

MALETSWAI LANDFILL SITE

**Aquatic Biodiversity Impact Assessment for the Proposed
Development of a New Landfill Site (Class B) & Infrastructure on the
Remaining Extent of Portion 1 of the Farm Melkspruit No.12, Walter
Sisulu Local Municipality, Eastern Cape Province**



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Report Reference: Maletswai LF_AQ_04

Date of Report: **February 2026**

i. DOCUMENT INFORMATION

PROJECT TITLE: Maletswai Landfill Site

STUDY NAME: Aquatic Biodiversity Impact Assessment

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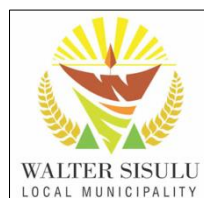
CONTACT PERSON: Kabedi Mashilo

APPLICANT: Walter Sisulu Local Municipality

DATE OF REPORT: February 2026 (edited 23 August 2026)

REPORT STATUS: Final Report

REPORT REFERENCE: Maletswai LF_AR_04



ii. EXECUTIVE SUMMARY

Project Overview

The existing landfill site at Maletswai (Aliwal North) has reached the end of its lifespan and is in the process of being decommissioned. A new landfill site is urgently required, and as part of the process, two nearby potential sites were recommended by authorities. These sites need to be investigated as to their viability.

Rambuda Consultants (Pty) Ltd was appointed as the lead Environmental Assessment Practitioner (EAP) on the project.

Flori Scientific Services cc was appointed to conduct a site investigation and aquatic impact assessment for the site alternatives.

Site investigations were conducted over two days on 17 & 18 November 2025, which is during the wet (summer) season for the region.

Note: The study only focuses on the three potential alternative sites. It does not directly address the old site or its' closure (decommissioning).

Substantiated Statement

Below is a substantiated statement, based on the findings of the specialist assessment, study and report, regarding the acceptability, or not, of the proposed development, if it should receive approval or not and any conditions to which this statement is subject.

There are no watercourses directly within either of the three alternative landfill sites investigated. There is a small impoundment within the area of the Preferred Site. Option 1 is located on the edge of a natural small stream/drainage line, while Option 2 has a small natural drainage line within it. Options 1 & 2 have the potential to have larger negative impacts on the natural water environment.

The main watercourses in the region are the perennial Orange River and semi-perennial Melkspruit. The Melkspruit flows north into the Orange River and varies from about 1,7km to 2,4km west of the study site. The Orange River varies in distance between 450m and 500m northwest of the Preferred Site. The landfill site will have no direct impact on either of these two watercourses.

There are a few small and highly ephemeral streams and drainage lines in the vicinity of the new landfill site alternatives. Those in the vicinity of the Preferred Site flow directly into the Orange River, while those near Option 1 and Option 2 flow into the Melkspruit. There is a small out-of-stream impoundment at the Preferred Site. The small impoundment is not very functional and was created to trap (impound) surface rainwater runoff, probably to retain some water for grazing livestock. However, the water volumes are low, and the impoundment is dry (that is, no visible surface water) for most of the year. The impoundment is not a natural watercourse. There are occasions when a dam becomes part of the natural aquatic environment, but these are mostly in-stream dams that form an integral part of the linear river/stream and are important in terms of upstream and downstream connectivity. Out-of-stream dams do not serve this

same important aquatic function. However, there are out-of-stream dams that have become part of the aquatic environment and support wildlife such as waterbirds, but these are typically large dams that have permanent open bodies of water and not small, shallow and insignificant impoundments that dry out quickly, such as the one at the Preferred Site. These large dams act very much like large natural pans or lakes.

The natural environments in the area of Options 1 & 2 are in a much better condition than that of the Preferred Site, which for many years was cultivated as fields and is therefore transformed.

Therefore, the Preferred Site is the preferred alternative for the new landfill site, which is required, because the existing old site is at capacity and is in the process of closure.

As mentioned, there is a small out-of-stream impoundment in the area investigated at the Preferred Site, but this feature is far less sensitive than the natural watercourses found adjacent to and within Options 1 & 2. Nevertheless, buffer zones have been delineated that should be strictly implemented. This, along with stormwater management plans, should ensure that the landfill site will have little to very low negative impacts on the water environment in the area, especially that of natural watercourses.

Site 1 is therefore the recommended site alternative for the new Maletswai Landfill Site.

The areas investigated within the three landfill site alternatives are larger than required. This was done in order to give some flexibility in the final placement of the landfill site. Therefore, recommended buffer areas must be implemented, and the site should be established as far back from the impoundment as possible. The site should be properly fenced from the onset. A detailed stormwater plan is also required that must include details of construction and management. With proper construction and management, impacts on the surrounding aquatic systems/water environment will be limited. In reality, the impact on the aquatic environment is low with the implementation of necessary mitigating measures, which not only include those listed in the report, but also those required by other relevant legislation controlling the establishment and operation of landfill sites. This will include protecting groundwater and controlling of polluted and contaminated onsite surface water.

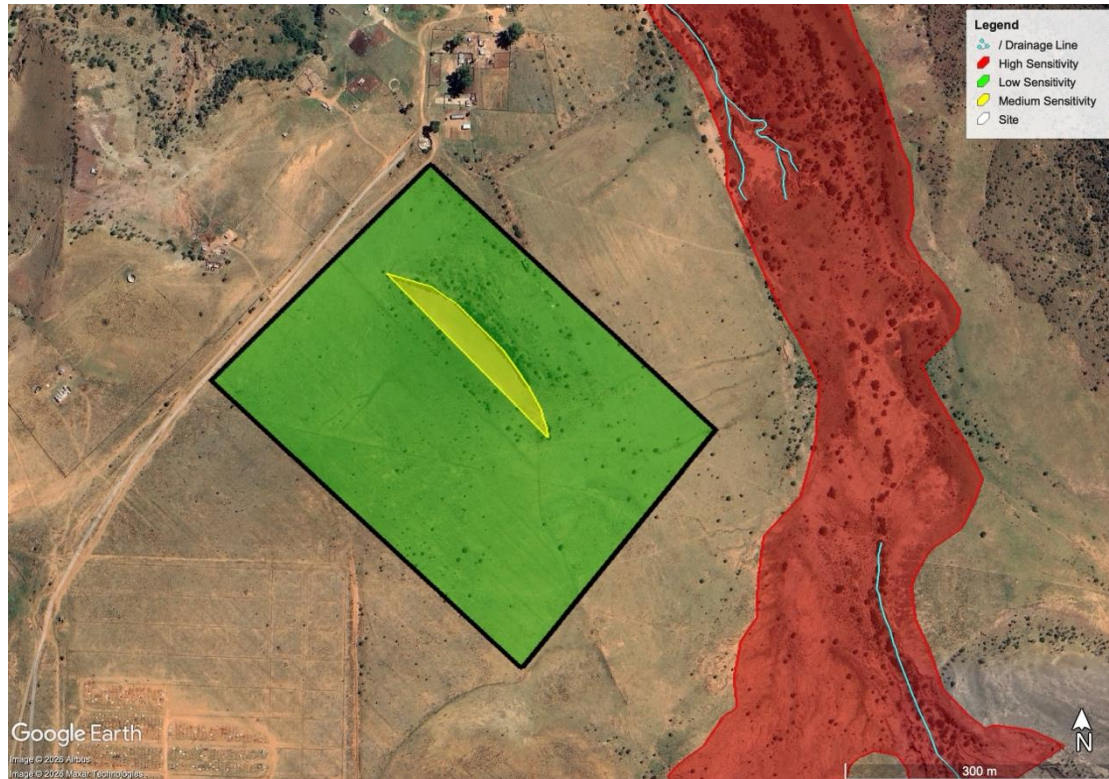
If properly established and well managed, the landfill site will have little negative impact on the water environment.

Conclusions

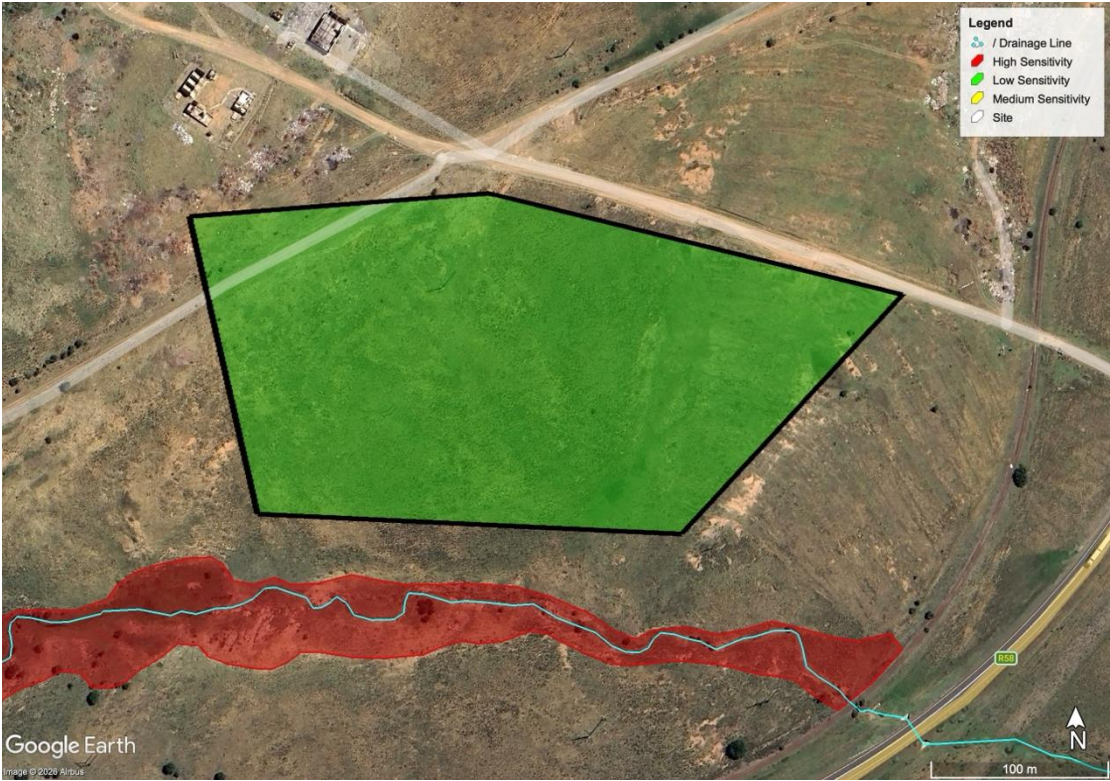
- Three alternative sites were investigated for the establishment of a new but necessary landfill site of Maletswai (Aliwal North).
- The main watercourses in the region are the perennial Orange River and semi-perennial Melkspruit. The Melkspruit flows north into the Orange River and varies from about 1,7km to 2,4km west of the general study site. The Orange River varies in distance between 450m and 500m northwest of the Preferred Site.
- There are a few small and highly ephemeral streams and drainage lines in the vicinity of the site alternatives. Those in the vicinity of the Preferred Site flow directly into the Orange River, while

those near Options 1 & 2 flow into the Melkspruit. There are no wetlands in the or near to the three site alternatives.

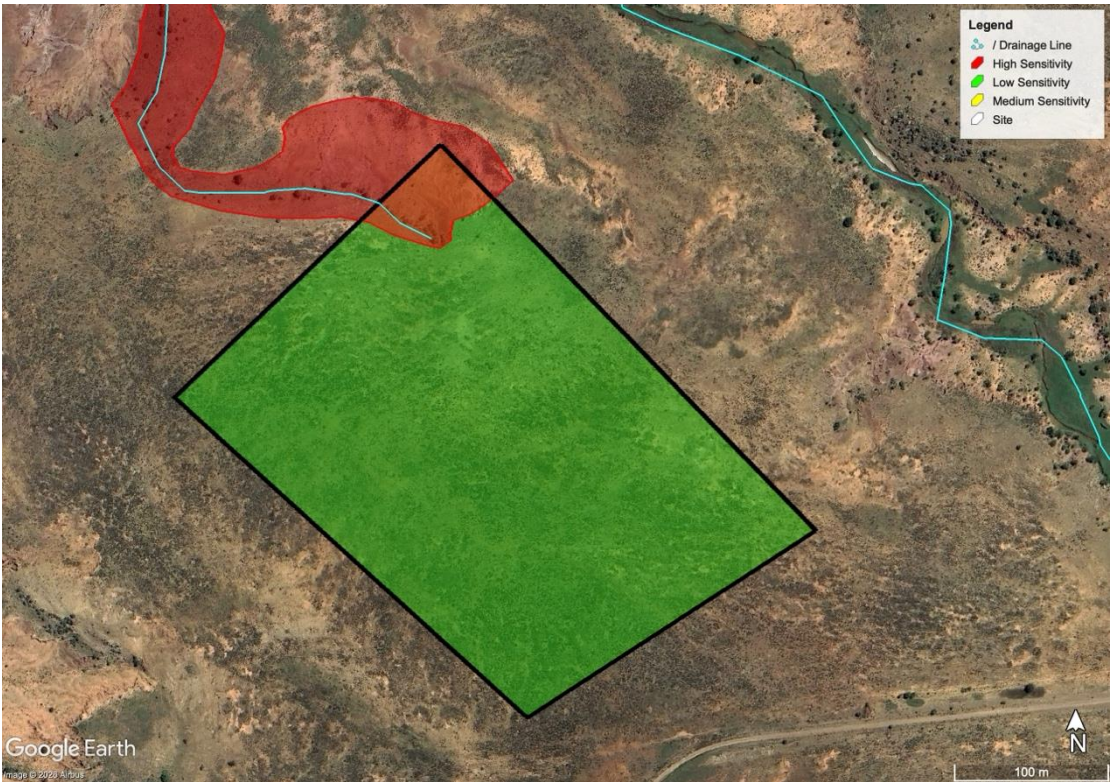
- There is a small out-of-stream impoundment at the Preferred Site. The impoundment is not a natural watercourse.
- The recommended site alternative for the new landfill site is: The Preferred Site.



