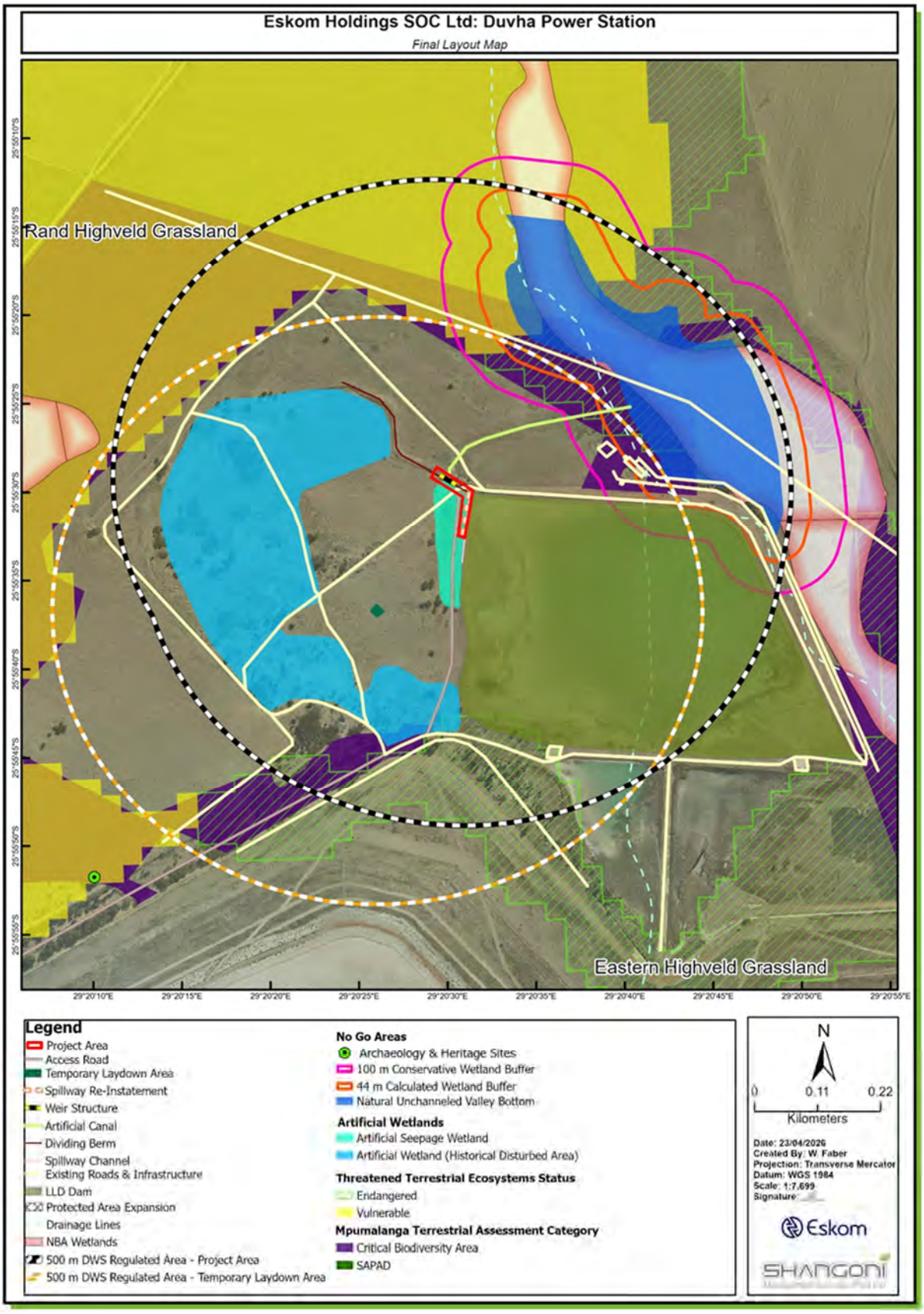


Figure 2 below illustrate the proposed spillway and associated infrastructure.

3.1.1.4 Temporary laydown area

A Temporary laydown area of 252 m² is required to store material for the re-instatement of the LLD Spillway. The temporary laydown area will be located west of the existing infrastructure and adjacent to an access road. The temporary laydown area is not located close to any natural wetland and is thus unlikely to have an impact on any watercourse.

