ESKOM HOLDINGS (SOC) LIMITED

ESKOM MAJUBA POWER STATION

PROPOSED GENERAL WASTE DISPOSAL SITE

EIA Specialist Report:
Wetland Delineation and Aquatic Biodiversity Impact Assessment

Field Survey: 23rd March 2018; 11th December 2018
Final Report: 30th June 2022

Permanently Saturated Hillslope Seepage Wetlands on Witkoppies 81HS. [23rd March 2018].

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Disclaimer

This report was based on the author's best scientific and professional knowledge and information available at the time of writing. Although Nepid Consultants has tried to ensure that all information contained within this report is accurate, Nepid does not warrant or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of the information presented in this report.

TERMS OF REFERENCE

1.2.3 The amendment of the specialist reports will require the following:

1.2.3.1 Wetland Delineation and Biodiversity Assessment

- A comparative Assessment of the two alternative sites (A and B) as well as recommendation as to which alternative is preferred for implementation.
- Update baseline information such that the findings address both Alternatives A and B.
- Update maps to show both Alternatives A and B.
- Add an impact assessment section where impact significance for direct, indirect, and cumulative impacts are identified during the Scoping Phase.
- Determine mitigation measures for each impact identified and to be included in the Impact Assessment section of the report.
- Recommend a sufficient buffer based on scientific findings as opposed to legislative requirements, or state reasons as to why a 32m buffer is recommended.
- Develop an alien invasive management plan for inclusion in the EMPr.
- Removal of or motivation for exclusion of autumn assessment as it is not part of the plan of study.

Email from Mmakoena Mmola, 2022-02-28

Note: **Alien Invasive Vegetation.** The two proposed development options will have no direct impacts on aquatic ecosystems, so there was no justification for a management plan for alien invasive vegetation with respect to aquatic ecosystems. An alien invasive management plan is included in the Specialist Report on Terrestrial Biodiversity.

Requirements for Aquatic Biodiversity Specialist Assessment Report

Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity. Government Notice No 320, 20th March 2020, National Environmental Management Act (No 107 of 1998)	**Reference**
2.7. The findings of the specialist assessment must be written up in an Aquatic Biodiversity Specialist Assessment Report that contains, as a minimum, the following information:	
2.7.1. contact details of the specialist	Robert William Palmer Cell: +27(0)82 574 4486 Email: rob@nepid.co.za
their SACNASP registration number,	No. 400108/95 (Appendix A)
their field of expertise	Biological Scientists Accredited biomonitoring practitioner (Appendix B)
and a curriculum vitae;	Appendix C
2.7.2. a signed statement of independence by the specialist;	Appendix D
2.7.3. a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 3.2
2.7.4. the methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant;	Chapter 3
2.7.5. a description of the assumptions made, any uncertainties or gaps in knowledge or data;	Section 3.10
2.7.6. the location of areas not suitable for development, which are to be avoided during construction and operation, where relevant;	Figure 5-1
2.7.7. additional environmental impacts expected from the proposed development;	Chapter 6
2.7.8. any direct, indirect and cumulative impacts of the proposed development on site;	Chapter 6
2.7.9. the degree to which impacts and risks can be mitigated;	Section 8-2
2.7.10. the degree to which the impacts and risks can be reversed;	n/a
2.7.11. the degree to which the impacts and risks can cause loss of irreplaceable resources;	Section 8-2
2.7.12. a suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies;	Figure 5-1 Section 6.1
2.7.13. proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr);	Chapter 6
2.7.14. a motivation must be provided if there were development footprints identified as per paragraph2.4 above that were identified as having a "low" aquatic biodiversity sensitivity and that were not considered appropriate;	n/a
2.7.15. a substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not; and	Section 8.2
2.7.16. any conditions to which this statement is subjected.	Disclaimer

ACKNOWLEDGMENTS

The following are gratefully acknowledged for assisting with the information presented in this report:

- Amaris Dalton, Eskom Holding (SOC) Limited, Majuba Power Station
- Duncan McKenzie, Digital Earth (Pty) Ltd, Nelspruit
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- Ilonka Haylett, BTW & Associates (Pty) Ltd, Garsfontein
- Manoko Selolo, BTW & Associates (Pty) Ltd, Garsfontein
- Keith Snyman, Snyman & Associates, Pietermaritzburg
- Adie Erasmus, AdiEnvironmental CC, Witbank
- Cornel Klaasen, Savannah Environmental (Pty) Ltd, Woodmead
- Mmakone Mmola, Savannah Environmental (Pty) Ltd, Woodmead

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ABBREVIATIONS

EIA	Environmental Impact Assessment
PES	Present Ecological State
SANBI	South African National Botanical Institute

GLOSSARY OF TERMS

Buffer	*A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted to reduce the impact of adjacent land use on the wetland or riparian area. [DWAF 2008].*
Gilgai	*Microrelief "mound and basin" topography that develops when clay soil layers shrink and swell during alternate drying and wetting cycles* (Fey 2010).
Riparian Habitat	*the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.* [National Water Act (Act No. 36 of 1998)].
Watercourse	*a) a river or spring;* *b) a natural channel or depression in which water flows regularly or intermittently;* *c) a wetland, lake or dam into which, or from which, water flows; and* *d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse.* [National Water Act (Act No. 36 of 1998)].
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 No. 36 of 1998)].

1. INTRODUCTION

1.1 Background

Eskom Majuba Power Station is proposing the development of a new general waste site and associated infrastructure on a site located ~13 km southwest of Amersfoort and ~40 km north-northwest of Volksrust, within jurisdiction of the Dr Pixley Ka Isaka Seme Local Municipality, which forms part of the Gert Sibande District Municipality, in the Mpumalanga Province. This report forms part of the environmental authorisation process and concerns the potential impacts of the proposed activity on aquatic biodiversity. The report is based on a review of available information and a field survey conducted by Nepid Consultants CC.

1.2 Project Description

A project site, with an extent of ~866 ha, immediately south of the Eskom Majuba Power Station, was identified as a technically feasible site for the development of a new general waste disposal site. A development footprint of 6 ha was identified within the project site by the proponent for the development. The 6 ha will accommodate the landfill, together with the associated infrastructure that will be required for the operation of the site. Infrastructure associated with the new general waste disposal site will include the following:

- Fencing with appropriate signage.
- An adequate access road (gravel or surfaced).
- An access control gate.
- A guard house with an ablution facility.
- A conservancy tank connected to the ablution facility.
- Covered parking facilities.
- A designated area for parking and servicing of plant and machinery.
- Sorting and storage facilities for recyclables.
- Adequate water and electricity connection from the existing rising mains.
- Stormwater drainage network and a stormwater evaporation pond for the stormwater entering the site through the waste body.
- A leachate management system and a leachate evaporation pond.

Two alternative sites are being considered for establishment of the general waste disposal site, namely:

- **Alternative A,** located on Portion 6 of the Farm Witkoppies 81HS, immediately east of an existing but decommissioned General Waste Site; and
- **Alternative B**, located on Portions 1 and 2 of the Farm Witkoppies 81HS, immediately south of the decommissioned General Waste Site

(Figure 1-1).

Both sites are contained within Eskom-owned land. Photographs of the two options are presented in Appendix E.

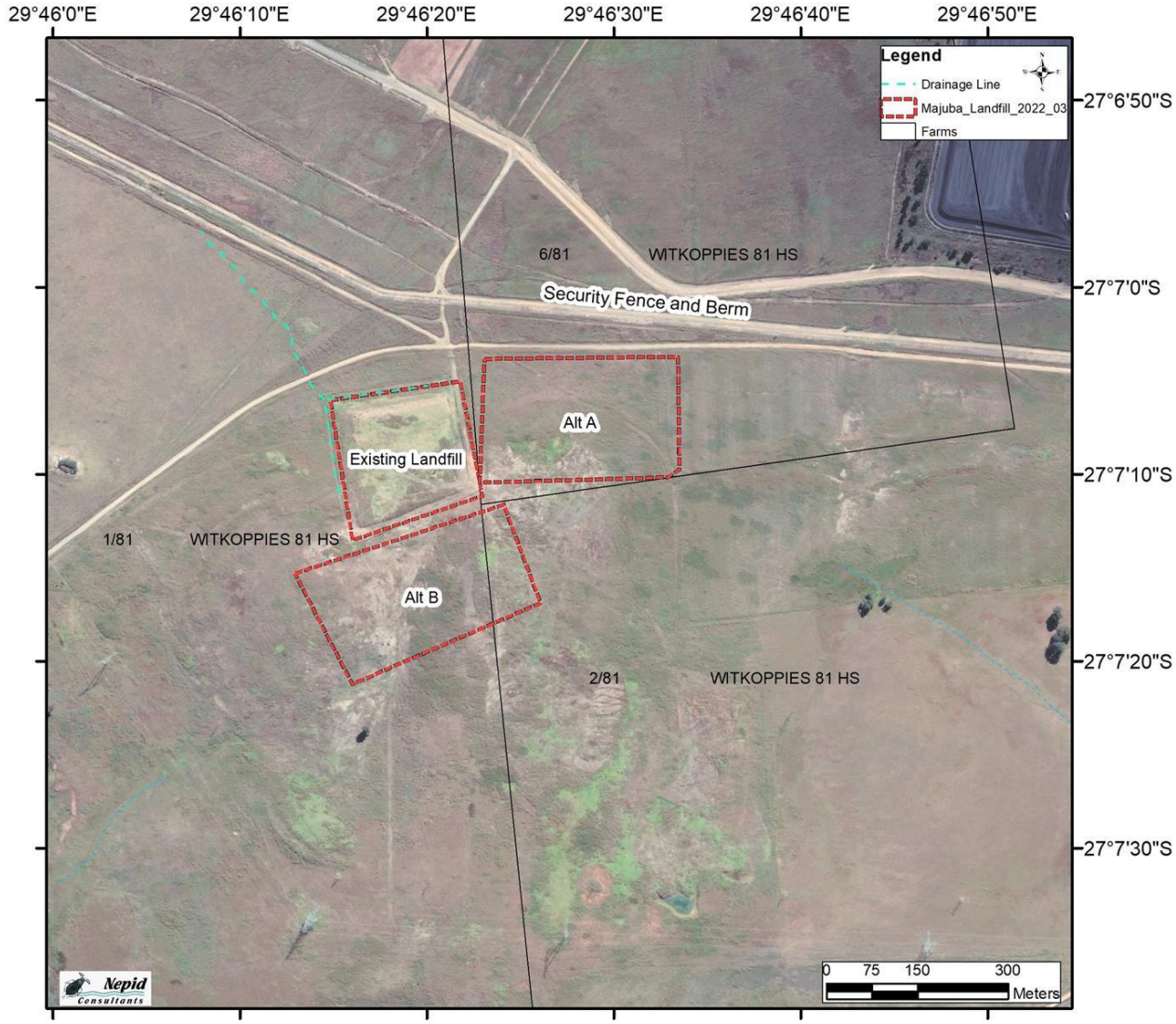


Figure 1-1. Alternatives for Proposed General Waste Disposal Site

[Image Source: Google Earth 2019-05-19].

1.3 Legal Context

This report addresses the requirements of:

- **National Water Act, 1998 (Act No. 36 of 1998)**
  - Section 21c – impeding or diverting flow in a watercourse; and
  - Section 21i - altering the bed, banks, course or characteristics of a watercourse.

- **National Environmental Management Act, 1998 (Act No. 107 of 1998)**
  - Environmental Impact Assessment regulations of 2014, as amended.

1.4 Aims of This Report

The aims of this report were:

- **Baseline:** to describe the aquatic ecosystems that could be affected by the proposed development, against which the likely impacts can be evaluated, and future changes compared (i.e., to collect baseline data);

- **Risks:** to assess the potential risks of the proposed development to aquatic ecosystems; and

- **Recommendations**: to provide a reasoned opinion as to whether the proposed development should be authorised in terms of potential impacts on aquatic ecosystems; and to recommend appropriate mitigation, management and monitoring measures to minimise the detrimental impacts of the proposed development on aquatic ecosystems, and enhance positive impacts, where appropriate.

2. STUDY AREA

2.1 General

The proposed General Waste Disposal Site is ~40 km north-west of Volksrust, and ~13 km south-west of Amersfoort, in the Dr Pixley ka Seme Local Municipality, Mpumalanga Province (Figure 2-1).

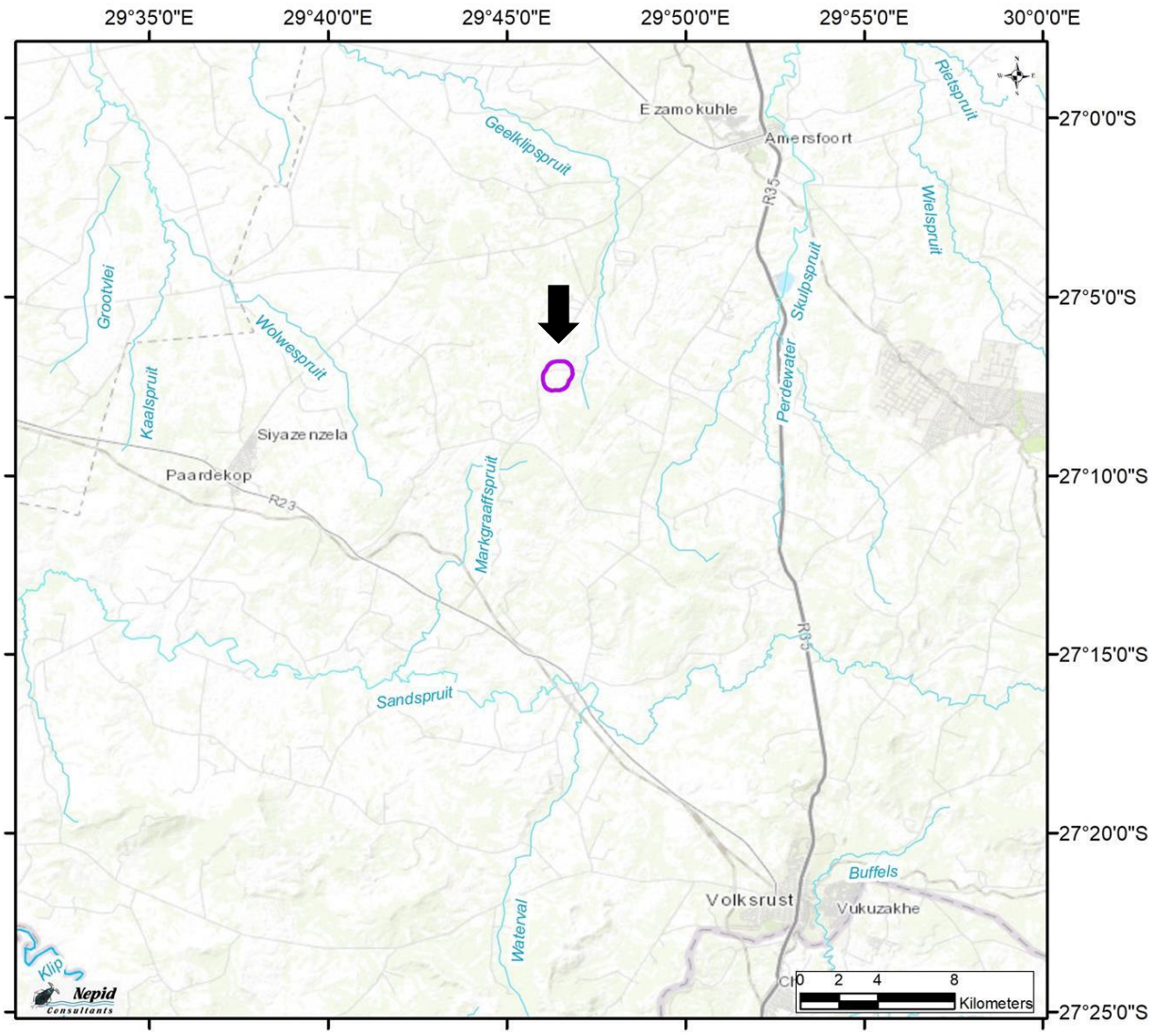


Figure 2-1. General Locality Map.

