Tate Environmental

Specialist Services

Kareekloof PV-SEF

Wetland Ecology Study

Northern Cape, South Africa

August 2023

TATE ENVIRONMENTAL SPECIALIST SERVICES

Hydrology Biodiversity Ecology

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Declaration

I, Russell Tate, declare that:

- I act as the independent specialist in this study;
- I will perform the work relating to the study in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the science relevant to this study, including knowledge of the Act, regulations and any guidelines that have relevance to the study;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the study;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.
- Please refer to appendix A for the specialist CV.

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Water Resource Specialist

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TESS

August 2023

Executive Summary

An executive summary will be prepared for the final report.

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1 Introduction

Tate Environmental Specialist Services (TESS) was appointed by Enviro-Insight to complete a wetland ecology specialist study for areas associated with the proposed Kareekloof Photovoltaic Solar Energy Facility (PVSEF). The project covers an area of ~3720 ha, has a proposed generation capacity of up to 800 MW, and is located ~14 km southeast of Potfontein in the Northern Cape Province (Figure 2-2).

This document presents the scoping inputs for the wetland ecology components of the Environmental Impact Assessment (EIA) required as part of the process to obtain environmental authorisation (EA) for the proposed development.

The aim of this overall study was to derive the extent and condition of the watercourses associated with the project and investigate the nature of the anticipated impacts of the activities. In line with the aims of the study, the following Scope of Work (SoW) was established:

1. Comply with the specialist assessment protocols established in Government Gazette 43110 – GN320 and other relevant legislation.
2. Assess the nature and extent of the watercourses associated with the development;
3. Establish the Present Ecological Status (PES) of the associated watercourses;
4. Provide shapefiles and maps which visualise sensitive habitats;
5. Provide a risk assessment for the completed activities; and
6. Provide recommendations for mitigation and avoidance actions.

1.1 Definitions

According to the National Water Act (NWA) Act Number 36 of 1998 the definition of wetland and riparian areas are provided as:

- **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.
- **Riparian:** 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 areas.

Further definitions provided in the NWA defines a watercourse as:

- A river or spring
- A natural channel in which water flows regularly or intermittently
- A wetland, lake or dam into which, or from which water flows

- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse.
- The watercourse includes, where relevant its bed and banks.

The definition of the extent of a watercourse is defined in the amendment of the General Authorisation for section 21 (c) and (i) water uses (RSA Government, 2016). The extent of the watercourse 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; and
- Wetlands and pans: the delineated boundary (outer temporary zone) of any wetland or pan.

The definition of wetland areas is further defined by the Department of Water and Forestry (DWAF) 2005 guidelines (DWAF, 2005) where the following is considered pertinent to their classification:

- The presence, either permanently, seasonally or temporarily, of water at or near the surface
- Distinctive redoximorphic features in the soils, and
- Vegetation which is adapted to or tolerant of saturated soils.

2 Description of the Study Area

The study area was located approximately 14 km southeast of Potfontein in the Northern Cape Province, South Africa.

The Mean Annual Precipitation (MAP) for the derived Area of Interest (AoI) over the periods 2009-2022 was 331 mm, peaking in 2022 at 623 mm, with the lowest value recorded in 2015 at 231 mm. The temporal distribution of rainfall in the AoI consisted of a unimodal flood regime where peak flows are observed in the summer between November and March. As is observed in the analysis the 2022/2023 hydroperiod received significantly more rainfall in November and December in comparison to previous periods.