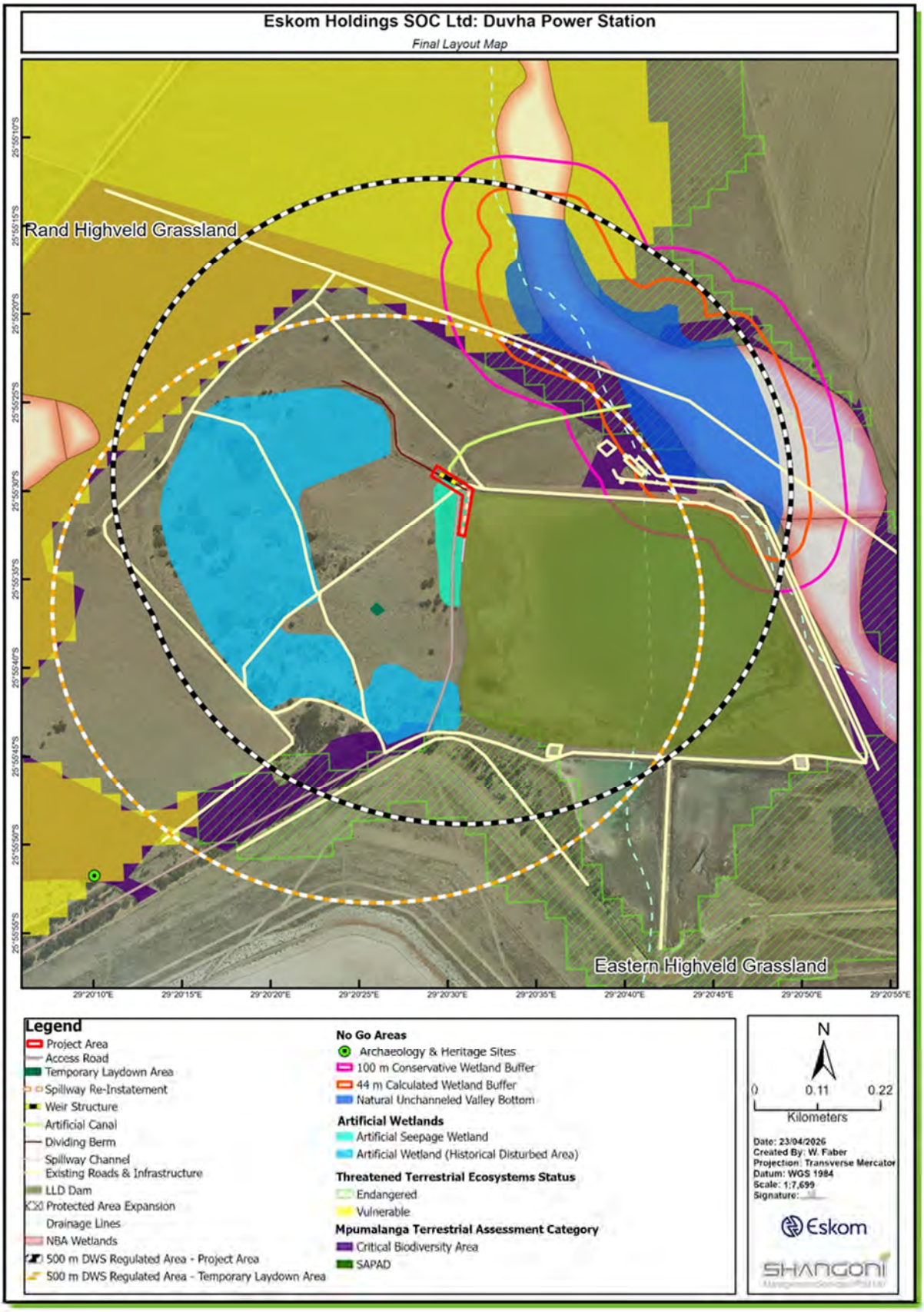


Figure 2: Layout map of the proposed Spillway

4 Basic Assessment Reporting Process

An Application for Environmental Authorisation in terms of the National Environmental Management Act (Act No. 107 of 1998) (NEMA) and the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended) has been made for the proposed Project. In terms of the aforementioned Act, the lead decision-making authority for the environmental assessment is the Department of Forestry, Fisheries and the Environment (DFFE).

The process for seeking authorisation is being undertaken in accordance with Government Notice No. R. 982 of 4 December 2014 (as amended). Although the Project triggers activities listed in Listing Notice 1 a Basic Assessment Process is being undertaken.

Shangoni Management Services (Pty) Ltd was appointed by the Applicant as the Environmental Assessment Practitioner (EAP) to undertake the Basic Assessment Process for the proposed Project.

5 Site Sensitivity Verification Report

The Protocols for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes ("the Protocols") were published in Government Gazette No. 43110 on 20 March 2020 and Government Gazette No. 43855 on 30 October 2020, in terms of Sections 24(5)(a) and (h) and 44 of the NEMA.

After 9 May 2020, compliance to the Protocols was mandatory for every new application for Environmental Authorisation submitted. According to the Protocols, the EAP must verify the current use of the site in question and potential environmental sensitivity as identified by the Screening Tool to determine the need for specialist inputs in relation to the themes included in the Protocols.

This document serves as the Site Sensitivity Verification Report for the proposed development for the specialist studies that were not undertaken or included in the application. Furthermore, this report complies with the Site Sensitivity Verification section within the Protocols.

5.1 Specialist Assessment Identified

Based on the selected classification, and the known impacts associated with the proposed development, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

Table 4: Specialist assessments identified and undertaken

No	Specialist assessment	Undertaken
1	Landscape/Visual Impact Assessment	No

No	Specialist assessment	Undertaken
2	Archaeological and Cultural Heritage Impact Assessment	Yes
3	Palaeontology Impact Assessment	Yes
4	Terrestrial Biodiversity Impact Assessment	No
5	Aquatic Biodiversity Impact Assessment	Yes
6	Hydrology Assessment	No
7	Socio-Economic Assessment	No
8	Plant Species Assessment	No
9	Animal Species Assessment	No

6 Specialist Input Required

Based on the above, the following specialist input will be required for undertaking the licencing processes:

- Wetland Biodiversity Assessment – The site area has been highly transformed and disturbed due to ash dams, alien plant infestation and mining activities. According to the Mpumalanga. Biodiversity Conservation Plan, the proposed site area falls within the “Moderately modified - Old lands”.
- Wetland delineation Assessment - this study will provide recommendations on the placement of erosion protection, spillway infrastructure and wetland rehabilitation measures.