2.2 Detail

The Study Area for this report considered all aquatic ecosystems within 500 m of the two proposed alternatives, as required in terms of Government Notice 509 (26th August 2016). The Study Area for this report covered an area of ~160 hectares (Figure 2-2).

2.3 Potential Areas of Influence

There were no aquatic ecosystems within the two proposed alternative sites and access road, so the proposed development will have no Direct impact on aquatic ecosystems. Three potential Indirect Areas of Influence on aquatic ecosystems were identified as follows:

West: A watercourse west of the existing landfill and south of an existing stormwater berm;
South: A watercourse south of Alternative B; and
East: A watercourse east of the two alternatives and south of the existing stormwater berm **(Figure 2-**2).

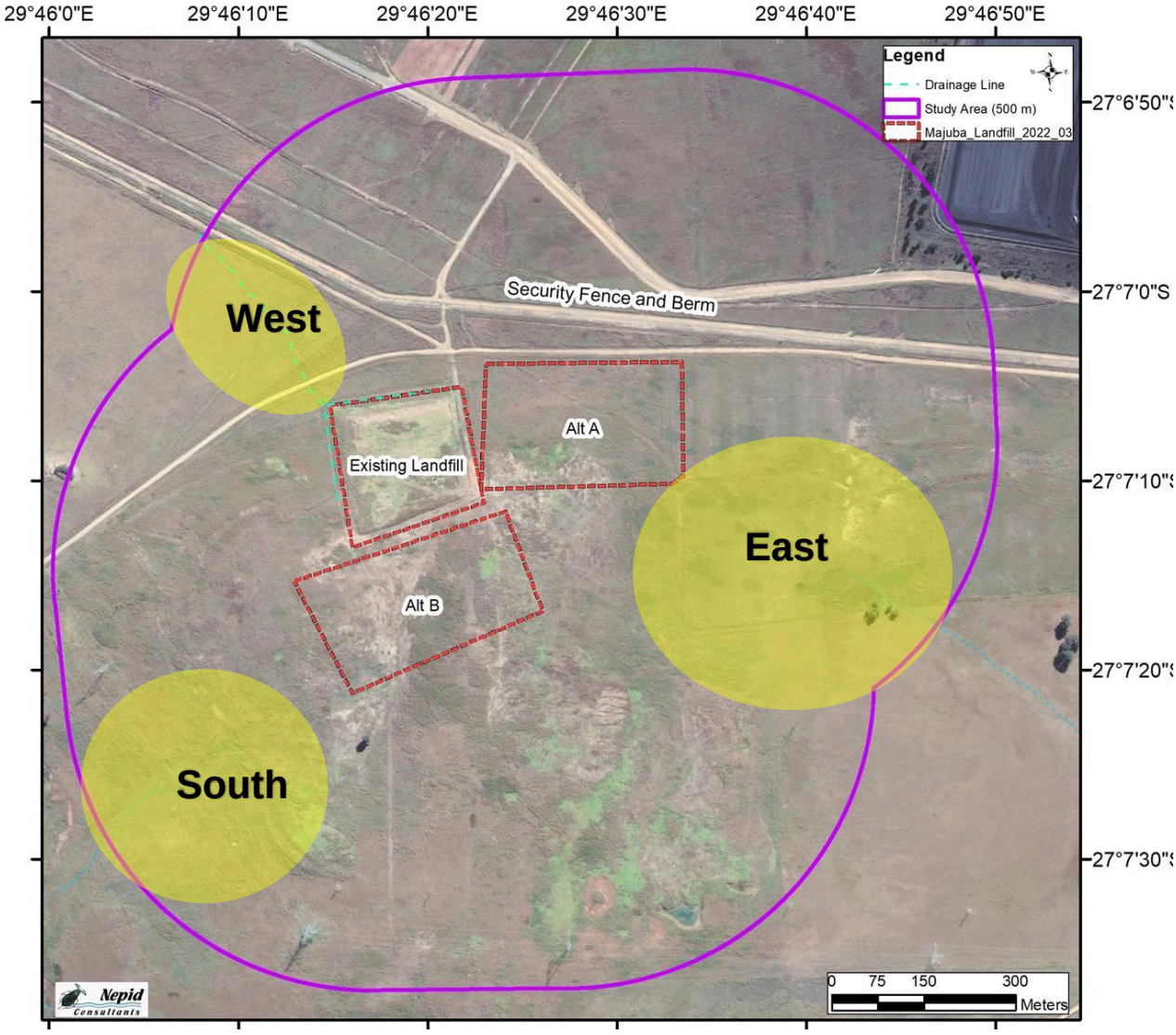


Figure 2-2. Areas of Potential Indirect Influence on Aquatic Ecosystems (Yellow Highlight)

[Image Source: Google Earth 2019-05-19].

3. METHODS

3.1 Review

A review of available ecological data pertaining to the proposed development area revealed the following important sources of information:

- Strategic biodiversity scoping report for the continuous Ash Disposal Facility at Eskom Majuba Power Station (BEC 2012);
- Desktop assessment of aquatic ecosystems at Eskom Majuba Power Station (Ecotone 2012);
- Specialist report on wetlands near Eskom Majuba Power Station (RHDHV 2014);
- Mpumalanga Biodiversity Sector Plan (MTPA 2011);
- National Freshwater Ecosystem Priority Areas (Nel *et al*. 2011);
- Google Earth images (various dates);
- Environmental Screening Tool (https://screening.environment.gov.za); and
- Google Earth™ images (various dates);

3.2 Field Surveys

Two field surveys were conducted for this report as follows:

Field Survey 1
Date: 23rd March 2018
Duration: 4 hrs
Season: Autumn (wet)
Timing: This survey was undertaken by Rob Palmer, Nepid Consultants CC, and focussed on Alternative A. This survey was suitably timed for an assessment of wetland vegetation. The survey was undertaken during heavy rainfall and this provided useful insight into the directions of surface flows during storm events.

Field Survey 2
Date: 11th December 2018
Duration: 2 hrs
Season: Summer (wet)
Timing: This survey was undertaken by Manoko Selolo, BTW & Associates (Pty) Ltd, and provided additional information on Alternative B. The survey was conducted during normal summer conditions.

The quality of data presented in this report is considered to be appropriate for the purposes of this report.

3.3 Aquatic Ecosystem Classification

Aquatic ecosystems were classified according to hydrogeomorphic units, as described by Ollis *et al*. (2013).

3.4 Aquatic Ecosystem Delineation

Wetland boundaries were delineated according to the methods of Kotze and Marneweck (1999), and the Department of Water Affairs and Forestry (DWAF 2005a).

3.5 Present Ecological State

The Present Ecological State of wetlands within the Potential Area of Influence was assessed using a rapid visual protocol that was developed for floodplain wetlands by Duthie (DWAF 1999). Two additional parameters were included, namely "connectivity", which is an important consideration for stream and river crossings, and "solid waste", which was relevant to the wetlands under investigation. The modified method involves rating twelve parameters on a numerical scale between 0 (*Critically Modified)* and 5 (*Natural*). The mean score was expressed as a percentage, and results were classified into one of six categories, ranging from *Natural* (Category A), to *Critically Modified* (Category F) (Table 3-1).

Table 3-1. Classification of Present Ecological State

Category	Description	Score (% of Total)
A	*Natural.*	> 90
B	*Largely Natural*	80-90
C	*Moderately Modified.*	60-79
D	*Largely Modified.*	40-59
E	*Seriously Modified.*	20-39
F	*Critically Modified.*	< 20

[Source: DWAF 1999.]

3.6 Ecological and Functional Importance

Ecological and Functional Importance of aquatic ecosystems that could be impacted directly by the proposed development was assessed using a rapid method that considers: 1) Ecological Importance, 2) Hydro-functional Importance and 3) Direct Human Benefits (Rountree 2012). The method involved rating 25 parameters on a numerical scale between 0 (*Zero)* and 4 (*Very High*).

3.7 Impact Assessment

Impacts were assessed according to a standard method provide by Savannah Environmental (Pty) Ltd. The method rates the significance of each impact as Low, Medium or High, before and after mitigation. Significance is based on the probability of occurrence (1 to 5), multiplied by the sum of the extent (1 to 5), duration (1 to 5) and magnitude (0 to 10).

3.8 Risk Assessment

Risks were assessed using the Department of Water Affairs and Sanitation GN509 Risk Assessment Matrix, dated September 2016. The method complies with General Authorisations for impeding or diverting the flow of water in a watercourse (National Water Act Section 21c), and/or altering the bed, banks, course or characteristics of a watercourse (National Water Act Section 21i) (DWA 2016).

3.9 Wetland Buffer Zones

Wetland buffer zones were based on assessment of various considerations including Present Ecological State, Ecological Importance and Sensitivity, potential risks, slope, vegetation cover, and soil permeability, *inter alia*, as detailed by Macfarlane *et al*. (2015).

3.10 Assumptions and Limitations

3.10.1 Report Focus

This report focusses on aquatic ecosystem classification, delineation, Present Ecological State, functions, and Ecological Importance and Sensitivity. The report does not address various aspects related to aquatic ecosystems, such as hydrology, water abstraction, hydraulics, aquatic macroinvertebrates, amphibians, reptiles, waterbirds or fish. However, the level of detail collected and presented is considered appropriate for the purposes of this report.

3.10.2 Field Surveys

The initial field survey for this report was conducted during heavy rainfall for most of the day, and this provided useful insight into surface flows.

3.10.3 Spatial Coverage

To the northern portion of the Study Area, north of the Eskom Majuba Power Station perimeter security fence, was assessed from aerial imagery only. Wetlands in this area were not surveyed in further detail because of access restrictions. These wetlands were outside of the potential Area of Influence of the two proposed landfill alternatives, so there was no need to assess these wetlands in further detail for the purposes of this report.

3.10.4 Spatial Resolution

The delineation of wetlands in this report was based on a combination of plant species composition, landform setting, microtopography (gilgai), aerial imagery, and hand-held GPS. Soils could not be used to define wetland boundaries because of the prevalence of vertic clays, which tend to be uniform along the catena and do not show redoximorphic features. Wetland boundaries presented in this report are considered accurate to within 15 m. The level of accuracy is considered sufficient for the purposes of this report.

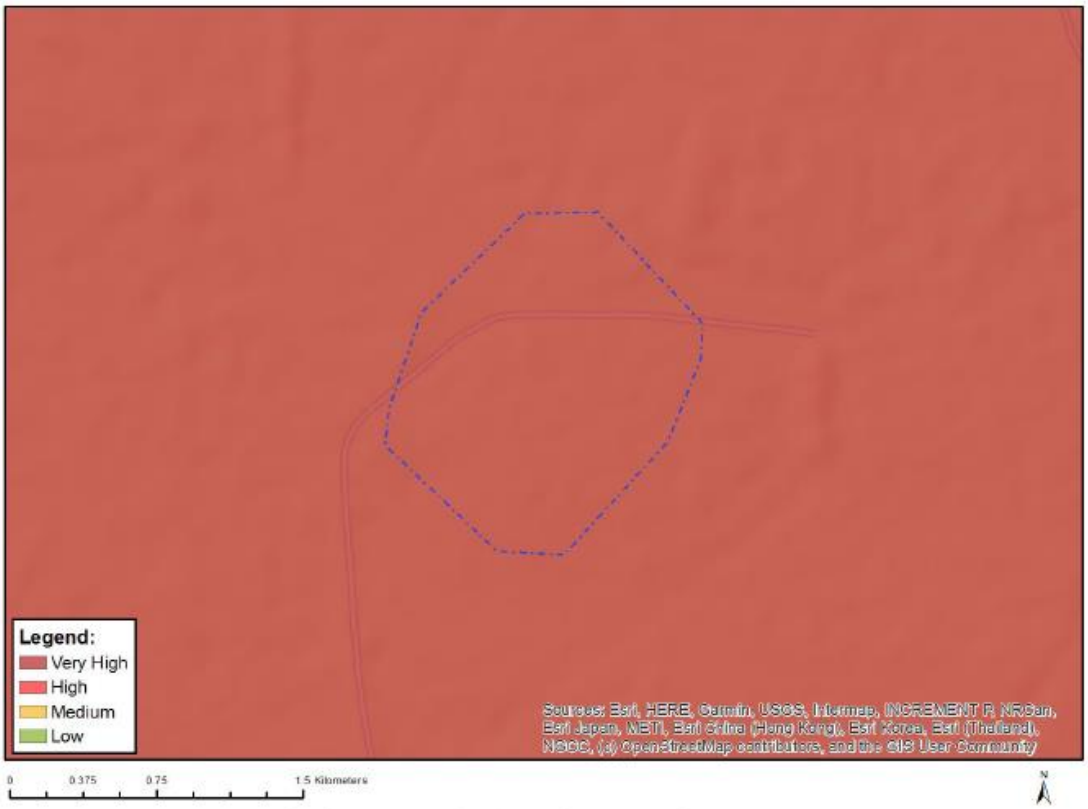
3.10.5 Temporal Resolution

Baseline data for this report were based mostly on the field survey conducted in March 2018, while the field survey in December 2018 comprised compilation of site photographs, focussing on Alternative B. Seasonal variation in baseline conditions were not quantified, and some plant species are likely to have been overlooked, particularly geophytes. However, the survey effort is considered appropriate for the purposes of this report.

4. ECOLOGICAL CONTEXT

4.1 Aquatic Biodiversity Sensitivity

The National Environmental Screening Tool indicated that the aquatic biodiversity sensitivity of the proposed development area was *Very High* (Figure 4-1). The very high sensitivity is attributed to the presence of wetland features and freshwater ecosystems priority areas.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Wetlands and Estuaries
Very High	Freshwater ecosystem priority area quinary catchments

Figure 4-1. Aquatic Biodiversity Theme Sensitivity

[Source: Environmental Screening Tool (https://screening.environment.gov.za).]

4.2 Aquatic Species Identified by the Screening Tool

The Screening Tool did not list any sensitive aquatic species as potentially occurring in the Study Area.