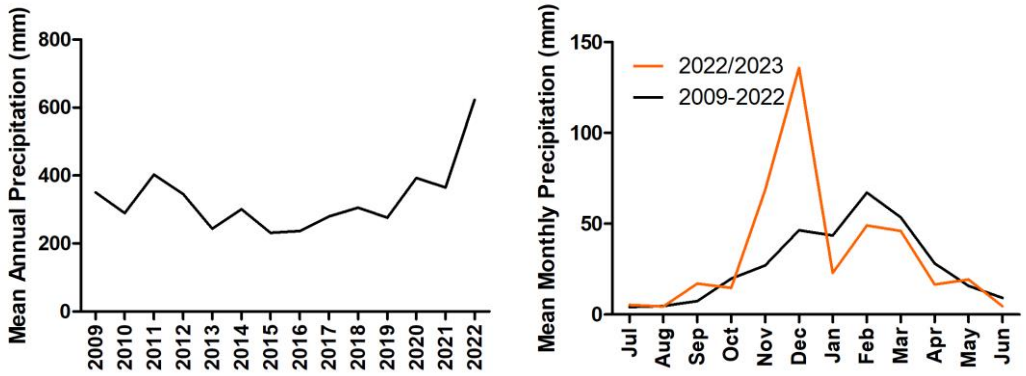

Figure 2-1: Annual (left) and mean monthly (right) precipitation in the Area of Interest between 2009 and 2022 (WaPOR, 2023)

The hydrological setting of the project was within the D62F and D33B quaternary catchment of the Orange River system. The nearest Sub Quaternary Reach associated with the project includes the D62F-04509. Within the context of the climate and hydrological setting, this project area is drained by unnamed non-perennial watercourses.

The National Freshwater Ecosystem Priority Area (NFEPA) and National Biodiversity Assessment (2018) maps indicated that there are riverine and impoundment related watercourses within the AoI (Figure 2-4).