7 Outcomes of the Site Sensitivity Verification

The following information was extracted from the *Wetland Biodiversity Assessment and Aquatic Site Sensitivity Verification Report* dated June 2025 compiled by Limosella Consulting.

The proposed reinstatement of the Low-Level Dam (LLD) spillway and associated infrastructure at Duvha Power Station is a necessary intervention to restore safe discharge capacity, ensure compliance with dam safety regulations, and reduce the long-term risk of uncontrolled overflow. The development footprint is entirely confined to artificial or heavily modified features, including the seepage wetland, canal, dividing berm, and the disturbed wetland overlying historical diggings. These features, while exhibiting wetland-like characteristics, are of anthropogenic origin and were confirmed to have very low ecological and functional value based on the WET-EcoServices assessment.

No direct impacts on natural wetlands or watercourses are anticipated. The nearest natural unchannelled valley-bottom wetland lies approximately 320 m from the activity footprint and remains outside both the calculated and conservative buffer zones. As such, no triggers under Section 21(f) or (g) of the National Water Act apply, and Section 21(c) and (i) are considered only as a precaution due to the proximity of engineered water features. The natural wetlands are confirmed to be highly sensitive as indicated in the screening report, the artificial wetlands are less sensitive but does contribute to some extent to ecosystem services.

All potential impacts are limited, localised, and temporary, and can be effectively mitigated through standard best-practice construction and rehabilitation measures. Long-term, the project is expected to reduce operational risk, enhance flow control, and prevent further degradation of surrounding artificial wetlands. As such, the development is considered environmentally acceptable and aligned with national policies on sustainable water resource management and climate adaptation. The important factors, relevant to Environmental Authorisation for the proposed project, are summarised in the table below:

Quaternary Catchment and WMA areas	B11G Limpopo-Olifants (LOCMA) #2 - Olifants: Major rivers include Elands, Wilge, Steelpoort, Olifants and Letaba Rivers
Watercourse	The primary watercourse feature is the Low-Level Dam (LLD), an artificial off-channel ash return dam. Although mapped as a wetland in the NFEPA and NBA2018 datasets, it does not represent a natural wetland system but rather an engineered containment structure with wetland-like characteristics. Downstream of the LLD, the spillway channel connects to a valley-bottom wetland associated with a non-perennial river. This wetland drains into the Witbank Dam. • NBA (2018) list the watercourses as **Vulnerable.** • NFEPA (2011) list the watercourses as **Vulnerable**

Quaternary Catchment and WMA areas	B11G Limpopo-Olifants (LOCMA) #2 - Olifants: Major rivers include Elands, Wilge, Steelpoort, Olifants and Letaba Rivers
Classification (SANBI, 2013)	Artificial Wetland Areas
WetEcoServices	Very Low for all metrics
EIS (Kotze, et al., 2020)	**Low Category -** Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers
Coj Generic Buffer and Calculated Buffer Zone (Macfarlane *et al,* 2015)	**Calculated Buffer Zone: 44 m** **Conservative Buffer: 100 m** **Artificial Wetland Areas: No Buffer**
DWS 2024 Risk Assessment	Risk scores fall in the **Low category**
National Screening Tool Findings	This study confirms that the natural wetlands are highly sensitive as indicated on the screening report, the artificial wetlands are less sensitive.

In accordance with the requirements of Government Notice No. 320 of 20 March 2020, a site sensitivity verification was undertaken prior to, and in support of, the aquatic specialist assessment. The purpose of this process was to verify the current land use and environmental sensitivities identified by the national environmental screening tool and to ensure that the specialist assessment is informed by confirmed site conditions. The site sensitivity verification process and outcomes are summarised in Table 5 below.

Table 5: Site Sensitivity Verification in accordance with GN 320 (20 March 2020)

GN 320 Requirement	Compliance Response
Requirement: Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site identified by the screening tool must be confirmed by undertaking a site sensitivity verification.	A site sensitivity verification was undertaken prior to the aquatic biodiversity and wetland assessment to verify the land use and aquatic sensitivities identified by the environmental screening tool. The verification focused on aquatic features associated with the existing low-level dam, spillway, downstream channel, and associated wetland areas within the development footprint.