4.3 Geology

Geology within the 500 m Study Area boundary comprises sandstones, shales and mudstones of the **Volksrust Formation** of the Ecca Group, and the Karoo Supergroup, which is intruded by Karoo dolerite sills and dykes. The Volksrust Formation is characterised by dark grey-green siltstones and mudstones. The formation developed during a period of deep-water deposition of muds along the northern margin of the main Karoo basin following a rise in relative water level and inundation of swamps and lakes that formed the underlying coal-bearing Vryheid Formation (Savannah, 2015). The development of the Volksrust Formation ended when the basin had filled and there was deposition of sediments of terrestrial origin that formed the overlying Beaufort Group (Savannah. 2015).

4.4 Soils

Soils within the Study Area are classified as **Eutric Planosols** according to the World Reference Base (Jones *et al.* 2013). Eutric Planosols are described as "*poorly structured surface layer abruptly overlying a slowly permeable layer, not acidic*" (Jones *et al.* 2012). Soils in the Study Area are considered to have a moderate risk of erosion (Schulze and Horan 2006).

4.5 Aquatic Ecoregion

The Study Area is located within the **Highveld** Level I Aquatic Ecoregion (*sensu* Kleynhans *et al.* 2005). The Highveld Ecoregion is characterised by gently undulating grasslands with numerous wetlands. Wetlands in the Study Area are classified as **Mesic Highveld Grasslands Group 8** (MTPA 2011).

4.6 Drainage

Quaternary Catchments

The Study Area is located in the upper reaches of the Geelklipsruit Catchment, a tributary of the Vaal River, within Quaternary Catchment C11J, in the Upper Vaal Water Management Area (Figure 4-2).

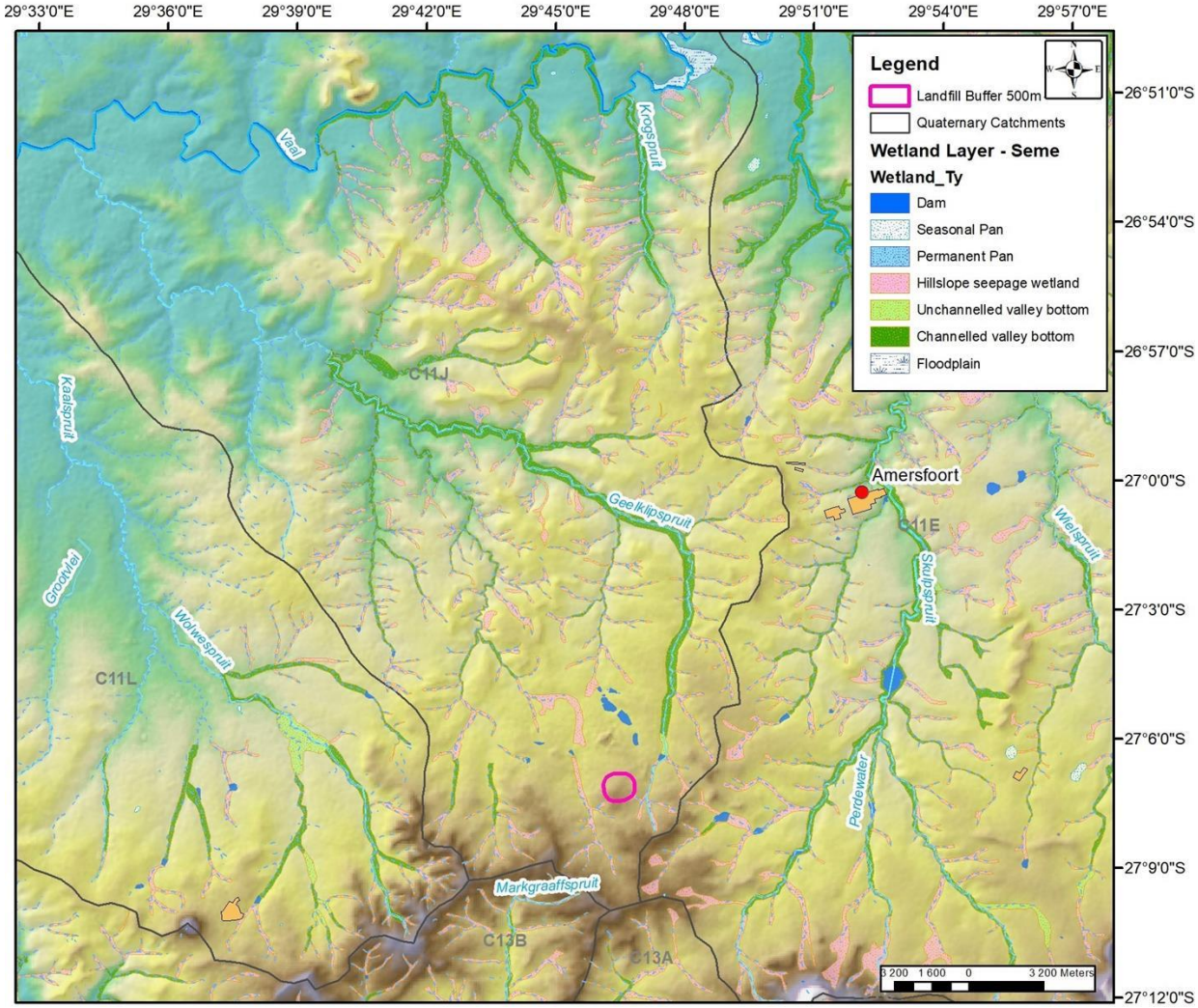


Figure 4-2. Quaternary Catchments

Local Drainage

An existing stormwater berm runs alongside the security fence for the power station, so all surface flow from the proposed alternative landfills will remain south of the berm (Figure 4-3). The proposed waste disposal site alternatives are located on a watershed between two sub-catchments, and surface flows from the either area will run in three possible directions as follows:

- **West.** Runoff from the western portion of the two proposed alternative sites flows west towards an unnamed tributary of the Geelklipsruit. The gradient between the watershed and the western boundary of the Study Area is estimated at around 0.0467, which is classified as “gentle”. The decommissioned landfill is located on this side of the watershed, and runoff from the landfill has been formalised into two primary drainage lines that run along the outer boundary of the landfill and converge in a small pollution control dam;

- **South.** The direction of surface flow from the southern portion of Alternative B is not known for certain but would appear to drain southwards into an unnamed tributary of the

Geelklipsruit, the same as above. The gradient between the southern boundary of Alternative B and nearest wetland is 0.0138, which is classified as “very gentle”; and

- **East.** Surface flow from the eastern portion of the two proposed alternative sites flows east towards the upper reaches of the main Geelklipspruit. The gradient between the watershed and the eastern boundary of the Study Area is estimated at around 0.039, which is classified as “gentle”

(Figure 4-3).

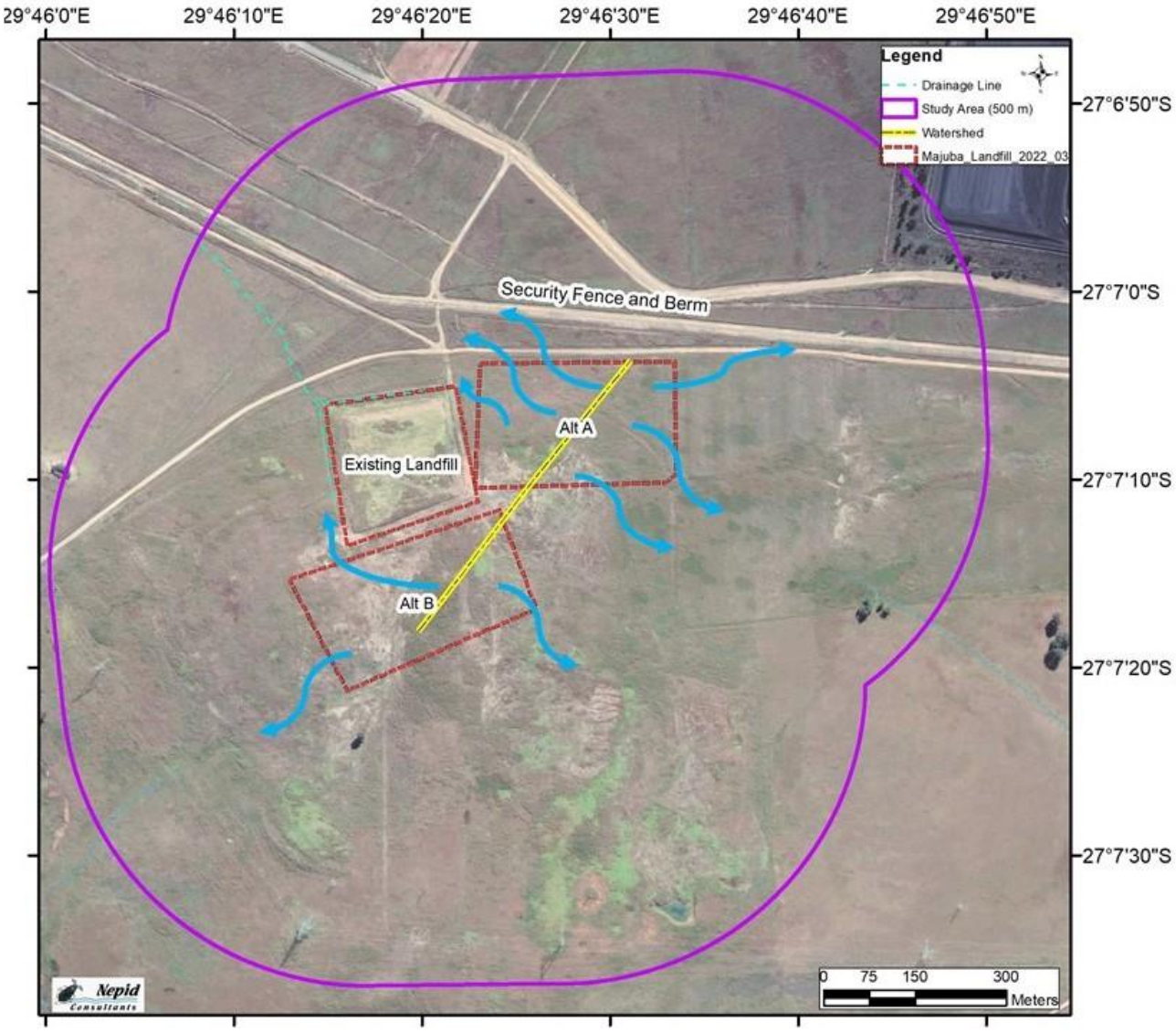


Figure 4-3. Local Drainage

[Image Source: Google Earth 2019-05-19].

4.7 Aquatic Ecosystem Threat Status

The Study Area is located within a National Freshwater Priority Area for rivers (Nel *et al.* 2011).

4.8 Aquatic Ecosystem National Priority Status

No information was available on the Ecological Importance and Sensitivity of aquatic ecosystems as the area falls outside areas that have been rated as such by the Department of Water Affairs and Sanitation (DWS, 2014). However, the Present Ecological State of the upper reaches of the Geelklipspruit (Reach C11J-01968), which borders the Study Area to the east, but outside the likely

Area of Influence of the proposed development, was assessed at a desktop level in 1999 as *Moderately Modified (*Category C). The Ecological Importance of this reach was rated as *High,* and Ecological Sensitivity was rated as *Moderate* (DWS 2014).

4.9 Aquatic Ecosystem Provincial Priority Status

The Mpumalanga Biodiversity Sector Plan Freshwater Assessment classifies most of the Study Area as an *Ecological Support Area (ESA): Important sub-catchment* (Figure 4-4). A small portion in the south-west of the Study Area is classified as an *Ecological Support Area (ESA): Wetlands* (Figure 4-4). The desired management objective for all ESAs is "*to maintain the land in a near-natural and ecologically functional state, even if some loss of ecosystem composition or structure takes place*" (MTPA 2011).

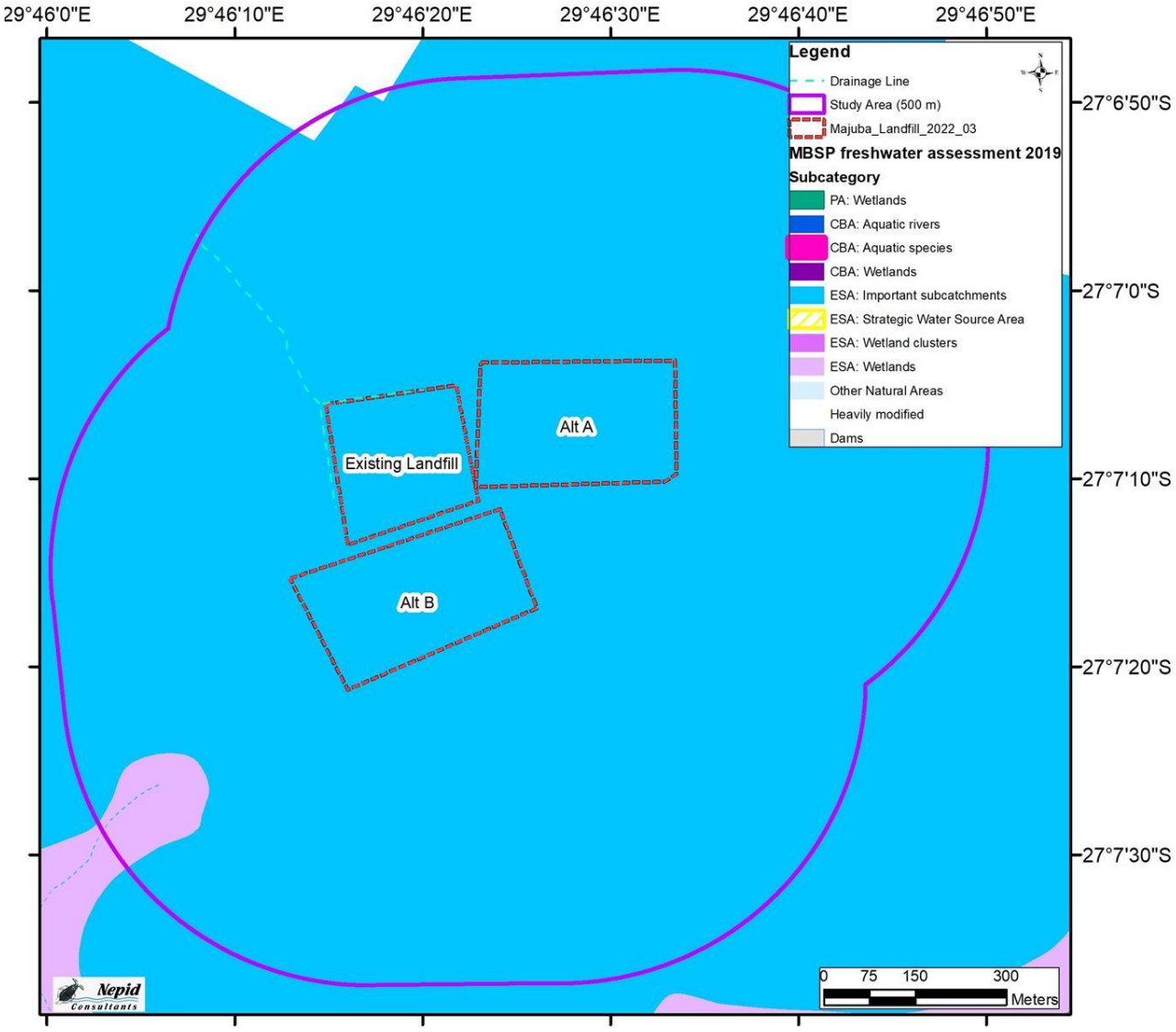


Figure 4-4. Mpumalanga Biodiversity Sector Plan

[Source: MTPA 2019].