Sensitivity Map: Preferred Site



Sensitivity Map: Option 1



Sensitivity Map: Option 2

iii. REPORT REQUIREMENTS

Below are the requirements for specialist reports as per the Procedures for the Assessment and Minimum Criteria for Reporting in identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation, which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. “the Protocols”) and in Government Notice No. 1150 of 30 October 2020; and Appendix 6 of the Environmental Impact Assessment Regulations (Gazette No. 40772, 7 April 2017, as amended).

The report, as a minimum, contains the following information:

Protocols	Section
Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae.	iv, 8.10
A signed statement of independence by the specialist.	iv, separate document
A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.	1.5
A description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant.	2
A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations.	1.4
A location of the areas not suitable for development, which are to be avoided.	4.2, 4.3
Description of potential impacts, cumulative impacts, and proposed mitigating measures.	5
Proposed impact management actions and mitigating measures or inclusion in the EMP.	5.5
A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not and any conditions to which this statement is subjected.	6

iv. EXPERTISE & EXPERIENCE OF SPECIALIST

Johannes Oren Maree

Expertise of Specialist

Qualifications & Expertise in: Terrestrial Ecology, Aquatic Ecology and Avifaunal Assessments.

- 3 Masters degrees (MSc, MBA, MTS); 2 Diplomas (Business & Public Speaking).
- Co-Author of two books: Cut Flowers of the World. 2010 & 2020 (2nd ed), Briza, Pretoria.
- SAQA accreditation and qualifications in training, assessing & service provision (AgriSeta).
- Registered with South African Council for Natural Scientific Professions (SACNASP). Registration number: 005165
- 21 years of experience in technical and managerial positions, project management and consultancy.
- 19 years of experience in writing of articles, books, training material, training & presentations, and proposals.
- 15 years of direct experience in EIAs.
- Conducted hundreds of field investigations and compiled hundreds of technical specialist reports for EIAs, ecological (fauna & flora), aquatic and avifauna impact assessments.
- Projects include power lines, roads, quarries, residential and mixed developments, mines, wind- and solar PV farms.

Declaration

In terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the 2014 NEMA Environmental Impact Assessment (EIA) Regulations, as amended.

I, **Johannes Oren Maree**, do hereby declare that I:

- Act as an independent specialist in compiling this report;
- Do not have any financial interests, or stand to gain in any way in the undertaking of this activity, other than remuneration for work performed;
- Do not have, nor will have, any vested interest in the proceeding activity or project;
- Have no, neither will engage in, conflicting interests in the undertaking of this activity;
- Undertake to disclose, to the competent authority, any material information that has, or may have, the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required; and
- Will provide competent authority access to my information regarding the report and investigations, whether such information is favourable to the applicant or not.

Signed:  Electronic Signature

Date: 23 August 2026

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viii. ACRONYMS

CBA	Critical Biodiversity Areas
CMA	Catchment Management Agencies
DFFE	Department of Forestry, Fisheries and the Environment
DWS	Department Water and Sanitation
EAP	Environmental Assessment Practitioner
EIS	Ecological Importance & Sensitivity
EMC	Environmental Management Class
FSA	Fish Sanctuary Area
GA	General Authorisation
HGM	Hydrogeomorphic
NFEPA	National Freshwater Ecosystem Priority Areas
NPAES	National Protected Areas Expansion Strategy
PES	Present Ecological State
PDA	Primary Drainage Area
QDA	Quaternary Drainage Area
REC	Recommended Ecological Category (or Class)
REMC	Recommended Ecological Management Category (or Class)
SWSA	Strategic Water areas of South Africa

1 BACKGROUND

1.1 Project Overview

The existing landfill site at Maletswai (Aliwal North) has reached the end of its' lifespan and is in the process of being decommissioned. A new landfill site is urgently required and as part of the process two nearby potential sites were recommended by authorities. These sites need to be investigated as to their viability.

Rambuda Consultants (Pty) Ltd was appointed as the lead Environmental Assessment Practitioner (EAP) on the project.

Flori Scientific Services cc was appointed to conduct a site investigation and aquatic impact assessment for the site alternatives.

Site investigations were conducted over two days on 17 & 18 November 2025, which is during the wet (summer) season for the region.

Note: The study only focusses on the three potential alternative sites. It does not directly address the old site or its' closure (decommissioning).

1.2 Purpose of the study

The purpose of the study is to identify, delineate and assess any watercourses found on the site. As well as to assess any wetlands within a 500m radius of the site. Part of study is to determine the Present Ecological State (PES) and Ecological Importance & Sensitivity (EIS) of each watercourse identified and to recommended mitigating measures to help reduce any negative impacts.

The aquatic ecology focuses on surface water in the environment and looks at all watercourses. These watercourses include rivers, streams, drainage lines and wetlands. Wetlands include marshes, seeps and pans (freshwater and saltwater). Manmade systems (artificial systems) such as farm dams, canals and artificial wetlands are also investigated and discussed in aquatic ecology. Although rivers, streams and wetlands are all watercourses, the legal implications differ in terms of development, buffer zones, etc.

According to the National Water Act (36 of 1998) a 'watercourse' means:

- a. A river or spring;
- b. A natural channel in which water flows regularly or intermittently;
- c. A wetland, lake or dam into which or from which water flows; and
- d. Any collection of water, which the Minister may, by notice in the Gazette, declare to be a watercourse.

The reference to a watercourse includes, where relevant, beds, banks, floodlines, floodplains and riparian zones. The official definitions of the different watercourses, including that of a riparian zone, can be found in the Appendices.

1.3 Quality and age of base data

Data used for background information included the following:

- Threatened ecosystems: Latest datasets were obtained from the SANBI website (www.bgis.sanbi.org).
- Veldtypes and ecosystems: Mucina & Rutherford, 2006, 2010. Updated 2012, 2018.
- SANBI data sets – latest updated website data (www.bgis.sanbi.org).
- Environmental Screening Tool – DFFE (screening.environment.gov.za).
- National Freshwater Ecosystem Priority Areas (NFEPA) – DWS & SANBI databases.
- National Wetland Map 5 (2018) – SANBI, CSIR.
- National Wetland Map 6 (2022) - <https://freshwaterbiodiversity.org>.
- Eastern Cape Province Biodiversity Conservation Plan (2019).

1.4 Assumptions and Limitations

The assumptions and limitations for the assessment are as follows:

- All information regarding the project as provided by the Client is taken to be accurate.
- Field investigations were conducted on 17 & 18 November 2025, which is during the wet (summer) season for the region. The habitats and aquatic systems are well known to the specialist who has conducted similar studies in the region.
- During site investigations all areas were easily accessed.
- The site investigations and study are considered adequate for the project and no further specialist aquatic (surface water, wetland, etc.) studies are necessary or recommended.
- Precise buffer zones or exact GPS positions cannot be made using generalised corridors or KML files on Google Earth. However, the buffer zones drawn are accurate to within 2-3m;
- There were no significant or specific limitations encountered that hindered the outcomes of the study.
- **NOTE:** Recommendations put forward in the report are based on actual biodiversity and specialist findings, but this does not mean that legal requirements do not still apply. In other words, recommendations do not negate legal requirements as set out in various acts such as NEMA (Act 107 of 1998) and NEMBA (Act 10 of 2004) and amendments.
- **NOTE:** Recommendations and impact assessments are based on the project information and location as obtained at the time of the study. Any later changes in project layout, site location, etc. may negate the findings and recommendations of this study and report.

1.5 Duration, Season and relevance to Outcome of Assessment

Site investigations were conducted over two days on 17 & 18 November 2025, which is during the wet (summer) season for the region. The area had received good summer rainfall as well as later autumn rain, resulting in a longer growing season. The study site is a small footprint, which was easily accessed and investigated. All information was able to be collected, including whether protected plants and trees may be present. During site investigations the environments encountered were expected and there were

no unusual or unexpected habitats, species (fauna and flora) encountered. The specialist conducting the study has knowledge and experience of the region and ecosystems, having conducted other projects in the region.

Therefore, in terms of duration the two days were adequate for the area and project. In terms of the season the wet (summer) assessed was relevant to the findings and outcome of the assessment.

2 METHODOLOGY

2.1 Desktop Assessment

A desktop assessment was conducted using background data as shown above in Section 1.3.

2.2 Site Investigation

A site investigation was undertaken on 1 October 2025 during which time the desktop assessment was also ground-truthed. Cognisance was taken of environmental features and habitats. Watercourses were identified, delineated and assessed, including wetlands within a 500m area of the site.

2.3 Impact Assessment

An impact assessment was conducted using the scoring methodology shown below in Table 1 and Table 2. More details regarding the method are found in the appendices (8.9).

Table 1: Scoring Method for Impact Assessment

Probability	Duration
5 - Definite/unknown	5 - Permanent
4 - Highly probable	4 - Long-term (Impact ceases after operational life of the activity)
3 - Medium probability	3 - Medium-term (5-15 years)
2 - Low probability	2 - Short-term (0-5 years)
1 - Improbable	1 - Immediate
0 - None	0 - None
Scale (Extent)	Magnitude (Intensity)
5 – International	10 - Very high/unknown
4 – National	8 - High
3 – Regional	6 - Moderate
2 – Local	4 - Low
1 - Site only	2 - Minor
0 - None	0 - None

Once the above factors had been ranked for each impact, the overall risk (environmental significance) of each impact will be assessed using the following formula:

$$\text{Significance (SP)} = [\text{Magnitude (M)} + \text{Duration (D)} + \text{Scale(S)}] \times \text{Probability (P)}.$$

Table 2: Significance Scoring

Score	Significance Points (SP)	Description
<10	Negligible	The impact is non-measurable to zero / absent.
10 – 20	Low	Where the impact would not have a direct influence on the decision to develop in the area.
20 – 50	Medium	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
50 – 70	High	Where the impact must have an influence on the decision process to develop in the area.
>70	Very High	Where the impact may constitute a fatal flaw for the project.

3 RECEIVING ENVIRONMENT

3.1 Study Site Location

The study site consists of three potential alternative sites for the new Maletswai Landfill Site. The study site is west of Maletswai (Aliwal North), south of the Orange River and north of the R58 in the Eastern Cape Province. The preferred site (Site 1) is north of the existing landfill site and the two alternative site options (Option 1 & Option 2) are south and southwest.

Note: The study only focusses on the three alternative sites investigated for the new potential landfill site. It does not directly address the old landfill site or its' closure (decommissioning).

- Preferred Site : 30°41'25.76"S; 26°39'50.87"E.
- Option 1 (1st Alternative): 30°42'23.93"S; 26°40'19.00"E.
- Option 2 (2nd Alternative): 30°42'27.15"S; 26°39'28.44"E.
- Existing Maletswai Landfill Site: 30°42'12.61"S; 26°40'11.37"E.
- Maletswai (Aliwal North): 30°41'45.14"S; 26°42'32.18"E.
- Quarter Degree Square (QDS): 3026DA.
- Quaternary Drainage Area (QDA): D14A.



Figure 1: Site Location (Google Earth)

3.2 Topography

The topography of the area is undulating plains and low hills. The average height above sea level at Site 1 (Preferred Alternative) is approximately 1 323m, with a maximum and minimum of around 1 326m and 1 321m, respectively. The general downward slope is from southwest to northeast.

The average height above sea level at Site 2 (Alternative) is approximately 1 343m, with a maximum and minimum of around 1 346m and 1 338m, respectively. The general downward slope is from north to south. The low point in the general area is the Orange River to the north of the site alternatives and the existing Maletswai Landfill Site.

3.3 Climate

The study site is situated within the medium rainfall zone of 401mm – 601mm per annum and in the Cold Interior Climatic Zone of South Africa. The site is within a summer rainfall region of South Africa, with mild to warm summers and cool to cold winters that are very dry. Frost during the winter months is common. The average annual rainfall in the area of Maletswai (Aliwal North) is typically between 400mm to 500mm. With most rainfall occurring in the months of December and January. The overall yearly mean for temperatures for the area is 15°C to 20°C. The warmest period is from December to February with daily highs typically 28 - 30°C. The coolest period is the winter months of June to July, with mean temperatures around 7 - 8°C and overnight lows around 0 - 1°C.

3.4 Vegetation

3.4.1 General vegetation

The study site is within the Upper Karoo Bioregion of the Nama-Karoo Biome. The site is within the original extent of the veldtype commonly known as **Eastern Upper Karoo**.

Eastern Upper Karoo is characterised by flats and gently sloping plains (interspersed with hills and rocky areas of Upper Karoo Hardeveld in the west, Besemkaree Koppies Shrubland in the northeast and Tarkastad Montane Shrubland in the southeast), dominated by dwarf microphyllous shrubs, with 'white' grasses of the genera *Aristida* and *Eragrostis* (these become prominent especially in the early autumn months after good summer rains). The grass cover increases along a gradient from southwest to northeast (Mucina & Rutherford, 2010).