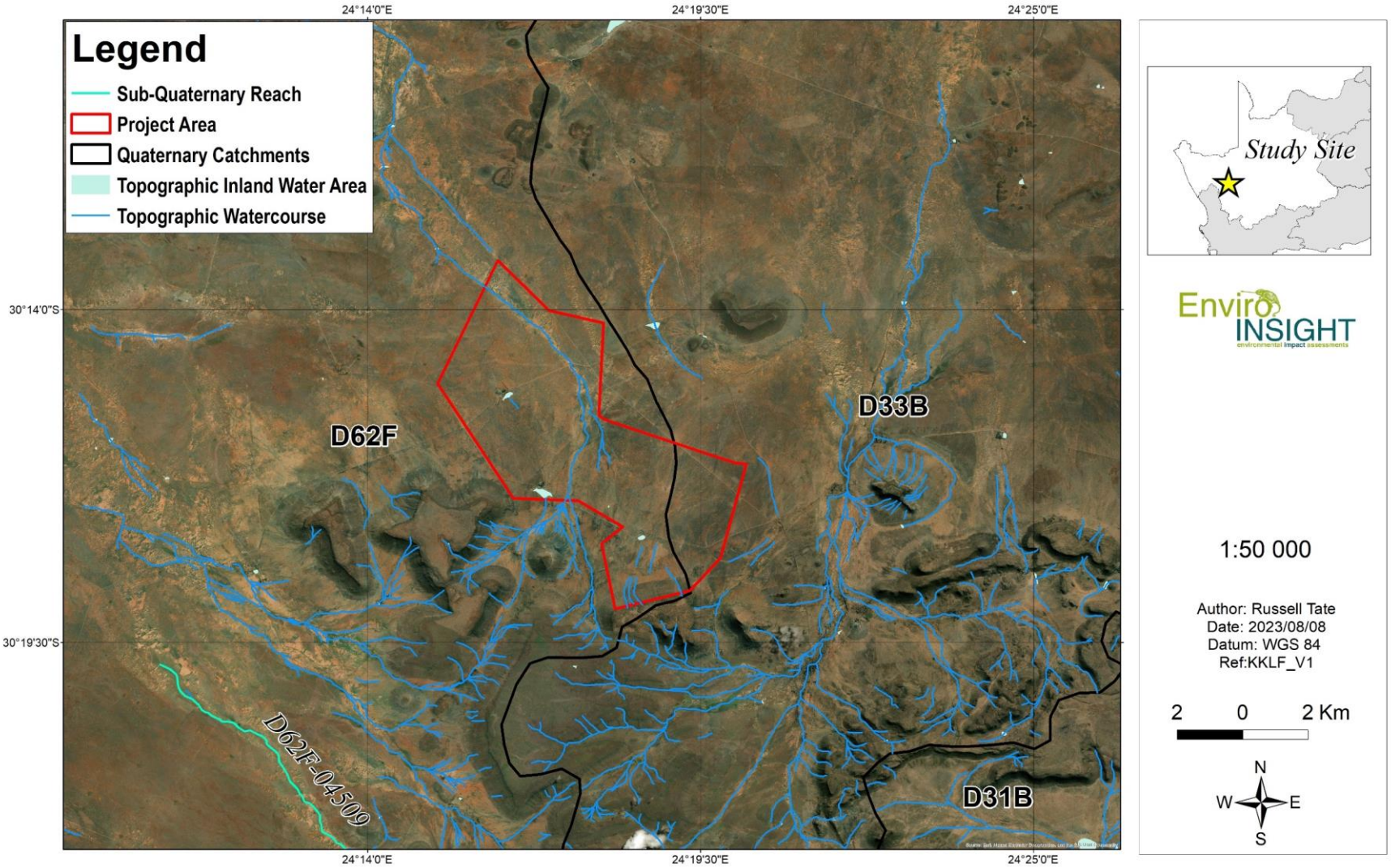

Figure 2-2: Hydrological and Local Setting of the Study Area