4.10 Strategic Water Source Areas

The Study Area is not located within or near a Strategic Water Source Area (*sensu* Proserve 2011). Mean Annual Rainfall is estimated at 735 mm (Hijmans *et al.* 2005).

4.11 Land Use

Land Use in the Study Area in March 2018[1] comprised:

- disturbed grassland, most of which appears to have been cultivated in the past and also disturbed by what appears to be the removal of topsoil, possibly to provide cover for the existing decommissioned landfill. The areas appear not to have been disturbed for the last ten years, so the area is classified as "*virgin soil with indigenous vegetation*" in terms of the National Environmental Management Act (Act No 107 of 1998), Listing Notice 2 (No R 984, 4th December 2014);
- the existing, decommissioned landfill; and
- a network of unpaved roads associated with the operation of the Eskom Majuba Power Station.

(Figure 4-3).

[1] Land Use in March 2022 appears unchanged since March 2018 (Duncan McKenzie, pers. comm).

5. BASELINE ASSESSMENT

5.1 Aquatic Ecosystems Delineation

The delineation of aquatic ecosystems within the Study Area is shown in Figure 5-1.

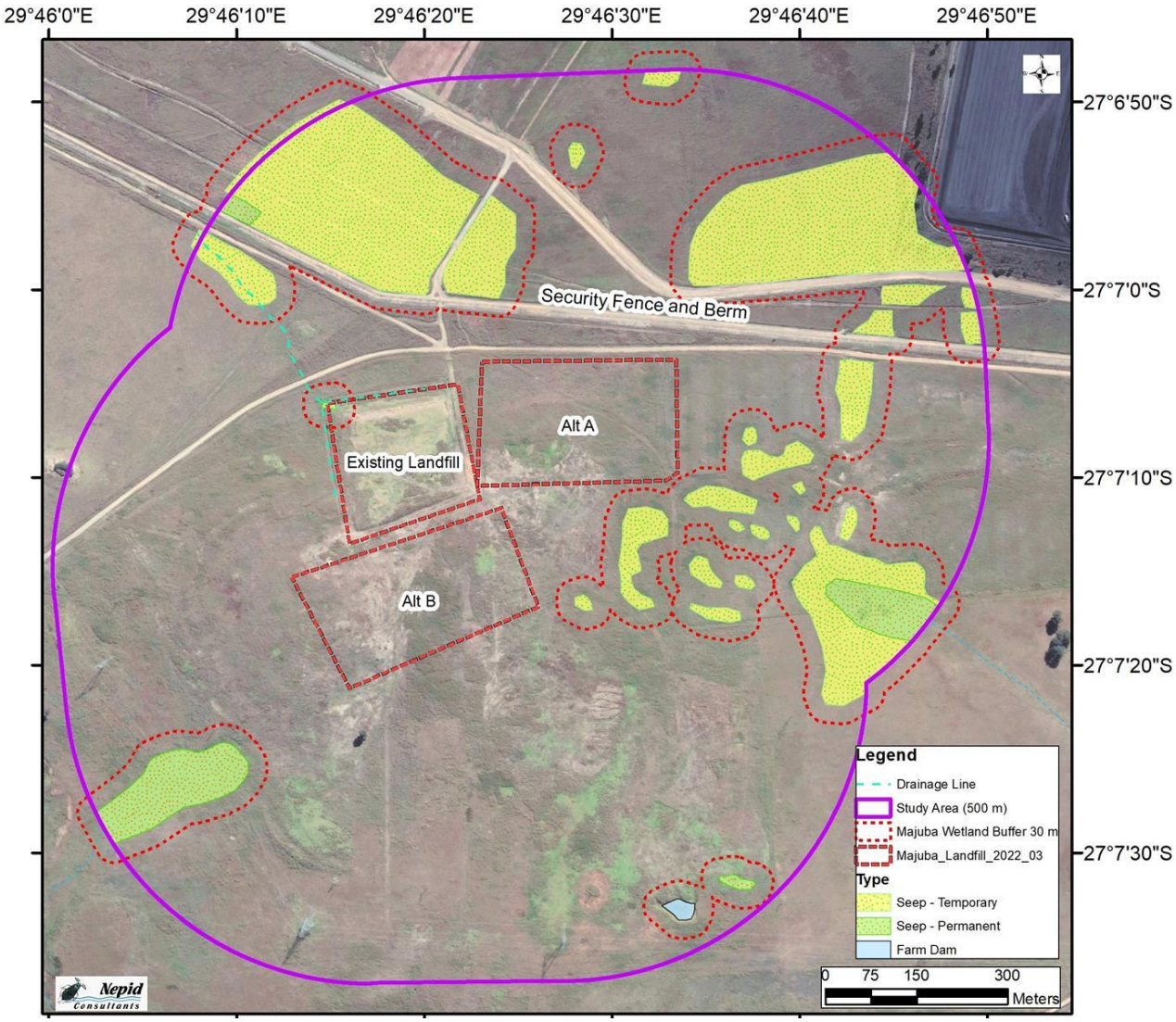


Figure 5-1. Delineation of Aquatic Ecosystems within Study Area

[Image: Google Earth 2019-05-19].

5.2 Aquatic Ecosystem Types

One natural hydro-geomorphic aquatic ecosystem type was identified within the potential Area of Indirect Influence of the two proposed alternative landfill sites as follows:

Type: Seepage Wetland

Description:

- **Seasonal.** The area surrounding the proposed landfill alternatives comprises a complex mosaic of seasonally saturated Seepage Wetlands of variable sizes, ranging from 0.01 to 1.9 hectares. The distance between the proposed landfills and the nearest seasonal wetland is 38 m (Figure 5-1). The hydrological regime of these areas was characterised by seasonal saturation, with short periods of inundation during storm events. Plant species diversity was high, with a total of 51 species (53% of the total list), of which 14 (27%) were alien (Appendix F). These wetlands were characterised by the herbs *Monopsis decipiens* and *Sebaea sedoides.* The comparatively high diversity of plants is unusual for wetlands and reflects a complex mosaic of wetlands of different sizes and different patterns of inundation and saturation.

- **Permanent**. Two Seepage Wetlands were characterised by permanent saturation and seasonal inundation. The vegetation was characterised by the sedges *Juncus exsertus* and *Cyperus nitidus.* A total of 25 species of plant (26% of the total list) was recorded, of which 10 (40%) were alien (Appendix F). The two permanent wetlands were located as follows:

  - ~290 m south-east of Alternative A at their nearest points; and
  - ~190 m south-west of Alternative B at their nearest points

  (Figure 5-1).

Note: The Study Area also has one farm dam in the southern portion of the Study Area (Figure 5-1). This dam was mapped at a desktop level but is unlikely to be impacted by the proposed development, so it was not considered further for the purposes of this report.

Figure 5-2. Photographs of Seepage Wetlands within the Proposed Development Area.

5.3 Aquatic Habitats

Aquatic habitats in Seepage Wetlands comprised mostly seasonally saturated areas with clay substrate characterised by a high diversity of wetland facultative herbs and grasses, and two smaller areas of permanently saturated clays characterised by wetland obligate sedges, herbs and grasses.

5.4 Aquatic Species

The diversity of wetland indicator species within the Study Area was high, with a total of 65 wetland plant species recorded, of which 47 are classified as facultative wetland species, and 18 are classified as obligate wetland species. Aquatic plant species recorded in the seepage wetland include the following:

Obligate Wetland Species

- *Agrostis lachnantha*
- *Berula erecta*
- *Cenchrus geniculatus*
- *Cyperus difformis*
- *Cyperus nitidus*
- *Eleocharis dregeana*
- *Haplocarpha nervosa*
- *Juncus exsertus*
- *Leersia hexandra*
- *Limosella maior*
- *Schoenoplectus decipiens*
- *Typha capensis*
- *Veronica anagallis-aquatica*

Alien

Facultative Wetland Species

- *Berkheya insignis*
- *Berkheya radula*
- *Brachiaria serrata*
- *Cotula anthemoides*
- *Cynodon dactylon*
- *Cyperus congestus*
- *Cyperus esculentus*
- *Cyperus longus*
- *Echinochloa jubata*
- *Geranium multisectum*
- *Haplocarpha scaposa*
- *Hibiscus microcarpus*
- *Hyparrhenia hirta*
- *Imperata cylindrica*
- *Lobelia erinus*

Obligate Wetland Species

- *Salix babylonica **
- *Persicaria lapathifolia **
- *Carex glomerabilis **
- *Lolium perenne **
- *Paspalum distichum **

Facultative Wetland Species

- *Monopsis decipiens*
- *Nidorella podocephala*
- *Salvia repens*
- *Scabiosa columbaria*
- *Sebaea sedoides*
- *Senecio inornatus*
- *Senecio polyodon*
- *Seriphium plumosum*
- *Themeda triandra*
- *Trisetopsis imberbis*
- *Turbina oblongata*
- *Wahlenbergia undulata*
- *Xysmalobium undulatum*

Alien

- *Amaranthus hybridus **
- *Chenopodium schraderianum **
- *Cirsium vulgare *1b*
- *Cosmos bipinnatus **
- *Cuscuta campestris *1b*
- *Cyclospermum leptophyllum **
- *Datura stramonium *1b*
- *Hibiscus trionum **
- *Oenothera rosea **
- *Paspalum dilatatum **
- *Plantago lanceolata **
- *Pseudognaphalium luteoalbum **
- *Ranunculus multifidus **
- *Rumex acetosella **
- *Rumex crispus **
- *Schkuhria pinnata **
- *Tagetes minuta **
- *Trifolium pratense **
- *Verbena bonariensis * 1b*

Photographs of selected wetland obligate plant species are shown in Figure 5-3.
Photographs of selected wetland facultative plant species are shown in Figure 5-4.
Photographs of selected alien plant species are shown in Figure 5-5.
Additional photographs of plant species at Witkoppies are included in Appendix G.

Figure 5-3. Selected Photographs of Obligate Wetlands Plant Species Recorded at Witkoppies

[*A) Cyperus difformis; B) Cyperus semitrifidus; C) Veronica anagallis-aquatica; D) Juncus exsertus; E) Agrostis lachnantha; F) Berula erecta; G) Eleocharis dregeana; H) Limosella maior*].

Figure 5-4. Selected Photographs of Facultative Wetlands Plant Species Recorded at Witkoppies

[*A) Berkheya insignis; B) Hibiscus microcarpus; C) Cotula anthemoides;D) Cyperus congestus; E) Brachiaria serrata; F) Sebaea sedoides; G) Salvia repens; H) Hyparrhenia hirta;I) Nodorella podocephala*].

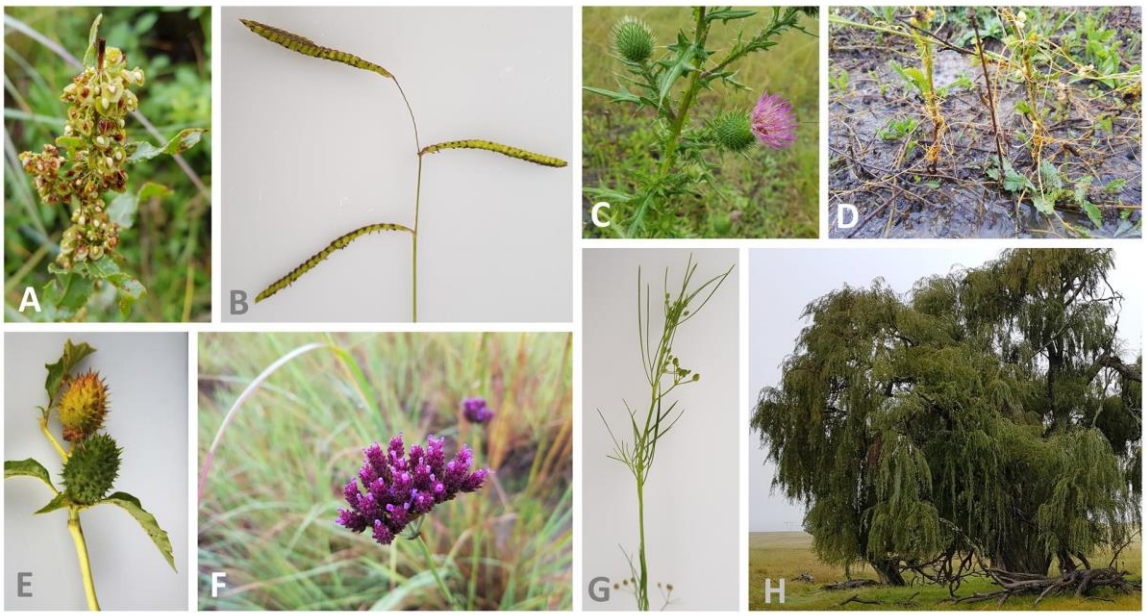


Figure 5-5. Selected Photographs of Alien Plant Species Recorded at Witkoppies

[*A) Rumex acetosella*; B) Paspalum dilatum*; C) Cirsium vulgare*; D) Cuscuta cappestris*; E) Datura stramonium*; F) Verbena bonariensis*; G) Cyclospermum leptophyllum*; H) Salix babylonica**].

5.5 Soils

Two soil forms were identified in the Potential Area of Influence and classified according to the South African Soil Classification Working Group as follows (SCWG 2018):

- **Rensburg Soil Form,** a vertic, hydromorphic (wetland) soil, characterised by a dark vertic A-horizon and underlain by glued subsoil (Figure 5-6a&b). These soils were confined mostly to the permanent seepage wetland, but localised areas with gilgai, indicative of seasonal saturation, were also present in places; and

- **Kroonstad Soil Form,** characterised by an Orthic A-horizon with grey, low chroma colours with no mottling; and found in areas of seasonal semi-permanent wetness (Figure 5-6c&d). These soils covered most of the Study Area, and were wet, deep and uniform along the catena, with no significant changes in colour or texture between crests and valley bottoms. The soils are largely impermeable when wet, so infiltration of rainfall is low, and runoff is high.