The study site is in an area where there are nearby hills covered with Besemkaree Koppies Shrubland. The area is also where the two biomes of Grassland and Nama-Karoo integrate.

Vegetation along the small, seasonal drainage lines and streams is often classified or group under Inland Azonal Vegetation and more specifically as Upper Gariep Alluvial Vegetation (Mucina & Rutherford, 2010).

Eastern Upper Karoo is not a threatened veldtype (ecosystem) with a status of 'Least Concern' (Revised National List of Threatened Ecosystems. 2022. DFFE).

Table 3, below, shows the hierarchy and classifications of the vegetation of the study area.

Table 3: Vegetation classification of the study site

Category Description	Classification
Biome	Nama-Karoo
Bioregion	Upper Karoo
Vegetation Types	Eastern Upper Karoo
Status	Least concern (Not threatened)

3.4.2 Aquatic vegetation

There is no aquatic vegetation on the study site.

3.5 Watercourses in the study area

The main watercourses in the region are the perennial Orange River and semi-perennial Melkspruit. The Melkspruit flows north into the Orange River and varies from about 1,7km to 2,4km west of the study site. The Orange River varies in distance between 450m and 500m northwest of Site 1. The Orange River is the largest and longest river in South Africa (Figure 2).

The national wetland map (Map 5, 2018. Map 5, 2022) (overlaid on Google Maps) does not highlight any wetlands in the vicinity of the three sites (Existing landfill site, Site 1 (Preferred new landfill site), Site 2 (Alternative site)) (Figure 3).



Figure 2: Main watercourses in the region



Figure 3: National Wetland Map (Map 5, 2018. Map 6, 2022)

There are a few small and highly ephemeral streams and drainage lines in the vicinity of the alternative landfill sites. Those in the vicinity of Preferred Site flow directly into the Orange River, while those near Option 1 and Option 2 flow into the Melkspruit. There is a small out-of-stream impoundment at the Preferred Site (Figure 4, Figure 5, Figure 6). The small impoundment is not very functional and was created to trap (impound) surface rainwater run-off, probably to retain some water for grazing livestock. However, the water volumes are low and the impoundment is dry (that is, no visible surface water) for most of the year. The impoundment is not a natural watercourse. There are occasions when a dam becomes part of the natural aquatic environment, but these are mostly in-stream dams that form an integral part of the linear river / stream and are important in terms of upstream and downstream connectivity. Out-of-stream dams do not serve this same important aquatic function. However, there are out-of-stream dams that have become part of the aquatic environment and support wildlife such as waterbirds, but these are typically large dams that have permanent open bodies of water and not small, shallow and insignificant impoundments that dry out quickly, such as the one at Preferred Site. These large dams act very much like large natural pans or lakes. Erosion and gully formation are problematic in the study area, which is especially evident in areas of poor veld management and old cultivated fields (such as in the case of the Preferred Site) where the loss of ground cover has occurred. During erratic rainfall soils are easily washed away along the slopes quickly creating erosion gullies that at first may look like natural drainage lines, but are not. Erosion gullies are particularly a problem in the area of the Preferred Site where the area has been transformed from years of ploughing and cultivated fields for crops. The eroded and denuded areas are visible as light, sandy areas in the satellite image shown below in Figure 4.

The veld in the areas of Options 1 & 2 is less impacted with less erosion gullies present. Option 1 is situated on the north side of a small natural seasonal stream / drainage line, while there is a small natural drainage line that originates in Option 2.

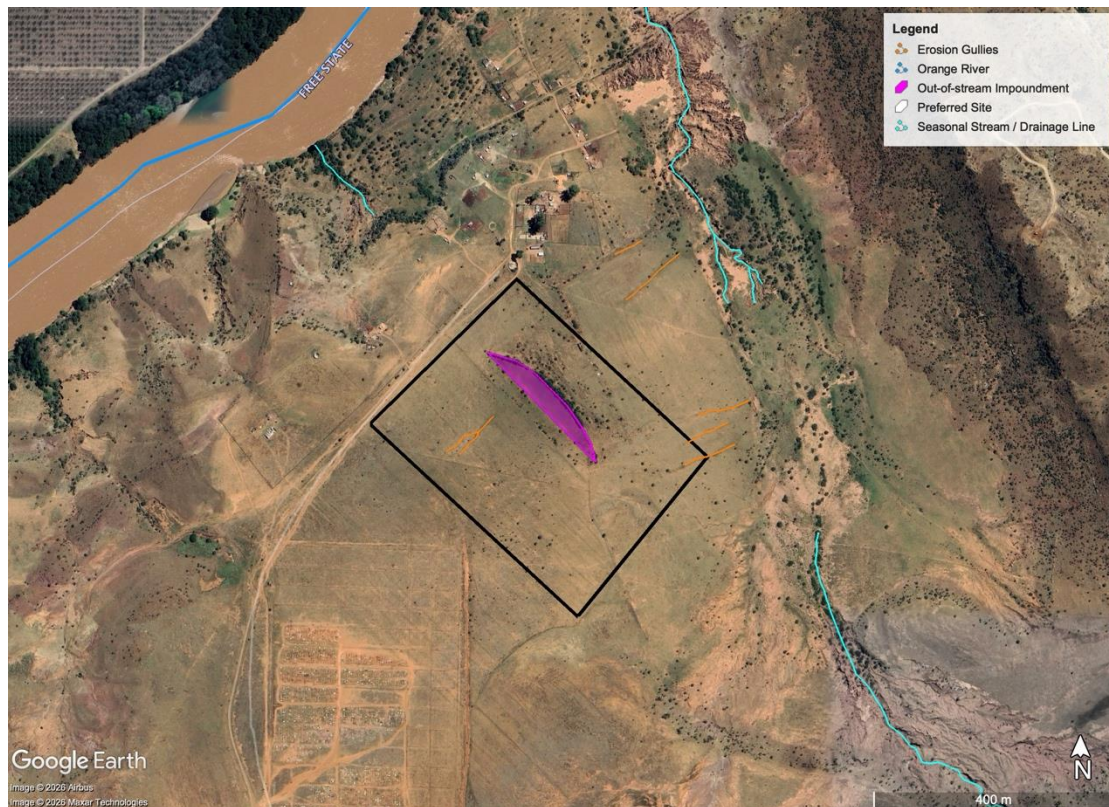


Figure 4: Watercourses in the vicinity of the Preferred Site

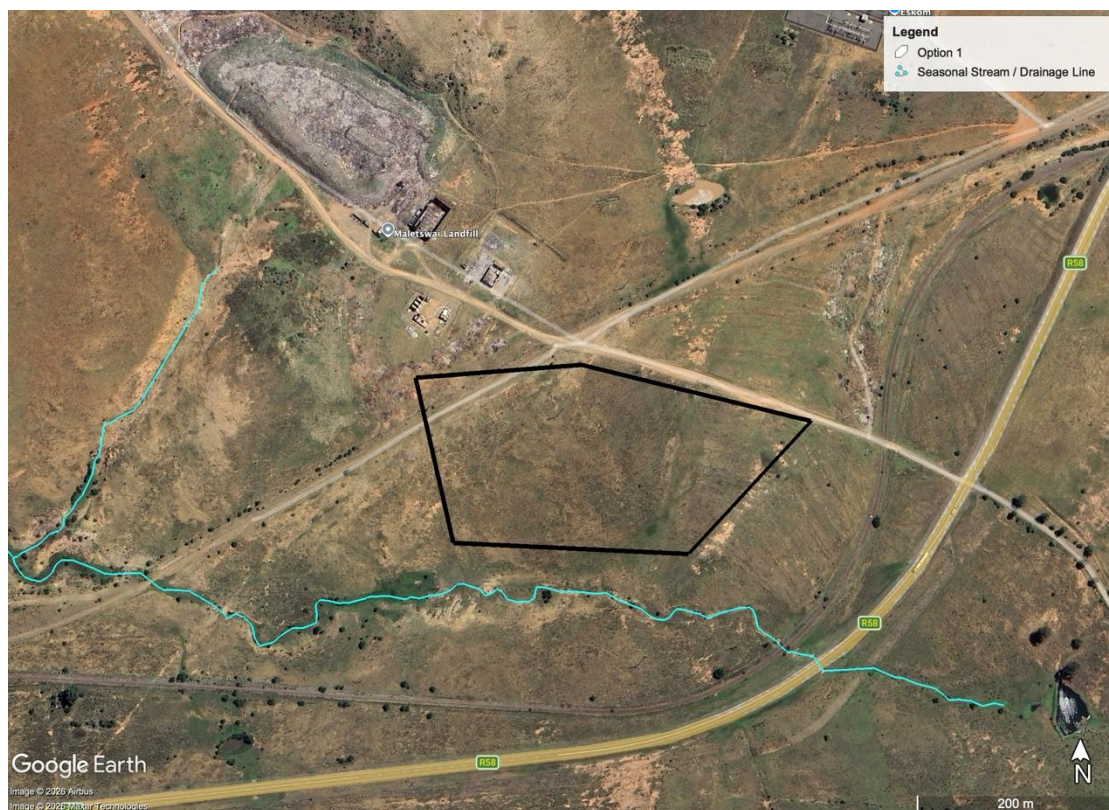


Figure 5: Watercourses in the vicinity of Option 1



Figure 6: Watercourses in the vicinity of Option 2

3.6 Classification of Watercourses in the Study Area

Identified watercourses were classified as shown below in Table 4.

All of the small seasonal streams and drainage lines in the immediate area of the study site were highly ephemeral in nature. All of them were unnamed.

Identified watercourses are classified along different hydrogeomorphic (HGM) types, up to Level 5, in terms of levels as refined for South Africa by Kleynhans, *et. al.* (2005) and as used in the Classification System for Wetlands user manual – SANBI Series 22 (Ollis *et. al.* 2013) (See appendices - Section 8.1).

Table 4: Classification of watercourses in the study area

Delineated systems	Level 1 System	Level 2 Regional Setting (Ecoregion)	Level 3 Landscape Unit	Level 4 HGM Unit	Level 5
Orange River	Inland	Upper Karoo / Grassland	Valley Floor / Plain	River (Lowland)	Perennial. Limnetic (>2m)
Melkspruit	Inland	Upper Karoo	Valley Floor / Plain	River (Lowland)	Non-perennial. Littoral (<2m)
Seasonal Streams	Inland	Upper Karoo / Grassland	Valley Floor / Plain	River (Lowland)	Non-perennial. Littoral (<2m)
Drainage Lines	Inland	Upper Karoo / Grassland	Valley Floor / Plain	River (Lowland)	Non-perennial. Littoral (<2m)

3.7 Drainage Regions

South Africa is geographically divided up into Primary Drainage Areas (PDAs) and Quaternary Drainage Areas (QDAs). The different areas are demarcated into Water Management Areas (WMAs) and Catchment Management Agencies (CMAs) (Government Gazette, 16 September 2016. No.1056, pg. 169-172). Table 5, below, is a summary of the drainage region and catchments in which the study site is located, along with Figure 7 showing the location of the study site within the QDA.

None of the three new site alternatives are in aquatic priority areas such as a SWSA, Fish Support Area (FSA), etc. The Preferred Option is within a larger FEPA sub-catchment, while Option 1 & 2 are not.

Table 5: Summary of Catchment Area information

Level	Category
Primary Drainage Area (PDA)	D
Quaternary Drainage Area (QDA)	D14A
Water Management Area (WMA) – Previous / Old	Upper Orange
Water Management Area (WMA) – New (as of Sept. 2016)	Orange (WMA 6)
Sub-Water Management Area	Kraai
Catchment Management Agency (CMA)	Orange (CMA 6)
Wetland Vegetation Ecoregion	Upper Nama-Karoo
RAMSAR Site	No
River FEPA	Yes (Orange River)
Wetland FEPA (Freshwater Ecosystem Priority Area)	No
Fish FEPA (Freshwater Ecosystem Priority Area)	No
Fish FSA (Fish Support Area)	No
Fish Corridor	No
Fish Migratory	No
Priority Quaternary Catchment / FEPA Sub-Catchment	Yes – Preferred Sit
Strategic Water Source Area (SWSA)	No

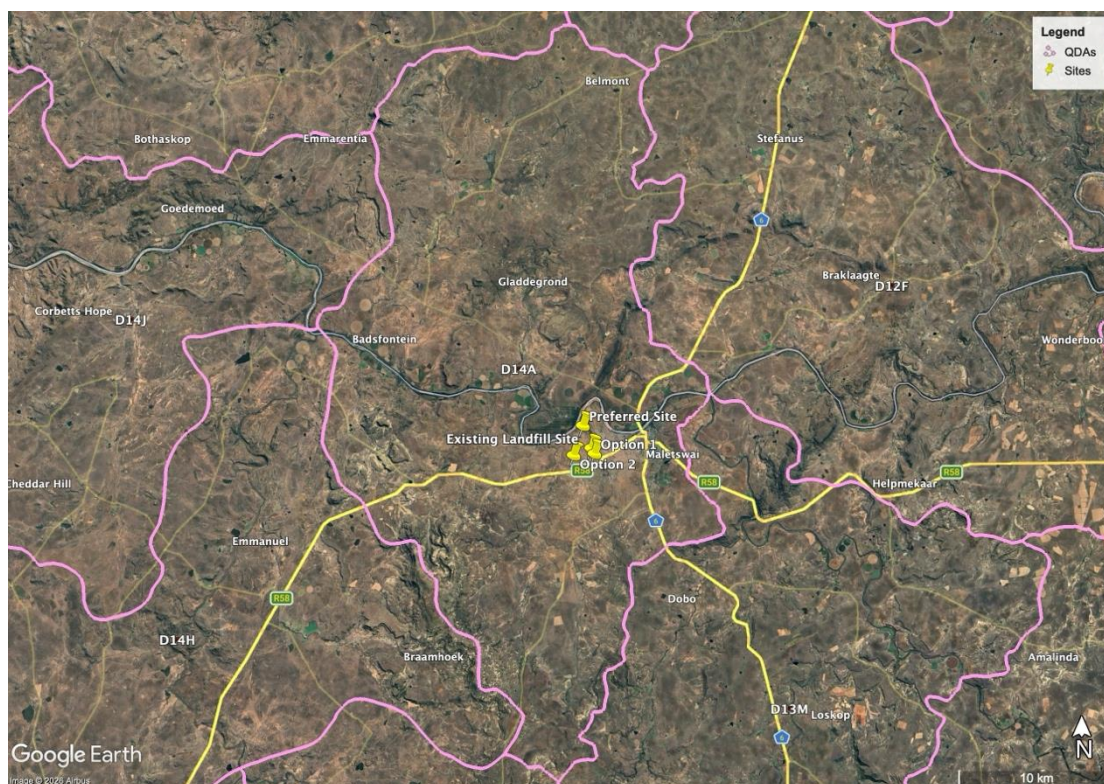


Figure 7: Quaternary Drainage Areas (QDAs)

3.8 Present Ecological State of Watercourses in the Study Area

All watercourses identified within the study area and surrounding areas were assessed to determine their Present Ecological State (PES) (Table 6). The assessment criteria and structure are based on the modified Habitat Integrity approach of Kleynhans (1996, 1999). The PES is calculated by looking at the hydrology, geomorphology, water quality and biota of each watercourse (Table 6). The ecological integrities of the main individual components making up the overall PES of the watercourse are shown below in Table 7. See appendices for the methodology (Section 8.7).