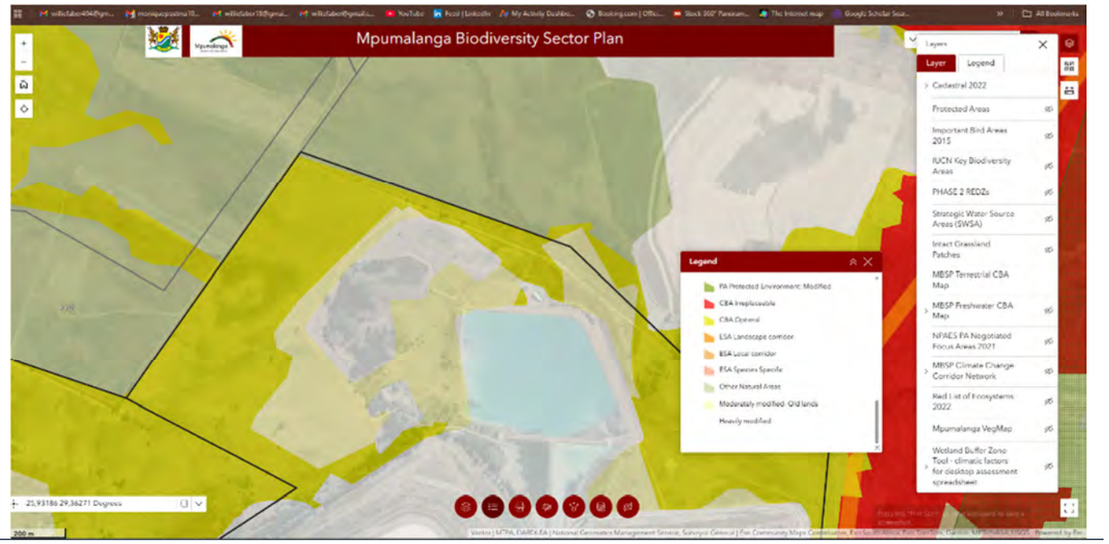
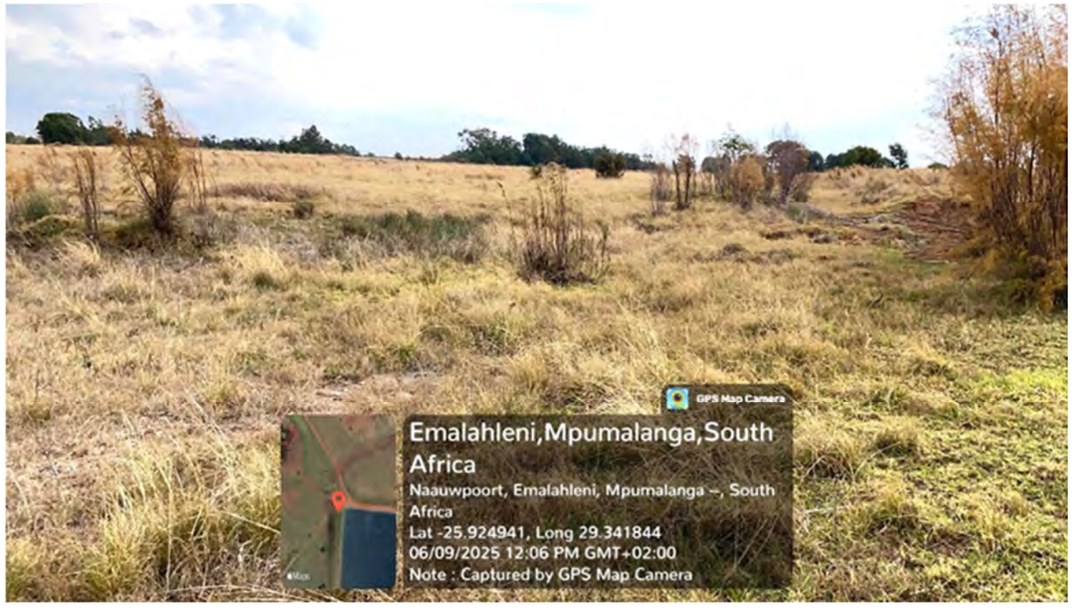
GN 320 Requirement	Compliance Response
2.1 The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist.	The site sensitivity verification was undertaken by a suitably qualified aquatic specialist registered with the South African Council for Natural Scientific Professions (SACNASP), with demonstrated experience in aquatic biodiversity assessments, wetland delineation, and regulatory compliance.
2.2(a) Desktop analysis using satellite imagery.	A desktop verification was conducted using recent and historical aerial and satellite imagery, topographical mapping, and available spatial datasets. This analysis verified the spatial extent of natural wetland areas, artificial or modified wetland features associated with historical infrastructure, and the surrounding land use context.
2.2(b) Preliminary on-site inspection.	A preliminary site inspection was undertaken to ground-truth the desktop findings and confirm current site conditions. The inspection verified the presence, condition, and degree of modification of both natural wetland areas and artificial wetland features, as well as the extent of instream and riparian disturbance associated with existing infrastructure.
2.2(c) Other available and relevant information.	Additional relevant information reviewed included existing specialist studies, project documentation, regulatory guidance, and photographic records. These sources were used to contextualise the origin, function, and condition of natural versus artificial wetland components within the study area.
2.3(a) Confirmation or dispute of current land use and environmental sensitivity identified by the screening tool.	The site sensitivity verification confirmed the presence of both natural and artificial wetland components within the study area. Natural wetland and their buffer areas were verified as **highly sensitive** due to their ecological functioning, hydrological connectivity, and biodiversity value. Artificial or engineered wetland areas associated with historical infrastructure were verified as having a **medium sensitivity,** reflecting their modified origin, reduced ecological integrity, and partial reliance on anthropogenic hydrological inputs.
2.3(b) Motivation and evidence (e.g. photographs) supporting the verified or revised sensitivity.	The differentiation in sensitivity is supported by site observations, photographic evidence, and interpretation of satellite imagery, which collectively demonstrate intact hydrological and vegetative characteristics in natural wetland areas, contrasted with structural modification, altered flow regimes, and simplified vegetation assemblages in artificial wetland features.

GN 320 Requirement	Compliance Response
2.3(c) Submission together with the relevant assessment report in accordance with the EIA Regulations.	This site sensitivity verification is documented as part of the aquatic specialist assessment report and is submitted in support of the Basic Assessment Report in accordance with the Environmental Impact Assessment Regulations, 2014 (as amended). The verified sensitivity classifications directly inform the impact assessment and mitigation measures presented in subsequent sections of this report.