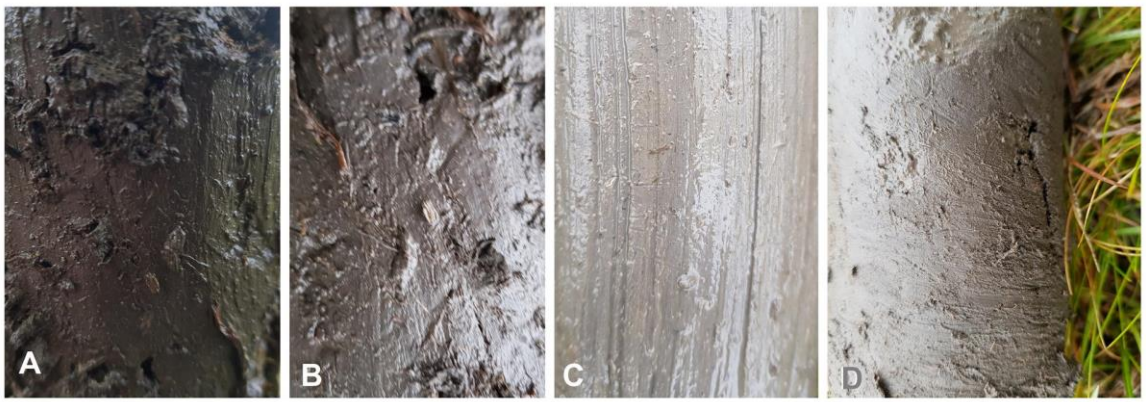


Figure 5-6. Soil Profiles.

[A&B) Rensburg Soil Formation; C&D) Kroonstad Soil Formation].

5.6 Migration Patterns

No migratory aquatic species were recorded or expected within the Study Area. Furthermore, aquatic ecosystems within the Study Area are unlikely to be an important corridor because of the location of the Study Area on a watershed.

5.7 Reference Ecological State

Reference conditions of the seepage wetlands investigated for this report are unknown but are likely to have been structurally similar to current conditions, but without any erosion, woody vegetation or alien vegetation.

5.8 Present Ecological State

The Present Ecological State of the Seasonal Seepage Wetlands within the Study Area in March 2018 was rated as *Moderately Modified* (Category C), while that of the permanent natural Seepage Wetlands was rated as *Largely Natural* (Category B). Details of the assessment are presented in Appendix H. The main existing impacts on aquatic biodiversity within the Study Area in March 2018 comprised the following:

- **Hydraulics.** The patterns of surface flow in the Study Area were modified by various factors, including 1) access roads (Figure 5-7a); 2) a stormwater berm that runs along the perimeter fence of the Power Station; 3) former cultivation and associated drainage networks; and 4) the existing, closed landfill that served to concentrate surface runoff to the west. There was slight evidence of head-cut erosion of Seepage Wetlands west of the local watershed, as shown in Figure 5-7b; and

- **Alien Vegetation.** The Seepage Wetland supported moderate abundance and diversity of opportunistic and alien plant species (Appendix F).

a) Stormwater runoff along service road.

b) Head-cut erosion of Seasonal Seepage Wetland downstream of existing, closed landfill.

Figure 5-7. Photographs of Stormwater Runoff and Erosion

5.9 Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity of seasonal and permanent Seepage Wetlands in the Study Area was rated as *Low* (Table 5-1). The following section details the assessment.

Table 5-1. Ecological Importance and Sensitivity

Parameter	Seasonal Seeps	Permanent Seep
Ecological Importance	2.2	1.5
Hydro-Functional Importance	0.9	2.4
Direct Human Benefits	0.2	0.7
Average	**1.1**	**1.5**

Scoring: 0=None; 1=Low; 2=Moderate; 3=High; 4 = Very High

Ecological Importance

Ecological Importance of Seasonal Seeps in the Study Area was rated as *Moderate*, whereas the Ecological Importance of the Permanent Seep was rated as borderline *Low* to *Moderate* (Table 5-2). No Red Data species are expected in the Seasonal Seeps in the Study Area, but at least two species of Red Data mammals (Serval and Cape Clawless Otter), and one species of Red Data bird species (African Marsh Harrier), are likely to occur periodically in the Permanent Seep. No Odonata species of conservation concern are expected in the Study Area (Appendix I). There were no unique species or uncommonly large populations of species in the two wetland types within the Study Area. Seasonal Seeps within the Study Area are likely to provide seasonal foraging habitat for a range of species, while the Permanent Seep is likely to provide foraging as well as breeding habitat for a range of species. The two wetland types are unimportant as migration corridors because of their location in the upper catchment. Aquatic ecosystems in the Study Area have no formal protection status, so protection status of the ecosystems was rated as *Zero.* The Study Area is located within **Amersfoort Highveld Clay Grassland** (Gm 13), which is not listed as threatened (Notice 1002 of Government Gazette 34809, 9 December 2011). None of this vegetation type is formerly conserved, and some 25% has been transformed mostly by cultivation (22%) (Mucina and Rutherford 2006). Regional context of ecological integrity of the Seepage Wetlands was rated as *High* because the Mpumalanga Biodiversity Sector Plan classifies part of the area as a "Critical Biodiversity Area" (MTPA 2011). The size and rarity of Seasonal Seeps was rated as *Moderate*, as although these wetlands comprise mostly small patches, together they constitute a significant ecological feature in the landscape that is restricted to hillslopes with vertic soils, which is unusual. The Permanent Seep is typical of Hillslope Seeps, which are common in the area, and therefore rated as *Low* in terms of size and rarity. Diversity of aquatic habitats in Seasonal Seeps was rated as *High* because of the wide range in wetland sizes and associated likely range in local hydraulic conditions. By contrast, the diversity of aquatic habitats in the Permanent Seep was comparatively uniform and therefore rated as *Low.* The two wetland types in the Study Area are not driven by high flow events, so sensitivity to changes in floods was rated as *Zero* for both types of wetlands. Seasonal Seeps tolerate variation in low flows, so their sensitivity to changes in low flow was rated as *Low*. By contrast, the Permanent Seep is highly sensitive to changes in low flow, so this was rated as *Very High.* Sensitivity to changes in water quality was rated as *Very Low* for the two wetland types as soils are highly buffered and therefore able to tolerate change in water quality.

Table 5-2. Ecological Importance

Parameter	Seasonal Seeps	Permanent Seep
Biodiversity support	**0.3**	**1.3**
Red Data species	0.0	2.0
Unique species	0.0	0.0
Migration/breeding/feeding	1.0	2.0
Landscape scale	**2.2**	**1.4**
Protection status of wetland	0.0	0.0
Protection status of vegetation type	2.0	2.0
Regional context	3.0	3.0
Size and rareity	3.0	1.0
Diversity of habitats	3.0	1.0
Sensitivity of the wetland	**0.5**	**1.5**
Sensitivity to floods	0.0	0.0
Sensitivity to low flows	1.0	4.0
Sensitivity to water quality	0.5	0.5
	2.2	**1.5**

Scoring: 0=None; 1=Low; 2=Moderate; 3=High; 4 = Very High

Functional Importance

The Functional Importance of Seasonal Seeps in the Study Area was rated as *Low*, whereas the functional importance of the Permanent Seep was rated as *Moderate to High* (Table 5-3). Seasonal Seeps in the Study Area have an insignificant role in terms of flood attenuation because of their small size and vegetation structure. By contrast, the Permanent Seep has a gentle gradient and dense vegetation and is considered moderately important for flood attenuation. Seasonal Seeps in the Study Area appear to contribute little in terms streamflow regulation, whereas the contribution of the Permanent Seep to streamflow regulation was rated as *High.* Seasonal Seeps in the Study Area do not contribute significantly to sediment trapping because of their small catchment areas, gradient, and limited vegetation growth. By contrast, the Permanent Seep has a gentle gradient and dense emergent aquatic vegetation and plays a highly significant role in sediment trapping. Both wetland types in the Study Area receive inputs of phosphate from livestock that use the wetlands for grazing. Seasonal Seeps are likely to provide moderate assimilation of nutrients and toxins during the wet season, and close to zero assimilation during the dry (winter) season. By contrast, the Permanent Seep is likely to assimilate nutrients and toxins throughout the year. This seep contains an abundance of emergent aquatic vegetation, and this provides opportunity for plant uptake and large surface area for bacterial colonisation. The potential for nutrient and toxin assimilation by the Seasonal Seeps was therefore rated as *Low,* whereas the Permanent Seep was rated as having *High* importance in terms of nutrient and toxin assimilation. Seasonal Seeps in the Study Area contribute significantly to erosion control because of the steep gradient in many of these areas. By contrast, the risk of erosion at the Permanent Seep is comparatively low because of the lower gradient. Carbon storage within the Seasonal Seep was rated as *Zero* because of the absence of woody vegetation and grey soils. By contrast, carbon storage in the Permanent Seep was rated as *Moderate* because a few [alien] trees were present (*Salix babylonica*), and black soils suggested elevated levels of carbon.

Table 5-3. Functional Importance

Parameter	Seasonal Seeps	Permanent Seep
Flood attenuation	0.5	2.0
Streamflow regulation	0.5	3.5
Sediment trapping	0.5	3.0
Phosphate assimilation	0.5	3.5
Nitrate assimilation	1.0	2.0
Toxicant assimilation	1.0	2.0
Erosion control	3.0	1.0
Carbon storage	0.0	2.0
	0.9	**2.4**

Scoring: 0=None; 1=Low; 2=Moderate; 3=High; 4 = Very High

Direct Human Benefits

The direct human benefits of Seasonal Seeps in the Study Area were rated as close to *Zero*, whereas the direct human benefits of the Permanent Seep were rated as *Low* (Table 5-4). Seeps in the Study Area do not appear to be used for any direct human use. By contrast, the Permanent Seep is used by livestock for drinking. Seasonal Seeps in the Study Area are grazed by livestock, at least during the summer season. By contrast, the Permanent Seep is likely to be used for livestock grazing throughout the year. There was no evidence of subsistence cultivation within the Seepage Wetlands. The importance of Seepage Wetlands in the Study Area to cultural heritage is unknown, but most likely *Zero* for the two wetlands. The importance of the two wetland types to tourism and recreation is almost certainly *Zero*. The importance of the two wetlands to education and research is almost certainly *Zero.*

Table 5-4. Direct Human Benefits

Parameter	Seasonal Seeps	Permanent Seep
Water for human use	0.0	2.0
Harvestable resources	1.0	2.0
Cultivated foods	0.0	0.0
Cultural heritage	0.0	0.0
Tourism and recreation	0.0	0.0
Education and research	0.0	0.0
	0.2	**0.7**

Scoring: 0=None; 1=Low; 2=Moderate; 3=High; 4 = Very High

6. IMPACTS AND MITIGATION

This section details potential impacts of the proposed development to aquatic biodiversity.

Construction Phase

6.1 Impact of Site Preparation on Siltation of Aquatic Habitats

Nature: Bulk earthworks and vegetation clearing associated with the proposed landfill and associated access road are likely to mobilise sediments during storm events during construction, and this could increase siltation of downstream watercourses, and in doing so, impact negatively on aquatic biodiversity.

	Alternative A		**Alternative B**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Site (1)	Local (2)	Site (1)
Duration	Long-term (5)	Medium-term (3)	Long-term (5)	Medium-term (3)
Magnitude	Moderate (6)	Low (4)	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Probable (3)	Highly Probable (4)	Probable (3)
Significance	**Medium (52)**	**Low (24)**	**Medium (52)**	**Low (24)**
Status	Negative	Negative	Negative	Negative
Reversibility	Medium	Medium	Medium	Medium
Irreplaceable loss of resources?	No	No	No	No
Can impacts be mitigated?	Yes	-	Yes	-

Mitigation/Enhancement Measures:

Planning Phase

Wetland Buffer Zone. A buffer zone of no development within 30 m from the outer edge of the Seepage Wetland is recommended, as shown in Figure 5-1. The aim of the buffer zone is to maintain the ecological integrity and functioning of the Seepage Wetlands by minimising indirect impacts that could be associated with the proposed landfill. A buffer zone of 30 m is recommended because:

- soils in and around the wetland have low permeability which means that ingress is low and runoff is high, so a wide buffer zone is appropriate;
- the slope of the surrounding topography is gentle but has been observed to be sufficient to generate significant surface runoff during storm events, so a wide buffer zone is appropriate;
- the Present Ecological State of the Seasonal Wetlands is *Moderately Modified* (Category C), while that of the Permanent Seepage Wetlands is *Largely Natural* (Category B), so a wide buffer zone is appropriate;
- wetland boundaries within the potential Areas of Indirect Impact are considered accurate to within 15 m, so a wide buffer zone is appropriate;
- the wetlands remain functionally intact and provide important ecological goods and services, including biodiversity support, grazing for cattle, and nutrient assimilation, so a wide buffer is appropriate so as to protect these services; and
- vegetation cover in and around the landfill is generally sparse, and this is likely to be more so after fire, so a wide buffer zone is appropriate.

Stormwater Management Plan. A Stormwater Management Plan must be developed for the proposed development and the associated access road and parking area. The design of the stormwater system must aim to reduce risks of sediment transport and water quality deterioration by:

- design and operation to ensure zero seepage of leachate into the receiving watercourse;

- separation of clean and dirty stormwater runoff;
- clean stormwater runoff from the proposed landfill must be managed to avoid elevated peak flows from impacting on watercourses. High water velocity greatly increases the erosion risk so drains that convey such water should contain energy brakes, such as lining with stones, concrete, grass or gabions to reduce the water velocity and therefore erosion;
- use of multiple smaller discharges rather than a few large discharges;
- dirty stormwater must be captured by inner perimeter drains and contained in a leachate sump or sumps with sufficient capacity to hold runoff 1:100 year flood event;
- appropriate diversion of stormwater runoff from existing and proposed access to avoid siltation of watercourses.
- retention ponds, where appropriate, to reduce the magnitude of stormwater flows; and
- swales, where appropriate, to improve the quality of seepage water.

Construction Phase

Environmental Compliance Officer (ECO). An independent ECO must be appointed by the developer to monitor compliance with the Environmental Authorisation (EA) during construction. The ECO must be appointed prior to commencement of construction and be involved in all aspects of project planning that can influence environmental conditions on the site. Where possible, the ECO must attend relevant project meetings, conduct inspections to assess compliance with the EA and relevant Health and Safety regulations, and be responsible for providing feedback on potential environmental problems associated with construction; and

Construction Schedule. Bulk clearing of vegetation should be restricted to the dry months between April and September.

Residual Risks:

The residual risk of site preparation on siltation of aquatic habitats is rated with high confidence as **Low.**

Operational Phase

6.2 Impact of Seepage and Stormwater Runoff from Landfill on Water Quality

Nature: Seepage of polluted leachate and runoff of polluted stormwater from the proposed landfill could impact negatively on the quality of surface water in receiving watercourses for the duration of the Operational Phase, and this could lead to a reduction in aquatic biodiversity.