Note PES of a linear watercourse such as the Orange River and Melkspruit may vary along its' course (length) and therefore, the PES assessments below are in proximity to the study site.

The desktop PES and EIS assessments as obtained from the DWS website for the study area are shown below, in Table 8 and Figure 8 (<https://www.dws.gov.za/iwqs/rhp/eco/>). The desktop PES and EIS (EI & ES) are ground-truthed and assessed as shown in Table 6 and Table 9.

Table 6: PES of Watercourses in the Study Area

Criteria	Identified Watercourses			
	Orange River	Melkspruit	Streams / Drainage Lines – Preferred Site & Site 1	Streams / Drainage Lines – Site 2
HYDROLOGY				

Flow modification	3	4	2	3
Permanent inundation	2	4	3	3
WATER QUALITY				
Water Quality Modification	3	4	2	3
Sediment Load Modification	3	3	2	3
GEOMORPHOLOGY				
Canalisation	3	4	2	3
Topographic Alteration	3	4	2	3
BIOTA				
Terrestrial Encroachment	2	4	2	3
Indigenous Vegetation Removal	2	4	3	3
Invasive Plant Encroachment	3	3	3	3
Alien Fauna	3	3	3	3
Over utilisation of Biota	3	4	3	3
Total:	30	41	27	33
Average:	2,7	3,7	2,5	3,0
Category:	C	B	C/D	C/B
Description	Moderately Modified	Mostly Natural	Moderately Modified	Moderately Modified
Description summary	A large loss of natural habitats and basic ecosystem functions has occurred.	Largely natural with few modifications, but with some loss of natural habitats	A large loss of natural habitats and basic ecosystem functions has occurred.	A large loss of natural habitats and basic ecosystem functions has occurred.
Recommended EMC	C	B	B	B

Table 7: Wet Health Scores for Sub-Components of the PES

Name	HGM	Hydrology	Water Quality	Geomorphology	Biota
Orange	River	Category C	Category C	Category C	Category C
Melkspruit	River	Category B	Category C	Category B	Category B
Streams/Drainage – Preferred Site	River	Category C	Category D	Category D	Category C/D
Streams/Drainage – Site 1	River	Category C	Category D	Category D	Category C/D
Streams/Drainage – Site 2	River	Category C	Category C	Category C	Category C/B

Category B = Mostly natural, Category C = Moderately modified. Category D = Largely modified

Table 8 and Figure 8, below, show the DWS Desktop PES and EIS (EI and ES) of the main rivers and streams in the area. Note that these values have been calculated from on-site records and assessments and therefore are typically accurate. Note that Site 1 (Preferred Site) and Site 2 (Option 1) are in different small catchment areas (Figure 8). The surface water at Site 1 (Preferred Option) drains into the Orange

River, while at Site 2 (Option 1) and at Option 2 (not shown on map) the surface stormwater first drains into the Melkspruit, which then drains into the Orange River.

Figure 9, below, highlights the assessed PES ratings and categories of watercourses in the vicinity of the three landfill site options (alternatives) as compared to the DWS assessment in Figure 8.

Table 8: DWS Desktop PES & EIS ratings for the study area

Watercourse	PES	EI	ES
Orange River	C	High	High
Melkspruit	C	Moderate	Moderate
Streams/Drainage – Site 1 (Preferred Site)	-	-	-
Streams/Drainage – Site 2 (Option 1)	-	-	-

PES = Present Ecological State. EI = Ecological Importance. ES = Ecological Sensitivity

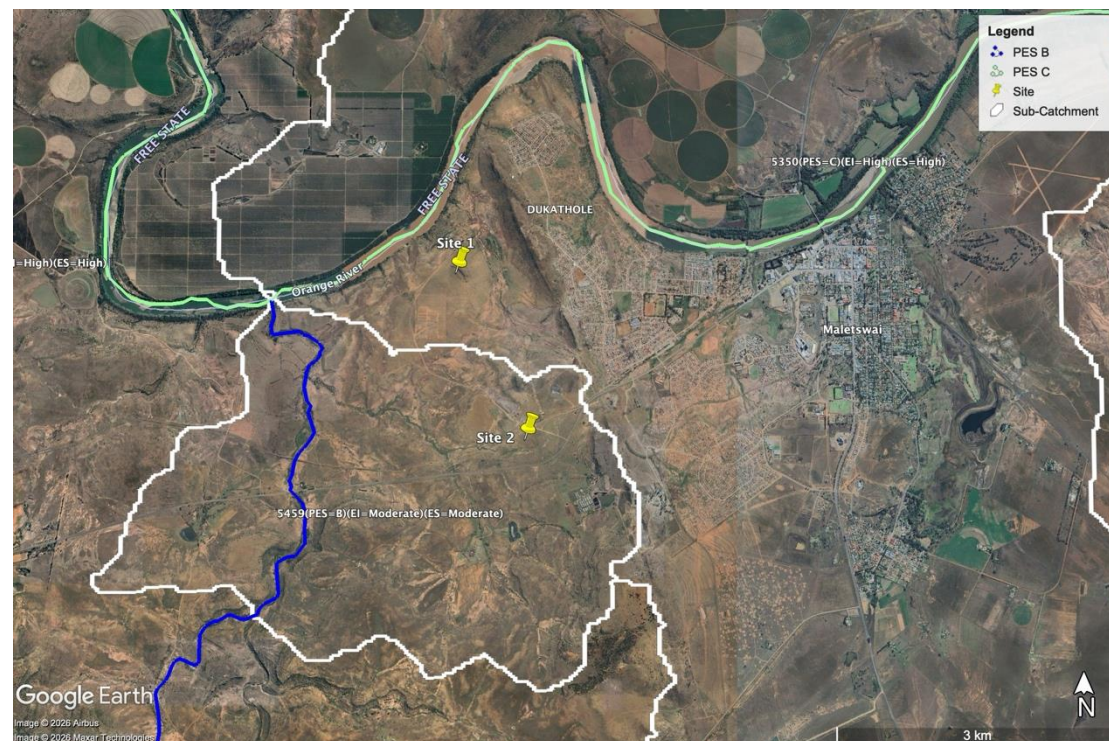


Figure 8: PES and EIS desktop ratings (DWS) of watercourses in study site sub-catchments



Figure 9: Assessed PES categories of watercourses in the vicinity of the landfill site alternatives

Note: Parameters such as pH (acidity / alkalinity) and EC (Electric conductivity) are important long-term measurements for ongoing / routine monitoring of watercourses and potential negative impacts from sources such as landfill sites. However, the once-off measurement of these parameters during a limited site investigation is not representative or useable in the PES determination of a watercourse, as conducted above. Therefore, no pH or EC measurements were done during site investigations.

3.9 Ecological Importance & Sensitivity of Watercourses in the Study Area

The Ecological Importance and Sensitivity (EIS) ratings of the watercourses were calculated as shown in the table below (Table 9). See the appendices for methodology (Section 8.8).

Table 9: EIS of watercourses in the study area

Determinants	Orange	Melkspruit	Seasonal Streams / Drainage Lines	Confidence
PRIMARY DETERMINANTS				
1. Rare & Endangered Species	2	1	0	4
2. Populations of Unique Species	2	1	1	4
3. Species/taxon Richness	2	2	1	4

4. Diversity of Habitat Types or Features	2	2	1	4
5 Migration route/breeding and feeding site for wetland species	2	1	0	4
6. Sensitivity to Changes in the Natural Hydrological Regime	3	1	1	3
7. Sensitivity to Water Quality Changes	3	2	1	3
8. Flood Storage, Energy Dissipation & Particulate / Element Removal	3	1	1	3
MODIFYING DETERMINANTS				
9. Protected Status	2	0	0	4
10. Ecological Integrity	2	2	2	4
TOTAL	23	13	8	-
AVERAGE	2,3	1,3	0,8	-
EIS Category	B	C	D	-
Description	High	Moderate	Low	-
	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.	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 of major rivers.	Not ecologically important and sensitive on any scale. The biodiversity of these watercourses is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	

Table 10: EI & ES Ratings for the study area

Watercourse	EI	ES
Orange River	High	High
Melkspruit	Moderate	Moderate
Streams/Drainage – Site 1	Low	Low
Streams/Drainage – Site 2	Low	Low

EI = Ecological Importance. ES = Ecological Sensitivity

During site investigations the PES and EIS of the identified watercourses were assessed. The comparison between the DWS desktop PES and EIS (EI & ES) ratings and on-site assessments are shown in the table below (Table 11).

Table 11: Comparison between Desktop and Site assessment ratings for PES and EIS

Watercourse	PES	EI	ES
Orange River	C	High	High
Melkspruit	C	Moderate	Moderate
Streams/Drainage – Site 1	-	-	-
Streams/Drainage – Site 2	-	-	-

PES = Present Ecological State. EI = Ecological Importance. ES = Ecological Sensitivity

3.10 Ecological Drivers and Eco Services

3.10.1 Hydrology

The hydrology looks at the movement of water through the environment / landscape. Water movement is predominantly driven by gravity and is always moving downwards and along the path of least resistance. Soils, rock formation, buildings, roads, dams, etc. all have a direct impact on the movement of water, including shallow sub-surface water. The aquatic assessment looks predominantly at surface water and at the shallow sub-surface water (up to a depth of 50cm), which is often active in wetland types such as seeps and valley bottom wetlands.

The general flow direction of surface stormwater in the study area is north into the Orange River. The stormwater at the Preferred Site runs east into small drainage lines that then flow north into the Orange River. The surface water at Option 1 runs more south into small natural seasonal streams / drainage lines that run west into the Melkspruit, which in turn flows north into the Orange River. The surface water at Option 2 runs north and east along small drainage lines and small stream into the Melkspruit.

3.10.2 Water Quality

Water quality is an important indicator and driver of the present ecological state (PES) of a watercourse and overall aquatic ecosystem. Water quality has a direct impact on aquatic macro-invertebrate, fish, frogs, etc., including flora. During site investigations the pH and EC of the water were not measured. The water quality is fair, but with high levels of siltation, especially in the area of the Preferred Site. The townships to the east and the old, existing landfill site have negative impact on the water quality. The water quality at Options 1 & 2 has less siltation and is of higher quality than at the Preferred Site.

3.10.3 Geomorphology

The geomorphology is undulating plains and low hills, but with a distinctive plateau and ridge to the east which influences surface water flow. The soils are fairly prone to erosion when denuded, which is an evident problem in the area of the Preferred Site and nearby to Option 2 as well.

3.10.4 Biota

The quality of the biota also plays an important role in the overall PES of a watercourse. The biota includes aspects such as: Terrestrial encroachment; Removal of indigenous vegetation; presence and level of invasive flora; presence and level of invasive fauna; and levels of utilisation of the natural resources (biota) of the watercourse system.

The biota is low in and along the small seasonal streams and drainage lines due to their ephemeral nature and low level of water flow. These watercourses are dry for most of the year and seldom flow end-to-end, which has a big influence on the presence and species richness of aquatic biota. The biota is also in better condition in the small drainage lines in the vicinity of Options 1 & 2, due to the lower levels of negative impacts, including erosion and resulting siltation.

Terrestrial encroachment

The levels of terrestrial encroachment are low directly in the study area. However, the encroachment was previously high in the area of the Preferred Site, during which time the area was cultivated.

Indigenous Vegetation removal

The present level of indigenous vegetation removal is low in terms of physical removal of vegetation such as reeds by locals. However, roaming grazing livestock have an impact on the vegetation in the watercourses as the grass here is greener and denser for longer.

Invasive Plant Encroachment

The level of invasive alien plants is low.