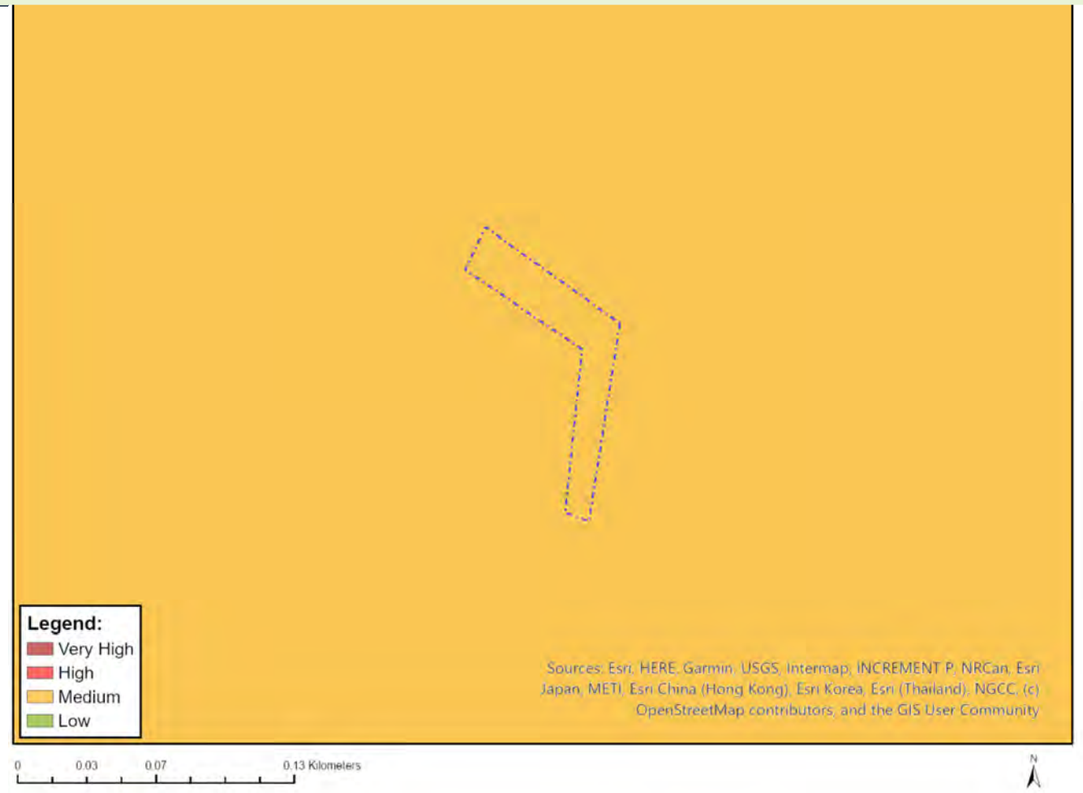
Table 6: List of identified themes for which specialist studies have not been undertaken

Theme/Specialist Study identified in the Screening Report	Sensitivity Rating as per the Screening report	Sensitivity Rating as per Verification Findings	Reasons for Site Sensitivity Verification and not undertaking the Specialist Study
Landscape/Visual Impact Assessment	Not applicable	Existing infrastructure is not visible to outside receptors.	Not applicable. Screening tool results did not include Landscape/Visual. The existing Low-Level Dam Spillway is not visible to any surrounding receptors and is considered integral to the functioning of the Duvha Power Station. The power station has been operational for over 40 years and consists of six 600 MW units with a total installed capacity of 3,600 MW operating with a turbine Maximum Continuous Rating of 37.6%. Duvha Power Station produces wet ash which is pumped into an Ash Dam. The settled water is then decanted into the Low-Level Dam ("LLD") before it is pumped back to the station for reuse. The LLD is an off-channel storage dam used to store ash water. Additionally, the LLD is also used to collect all contaminated storm water from the ash dam, station and the surrounding area with a capacity of 811 240 m³ at the spillway level of 7.2 m.
Hydrology Assessment	Not applicable	The *Wetland Biodiversity Assessment and Aquatic Site Sensitivity Verification Report* dated June 2025 compiled by Limosella Consulting found that no direct impacts on natural wetlands or watercourses are anticipated. The nearest natural unchannelled valley-bottom wetland lies approximately 320 m from the activity footprint and remains outside both the calculated and conservative buffer zones.	Not applicable. Screening tool results did not include Hydrology.
Socio-Economic Assessment	Not applicable	Duvha Power Station is one of the major contributors to local, provincial, and national electricity supply. As such, the proposed project contributes to the local economic and energy security. The reinstatement of the spillway will prevent costly unplanned shutdowns that could disrupt national power generation and ensure a long-term stability for industries reliant on a stable power grid.	Not applicable. Screening tool results did not Socio-Economic.

Theme/Specialist Study identified in the Screening Report	Sensitivity Rating as per the Screening report	Sensitivity Rating as per Verification Findings	Reasons for Site Sensitivity Verification and not undertaking the Specialist Study
Terrestrial Biodiversity Impact Assessment	Very high	Low as the area is disturbed and modified by existing Low-Level Dam Spillway.	According to the Mpumalanga Biodiversity Sector Plan (MBSP), The proposed construction footprint (spillway and weir) is also surrounded by Moderately Modified and Heavily Modified areas associated with historical land use, ash disposal, and infrastructure. The site area has been highly transformed and disturbed due to ash dams, alien plant infestation and mining activities. According to the Mpumalanga. Biodiversity Conservation Plan, the proposed site area falls within the “Moderately modified - Old lands”. 
Plant Species Assessment	Low	Low as the area is disturbed and modified by existing Low-Level Dam Spillway.	According to the Mpumalanga Biodiversity Sector Plan the project area to be classified as Moderately modified old lands. The project area is not located within CBA 1 or ESA 1.