	Alternative A		**Alternative B**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Site (1)	Local (2)	Site (1)
Duration	Long-term (5)	Long-term (5)	Long-term (5)	Long-term (5)
Magnitude	High (8)	Low (4)	High (8)	Low (4)
Probability	Highly Probable (4)	Probable (3)	Highly Probable (4)	Probable (3)
Significance	**Medium (60)**	**Medium (30)**	**Medium (60)**	**Medium (30)**
Status	Negative	Negative	Negative	Negative
Reversibility	Medium	Medium	Medium	Medium
Irreplaceable loss of resources?	No	No	No	No
Can impacts be mitigated?	Yes	-	Yes	-
Mitigation/Enhancement Measures:				
Wetland Buffer Zone. (As above)				

Stormwater Management Plan. (As above)

National Norms and Standards for the Storage of Waste. The National Norms and Standards for the Storage of Waste, as promulgated in Government Notice 926 on 29th November 2013, must be adhered to.

Minimum Requirements for Waste Disposal. The minimum requirements for waste disposal (DWAF 2005b), should be adhered to.

Leachate Management. All leachate must be directed to the Leachate Evaporation Pond. All leachate must be considered as hazardous and disposed of accordingly. Appropriate methods of disposal of leachate are detailed by Schoeman *et al*. (2003). Leachate with low salinity (<50 g/ℓ) should be treated using reserve osmosis (Scheoman *et al.* 2003). Leachate with high salinity (>50 g/ℓ) should be pre-treated with adsorbents, absorbents (ash), or flocculants prior to electrodialysis desalinisation, followed by reserve osmosis (Scheoman *et al.* 2003). Discharge of untreated leachate from the disposal site shall not be allowed.

Dirty Stormwater Management. All dirty stormwater must be directed to the Stormwater Evaporation Pond. All dirty stormwater must be considered as hazardous and disposed of accordingly (As above).

Residual Risks:

The residual risk of water quality deterioration caused by the proposed development on aquatic biodiversity is rated, with moderate confidence, as **Low.**

6.3 Impact of Stormwater Runoff from Landfill on Erosion of Wetland Habitats

Nature: The proposed landfill will alter the patterns and intensity of surface runoff, and this is likely to increase the risks of head-cut erosion in receiving watercourses. Low levels of head-cut erosion were observed in seasonal seepage wetlands downslope of the existing landfill during the baseline survey in March 2018. The erosion is attributed to increased magnitude of stormwater runoff from the landfill and access roads.

	Alternative A		**Alternative B**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Site (1)	Site (1)	Site (1)	Site (1)
Duration	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Minor (2)	Low (4)	Minor (2)
Probability	Highly Probable (4)	Improbable (2)	Highly Probable (4)	Improbable (2)
Significance	**Medium (40)**	**Low (16)**	**Medium (40)**	**Low (16)**
Status	Negative	Negative	Negative	Negative
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceable loss of resources?	No	No	No	No
Can impacts be mitigated?	Yes	-	Yes	-

Mitigation/Enhancement Measures:

Location. The location of the two proposed landfill options on a watershed between two sub-catchments significantly reduces the intensity of runoff.

Wetland Buffer Zone. (As above)

Stormwater Management Plan. (As above)

Residual Risks:

The residual risk of stormwater runoff on erosion of wetland habitats is rated with moderate confidence as **Low.**

6.4 Cumulative Impacts

Nature: Future developments in the area are not known for certain, but there are plans for development of a solar energy facility (Savannah 2015). Cumulative impacts of the proposed landfill and the proposed future developments on aquatic biodiversity are likely to arise from:

- deterioration of surface water quality associated with seepage and stormwater runoff from the proposed landfill; and
- increased erosion associated with increased hardening of surface and diversion of stormwater flows.

The footprint of likely future developments, such as the proposed power station expansion and proposed solar facility, are within the power station security fence boundary, and these areas are already impacted and partially transformed. Future developments beyond the power station security fence boundary are unknown, but examination of the 1:50 000 scale topographical map (undated) for the area indicates extensive areas of cultivation. Most of the areas that were formerly cultivated and are currently lying fallow. This suggests that there has been a decline in the cultivation over the years. This trend is likely to continue and have positive implications for aquatic biodiversity. The area of the proposed landfill is small compared to the areas of cultivated lands that are likely to become fallow over time, and this trend could offset any negative cumulative impacts of the proposed landfill on aquatic biodiversity.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Site (1)	Local (2)
Duration	Medium-term (3)	Long-term (5)
Magnitude	Minor (2)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (12)**	**Low (22)**
Status (positive or negative)	Negative	Positive
Reversibility	Medium	Low
Irreplaceable loss of resources?	No	Yes
Can impacts be mitigated?	Yes	Yes
Confidence in findings: Low.		
Mitigation: • Manage and monitor stormwater runoff.		

7. RISK ASSESSMENT

This section details the residual risks of the proposed development to aquatic biodiversity in terms of the Department of Water Affairs Risk Assessment Matrix. Details of the Risk Assessment are included in Appendix J.

Construction Phase

7.1 Risk of Site Preparation on Siltation of Aquatic Habitats

The residual severity of site preparation on the flow regime are likely to be negligible, so this aspect was rated as "1". The severity on water quality and biota is potentially harmful, so these aspects were rated as "2". Sedimentation could pose a significant negative risk to aquatic habitats, so this aspect was rated as "3". The total length of aquatic habitat that could be impacted indirectly by sediment deposition is estimated at no more than ~200 m, so the spatial scale was rated as "2". The duration of this impact could be long-lasting, but potentially reduced by mitigation, so duration was rated as "2". The frequency of activity could be with each major storm event during construction, so frequency was rated as "2". The probability of increased sediment deposition is unlikely, so this was rated "3". Habitat disturbance and sediment deposition may be observed with little effort, so detection was rated as "2". The overall risk of siltation of aquatic habitats that could be caused by site preparation is rated, with high confidence, as **Low.**

Operational Phase

7.2 Risk of Seepage and Stormwater Runoff from Landfill on Water Quality

The residual severity of seepage and stormwater runoff on water quality remains potentially harmful, so this aspect was rated as "4". The severity of this impact on the flow regime is likely to be negligible, so this was rated as "1". The severity of this impact on biota and habitats is potentially harmful, so these aspects were rated as "2". The total length of aquatic habitat that could be impacted indirectly by polluted seepage and dirty stormwater runoff is estimated at no more than the ~500 m, so the spatial scale was rated as "2". The duration of this impact could continue for the duration of operation, so duration was rated as "4". The frequency of activity could be with each major storm event during operation, so frequency was rated as "2". The probability of increased seepage and polluted stormwater is likely, so this was rated "5". This rating was based on visual examination of the decommissioned landfill, which indicated potential periodic runoff of polluted stormwater. Water quality monitoring shows no evidence of contamination, but could occur, so detection was rated as "3". The overall risk of water quality deterioration that could be caused by seepage and stormwater during operation is rated, with moderate confidence, as **Low.**

7.3 Risk of Stormwater Runoff from Landfill on Erosion of Wetland Habitats

The residual severity of stormwater runoff on the flow regime remains slightly harmful, so this aspect was rated as "3". The severity of this impact on water quality and biota are likely to be zero, so these aspects were rated as "1". The severity of this impact on aquatic habitats is potentially harmful, so this aspect was rated as "2". The total length of aquatic habitat that could be impacted indirectly by erosion is expected to be localised, so the spatial scale was rated as "1". The duration of this impact could be permanent, so duration was rated as "5". The frequency of activity could be with each major storm event during operation, so frequency was rated as "2". The probability of increased stormwater runoff is highly likely, so this aspect was rated "5". Erosion is easily observed, so detection was rated as "1". The overall risk of erosion caused by stormwater runoff during operation is rated, with moderate confidence, as **Low.**

8. RECOMMENDATIONS

8.1 Preferred Alternative

GENERAL WASTE DISPOSAL SITE AT THE ESKOM MAJUBA POWER STATION		
Alternative	**Preference**	**Reasons**
Alternative A	Acceptable	This site will have no direct impacts on aquatic biodiversity and the residual impacts and risks to aquatic ecosystems are **Low.** Furthermore, there is no measurable difference between the two alternatives in terms of potential impacts on aquatic biodiversity.
Alternative B	Acceptable	As above.

8.2 Authorisation

Authorisation of either of the two proposed waste disposal site alternatives in terms of risks to aquatic biodiversity is recommended on the grounds that:

- **Aquatic Habitats**. There are no aquatic habitats within the two proposed footprint areas, so the proposed development will have no direct impacts on aquatic biodiversity. The closest seasonal wetlands are some 80 m from the nearest proposed landfill, while the closest permanent wetland is some 320 m from the nearest proposed landfill;
- **Soils.** Soils within the proposed development area comprise gleyic soils of the Kroonstad Soil Formation, and these are suited to landfill development because they have a high clay content, low permeability and good buffering capacity;
- **Present Ecological State.** The potential development footprint is located in an area that has been disturbed by what appears to be historical cultivation and removal of topsoil for the existing, decommissioned landfill. Examination of available imagery suggests that the Present Ecological State of aquatic ecosystems within the potential Area of Indirect Influence in March 2018 appeared to have improved, despite surrounding development. The improvement is attributed to reduced cultivation in the area. The positive impacts of declining cultivation on aquatic biodiversity in the area over time are likely to override the negative impacts of the proposed landfill and other planned developments, as the later have a small footprint compared to areas under cultivation;
- **Ecological Connectivity.** The proposed development is not expected to impact longitudinal or lateral ecological connectivity, or the migration of aquatic species, because the proposed landfill is located on the watershed between two sub-catchments;
- **Ecological Importance and Sensitivity.** The proposed development is not expected to impact measurably on any threatened aquatic species;
- **Irreplaceable Resources.** The proposed development is not expected to cause the loss of any irreplaceable aquatic resources;
- **Mitigation.** most of the negative impacts of the proposed development on ecological functions can be avoided or mitigated through careful design and operation;
- **Hydrological Functions.** The proposed development could impact local hydraulic conditions and this may impact on hydrological functions in terms of elevated magnitude of stormwater, but any such impacts are likely to be localised and can be managed with appropriate Stormwater Management;
- **Sediment Transport.** The proposed development could increase sediment transport, especially during construction. However, the potential impacts on sediment transport are likely to be localised and can be minimised through appropriate scheduling, and managed with appropriate Stormwater Management;

- **Water Quality.** Surface and groundwater quality deterioration associated with the proposed development is the main potential issue of concern with respect to potential impacts on aquatic ecosystems. While of concern, these can be monitored and managed;
- **Water Users and Uses**. The proposed developments are not expected to have measurable impacts on other water users or uses; and
- **Key Ecosystem Services.** The proposed development is not expected to impact measurably on ecosystem services.

8.3 Monitoring

Construction Phase

- **Housekeeping.** Regular housekeeping inspections by the Environmental Compliance Officer (ECO) are recommended during construction. The recommended frequency of such inspections during initial construction is weekly, but the frequency of inspections may be changed, pending the severity of impacts identified. The aim of the inspections is to ensure that the control measures detailed in the EA are adhered to. All watercourses within the potential Area of Influence must be inspected for signs of sediment transport and deposition, and water quality deterioration, especially after storm events. Immediate corrective action must be taken if inspections identify any failures to comply.

Operational Phase

- **Housekeeping.** Periodic housekeeping inspections by the developer are recommended during operation. The recommended frequency of such inspections during initial operation is 6-monthly, but the frequency of inspections may be changed, pending the severity of impacts identified. The aim of the inspections is the same as for the Construction Phase (above). Immediate corrective action must be taken if inspections identify any failures to comply.

- Leachate Monitoring. A system

Monitoring of aquatic ecosystems is not considered necessary because the low potential impacts that the proposed development is expected to have if the recommended mitigation measures are adhered to.

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10. APPENDICES

Appendix A: SACNASP Certificate

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Robert William Palmer

Registration Number: 400108/95

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Biological Science (Professional Natural Scientist)

Effective 25 October 1995 Expires 31 March 2023

Chairperson

Chief Executive Officer

To verify this certificate scan this code

Appendix B: SASS5 Certificate

NATIONAL AQUATIC ECOSYSTEM HEALTH MONITORING PROGRAMME

Water and Sanitation

Environment Affairs

Water Research Commission

CERTIFICATE OF ACCREDITATION

This is to certify that

Rob Palmer

has met the requirements of the
River Health Programme as a SASS5 Practitioner

COMPETENCY IN THE FOLLOWING AREAS HAVE BEEN DEMONSTRATED:

UNDERSTANDING OF THE SCOPE AND APPLICATION OF THE SASS5 METHOD.

DEMONSTRATION OF THE CORRECT SAMPLING PROTOCOLS

DEMONSTRATION OF THE CORRECT SAMPLE PREPARATION PROTOCOLS

IDENTIFICATION OF AQUATIC MACROINVERTEBRATES

COMPETENCY IS VALID FOR 3 YEARS FROM CERTIFICATE DATE

NATIONAL SASS5 AUDITOR

13 April 2019
DATE

Appendix C: Curriculum Vitae

Curriculm Vitae: One Page — **Robert William Palmer**

Profession	:	**Aquatic Ecologist**
Date of Birth	:	15 Dec 1961
Name of Firm	:	Nepid Consultants CC
Position in Firm	:	Director
Years with Firm	:	16
Years' Experience	:	30
Nationality	:	South African
Place of birth	:	Grahamstown, South Africa
Marital Status	:	Married

Summary

Rob is an aquatic ecologist with a PhD in Zoology from Rhodes University, South Africa. He has over 30 years' experience as an independent consultant. He has specialist knowledge of the biodiversity of African rivers and wetlands, including aquatic flora, invertebrates and fish. He has participated in numerous ESIAs throughout Africa, many to environmental standards required by the IFC or World Bank. He has been a team leader for various mining and water resource development projects and environmental impact assessments involving coordination of multi-disciplinary teams. He is a member of the SA Council for Natural Scientific Professions and an accredited SASS5 biomonitoring practitioner.