Over Utilisation of Biota

The current levels of utilisation of biota, such as the removal of sand, removal of plants (reeds, etc.) and the extraction of water for animal and/or human consumption are at low levels in the area of the study site.

3.10.5 Eco Services

Hydrological functions and drivers are important in helping to regulate flood attenuation, sediment trapping, control erosion and trap nutrients such as phosphate and nitrates across the study area and adjacent areas. EcoServices includes the assessment of several ecosystem services that the wetland / watercourse / aquatic system provides to the ecosystem.

There are no wetlands present in the study site, but the small drainage lines and Melkspruit do serve hydrological functions (Table 12, Table 13).

Table 12: Hydrological Functions according to hydrological type

Hydrogeomorphic Type	Source of water maintaining the wetland		Hydrological functions potentially performed by the wetland								
			Flood Attenuation		Stream flow augmentation		Erosion Control	Potential for water quality enhancement			
	Surface	Sub-Surface	Early wet season	Late wet season	Early wet season	Late wet season		Sediment trapping	Phosphate removal	Nitrate	Toxins
Floodplain	1	0	++	+	-	-	++	++	++	+	+
VB Channelled	1	1	+	-	-	-	++	+	+	+	+
VB Unchannelled	1	1	+	+	+	+	++	+	+	+	++
Hillslope Seep connected	0	1	+	-	+	+	++	-	-	++	++
Hillslope Seep unconnected	0	1	+	-	+	+	++	-	-	++	++
Pan / depression	1	1	+	+	-	-	-	-	-	+	+

Key:
VB = Valley Bottom.
1 = Important Contribution; 0 =Minimal Contribution; ++ = High level of function and contribution;
+ = Function likely to be present to some degree; - = Function unlikely at any significant level.

Reference: DWS, 2017.

Table 13: EcoServices supplied by Wetlands and other Watercourses

Indirect Benefits	
Flood Attenuation	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream.
Stream flow regulation	Sustaining stream flow during low flow periods.
Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters.
Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters.
Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters.
Toxin assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters.
Erosion Control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
Carbon storage	The trapping of carbon by the wetland, principally as soil organic matter.
Direct Benefits	
Biodiversity maintenance	Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity.
Provision of water as a resource	The provision of water extracted directly from the wetland for domestic, agriculture or other purposes.
Provision of harvestable resources	The provision of natural resources from the wetland, including livestock grazing, craft plants, fish etc.
Provision of cultivated food	The provision of areas in the wetland favourable for the cultivation of foods
Cultural heritage	Places of special cultural significance in the wetland, e.g. for baptisms or gathering of culturally significant plants.
Tourism and recreation	Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife.
Education and research	Sites of value in the wetland for education or research.

Table 14: EcoServices provided by the watercourses

ID	HGM Type	Stream flow regulation	Education & Research	Tourism & Social Significance	Food cultivation	Sediment trapping	Phosphate trapping	Nitrate removal	Toxin removal	Water supply humans, livestock	Biodiversity maintenance
Melkspruit	River	1	0	0	0	3	2	2	2	0	2
Streams / Drainage Lines	River										

The ecological services (EcoServices) rating supplied by a wetland / watercourse system are ranked as follows: 0 – Low, 1 – Moderately Low, 2 – Moderate, 3 – Moderately High and 4 – High.

4 SENSITIVITY

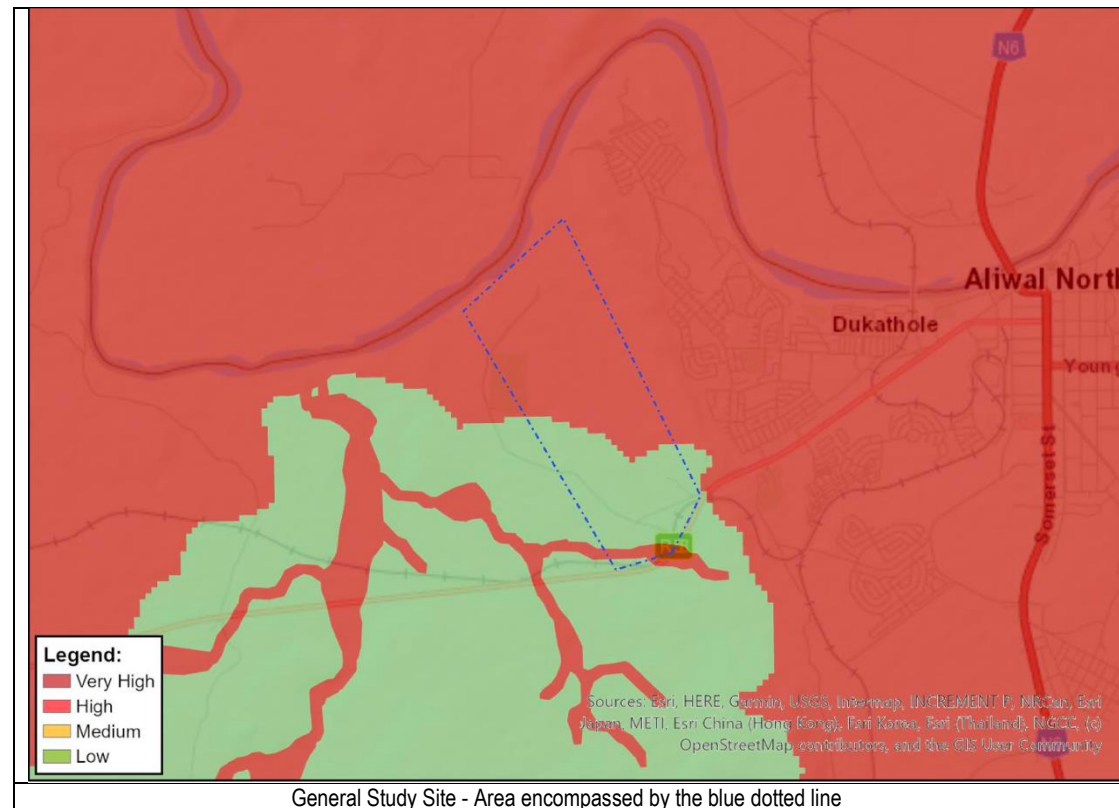
The sensitivities of the different areas in terms of the water environment are determined by taking all aspects discussed in the report into consideration. All watercourses are, by default, considered sensitive, despite their levels of disturbance, pollution, degradation, etc.

4.1 National Screening Tool Assessment

According to the National Screening Tool assessment the aquatic biodiversity sensitivity of the study area is 'Very High' and 'Low' (www.screening.environment.gov.za) (Table 15).

The Preferred Site is within a 'very high' area, while Options 1 & 2 are within a 'low' sensitivity area. The drainage line systems in the area of site Options 1 & 2 are delineated 'very high'. The 'very high' areas are because it is within an ESA and FEPA sub-catchment.

Table 15: Aquatic Theme Sensitivity Map of area taken from National Screening Tool



4.2 Aquatic Sensitivity Map

The sensitivity maps for the three investigated sites for the new landfill site, in terms of only the aquatic ecology, are shown below (Figure 10, Figure 11, Figure 12). The small impoundment is not a 'high' sensitivity aquatic habitat or feature.

The large 'high sensitivity' areas shown in Figure 10 and Figure 12 include areas that have high levels of erosion and gully formation near and along the watercourses and low-lying areas and therefore best avoided entirely.

The potential sites basically have a 'low' aquatic sensitivity. However, Option 1 is situated directly on the edge of natural watercourses and therefore potentially has a bigger negative impact on the aquatic environment. Option 2 is similar to Option 1, with a drainage line within the demarcated site area.

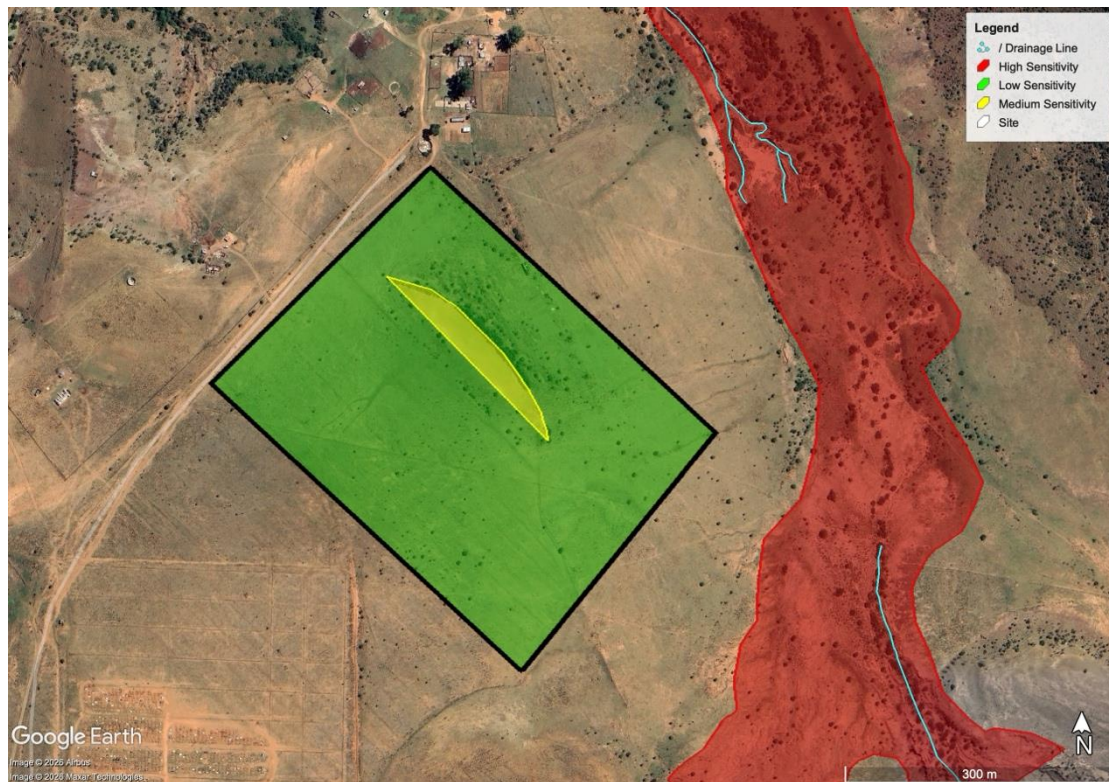


Figure 10: Aquatic Sensitivity Map: Preferred Site



Figure 11: Aquatic Sensitivity Map: Option 1

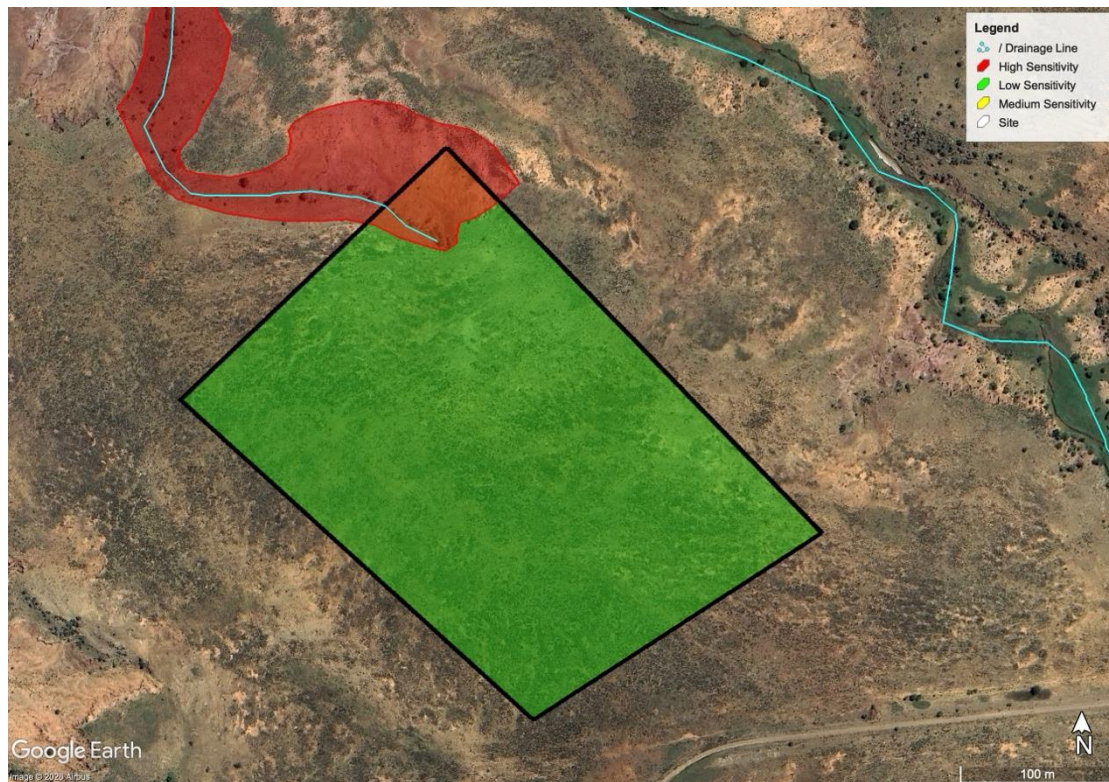


Figure 12: Aquatic Sensitivity Map: Option 2

4.3 Proposed Buffer Zones & Regulated Zones

Buffer zones around all natural watercourses of 32m wide from the bank edges are recommended.

Buffer zones include 'high sensitivity' aquatic areas as determined and shown above in the sensitivity maps for the three potential site alternatives.