Theme/Specialist Study identified in the Screening Report	Sensitivity Rating as per the Screening report	Sensitivity Rating as per Verification Findings	Reasons for Site Sensitivity Verification and not undertaking the Specialist Study
			
Animal Species Assessment	Medium	Low as the area is disturbed by existing Low-Level Dam Spillway.	The site area has been highly transformed and disturbed due to ash dams, alien plant infestation and mining activities. According to the Mpumalanga. Biodiversity Conservation Plan, the proposed site area falls within the “Moderately modified - Old lands”.  The Terrestrial Ecological Assessment Report for the Proposed Duvha Ash Dam Seepage Interception Drains, compiled by Nemai Consulting and dated July 2017 found that mammal species diversity was very low, and this

Theme/Specialist Study identified in the Screening Report	Sensitivity Rating as per the Screening report	Sensitivity Rating as per Verification Findings	Reasons for Site Sensitivity Verification and not undertaking the Specialist Study
			could have been due to habitat transformation and mining activities. Mammals are naturally sensitive to disturbances. The following mammals were recorded: • Common Duiker; • Cape Porcupine; • Blesbok; • Plains zebra; • Scrub hare; • African Mole Rat; and • Slender mongoose. The likelyhood of ocurrence of Red Data Listed Mammal species for Southern African Hedgehog and Oribi is low (Skinner and Chimimba, 2005). <u>The following species were identified by the Screening Tool:</u> Aves – Hydroprogne caspia – Caspian Tern Mammalia – Crocidura maquassiensis – Makwassie musk shrew Mammalia – Hydricutis maculicollis – Spotted necked otter Mammalia – Ourebia ourebi ourebi - Oribi Reptilia – Kinixys lobatsiana - Lobatse hinge-back tortoise A site visit was conducted and with the information gathered during this process the following conclusions were made with regards to the probability of these species occurring on site refer to Appendix A). From the information contained in Table 1, it was determined that no terrestrial or avifaunal specialist studies were required during the assessment of the project site.

Theme/Specialist Study identified in the Screening Report	Sensitivity Rating as per the Screening report	Sensitivity Rating as per Verification Findings	Reasons for Site Sensitivity Verification and not undertaking the Specialist Study
			

8 Conclusion and Recommendations

This Site Verification Report for the proposed development for the specialist studies that were not undertaken or included in the application include:

- Landscape/Visual Impact Assessment;
- Terrestrial Biodiversity;
- Hydrology Assessment;
- Socio-Economic Assessment;
- Plant Species Assessment; and
- Animal Species Assessment.

The project area is situated within the Duvha Power Station, an industrial area that has been significantly modified and disturbed by historical construction, power generation operations, and previous infrastructure upgrades. Based on the outcome of the above Site Verification Report, the following has been confirmed:

- No natural or sensitive ecosystems remain within the direct project footprint;
- Although the area falls within a high terrestrial biodiversity sensitivity, the area has been developed, has no remaining intact indigenous vegetation and is operationally managed.

Additionally, the spillway and berms were engineered structures originally constructed during the power station's development. The reinstatement of the spillway project will require Water Use Licence Application and Environmental Authorisation through a basic Assessment process.

9 Declaration of independence

Shangoni hereby declares that it is an independent consultant in that it has no business, financial, personal or other interest in this project in respect of which Shangoni is appointed. Furthermore, no circumstances exist that may compromise the objectivity of Shangoni, excluding fair remuneration for work performed in connection with this Site Sensitivity Verification report.

Report compiled by: **DRAFT FOR REVIEW** **Report reviewed by:** **DRAFT FOR REVIEW**

Lee-Anne Fellowes
EAPASA No.2019/850

SACNASP No.115574

Jan Nel

Appendix A

The following species were identified by the Screening Tool:

- Aves – *Hydroprogne caspia* – Caspian Tern
- Mammalia – *Crocidura maquassiensis* – Makwassie musk shrew
- Mammalia – *Hydricutis maculicollis* – Spotted necked otter
- Mammalia – *Ourebia ourebi ourebi* - Oribi
- Reptilia – *Kinixys lobatsiana* - Lobatse hinge-back tortoise

A site visit was conducted and with the information gathered during this process the following conclusions were made with regards to the probability of these species occurring on site (Refer to Table 1). From the information contained in Table 1, it was determined that no terrestrial or avifaunal specialist studies were required during the assessment of the project site.

Table 7: Evaluation of the probability of occurrence of screening tool listed species