Qualifications:

• PhD [Zoology]	Rhodes University, Grahamstown, RSA	1992
• BSc (Hons) [Mammalogy]	Pretoria University, RSA	1985
• BSc [Zoology]	University of Cape Town, RSA	1984

Professional Registrations:

- SA Council for Natural Scientific Professions (Biological Science): No 400108/95
- SASS5 Accreditation (Dept. Water Affairs & Sanitation)

Professional Societies

- International Association for Impact Assessment (South Africa)
- Southern African Society of Aquatic Scientists

Languages:

	Speaking	Reading	Writing
English (home):	Excellent	Excellent	Excellent
Afrikaans:	Good	Good	Poor
Xhosa:	Fair	Poor	Poor
Portuguese:	Poor	Fair	Poor

Countries of Work Experience (short-term consultancies):

Southern Africa:	Angola, Lesotho, Malawi, Namibia, South Africa, Swaziland, Zambia
East Africa:	Eritrea, Ethiopia, Mozambique, Tanzania, Uganda
West Africa:	Burkina Faso, Guinea, Mali, Sierra Leone
Central Africa:	Cameroon, DRC
North Africa:	Morocco
Asia:	Afghanistan (virtual)

Key Qualifications: Freshwater Biodiversity - Rivers & Wetlands

Employment Record:

2005 – present	Nepid Consultants CC	Founder Director
2021 – present	World Bank	Short-Term Consultant (S Asia)
1997 – 2004	AfriDev Consultants Pty Ltd	Associate from 1997; Director from 2000
1991 – 1997	Onderstepoort Veterinary Institute	Research Fellow
1986 – 1991	Rhodes University	PhD Student

Contact Details: email: rob@nepid.co.za; Tel: +27(0)82 574 4486; PO Box 4349, White River, 1240, RSA
website: https://nepid.co.za/ ; Linkedin: www.linkedin.com/in/palmer-rob

Dated: 3rd January 2022

Page 1

Appendix D: Declaration of Independence

The Specialist Appointed in terms of the Regulations

I, **Robert William Palmer**, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that I:

- in terms of the general requirement to be independent (tick which is applicable):

✓	other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
	am not independent, but another EAP that is independent and meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);

- have expertise in conducting specialist work as required, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- will ensure compliance with the EIA Regulations 2014;
- 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 application;
- will take into account, to the extent possible, the matters listed in regulation **18** of the regulations when preparing the application and any report, plan or document relating to the application;
- will disclose to the proponent or applicant, registered interested and affected parties 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 or the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority (unless access to that information is protected by law, in which case I will indicate that such protected information exists and is only provided to the competent authority);
- declare that all the particulars furnished by me in this form are true and correct;
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist

Nepid Consultants CC

Name of company

2022-01-03

Date

Signature of the Commissioner of Oaths for project/application:

2022/01/03

Date:

Designation:

Official stamp (below):

2022 -01- 03

SOUTH AFRICAN POLICE SERVICE

Appendix E: Baseline Photographs

A) Option A

A01) (2018-03-23: S27.118370; 29.774070).

A02) (S27.118579; E29.773531).

A03) (S27.118025; E29.773258).

A04) (S27.118474; E29.77497).

A05) (S27.118728; E29.774173).

A06) (S27.118681; E29.774762).

B) Option B

B01) Area with topsoil stripped (S27.121054; E29.771979).

B02) Trig beacon (S27.121370; E29.771931).

B03) Rubble (S27.121422; E29.771560).

Appendix F: Detailed Data - Plant Species List

E1) Plant species recorded in the Study Area within Witkoppies 81HS in March 2018.

Family	Species	Common Name	Growth form	Grassland	Seasonal	Permanent
Monocots						
Anthericaceae	*Chlorophytum sp.*	-	herb	1	-	-
Cyperaceae	*Carex glomerabilis* *	Foxtail sedge	sedge	-	2	3
Cyperaceae	*Cyperus difformis*	Smallflower umbrella sedge	sedge	-	3	2
Cyperaceae	*Cyperus esculentus*	Yellow nutsedge	sedge	2	2	-
Cyperaceae	*Cyperus longus*	Sweet cyperus	sedge	-	-	2
Cyperaceae	*Cyperus uitenhagensis*	-	sedge	1	2	-
Cyperaceae	*Eleocharis dregeana*	Finger sedge	sedge	-	-	2
Cyperaceae	*Mariscus congestus*	Hedgehog sedge	sedge	-	2	3
Cyperaceae	*Cyperus nitidus*	-	sedge	-	-	3
Cyperaceae	*Schoenoplectus decipiens*	-	sedge	-	-	1
Hypoxidaceae	*Hypoxis spp.*	-	geophyte	1	-	-
Iridaceae	*Gladiolus sp.*	-	geophyte	1	-	-
Juncaceae	*Juncus exsertus*	-	rush	-	-	3
Poaceae	*Agrostis lachnantha*	Bent grass	grass	-	1	2
Poaceae	*Brachiaria serrata*	Velvet signal grass	grass	-	2	-
Poaceae	*Cenchrus geniculatus*	Thunberg's pennisetum	grass	-	-	2
Poaceae	*Cynodon dactylon*	Couch grass	grass	3	2	-
Poaceae	*Digitaria ciliaris*	Southern crab grass	grass	-	2	-
Poaceae	*Echinochloa jubata*	Hedgehog grass	grass	-	-	1
Poaceae	*Eragrostis curvula*	Weeping love grass	grass	3	2	-
Poaceae	*Fingerhuthia africana*	Thimble grass	grass	-	2	-
Poaceae	*Hyparrhenia hirta*	Common thatching grass	grass	5	-	-
Poaceae	*Imperata cylindrica*	Cotton wool grass	grass	-	2	-
Poaceae	*Leersia hexandra*	Wild rice grass	grass	-	-	2
Poaceae	*Lolium perenne* *	Perennial rye grass	grass	-	-	2
Poaceae	*Paspalum dilatatum* *	Dallis grass	grass	-	-	2
Poaceae	*Paspalum distichum* *	Water couch	grass	-	-	3
Poaceae	*Pennisetum clandestinum* *1b	Kikuyu	grass	4	-	-
Poaceae	*Pennisetum villosum* *1b	Feathertop	grass	2	-	-
Poaceae	*Setaria pumila*	Yellow foxtail	grass	-	3	2
Poaceae	*Sporobolus africanus*	Rat's tail dropseed	grass	2	-	-
Poaceae	*Themeda triandra*	Red grass	grass	1	3	-
Poaceae	*Trisetopsis imberbis*	Small oats grass	grass	-	2	-
Poaceae	*Vulpia myuros* *	Rat's tail fescue	grass	-	3	-
Typhaceae	*Typha capensis*	Short bulrush	hydrophyte	-	-	2
Dicots						
Amaranthaceae	*Amaranthus hybridus* *	Marog	herb	1	-	-
Apiaceae	*Berula erecta*	Toothache root	hydrophyte	-	-	1
Apiaceae	*Cyclospermum leptophyllum* *	Wild celery	herb	-	1	-
Apocynaceae	*Gomphocarpus fruticosus*	Milkweed	herb	1	1	-
Apocynaceae	*Xysmalobium undulatum*	Milkwort	herb	-	1	-

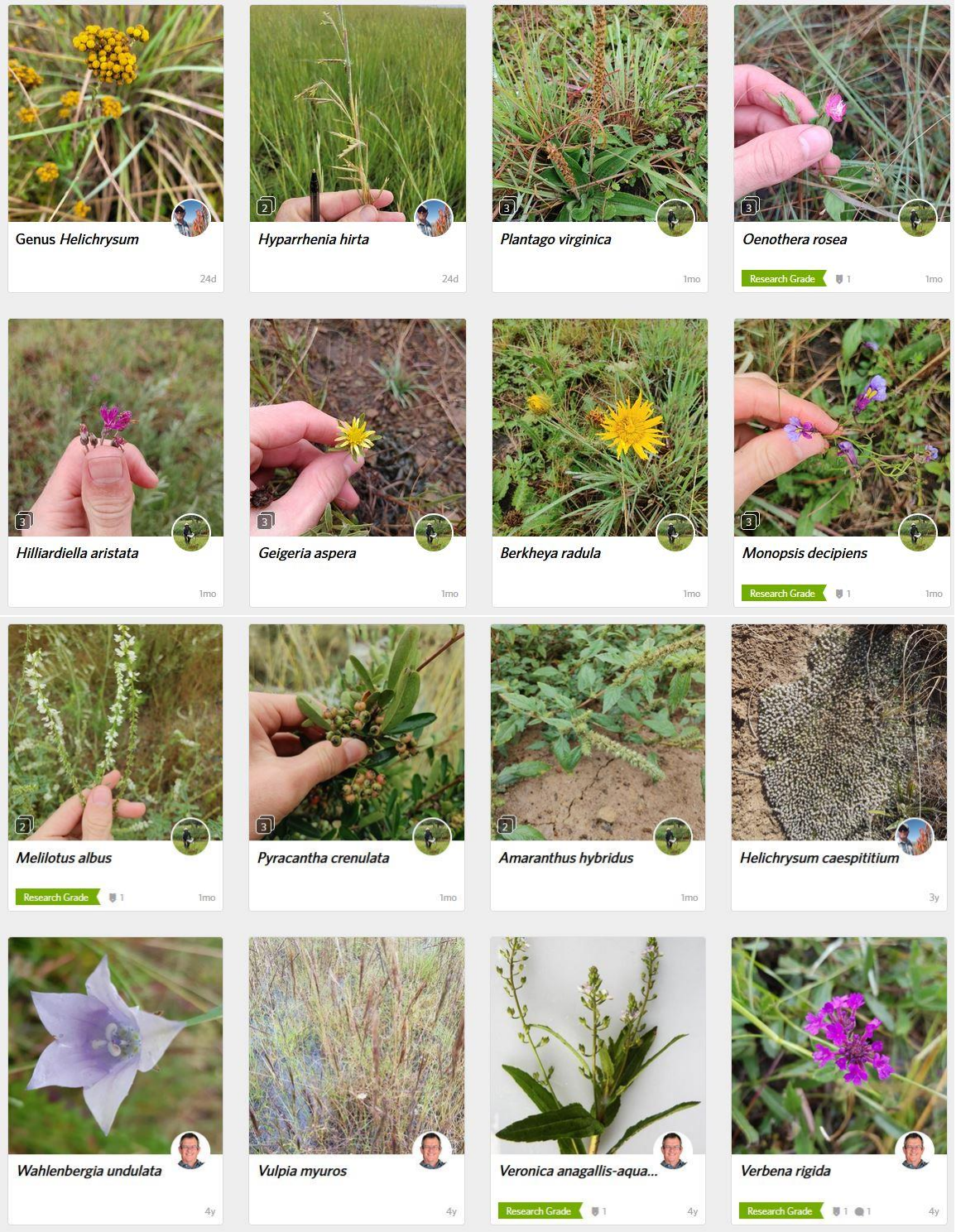
Family	Species	Common Name	Growth form	Grassland	Seasonal	Permanent
Asteraceae	*Berkheya insignis*	-	herb	3	-	-
Asteraceae	*Berkheya radula*	-	herb	2	-	-
Asteraceae	*Berkheya sp.*	-	herb	2	-	-
Asteraceae	*Cirsium vulgare *1b*	Scotch thistle	herb	1	-	-
Asteraceae	*Cosmos bipinnatus **	Cosmos	herb	2	-	-
Asteraceae	*Cotula anthemoides*	-	herb	-	2	-
Asteraceae	*Erigeron aegyptiacus*	-	herb	-	2	-
Asteraceae	*Haplocarpha nervosa*	-	herb	-	3	-
Asteraceae	*Haplocarpha scaposa*	Tontelbossie	herb	-	3	-
Asteraceae	*Helichrysum nudifolium*	-	herb	-	3	-
Asteraceae	*Laphangium luteoalbum*	-	herb	-	2	-
Asteraceae	*Nidorella podocephala*	-	herb	-	3	-
Asteraceae	*Nidorella resedifolia*	Stinkkruid	herb	3	-	-
Asteraceae	*Pseudognaphalium luteoalbum **	Jersey Cudweed	herb	-	2	-
Asteraceae	*Schkuhria pinnata **	Dwarf marigold	herb	3	2	-
Asteraceae	*Senecio inornatus*	Marsh senecio	herb	-	1	-
Asteraceae	*Senecio polyodon*	-	herb	-	2	-
Asteraceae	*Seriphium plumosum*	Bankrupt bush	shrub	2	-	-
Asteraceae	*Symphyotrichum squamatum **	-	herb	-	2	-
Asteraceae	*Tagetes minuta **	Khaki weed	herb	3	3	-
Campanulaceae	*Wahlenbergia undulata*	-	herb	-	2	-
Chenopodiaceae	*Chenopodium schraderianum **	-	herb	1	-	-
Convolvulaceae	*Cuscuta campestris *1b*	Common dodder	parasite	-	1	-
Convolvulaceae	*Turbina oblongata*	Wild morning glory	herb	-	3	-
Dipsacaceae	*Scabiosa columbaria*	-	herb	-	3	-
Ebenaceae	*Diospyros lycioides subp. guerkei*	Monkey plum	shrub	1	-	-
Fabaceae	*Melilotus albus **	White sweet clover	herb	2	-	-
Fabaceae	*Trifolium pratense **	Red Clover	herb	-	2	-
Gentianaceae	*Chironia palustris*	Marsh chironia	herb	-	1	-
Gentianaceae	*Exochaenium grande*	-	herb	-	2	-
Gentianaceae	*Sebaea sedoides*	-	herb	-	4	-
Geraniaceae	*Erodium cicutarium **	Redstem Filaree	herb	2	-	-
Geraniaceae	*Geranium multisectum*	Crane's bill	herb	-	2	-
Geraniaceae	*Pelargonium graveolens*	Rose geranium	shrub	-	1	-
Lamiaceae	*Salvia repens*	Creeping sage	herb	-	2	-
Lobeliaceae	*Lobelia erinus*	Garden lobelia	herb	-	2	-
Lobeliaceae	*Monopsis decipiens*	Butterfly lobelia	herb	-	3	-
Malvaceae	*Hibiscus microcarpus*	-	herb	-	1	-
Malvaceae	*Hibiscus trionum **	Bladder hibiscus	herb	-	3	-
Myrtaceae	*Eucalyptus grandis *1b*	Saligna gum	tree	1	-	-
Onagraceae	*Oenothera rosea **	Rose evening primrose	herb	-	3	-
Plantaginaceae	*Plantago lanceolata **	English plantain	herb	1	3	-
Polygonaceae	*Persicaria lapathifolia **	Pale persicaria	herb	-	-	3
Polygonaceae	*Rumex acetosella **	Sheep's sorrel	herb	-	2	1
Polygonaceae	*Rumex crispus **	Curly dock	herb	-	-	1

Family	Species	Common Name	Growth form	Grassland	Seasonal	Permanent
Ranunculaceae	*Ranunculus multifidus* *	African buttercup	herb	-	-	2
Salicaceae	*Salix babylonica* *	Weeping willow	tree	-	-	1
Scrophulariaceae	*Limosella major*	Tsika-metsi	herb	-	-	2
Scrophulariaceae	*Veronica anagallis-aquatica*	Water speedwell	hydrophyte	-	-	2
Solanaceae	*Datura stramonium* *1b	Stinkblaar	herb	2	-	-
Solanaceae	*Physalis angulata* *	Cutleaf groundcherry	herb	2	-	-
Solanaceae	*Solanum retroflexum*	Sobosobo Berry	herb	2	-	-
Solanaceae	*Solanum sp.*	-	herb	1	-	-
Verbenaceae	*Verbena aristigera* *	Wild verbena	herb	2	-	-
Verbenaceae	*Verbena bonariensis* * 1b	Purple top	herb	-	2	-
Total				**34 (16*)**	**51 (14*)**	**25 (10*)**
					95 (34*)	

Rating (0-6):
- = absent
1 = rare (<5%)
2 = sparse (>5-25%)
3 = common (>25-50%)
4 = abundant (>50-75%)
5 = predominant (>75-95%)
6 = near entire (>95%)

Appendix G: Photographs of Selected Plants at Witkoppies

[Extracted from https://www.inaturalist.org/]



Ipomoea oblongata

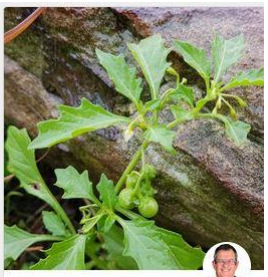
4y

Themeda triandra

Research Grade 1 4y

Symphyotrichum subul...