The buffer zone around a natural drainage line is within the site area at Option 2 and the site is therefore also not recommended as a viable option. The buffer zone also includes an area of high erosion potential. (See the appendices for the differences between a buffer zone and a regulated zone).

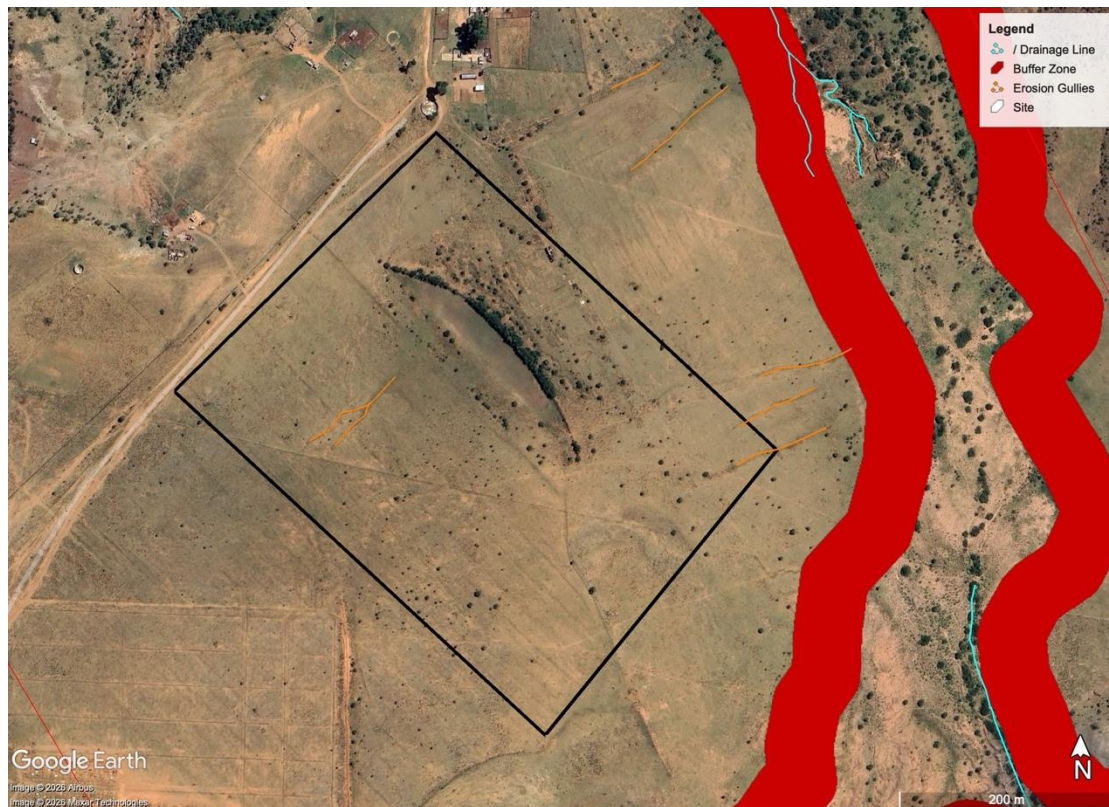


Figure 13: Buffer Zones in the vicinity of Site 1

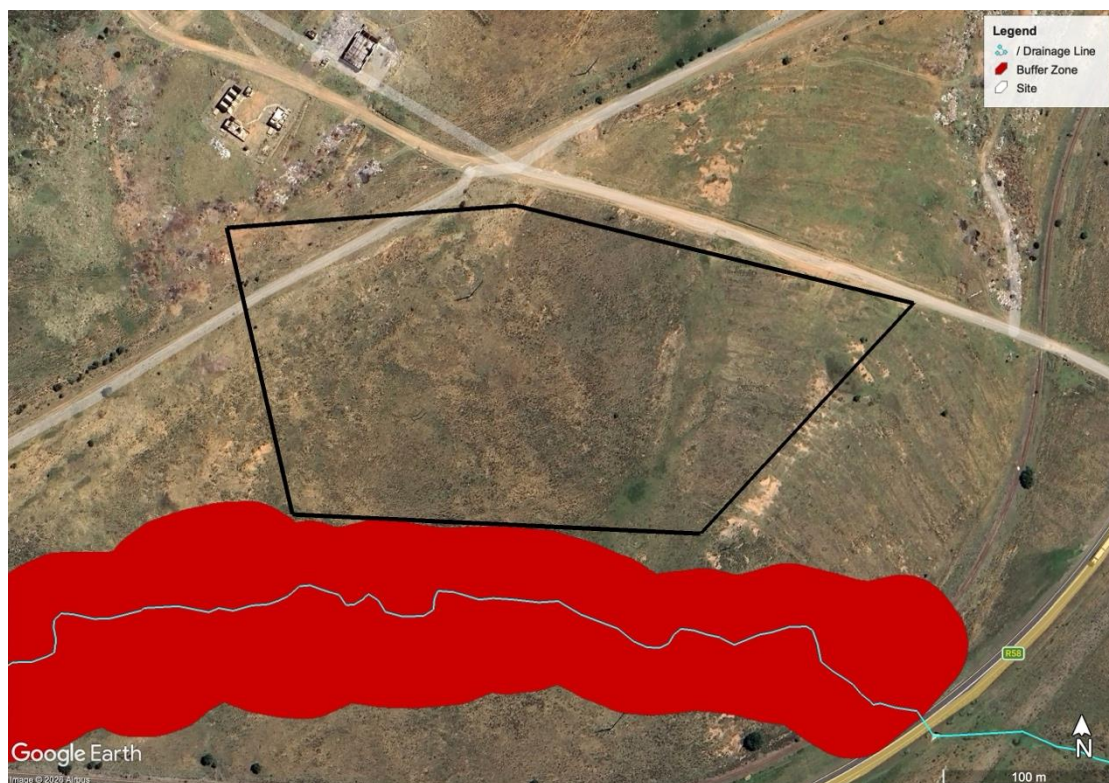


Figure 14: Buffer Zones in the vicinity of Option 1

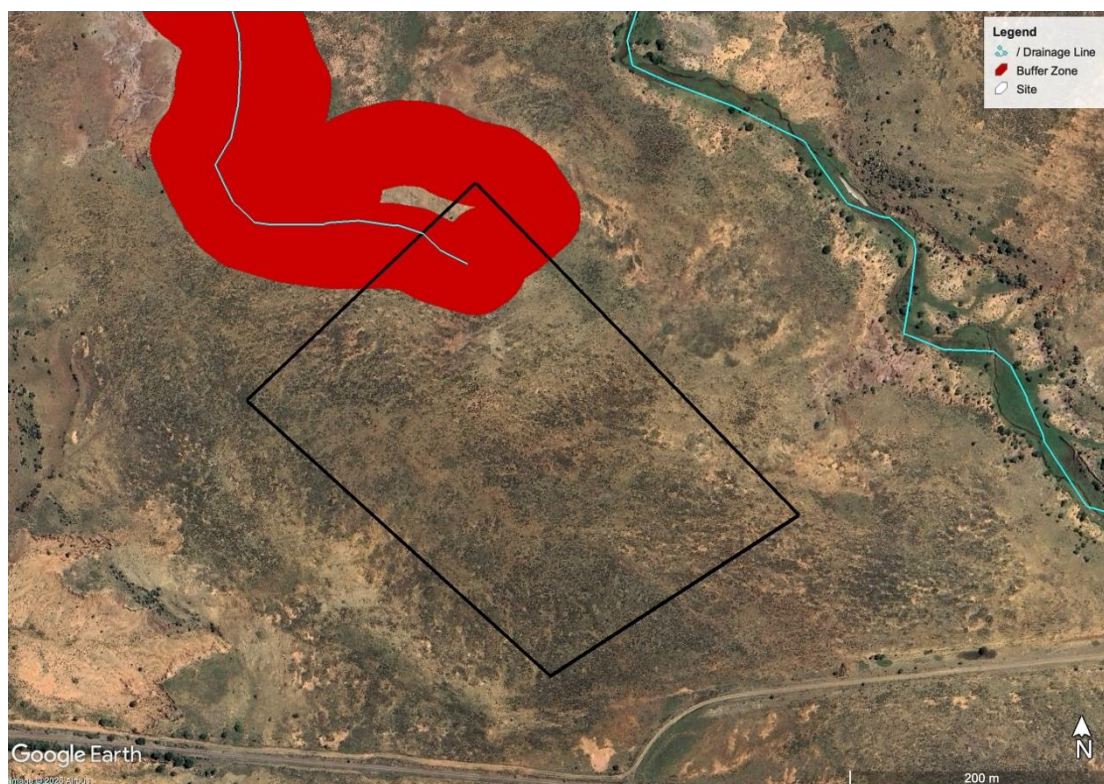


Figure 15: Buffer Zones in the vicinity of Option 2

5 IMPACT ASSESSMENT

5.1 Existing Impacts

There are existing impacts on the aquatic environment in the general area and study site. These negative impacts include formation of erosion gullies and resulting siltation of watercourses.

5.2 Potential Impacts

Potential negative impacts include the pollution of surface stormwater run-off that then lands up in watercourses, as well as pollution of underground water.

There are no positive impacts arising from the proposed project on the immediate environment. However, the opening and proper management of a necessary landfill site will help to reduce negative impacts on other environments by impacts such as random dumping due to lack of proper facilities. In this sense, the project will have positive impacts.

5.3 Cumulative Effect

The Cumulative Effect can be defined as the total of negative impacts on the natural environment that are caused by the sum of all effects of past, current and future activities. The proposed project will lead to an increase in the cumulative impact (sum of negative impacts) on the aquatic environment.

5.4 Assessment of Potential Impacts

The assessment of the potential impacts on the project site and surroundings is shown in Table 17.

The scoring method used in the impact assessment is as follows:

$$\text{Significance (SP)} = [\text{Extent (E)} + \text{Duration (D)} + \text{Magnitude (M)}] \times \text{Probability (P)}$$

The maximum value is 100 significance points (SP). Environmental impacts will be rated as shown in Table 16 below.

Further explanation of the assessment methodology is found above in the section on methodology.

Note: The Impact Assessment only relates to the Aquatic Environment.

Table 16: Significance Scoring

Score	Significance Points (SP)	Description
<10	Negligible	The impact is non-measurable to zero / absent.
10 – 20	Low	Where the impact would not have a direct influence on the decision to develop in the area.
20 – 50	Medium	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
50 – 70	High	Where the impact must have an influence on the decision process to develop in the area.
>70	Very High	Where the impact may constitute a fatal flaw for the project.

Table 17: Impact Assessment of Potential Impacts

Potential Impacts arising from Project	Phase of Project	Impact Rating (Negligible: <10; Low: 10-20; Medium: 20-50; High: 50-70; Very High: >70)					
		Extent	Duration	Magnitude	Probability	Total	Significance
	Establishment Phase: Pre-mitigation	Local (2)	Long-term (4)	Moderate (6)	Medium (3)	36	Medium
	Establishment Phase: Post mitigation	Site (1)	Long-term (4)	Minor (2)	Low (2)	14	Low
	Operational Phase	Site (1)	Short-term (2)	Minor (2)	Low (2)	10	Negligible
Cumulative Effect of Project on Study Site	After construction and during operational phase	Site (1)	Short-term (2)	Minor (2)	Improbable (1)	5	Negligible
Individual Impacts (Negligible: <10; Low: 10-20; Medium: 20-50; High: 50-70; Very High: >70)							
		Extent	Duration	Magnitude	Probability	Total	Significance
1. Loss of aquatic vegetation	Establishment Phase: Pre-mitigation	Site (1)	Short-term (2)	Moderate (6)	Low (2)	18	Low
	Establishment Phase: Post mitigation	Site (1)	Short-term (2)	Minor (2)	Low (2)	10	Low
	Operational Phase	Site (1)	Short-term (2)	None (0)	Improbable (1)	3	Negligible

2. Impeding & Impounding waterflow	Establishment Phase: Pre-mitigation	Site (1)	Long-term (4)	Low (4)	Medium (3)	27	Medium
	Establishment Phase: Post mitigation	Site (1)	Short-term (2)	Low (4)	Low (2)	14	Low
	Operational Phase	Site (1)	Short-term (2)	Minor (2)	Low (2)	10	Low
3. Altering the flow of a watercourse	Establishment Phase: Pre-mitigation	Site (1)	Short-term (2)	Moderate (6)	Low (2)	18	Low
	Establishment Phase: Post mitigation	Site (1)	Short-term (2)	Low (4)	Low (2)	14	Low
	Operational Phase	Site (1)	Short-term (2)	Minor (2)	Low (2)	10	Negligible
4. Changing the characteristics of a watercourse	Establishment Phase: Pre-mitigation	Site (1)	Short-term (2)	Moderate (6)	Low (2)	18	Low
	Establishment Phase: Post mitigation	Site (1)	Short-term (2)	Low (4)	Low (2)	14	Low
	Operational Phase	Site (1)	Short-term (2)	Minor (2)	Low (2)	10	Low
5. Siltation and erosion	Establishment Phase: Pre-mitigation	Local (2)	Long-term (4)	Moderate (6)	Medium (3)	36	Medium
	Establishment Phase: Post mitigation	Site (1)	Short-term (2)	Minor (2)	Low (2)	10	Low
	Operational Phase	Site (1)	Short-term (2)	Minor (2)	Low (2)	10	Low

5.5 Mitigating Measures

The following are mitigating measures that must form part of the conditions of the EMP, WULA / GA and any other management reports or licenses. The mitigating measures relate directly to the impact assessment above and the individual potential impacts. The implementation of the mitigating measures is necessary to reduce the significance of potential impacts as shown above in the impact assessment.