			Habitat	Observed	Probability	Potential impact	
Aves	*Hydroprogne caspia*	Caspian Tern	Coastal: Sheltered bays, estuaries, river mouths, mudflats, and beaches. Inland: Large freshwater or saltwater bodies, including lakes, reservoirs, saline pans, and even sewage ponds. Nesting Sites: Islands (offshore, artificial, or in pans/dams), sandy or pebbly shores, often near other colonial waterbirds.	No	Highly unlikely	This species has never been recorded within the study area according to the South African Bird Atlas Project. (Refer to Table 2 for the complete list of avian species recorded) Therefore there is no risk to be mitigated or potential impact (SABAP, 2026).	No specialist studies required
Mammalia	*Crocidura maquassiensis*	Makwassie musk shrew Vulnerable	As of 2026, the species is generally listed as Least Concern on the IUCN Red List, but vulnerable regionally. This species can be found patchily across South Africa (including Limpopo, Mpumalanga, KwaZulu-Natal, and Northwest provinces. Typically inhabits rocky areas and moist grasslands within savanna and grassland biomes.	No	Highly unlikely	This species has a poor dispersal ability and prefers natural wetlands avoiding overgrazed or mowed areas. Areas with high compaction, such as roads and trampled soil make it difficult for them to burrow. This species is small, relatively rare and seldom caught in traps during sampling. The study area is very degraded through anthropogenic activities and human disturbances which makes it highly unlikely that it would occur in the study site. Current research states that this species are not easily trapped. With the status of the habitat in conjunction with the habits of this species there will be no risk to mitigate or potential impact (SANBI, 2026).	No specialist studies required
Mammalia	*Hydricutis maculicollis*	Spotted necked otter	Prefers large, permanent, and continuous freshwater /unpolluted systems. It hunts by site and requires clear water with good visibility. Preferred vegetation is dense with large boulders along the shoreline. Its diet includes fish, frogs, crabs, and aquatic insects. (SANBI, 2026).	No	Highly unlikely	The study site has no viable habitat for this species, therefore there will be no risk to be mitigated or potential impact.	No specialist studies required

			Habitat	Observed	Probability	Potential impact	
Mammalia	*Ourebia ourebi ourebi*	Oribi	Oribi inhabit savannah woodlands, floodplains and other open grasslands, from around sea level to about 2,200 (Mpumalanga Province). They reach their highest density on floodplains and moist tropical grasslands, especially in association with large grazers. They prefer open grassland in good condition containing a mosaic of both short grass for feeding and long grass for feeding and shelter (SANBI, 2026).	No	Highly unlikely	The study area consists of disturbed grassland, with anthropogenic disturbance, including access roads. The wetland is not a natural wetland, and the site is under pressure from several Alien Invasive Species (AIS). *Acacia mearnsii* (Black Wattle) Eucalyptus species, *Pennisetum clandestinum* (Kikuyu) and *Datura ferox* (Thorn apple). The state of veld degradation, in conjunction with disturbances from anthropogenic activity, concludes that this area is not suitable for this species therefore there will be no risk to be mitigated or potential impact.	No specialist studies required
Reptilia	*Kinixys lobatsiana*	Lobatse hinge-back tortoise	The range of K. lobatsiana falls mainly within Limpopo Province of South Africa, for which 15% of land cover is considered developed or degraded (Limpopo Environmental Outlook Report 2016). Kinixys lobatsiana is a savanna species that inhabits rocky hillsides in habitats of mixed Acacia and Combretum woodland, tropical Bushveld and Thornveld were vegetation ranges from dense, short shrubland to open tree savanna (SANBI, 2026).	No	Highly unlikely	The study site has no viable habitat for this species, therefore there will be no risk to be mitigated or potential impact.	No specialist studies required

Table 8 Bird species list: https://sabap2.birdmap.africa/coverage/pentad/2555_2920

Ref	Common group	Common species	Genus	Species
72		Hamerkop	*Scopus*	*umbretta*
637		Neddicky	*Cisticola*	*fulvicapilla*
844		Quailfinch	*Ortygospiza*	*atricollis*
256		Ruff	*Calidris*	*pugnax*
439	Barbet	Crested	*Trachyphonus*	*vaillantii*
404	Bee-eater	European	*Merops*	*apiaster*
812	Bishop	Yellow-crowned	*Euplectes*	*afer*
545	Bulbul	Dark-capped [x]	*Pycnonotus*	*tricolor*
154	Buzzard	Common	*Buteo*	*buteo*
860	Canary	Black-throated	*Crithagra*	*atrogularis*
575	Chat	Ant-eating	*Myrmecocichla*	*formicivora*
646	Cisticola	Levaillant's	*Cisticola*	*tinniens*
634	Cisticola	Wing-snapping	*Cisticola*	*ayresii*
629	Cisticola	Zitting	*Cisticola*	*juncidis*
212	Coot	Red-knobbed	*Fulica*	*cristata*
50	Cormorant	Reed	*Microcarbo*	*africanus*
47	Cormorant	White-breasted	*Phalacrocorax*	*lucidus*
203	Crake	Black	*Zaporina*	*flavirostra*
522	Crow	Pied	*Corvus*	*albus*
352	Cuckoo	Diederik	*Chrysococcyx*	*caprius*
52	Darter	African	*Anhinga*	*rufa*
317	Dove	Laughing	*Spilopelia*	*senegalensis*
318	Dove	Namaqua	*Oena*	*capensis*
314	Dove	Red-eyed	*Streptopelia*	*semitorquata*
316	Dove	Ring-necked	*Streptopelia*	*capicola*
940	Dove	Rock	*Columba*	*livia*
103	Duck	Maccoa	*Oxyura*	*maccoa*