Research Grade 1 1 4y



Solanum retroflexum

Research Grade 1 4y

Setaria pumila

4y

Seriphium plumosum

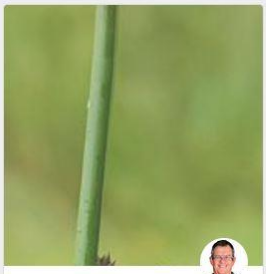
Research Grade 1 4y

Senecio inornatus

Research Grade 1 4y

Genus *Sebaea*

2 4y



Schoenoplectus decipie...

4y

Salvia repens

Research Grade 1 4y

Rumex acetosella

4y

Cyperus semitrifidus

Research Grade 1 4y

Physalis angulata

Research Grade 1 4y

Persicaria lapathifolia

Research Grade 1 4y

Cenchrus longisetus

Research Grade 1 4y

Pelargonium minimum

Research Grade 3 3 4y

Paspalum dilatatum

Research Grade 1 4y

Genus *Helichrysum*

1 1 4y

Melilotus albus

Research Grade 1 4y

Cyperus congestus

Research Grade 1 4y

Lolium multiflorum

Research Grade 1 4y

Limosella maior

1 4y

Juncus exsertus

4y

Genus *Juncus*

4y

Hyparrhenia hirta

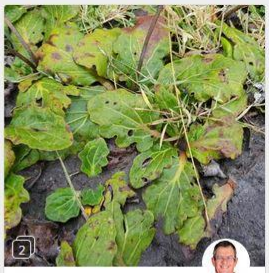
4y

Hibiscus trionum

4y

Hibiscus microcarpus

4y



Haplocarpha scaposa

Research Grade 1 1 4y

Gomphocarpus fruticos...

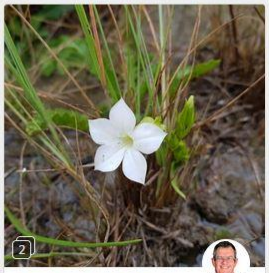
Research Grade 2 4y

Geranium multisectum

4y

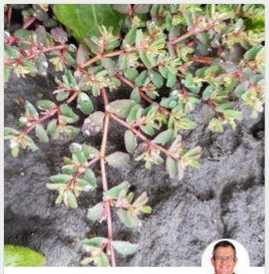
Fingerhuthia africana

Research Grade 1 4y



Exochaenium grande

Research Grade 1 4y

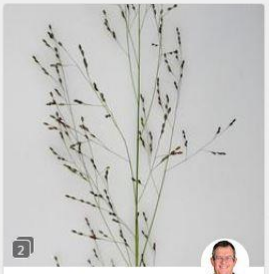


Section Anisophyllum

2 5 1 4y

Erodium cicutarium

Research Grade 1 4y



Eragrostis curvula

Research Grade 1 4y

Diospyros lycioides gue...

Research Grade 1 4y

Datura stramonium

Research Grade 1 4y

Digitaria ciliaris

4y

Cyperus teneristolon

Research Grade 1 1 4y

Cyperus longus

4y

Cyperus longus

4y

Cyperus congestus

Research Grade 1 4y

Hyparrhenia hirta

4y

Cosmos bipinnatus

Research Grade 1 4y

Cirsium vulgare

Research Grade 1 4y

Chironia palustris

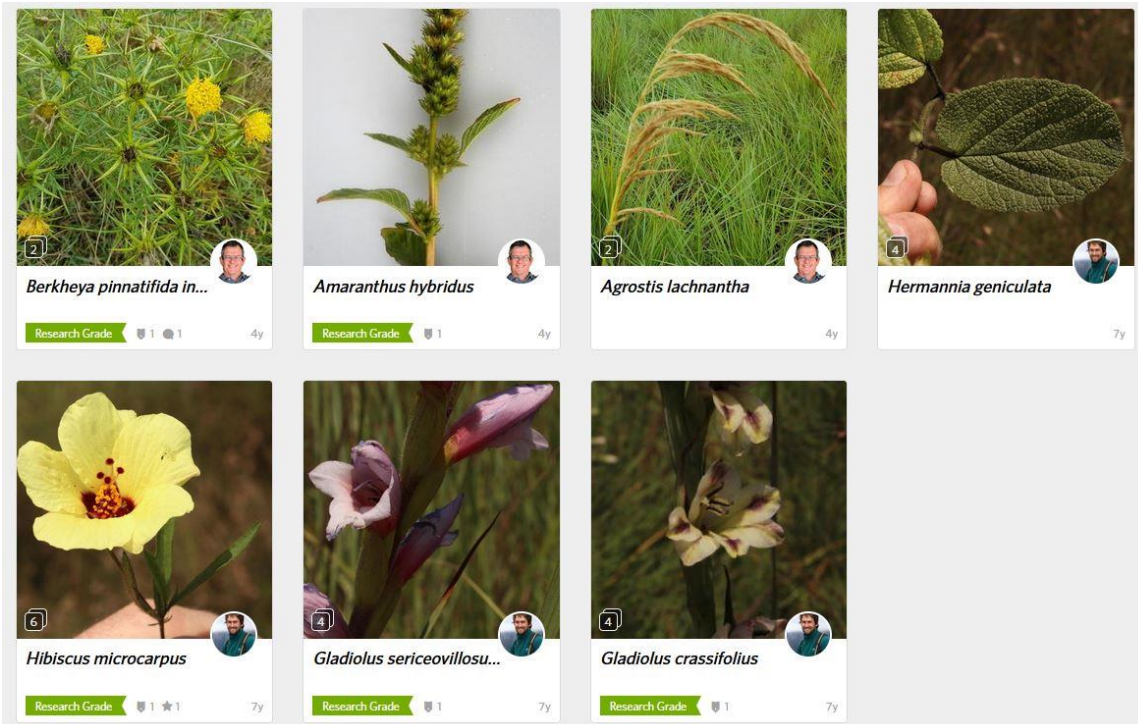
4y

Cenchrus geniculatus

4y

Urochloa serrata

Research Grade 1 4y


Berkheya pinnatifida in...
Research Grade
4y
Amaranthus hybridus
Research Grade
4y
Agrostis lachnantha
4y
Hermannia geniculata
7y
Hibiscus microcarpus
Research Grade
7y
Gladiolus sericeovillosu...
Research Grade
7y
Gladiolus crassifolius
Research Grade
7y

Appendix H: Present Ecological State

Present Ecological State: Seepage Wetland - Seasonal

Site Code:	-
Farm:	**Witkoppies 81HS**

Date:	2018/03/23
Assesor:	Rob Palmer

Figure A. (S27°06'59" E29°46'09").

Figure B. (S27°06'58" E29°46'09").

Landuse	Rate	Comment
Conservation/Wilderness	-	
Livestock - grazing	3	Cattle
Mining - underground	3	Unknown, but propable
Forestry	-	
Recreation	-	
Cultivation - dryland	3	Fallow lands
Cultivation - irrigated	-	
Residential - rural	-	
Residential - urban	-	
Commercial	-	
Industrial - light	-	
Industrial - heavy	-	
Livestock - feedlots	-	
Mining - open cast	-	
Other	-	

Rating (0-6):
- = absent
1 = rare (<5%)
2 = sparse (>5-25%)
3 = common (>25-50%)
4 = abundant (>50-75%)
5 = predominant (>75-95%)
6 = near entire (>95%)

Habitat Integrity of Palustrine Wetland PES (Duthie 1999)

Parameter	Rate	Comment
Hydrology		
Flow Modification	4	Drainage slightly altered by former cultivation drains
Inundation	5	None.
Water Quality		
Water Quality Modification	4	Livestock; Landfill
Sediment Modification	4	Slightly increased sediment inputs from old lands
Geomorphology		
Channel Modification	3	Channels
Topographic Alteration	4	Fallow lands; Drains; Some erosion
Biota		
Terrestrial Encroachment	3	Weedy opportunistic species
Vegetation Removal	2	Former cultivation
Alien Invasive Flora	2	14 alien plant species recorded
Utilisation of Biota	5	
Additional Parameters		
Connectivity	-	Not applicable
Solid Waste	3	Moderate
Mean	**3.5**	
Percentage	71%	
Category (A-F)	**C**	

Rating (0-5):
0 = Critically Modified (F)
1 = Serious (E)
2 = Largely Modified (D)
3 = Moderately Modified (C)
4 = Largely Natural (B)
5 = Natural (A)

Present Ecological State: Seepage Wetland - Permanent

Site Code:	-
Farm:	**Witkoppies 81HS**

Date:	2018/03/23
Assesor:	Rob Palmer

Figure A. (S27°06'07" E29°46'48").

Figure B. (S27°06'07" E29°46'48").

Landuse	Rate	Comment
Conservation/Wilderness	-	
Livestock - grazing	3	Cattle
Mining - underground	3	Unknown, but propable
Forestry	-	
Recreation	-	
Cultivation - dryland	3	Fallow lands
Cultivation - irrigated	-	
Residential - rural	-	
Residential - urban	-	
Commercial	-	
Industrial - light	-	
Industrial - heavy	-	
Livestock - feedlots	-	
Mining - open cast	-	
Other	-	

Rating (0-6):
- = absent
1 = rare (<5%)
2 = sparse (>5-25%)
3 = common (>25-50%)
4 = abundant (>50-75%)
5 = predominant (>75-95%)
6 = near entire (>95%)

Habitat Integrity of Palustrine Wetland PES (Duthie 1999)

Parameter	Rate	Comment
Hydrology		
Flow Modification	4	Drainage slightly altered by former cultivation drains
Inundation	5	None.
Water Quality		
Water Quality Modification	4	Livestock
Sediment Modification	4	Slightly increased sediment inputs from old lands
Geomorphology		
Channel Modification	5	None.
Topographic Alteration	5	None.
Biota		
Terrestrial Encroachment	5	None.
Vegetation Removal	4	Former cultivation
Alien Invasive Flora	3	10 alien species recorded
Utilisation of Biota	5	None.
Additional Parameters		
Connectivity	-	Not applicable
Solid Waste	5	None.
Mean	**4.5**	
Percentage	89%	
Category (A-F)	**B**	

Rating (0-5):
0 = Critically Modified (F)
1 = Serious (E)
2 = Largely Modified (D)
3 = Moderately Modified (C)
4 = Largely Natural (B)
5 = Natural (A)

Appendix I: Detailed Data – Odonata

List of Odonata species recorded in the vicinity of Majuba Power Station (2729BB) (http://vmus.adu.org.za).

Family	Species	Common Name	Conservation Status
AESHNIDAE	*Anax ephippiger*	Vagrant Emperor	LC
AESHNIDAE	*Anax imperator*	Blue Emperor	LC
AESHNIDAE	*Anax speratus*	Orange Emperor	LC
AESHNIDAE	*Pinheyschna subpupillata*	Stream Hawker	LC
AESHNIDAE	*Zosteraeschna minuscula*	Friendly Hawker	LC
CHLOROCYPHIDAE	*Platycypha caligata*	Dancing Jewel	LC
CHLOROCYPHIDAE	*Platycypha fitzsimonsi*	Boulder Jewel	LC
COENAGRIONIDAE	*Africallagma fractum*	Slender Bluet	-
COENAGRIONIDAE	*Africallagma glaucum*	Swamp Bluet	LC
COENAGRIONIDAE	*Africallagma sapphirinum*	Sapphire Bluet	LC
COENAGRIONIDAE	*Ischnura senegalensis*	Tropical Bluetail	LC
COENAGRIONIDAE	*Proischnura rotundipennis*	Round-winged Bluet	LC
COENAGRIONIDAE	*Pseudagrion citricola*	Yellow-faced Sprite	LC
COENAGRIONIDAE	*Pseudagrion kersteni*	Powder-faced Sprite	LC
COENAGRIONIDAE	*Pseudagrion salisburyense*	Slate Sprite	LC
COENAGRIONIDAE	*Pseudagrion spernatum*	Upland Sprite	LC
GOMPHIDAE	*Ceratogomphus pictus*	Common Thorntail	LC
GOMPHIDAE	*Paragomphus cognatus*	Rock Hocktail	LC
LESTIDAE	*Lestes plagiatus*	Highland Spreadwing	LC
LIBELLULIDAE	*Crocothemis erythraea*	Broad Scarlet	LC
LIBELLULIDAE	*Crocothemis sanguinolenta*	Little Scarlet	LC
LIBELLULIDAE	*Orthetrum caffrum*	Two-striped Skimmer	LC
LIBELLULIDAE	*Orthetrum hintzi*	Dark-shouldered Skimmer	LC
LIBELLULIDAE	*Orthetrum icteromelas*	Spectacled Skimmer	LC
LIBELLULIDAE	*Orthetrum machadoi*	Highland Skimmer	LC
LIBELLULIDAE	*Palpopleura jucunda*	Yellow-veined Widow	LC
LIBELLULIDAE	*Pantala flavescens*	Wandering Glider	LC
LIBELLULIDAE	*Sympetrum fonscolombii*	Red-veined Darter	LC
LIBELLULIDAE	*Trithemis arteriosa*	Red-veined Dropwing	LC
LIBELLULIDAE	*Trithemis dorsalis*	Highland Dropwing	LC
LIBELLULIDAE	*Trithemis furva*	Navy Dropwing	LC
LIBELLULIDAE	*Trithemis stictica*	Jaunty Dropwing	LC
LIBELLULIDAE	*Zygonyx natalensis*	Blue Cascader	LC
PLATYCNEMIDIDAE	*Allocnemis leucosticta*	Goldtail	LC
PLATYCNEMIDIDAE	*Elattoneura glauca*	Common Threadtail	LC
SYNLESTIDAE	*Chlorolestes fasciatus*	Mountain Malachite	LC

Appendix J: Risk Matrix

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

NAME and REGISTRATION No of SACNASP Professional member: RW Palmer Reg no. 400108/95

10 April 2022

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

					Severity																
No.	Phases	Activity	Aspect	Impact	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	PES AND EIS OF WATERCOURSE
1	Construction	Bulk earthworks; Access road;	Vegetation clearing; Soil disturbance; Elevated turbidity	Impact of Site Preparation on Siltation of Aquatic Habitats	1	2	3	2	**2.0**	2	2	**2.0**	2	3	5	2	**12.0**	**24**	**Low**	80	See Text	Seasonal Seeps PES = C; EIS = Low
2	Operation	Disposal of general waste	Seepage of leachate; Stormwater runoff from landfill	Impact of Landfill Seepage and Stormwater on Water Quality	1	4	2	2	**2.3**	2	4	**2.6**	5	5	5	3	**18.0**	**46**	**Low**	60	As above	As above
3	Operation	Hardening of surfaces; altered surfaced flow patterns	Stormwater runoff from access road and landfill	Impact of Stormwater Runoff on Erosion of Wetland Habitats	3	1	2	1	**1.8**	1	5	**2.2**	2	5	5	1	**13.0**	**28**	**Low**	70	As above	As Above