- No vegetation within any watercourses may be removed or cleared for any project activities.
- No general vegetation may be unnecessary cleared as this can lead to an increase in erosion potential and resulting siltation of watercourses.
- No natural watercourses, including drainage lines may be impeded or impounded for the establishment of the landfill site. This includes access roads.
- Under no circumstances may project activities impact on natural watercourses.

- No project-related activities, including temporary sites during establishment be within delineated watercourses or within any delineated buffer zones. This includes access roads into the landfill site.
- A monitoring programme is required for the weekly monitoring of nearby watercourses as well as of any water seepage from out of the landfill site. The weekly monitoring to be done by local officials working at the landfill site. Monthly or bi-monthly monitoring by an independent specialist should also be implemented. This should include water samples that are sent to a registered lab for analysis. As part of the monitoring pH, EC, turbidity and TDS must be measured and recorded. These records must be kept on site.
- Monthly water samples must be taken (upstream and downstream of the final landfill site), including samples from the Orange River. These samples must be sent to a registered laboratory of analysis. Any necessary remedial actions must then be taken on the results and recommendations from the laboratory.
- A surface stormwater management plan is required. This needs to include detail on preventing the flow of clean stormwater onto the landfill site, as well as the seepage and flow of polluted water from out of the landfill site.
- Polluted surface stormwater on the site must be managed and contained as not to allow it to flow off the site to pollute any nearby watercourses.
- The groundwater in the immediate area must also be protected from seepage of polluted and contaminated water arising on the landfill site.
- The landfill must be managed in such a manner that no waste, contaminated runoff, leachate, sediment, hydrocarbons or other pollutants are permitted to enter the nearby Orange River or the associated drainage system, either directly or indirectly. Emphasis should be placed on surface stormwater run-off and separation, landfill cover, erosion control, litter containment, progressive rehabilitation and appropriate surface- and groundwater monitoring.

Because the site is fairly near to the Orange River, the following mitigating measures are of particular importance:

- Maintain a substantial protective separation between the waste disposal footprint and the Orange River and associated drainage features.
- Ensure that clean stormwater is diverted around the landfill and that contaminated runoff cannot discharge towards the Orange River. Settling ponds / maturation ponds are required into which all polluted stormwater and leachate should be diverted and prevented from leaving the site.
- Implement appropriate landfill containment/leachate management and progressively cover exposed waste. The National Norms and Standards for Disposal of Waste to Landfill provide requirements relating to containment barriers, drainage layers and landfill design.

- Establish a surface-water and groundwater monitoring programme, with sampling locations selected to detect any potential migration of landfill-related pollutants towards the Orange River.
- Maintain the natural/vegetated area between the landfill and the river as far as practicable, avoiding unnecessary clearing and using it as an additional attenuation zone for sediment and runoff.
- All planning, design, construction, operation, maintenance and eventual closure of the landfill facility must comply with applicable South African legislation, national norms and standards, accepted industry standards and good engineering practice, including the requirements applicable to landfill classification, containment, waste acceptance, operational controls and rehabilitation. The National Norms and Standards for Disposal of Waste to Landfill, promulgated under the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), specifically prescribe requirements for landfill disposal and minimum engineering design requirements.

6 SUBSTANTIATED STATEMENT

Below is a substantiated statement, based on the findings of the specialist assessment, study and report, regarding the acceptability, or not, of the proposed development, if it should receive approval or not and any conditions to which this statement is subjected.

There are no watercourses directly within either of the three alternative landfill sites investigated. There is a small impoundment within the area of the Preferred Site. Option 1 is located on the edge of a natural small stream / drainage line, while Option 2 has a small natural drainage line within it. Option 1 & 2 have the potential to have larger negative impacts on the natural water environment.

The main watercourses in the region are the perennial Orange River and semi-perennial Melkspruit. The Melkspruit flows north into the Orange River and varies from about 1,7km to 2,4km west of the study site. The Orange River varies in distance between 450m and 500m northwest of the Preferred Site. The landfill site will have no direct impact on any of these two watercourses.

There are a few small and highly ephemeral streams and drainage lines in the vicinity of the new landfill site alternatives. Those in the vicinity of the Preferred Site flow directly into the Orange River, while those near Option 1 and Option 2 flow into the Melkspruit. There is a small out-of-stream impoundment at the Preferred Site. The small impoundment is not very functional and was created to trap (impound) surface rainwater run-off, probably to retain some water for grazing livestock. However, the water volumes are low and the impoundment is dry (that is, no visible surface water) for most of the year. The impoundment is not a natural watercourse. There are occasions when a dam becomes part of the natural aquatic environment, but these are mostly in-stream dams that form an integral part of the linear river / stream and are important in terms of upstream and downstream connectivity. Out-of-stream dams do not serve

this same important aquatic function. However, there are out-of-stream dams that have become part of the aquatic environment and support wildlife such as waterbirds, but these are typically large dams that have permanent open bodies of water and not small, shallow and insignificant impoundments that dry out quickly, such as the one at the Preferred Site. These large dams act very much like large natural pans or lakes.

The natural environments in the area of Options 1 & 2 are in a much better condition than that of the Preferred Site, which for many years was cultivated fields and is therefore transformed.

Therefore, the Preferred Site is the preferred alternative for the new landfill site, which is required, because the existing old site is at capacity and is in the process of closure.

As mentioned, there is a small out-of-stream impoundment in the area investigated at the Preferred Site, but this feature is far less sensitive than the natural watercourses found adjacent to and within Options 1 & 2. Nevertheless, buffer zones have been delineated that should be strictly implemented. This along with stormwater management plans should ensure that the landfill site will have little to very low negative impacts on the water environment in the area, especially that of natural watercourses.

Site 1 (Preferred Site) is therefore the recommended preferred site alternative for the new Maletswai Landfill Site.

The areas investigated within the three landfill site alternatives are larger than required. This was done in order to give some flexibility in the final placement of the landfill site. Therefore, recommended buffer areas must be implemented and the site should be established as far back away from the impoundment as possible. The site should be properly fenced from the onset. A detailed stormwater plan is also required that must include detail of construction and management. With proper construction and management impacts on the surrounding aquatic systems / water environment will be limited. In reality, the impact on the aquatic environment is low with the implementation of necessary mitigating measures, which not only includes those listed in the report, but also those required by other relevant legislation controlling the establishment and operation of landfill sites. This will include protecting groundwater and controlling of polluted and contaminated onsite surface water.

If properly established and well managed, the landfill site will have little negative impact on the water environment.

7 CONCLUSIONS

The conclusions and recommendations arising from the study are as follows:

Conclusions

- Three alternative sites were investigated for the establishment of a new but necessary landfill site of Maletswai (Aliwal North).

- The main watercourses in the region are the perennial Orange River and semi-perennial Melkspruit. The Melkspruit flows north into the Orange River and varies from about 1,7km to 2,4km west of the general study site. The Orange River varies in distance between 450m and 500m northwest of the Preferred Site.
- There are a few small and highly ephemeral streams and drainage lines in the vicinity of the site alternatives. Those in the vicinity of the Preferred Site flow directly into the Orange River, while those near Options 1 & 2 flow into the Melkspruit. There are no wetlands in the or near to the three site alternatives.
- There is a small out-of-stream impoundment at the Preferred Site. The impoundment is not a natural watercourse.
- The recommended site alternative for the new landfill site is: The Preferred Site.

8 APPENDICES

8.1 Photographs

8.1.1 Preferred Site

	
Out-of-stream impoundment on the study site	Out-of-stream small and shallow impoundment
	
Study Site – Preferred Option / Landfill Site	Open previously cultivated fields on the preferred site
	
Preferred site with ridges to the east of the site	Study site – Preferred Site for the new Maletswai Landfill

8.1.2 Option 1

	
Study site – Option 1 (Alternative site to the preferred site)	Study site with R58 in the background
	
Undulating hills of the study site	Study site
	
Some low levels of soil erosion at the study site	Drainage line in the study area

8.1.3 Option 2

	
Study site – Option 2, the second alternative to the preferred site	Study site showing open fairly good quality Karoo Veld
	
Study Site	Study Site
	
Study Site showing undulating plains and low hills	Undulating plains with small seasonal stream in the mid-ground

8.2 Classification of Watercourses

Watercourses identified are classified along different hydrogeomorphic (HGM) units, typically up to Level 4, in terms of six levels as refined for South Africa by Kleynhans, *et. al.* (2005) and used in the Classification System for Wetlands user manual – SANBI Series 22 (Ollis *et. al.* 2013).

LEVEL 1 System	LEVEL 2 Regional setting (Ecoregion)	LEVEL 3 Landscape Unit	LEVEL 4 HGM Unit	
			HGM Type	Landform
Inland	SA Ecoregions according to DWS and/or NFEPA	- Valley floor - Slope - Plain - Bench	River	- Mountain headwater stream - Mountain stream - Transitional stream - Upper foothill - Lower foothill - Lowland - Rejuvenated foothill - Upland floodplain
			Channelled valley bottom wetland	
			Unchannelled valley bottom wetland	
			Floodplain Wetland	
			Depression	- Exorheic - Endorheic - Dammed
			Seep	- With channel outflow (connected) - Without channel outflow (disconnected)
			Wetland flat	

LEVEL 5 Hydrological Regime	LEVEL 6 Ecosystem Characteristics
- Perenniality (Perennial & non-perennial) - Period & depth of inundation (Limnetic (>2m) and Littoral (<2m) maximum depth at the average annual low water level) - Period of saturation (Only of relevance to actual wetlands)	- Natural vs artificial - Salinity - pH - Substratum type - Vegetation cover type - Geology

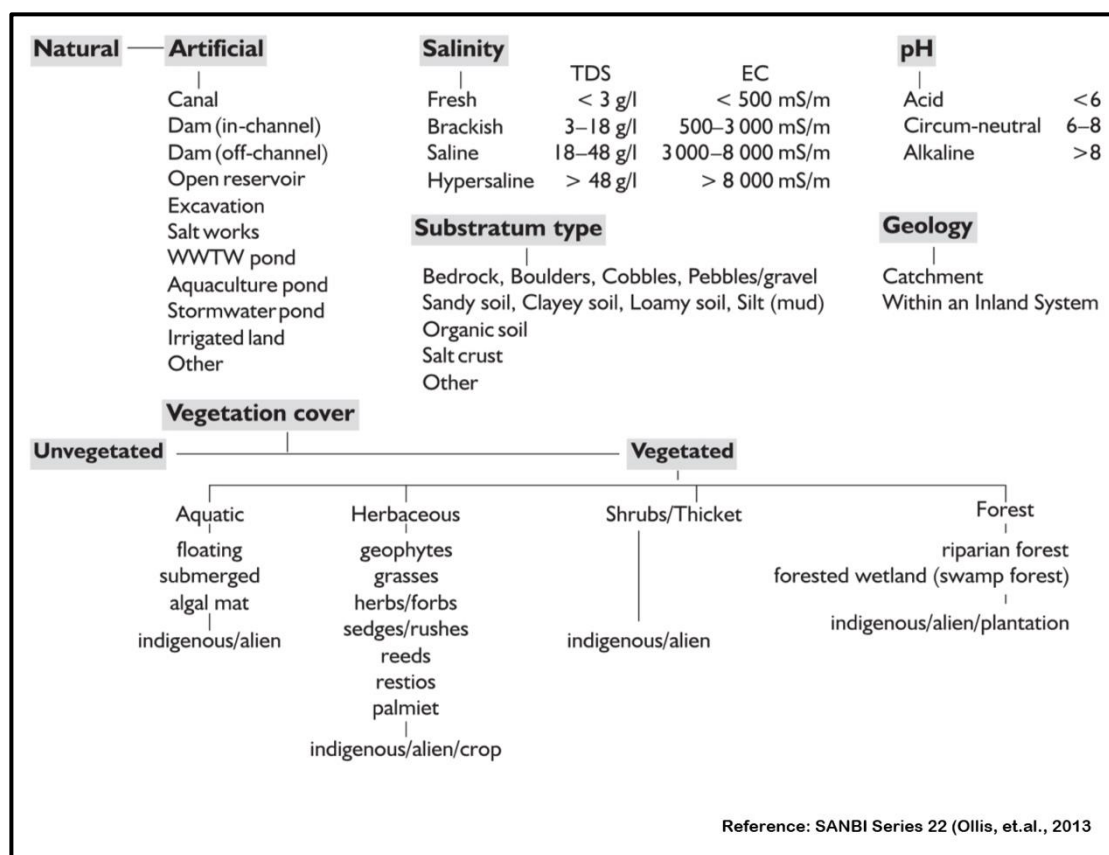


Figure 16: Schematic of Level 6 (Ecosystem Characteristics)

8.3 Definitions

8.3.1 Wetlands

'Wetland' is a broad term and for the purposes of this study it is defined according to the parameters as set out by the Department of Water & Sanitation (DWS) in their guideline (A practical field procedure for identification and delineation of wetlands and riparian areas, 2005).

According to the DWS document and the National Water Act (NWA) a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near 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.*"

Furthermore, the guidelines stipulate that wetlands must have one or more of the following defining attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of water-loving plants (hydrophytes); and
- A high-water table that results in saturation at or near surface, leading to anaerobic conditions developing in the top 50 cm of the soil.