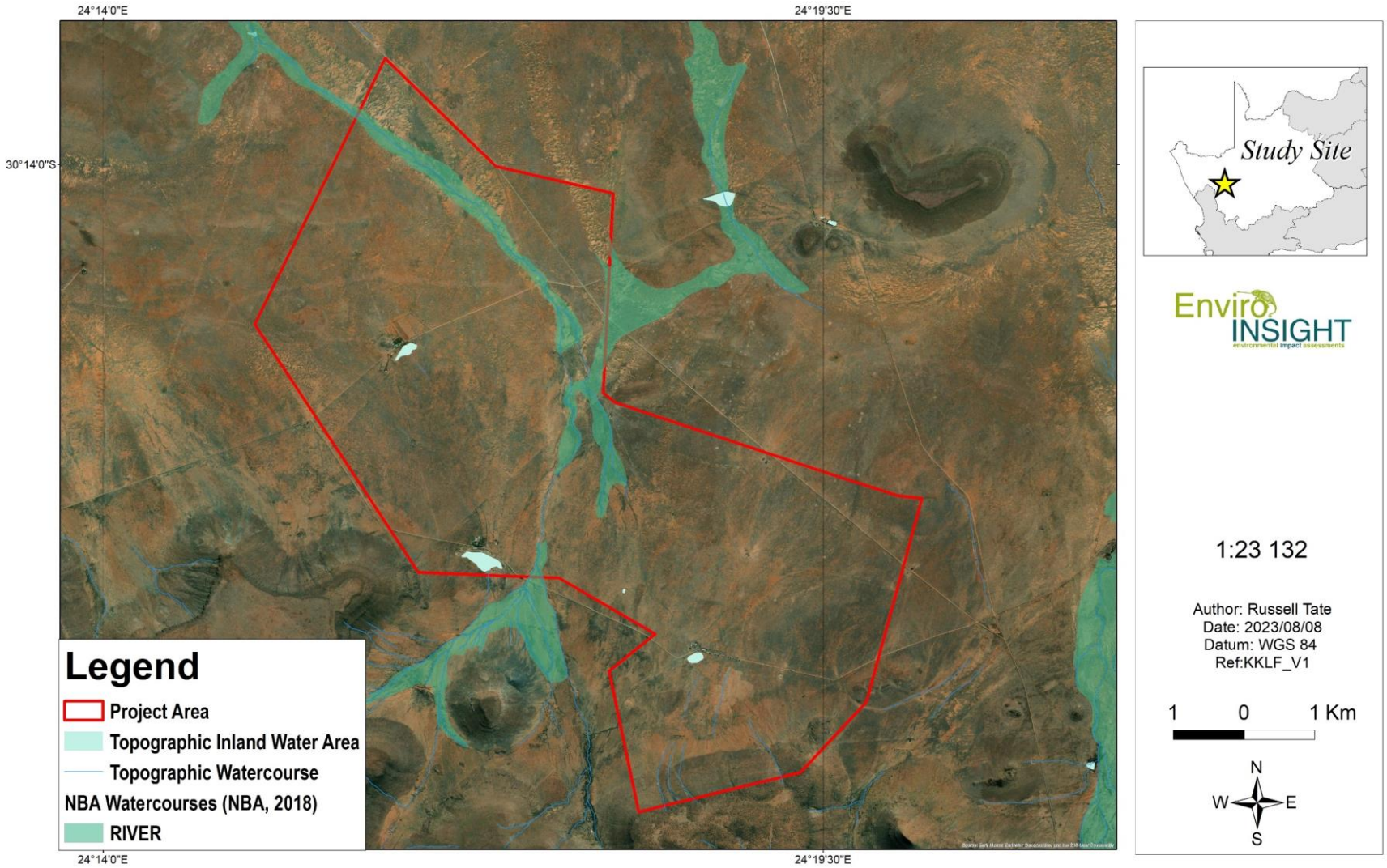

Figure 2-3: Desktop Wetlands (NBA, 2018)