Ref	Common group	Common species	Genus	Species
104	Duck	White-backed	*Thalassornis*	*leuconotus*
96	Duck	Yellow-billed	*Anas*	*undulata*
60	Egret	Intermediate [x]	*Ardea*	*intermedia*
59	Egret	Little	*Egretta*	*garzetta*
61	Egret	Western Cattle	*Bubulcus*	*ibis*
707	Fiscal	Southern	*Lanius*	*collaris*
86	Flamingo	Greater	*Phoenicopterus*	*roseus*
87	Flamingo	Lesser	*Phoeniconaias*	*minor*
665	Flycatcher	Fiscal	*Melaenornis*	*silens*
89	Goose	Egyptian	*Alopochen*	*aegyptiaca*
88	Goose	Spur-winged	*Plectropterus*	*gambensis*
4	Grebe	Great Crested	*Podiceps*	*cristatus*
6	Grebe	Little	*Tachybaptus*	*ruficollis*
192	Guineafowl	Helmeted	*Numida*	*meleagris*
288	Gull	Grey-headed	*Chroicocephalus*	*cirrocephalus*
55	Heron	Black-headed	*Ardea*	*melanocephala*
56	Heron	Goliath	*Ardea*	*goliath*
54	Heron	Grey	*Ardea*	*cinerea*
57	Heron	Purple	*Ardea*	*purpurea*
418	Hoopoe	African	*Upupa*	*africana*
81	Ibis	African Sacred	*Threskiornis*	*aethiopicus*
84	Ibis	Hadada	*Bostrychia*	*hagedash*
82	Ibis	Southern Bald	*Geronticus*	*calvus*
394	Kingfisher	Pied	*Ceryle*	*rudis*
130	Kite	Black-winged	*Elanus*	*caeruleus*
247	Lapwing	African Wattled	*Vanellus*	*senegallus*
245	Lapwing	Blacksmith	*Vanellus*	*armatus*
242	Lapwing	Crowned	*Vanellus*	*coronatus*

Ref	Common group	Common species	Genus	Species
488	Lark	Red-capped	*Calandrella*	*cinerea*
458	Lark	Rufous-naped	*Mirafra*	*africana*
703	Longclaw	Cape	*Macronyx*	*capensis*
509	Martin	Brown-throated	*Riparia*	*paludicola*
210	Moorhen	Common	*Gallinula*	*chloropus*
392	Mousebird	Red-faced	*Urocolius*	*indicus*
390	Mousebird	Speckled	*Colius*	*striatus*
734	Myna	Common	*Acridotheres*	*tristis*
1	Ostrich	Common	*Struthio*	*camelus*
311	Pigeon	Speckled	*Columba*	*guinea*
692	Pipit	African	*Anthus*	*cinnamomeus*
695	Pipit	Buffy	*Anthus*	*vaalensis*
694	Pipit	Plain-backed	*Anthus*	*leucophrys*
1332	Pochard	Red-crested	*Netta*	*rufina*
102	Pochard	Southern	*Netta*	*erythrophthalma*
650	Prinia	Black-chested	*Prinia*	*flavicans*
805	Quelea	Red-billed	*Quelea*	*quelea*
808	Red Bishop	Southern	*Euplectes*	*orix*
581	Robin-Chat	Cape	*Cossypha*	*caffra*
258	Sandpiper	Common	*Actitis*	*hypoleucos*
94	Shoveler	Cape	*Anas*	*smithii*
786	Sparrow	Cape	*Passer*	*melanurus*
784	Sparrow	House	*Passer*	*domesticus*
4142	Sparrow	Southern Grey-headed	*Passer*	*diffusus*
159	Sparrowhawk	Black	*Accipiter*	*melanoleucus*
85	Spoonbill	African	*Platalea*	*alba*
185	Spurfowl	Swainson's	*Pternistis*	*swainsonii*
746	Starling	Pied	*Lamprotornis*	*bicolor*

Ref	Common group	Common species	Genus	Species
745	Starling	Red-winged	*Onychognathus*	*morio*
253	Stint	Little	*Calidris*	*minuta*
576	Stonechat	African	*Saxicola*	*torquatus*
772	Sunbird	Amethyst	*Chalcomitra*	*amethystina*
493	Swallow	Barn	*Hirundo*	*rustica*
502	Swallow	Greater Striped	*Cecropis*	*cucullata*
504	Swallow	South African Cliff	*Petrochelidon*	*spilodera*
495	Swallow	White-throated	*Hirundo*	*albigularis*
208	Swamphen	African	*Porphyrio*	*madagascariensis*
387	Swift	African Palm	*Cypsiurus*	*parvus*
385	Swift	Little	*Apus*	*affinis*
383	Swift	White-rumped	*Apus*	*caffer*
98	Teal	Cape	*Anas*	*capensis*
97	Teal	Red-billed	*Anas*	*erythrorhyncha*
305	Tern	Whiskered	*Chlidonias*	*hybrida*
275	Thick-knee	Spotted	*Burhinus*	*capensis*
1104	Thrush	Karoo	*Turdus*	*smithi*
686	Wagtail	Cape	*Motacilla*	*capensis*
606	Warbler	African Reed [x]	*Acrocephalus*	*baeticatus*
604	Warbler	Lesser Swamp	*Acrocephalus*	*gracilirostris*
609	Warbler	Little Rush	*Bradypterus*	*baboecala*
843	Waxbill	Common	*Estrilda*	*astrild*
838	Waxbill	Orange-breasted	*Amandava*	*subflava*
803	Weaver	Southern Masked	*Ploceus*	*velatus*
804	Weaver	Thick-billed	*Amblyospiza*	*albifrons*
568	Wheatear	Capped	*Oenanthe*	*pileata*
846	Whydah	Pin-tailed	*Vidua*	*macroura*
816	Widowbird	Fan-tailed	*Euplectes*	*axillaris*

Ref	Common group	Common species	Genus	Species
818	Widowbird	Long-tailed	*Euplectes*	*progne*
453	Wryneck	Red-throated	*Jynx*	*ruficollis*