Hydrogeomorphic types		Description	Source of water maintaining the wetland	
			Surface	Sub-surface
Floodplain		Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel		Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/ ***
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hill slope seepage		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans)		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

¹ Precipitation is an important water source and evapotranspiration an important output in all of the above settings
 Water source: * Contribution usually small
 *** Contribution usually large
 */ *** Contribution may be small or important depending on the local circumstances
 */ *** Contribution may be small or important depending on the local circumstances.

 Wetland

8.4 Regulated Zone versus Buffer Zone

A buffer zone implies a zone or area in which “nothing” should be done, or no activities are allowed to take place. A regulated zone (or area), has certain legal implications, under which certain or regulated activities may or may not take place.

The following areas / zones and regulations are relevant:

- The **32 m** in the NEMA listed activities. This is 32 m from the 1:1 year flood line or first flood bank of the active stream area. This is not 32 metres from the 1:100 year flood line or 32 metres from the 500 m zone of the delineated wetland as determined by DWS. Experts keep on using

definitions in the NEMA to support or define things or issues in the NWA or vice versa. This should not be done.

- The 1:100 flood line, or the riparian area (whichever is the furthest) as defined by the GN509 in terms of the NWA; or
- The wetland area and 500 m from the wetland area as defined by GN509 in terms of the NWA

These areas are the “Extent” or “regulated area” of a watercourse. In other words areas in which the applicable legislation applies. Before any activity can take place as defined by the legislation the activity must be authorised in terms of that legislation. The term is “Regulated Area”.

This means an activity may take place within a regulated area. Only if after the necessary environmental evaluation processes have been followed and it has been determined that the impacts are acceptable or the mitigating actions implemented will address any unacceptable impacts.

8.5 Legislation relating to buffer & regulated zones for watercourses

1. Listed activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) EIA Regulations, 2014 (as amended) must be taken into consideration if any infrastructure is to be placed within the applicable zone of regulation. This must be determined by the EAP in consultation with the relevant authorities;

2. In accordance with GN509 of 2016 as it relates to the NWA, a regulated area of a watercourse for section 21(c) and 21(i) of the National Water Act, 1998 (Act 36 of 1998) is defined as:

- The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
- In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or
- A 500 m radius from the delineated boundary (extent) of any wetland or pan

3. In terms of Regulation GN704 of the NWA, 1998 (Act no. 36 of 1998), a 100 m zone of regulation around the watercourses is required. If any mining activities are to take place within 100 metres or the 1:100-year flood lines exemption in terms of this regulation, as well as General Notice No. 1199 of 2009, as it relates to the NWA, will also apply and therefore a Water Use License will be required

8.6 Vegetation indicators for Wetland zones

Below is a summary of vegetation indicators which could be expected in the three different wetness / wetland zones of a wetland (Table 18).

Table 18: Vegetation indicators for wetland zones

Vegetation	Temporary Zone	Seasonal Zone	Permanent Zone
Herbaceous	Predominantly grass species; mixture of species which occur extensively in non-wetland areas, and hydrophilic plant species which are restricted largely to wetland areas.	Hydrophilic sedge and grass species, which are restricted to wetland areas; <i>Phragmites australis</i> .	Dominated by: 1. emergent plants, including reeds (<i>Phragmites australis</i>), a mixture of sedges and bulrushes (<i>Typha capensis</i>), usually >1m tall; and/or 2. floating or submerged aquatic plants.
Woody	Mixture of woody species which occur extensively in non-wetland areas, and hydrophilic plant species that are restricted largely to wetland areas.	Hydrophilic woody species, which are restricted to wetland areas.	Hydrophilic woody species, which are restricted to wetland areas. Morphological adaptations to prolonged wetness (e.g. prop roots).

Reference: Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas. 2nd ed. Sept. 2008. DWS.

8.7 Present Ecological State

The Present Ecological State (PES) is the current (present) ecological condition (state) in which the watercourse is found, prior to any further developments or impacts from the proposed project. The PES of watercourses found in the study area is just as important to determine, as are the potential impacts of the proposed development. The PES of a watercourse is assessed relative to the deviation from the Reference State (also known as the Reference Condition).

The reference state is the original, natural or pre-impacted condition of the system. The reference state is not a static condition but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES Method (DWA, 2005) was used to establish the present state (integrity) of the unnamed drainage line in the study area. The methodology is based on the modified Habitat Integrity approach of Kleynhans (1996, 1999). The criteria used for assessing the habitat integrity or present ecological state (PES) of watercourses can be found below in Table 19, along with Table 20, which describes the allocation of scores to the various attributes. These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a watercourse. Table 21 gives a short description of each category. The approach is based on the assumption that extensive degradation of any of the attributes may determine the PES of the watercourse (DWA, 2005).

Table 19: Habitat Assessment Criteria

Rating Criteria	Relevance
Hydrology	
Flow modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural lands. Changes in flow regime (timing, duration, frequency), volumes, and velocity, which affect inundation of wetland

	habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.
Permanent inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
Water quality	
Water Quality Modification	From point or diffuse sources. Measured directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.
Geomorphology & Hydraulics	
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities, which reduce or changes wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Over utilisation of Biota	Overgrazing, over fishing, over harvesting of plant material, etc.

Table 20: Scoring Guidelines for Habitat Assessment Criteria

Scoring guidelines per criteria	
Natural / unmodified	5
Mostly natural	4
Moderately modified	3

Largely modified	2
Seriously modified	1
Critically modified (totally transformed)	0

Table 21: Wetland Integrity Categories

Category	Mean Score	Description
A	>4	Unmodified, natural condition.
B	>3 to 4	Largely natural with few modifications, but with some loss of natural habitats.
C	>2,5 to 3	Moderately modified, but with some loss of natural habitats.
D	2 to 2,5	Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
E	>0	Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
F	0	Critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

It must be emphasised that the A to F scale (Table 21) represents a continuum, and that the boundaries between categories are notional, artificially defined points along the continuum. There may therefore be cases where there is uncertainty as to which category a particular entity belongs. This situation falls within the concept of a 'grey area' between two categories, where a particular entity may potentially fall into both classes (Robertson et al. 2004). For practical purposes these situations are referred to as boundary categories and are denoted as B/C, C/D, and so on (see Figure 17, below).

The integrity of watercourses with a category rating of F, E & D are deemed to be Low. Category rating of C is deemed to be Medium, while Category ratings of B & A are deemed to be High.

**Figure 17: Continuum of PES Categories**

8.8 Ecological Importance and Sensitivity

Ecological importance and sensitivity (EIS) looks at the importance of the wetland, watercourse or water ecosystem in terms of biodiversity and maintenance. The determination is not just based on the identified watercourse in isolation, but also its' importance in terms of supplying and maintaining services to the larger catchment and water systems up and downstream.

The ecological sensitivity (ES) part of the EIS looks at how sensitive the system is to changes in services and environmental conditions. The Recommended Environmental Management Class (REMC) is the recommended state to which the watercourse should be returned to or maintained at. The EIS categories and descriptions are outlined in the table below (Table 22).

A high REMC relates to ensuring a high degree of sustainability and a low risk of ecosystem failure occurring. A low REMC would ensure marginal sustainability, but with a higher risk of ecosystem failure. The REMC is based on the results obtained from assessing the ecosystem / watercourse / wetland in terms of EIS, PES and function, and the desire to with realistic recommendations and mitigating actions to return the system to a certain level of functionality and original state. The determination of the Environmental Importance and Sensitivity (EIS) of the watercourses identified in the study area are shown below (Table 22).

Table 22: EIS Categories and Descriptions

EIS Categories	Median Range	Category
Wetlands that are considered ecologically important and sensitive on a national or international level. The biodiversity of these wetlands is usually very sensitive to flow & habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	Very high 3 - 4	A
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.	High 2 - 3	B
Wetland 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 of major rivers.	Moderate 1 - 2	C
Wetlands that are not ecologically important and sensitive on 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 of major rivers.	Low 0 - 1	D

8.9 Criteria for the classification of an impact

Scale (Extent)

Considering the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact.

- Site: Within the construction site
- Local: Within a radius of 2 km of the construction site
- Regional: Provincial (and parts of neighbouring provinces)
- National: The whole of the country
- International: Impact is across countries

Duration

Indicates what the lifetime of the impact will be.

- Immediate: The impact will either disappear with mitigation or will be mitigated through natural process in a time span shorter than the construction phase.

- Short-term: The impact will either disappear with mitigation or will be mitigated through natural process within 0 – 5 years.
- Medium-term: The impact will either disappear with mitigation or will be mitigated through natural process within 5 – 15 years.
- Long-term: The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. Impact ceases after the operational life of the activity.
- Permanent: The only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.

Magnitude (Intensity)

Describes whether an impact is destructive or benign.

- Low: Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.
- Medium: Effected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way.
- High: Natural, cultural and social functions and processes are altered to extent that they temporarily cease.
- Very high / Unknown: Natural, cultural and social functions and processes are altered to extent that they permanently cease.

Probability

Probability is the description of the likelihood of an impact actually occurring.

- Improbable: Likelihood of the impact materialising is very low.
- Low probability / Possible: The impact may occur.
- Medium probability: The impact will more than likely occur.
- Highly probable: High likelihood that the impact will occur.
- Definite / Unknown: Impact will definitely (most certainly) occur, or is unknown and therefore needs to be afforded a high probability score.

Significance

Significance (environmental significance) constitutes the overall risk and is determined through a synthesis of impact characteristics. It is an indication of the importance of the impact in terms of both the physical extent and the time scale and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Status

Status gives an indication of the perceived effect of the impact on the area.

- Positive (+): Beneficial impact.

- Negative (-): Harmful or adverse impact.
- Neutral Impact (0): Neither beneficial nor adverse.

8.10 Short CV of Specialist

Name: Johannes Oren Maree

Qualifications

- 2024 MTS, Grace Communion Seminary (USA)
- 2000 MBA, Oxford Brookes University (England)
- 1998 Diploma in Small Business Management (Damelin College)
- 1988 MSc (Rand Afrikaans University)
- 1987 BSc (Hons.) (Rand Afrikaans University)
- 1986 BSc (Rand Afrikaans University)

Publications

- Co-Authored Book: Cut Flowers of the World. 2010. Briza, Pretoria.
- Cut Flowers of the World, 2ed. 2020. Briza, Pretoria.
- 100s of articles for popular magazines such as Farmer's Weekly & SA Landscape

Professional Memberships

- SA Council of Natural Scientific Professions (SACNASP)
 - Reg. No. 005165
- South African Wetland Society
 - Reg. No: 998061
- Society of Wetland Scientists

Professional Career

Position: Director / Owner
Employer: Flori Scientific Services
Period: 2000 to current

Scope of Work Done:

- Conduct specialist studies and research for EIA projects.
- Specialist studies and consultancy includes
- Ecological studies
- Aquatic and Wetland assessments
- Avifaunal impact assessments
- Risk Matrices for water use licences
- Specialist Environmental Consultant
- Environmental Control Officer (ECO) work
- Specialist work involves field investigations and report writing.

9 REFERENCES

- Dean Ollis, D., K. Snaddon, N. Job & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. Pretoria.
- DWS. 2008. Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas. 2nd ed. Sept. 2008. DWS.
- Manning, J. 2009. Field Guide to Wild Flowers of South Africa. Stuirk, Cape Town.

- Mucina, L. & M.C. Rutherford (eds). 2010. The vegetation of South Africa, Lesotho and Swaziland. SANBI, Pretoria.
- SANBI. South African National Biodiversity website. www.sanbi.org.
- Skowno AL, Matlala M, Slingsby J, Kirkwood D, Raimondo DC, von Staden L, Holness SD, Lotter M, Pence G, Daniels F, Driver A, Desmet PG, Dayaram A (2019). Terrestrial ecosystem threat status assessment 2018 - comparison with 2011 assessment for provincial agencies. National Biodiversity Assessment 2018 Technical Report. South African National Biodiversity Institute, Pretoria.
- South African National Biodiversity Institute (SANBI). Threatened ecosystems of South African Biomes. Draft 2009. www.sanbi.org or www.bgis.sanbi.org.
- Van Tol, J., N. Job, D. Bouwer, S. Murugan & P. le Roux. 2023. Hydropedological Assessment Guidelines: Theory and application in a South African wetland management context. Water Research Commission.
- Water Research Commission. 2019. Strategic Water Source Areas: Vital for South Africa's Water, Food and Energy Security. Report No: SP 128/19.

The following are references consulted but not quoted directly in the report:

- Carruthers, V. 2001. Frogs and Frogging in Southern Africa. Struik, Cape Town.
- Gerber, A., Cilliers, C.J., van Ginkel, C. & Glen, R. 2004. Easy identification of Aquatic plants. Dept. of Water Affairs, Pretoria.
- IUCN Red List Categories and Criteria Version 3.1 (2001)
http://www.iucnredlist.org/info/categories_criteria.html
- IUCN (2006) 2006 IUCN Red List of Threatened Species: <http://www.iucnredlist.org>
- Palgrave, K.C. 1983. Trees of Southern Africa. 2ed. Struik, Cape Town.
- Raimondo D., L. von Staden, W. Fonden, JE Victor, NA. Helme, RC. Turner, DA. Kamundi, PA. Manyama (eds). 2009. Red List of South African Plants. Strelitzia 25. SANBI. Pretoria.
- Van Tol, J., N. Job, D. Bouwer, S. Murugan & P. le Roux. 2023. Hydropedological Assessment Guidelines. Theory and application in a South African wetland management context. Water Research Commission. Dec. 2023.