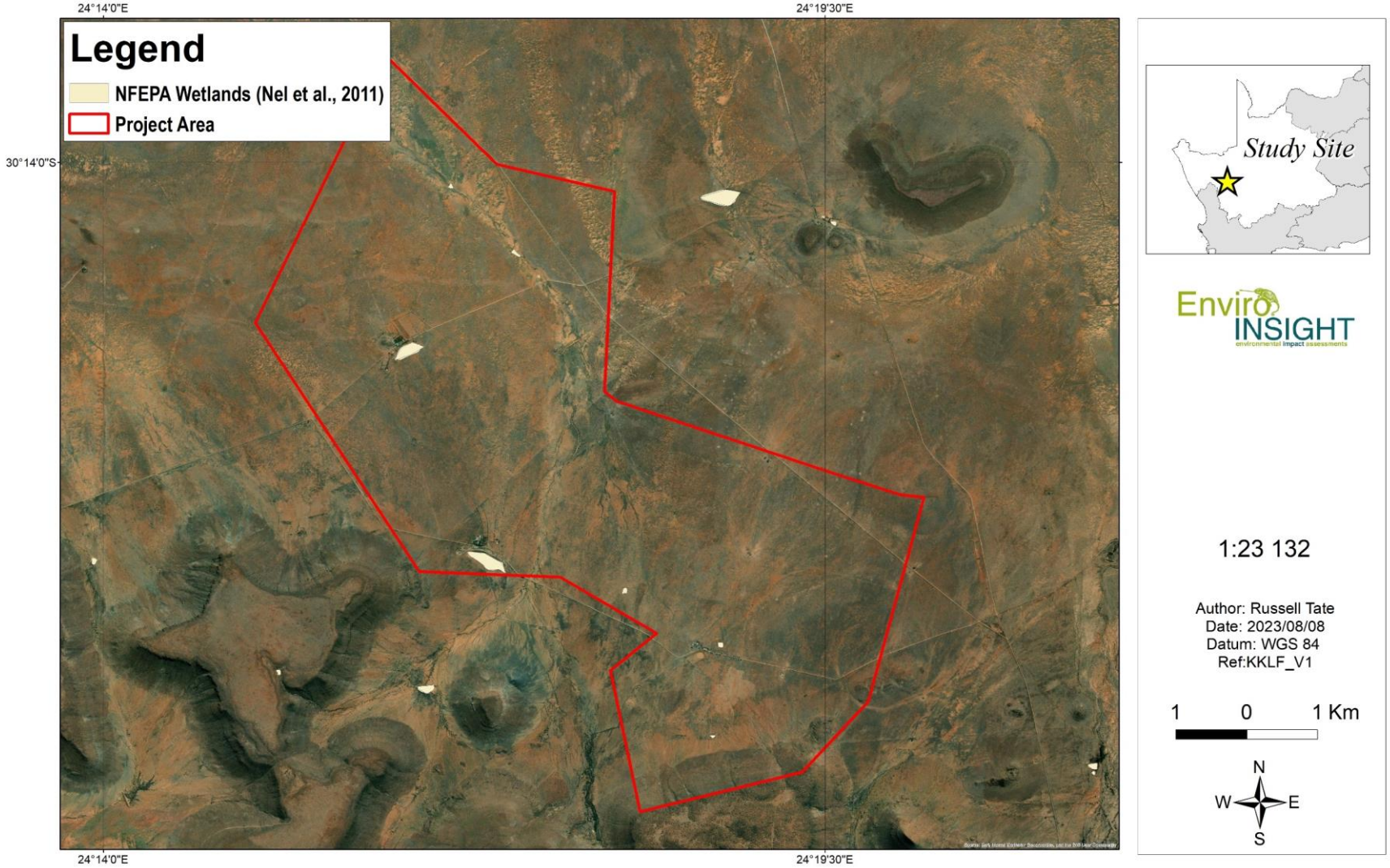

Figure 2-4: Desktop Wetlands (NFEPA)

3 Methods

The methods utilised in this report are presented in this scoping level assessment in order to define the context of the assessment. It is hereby noted that not all results are presented in this scoping level document but will be included in subsequent report submissions.

3.1 Survey

A single survey was completed for this study and the survey was between the 31st of July and 5th of August 2023. The proposed development site was enlarged by 500m to delineate the screening area. This 500m screening area was considered for the wetland assessment.

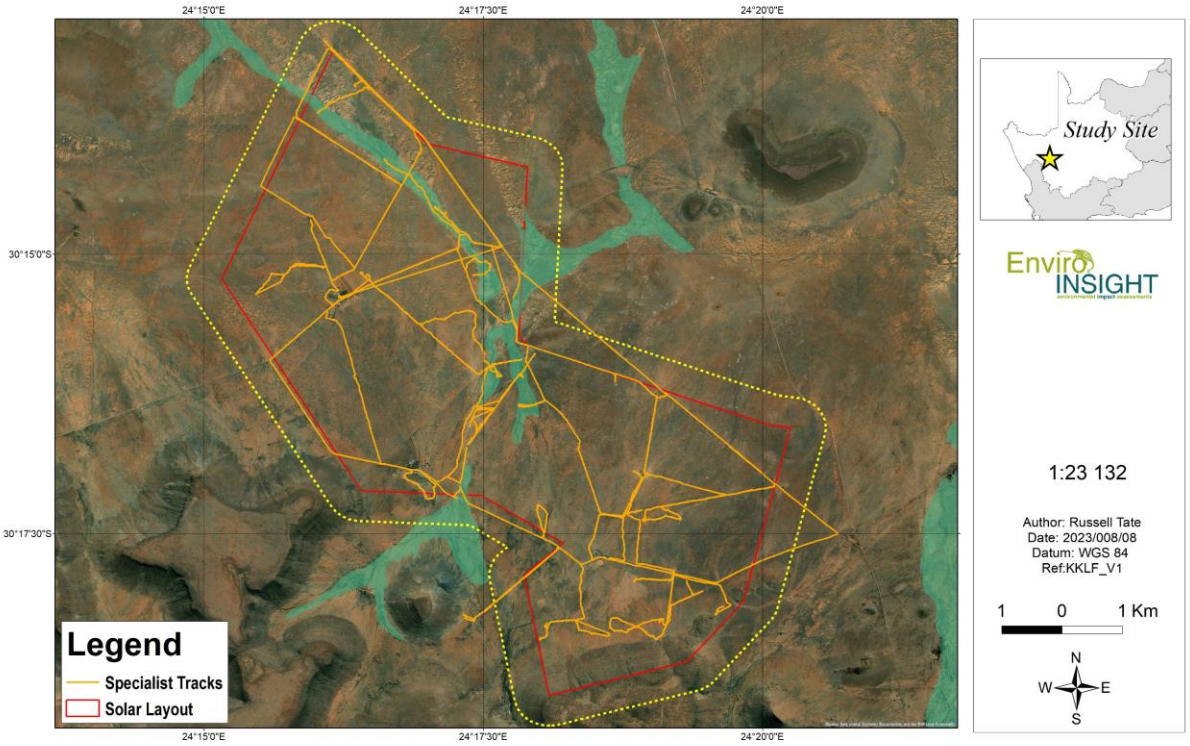

Figure 3-1: Watercourse specialist tracks (August 2023)

3.2 Literature Survey

The literature and spatial databases utilised to inform this study are presented below:

- Wetland Map 5 (NBA, 2018)
- National Freshwater Ecosystem Priority Areas (NFEPA, Nel et al., 2011)

3.3 Wetland Ecology

Following the desktop assessment, the wetland areas were delineated in accordance with the DWAF (2005) guidelines, where a cross section of a typical wetland profile is presented in Figure 3-2.

The identification of the wetland areas was completed by considering the following specific indicators:

- The terrain unit Indicator was used to identify areas in the landscape where wetlands are likely to occur;
- The soil form indicator, utilised the soil classifications where focus was drawn to soils that are associated with saturation;
    - Soils were assessed using a 75mm open bucket soil auger where notes on soil condition were made up to a depth of 50cm.
- The soil wetness indicator was utilised to study the morphological signatures of the soil profiles;
    - The following characteristics were used:
        - Permanent – Prominent Grey Matrix, Few to no high chroma mottles, sulphuric odour
        - Seasonal – grey matrix >10%, many low chroma mottles
        - Temporary – Minimal grey matrix <10%, few high chroma mottles
- The vegetation indicator was then used to confirm and identify hydrophilic vegetation associated with saturated soils according to the lists provided in DWAF (2005).

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) was used to classify the wetland hydrogeomorphic (HGM) types for this study (Ollis et al., 2013). This system uses a hierarchical classification where defining a wetland is based on the principles of the HGM approach which includes the assessment of the structural features of the wetland (Ollis et al., 2013).

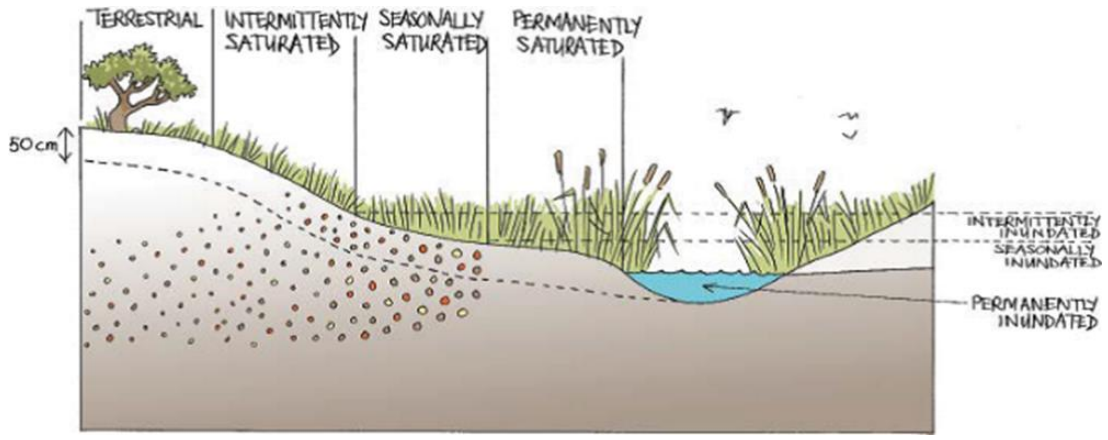

Figure 3-2: Cross section through a wetland (Ollis et al., 2013)

3.4 Wetland Present Ecological Status

The overall approach used in the PES method followed the established guidelines presented in Macfarlane et al. 2020. A level 1 assessment was completed. The method relies on the assessment of land cover types within an established watershed, within incoming stream and wetland buffers, as well as within homogenous disturbance units established in the delineated wetland.

The PES method relies on the comparison of the subject wetland to an expected reference condition. The method makes use of 4 primary metrics including:

- Hydrology
- Geomorphology
- Water quality
- Vegetation

Through the assessment of land cover and the nature of impacts within disturbance units, the wetland can be classified into a PES category as provided. The PES field techniques included the assessment of the 4 metrics within the homogenous disturbance units.

Table 3-1: The Present Ecological Status categories, (Macfarlane et al., 2020)

Impact Category	Description	Impact Score Range	PES
None	**Unmodified, natural**	**0 to 0.9**	**A**
Small	**Largely Natural** with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	**1.0 to 1.9**	**B**
Moderate	**Moderately Modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	**2.0 to 3.9**	**C**
Large	**Largely Modified.** A large change in ecosystem processes and loss of natural habitat and biota has occurred.	**4.0 to 5.9**	**D**
Serious	**Seriously Modified.** The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	**6.0 to 7.9**	**E**
Critical	**Critical Modification.** The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**8.0 to 10**	**F**

3.5 Wetland Eco-Services and Functional Assessment

Wetland areas are known to provide numerous and important ecosystem services to local communities. It is therefore of importance to study the ecological services of a wetland system in order to provide data which supports effective water resource management.

The assessment of the ecosystem services supplied by the identified wetland was conducted as per the guidelines as described in the WET-EcoServices manual (Kotze et al., 2020). A desktop assessment was completed prior to the survey where the

following aspects related to domestic, agricultural, subsistence, commercial and recreational activities were noted:

- Downstream water users
- Within wetland water users
- Within wetland and downstream effected communities

The wetlands under consideration were then rated based on the findings from a field survey and further informed by aerial imagery. Following the rating of criteria the eco-services were classified into categories as provided in Table 3-2.

Table 3-2: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

3.5.1 Determining the Ecological Importance and Sensitivity of the wetland

The method used for the Ecological Importance and Sensitivity (EIS) determination was adapted from the method as provided by DWS (1999). The method takes into consideration PES scores obtained for WET-Health as well as function and service provision of the systems to enable determination of the representative EIS category for the wetland feature. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 3-3, (Rountree et al., 2013).

Table 3-3: Description of Ecological Importance and Sensitivity categories

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

3.6 Water Quality

In situ water quality was obtained at each site using a calibrated Extech DO-600 Multimeter. The following constituents included conductivity (µS/m), temperature (°C), pH and dissolved oxygen (mg/l).

3.7 Aquatic Macroinvertebrates

Macroinvertebrate assemblages are indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour et al., 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour et al., 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

Invertebrate sampling within the inundated impoundment at HGM2 took place using standard kick and sweep methods whereby substrates were mobilised, and a 1mm mesh size net swept through the disturbed areas for up to 2 minutes per sample point. Invertebrates were then enumerated and identified to order and family levels using Day et al. 1999.

Figure 3-3: Invertebrate sampling completed during the August 2023 survey

3.8 Limitations and Assumptions

The following limitations and assumptions form part of this study:

- The results of this study were derived from rapid ecological assessments.
- No floodline delineation was completed for this assessment.
- This report presents the scoping level results with a final report still be submitted.
- Areas directly affected by the project were surveyed, whilst within the 500m screening area, desktop information was utilised.
- Watercourses are defined by dynamic processes. Temporal variation of the extent and condition of the watercourses is a naturally occurring process.

Therefore, the spatial extent of the watercourses provided in this study should be reconsidered within at least 5-10 years from the publishing of this study.

- No hydrological assessment was completed for this assessment.
- The delineations of the project were restricted within the accessible farm portions.
- Aside for discussions with local land owners and specialists working on the overall project, there was no additional consultation completed for this project.

4 Results

4.1 Screening Tool Results

The results of the Department of forestry, fisheries and the environment screening tool for aquatic biodiversity is provided in Figure 4-1. The screening tool identified "Very High" sensitivities for the various identified riverine systems as indicated in the National Biodiversity Assessment spatial database (NBA, 2018).

Considering the sensitivity level of the proposed development area, this study was completed and serves as the site sensitivity verification report.

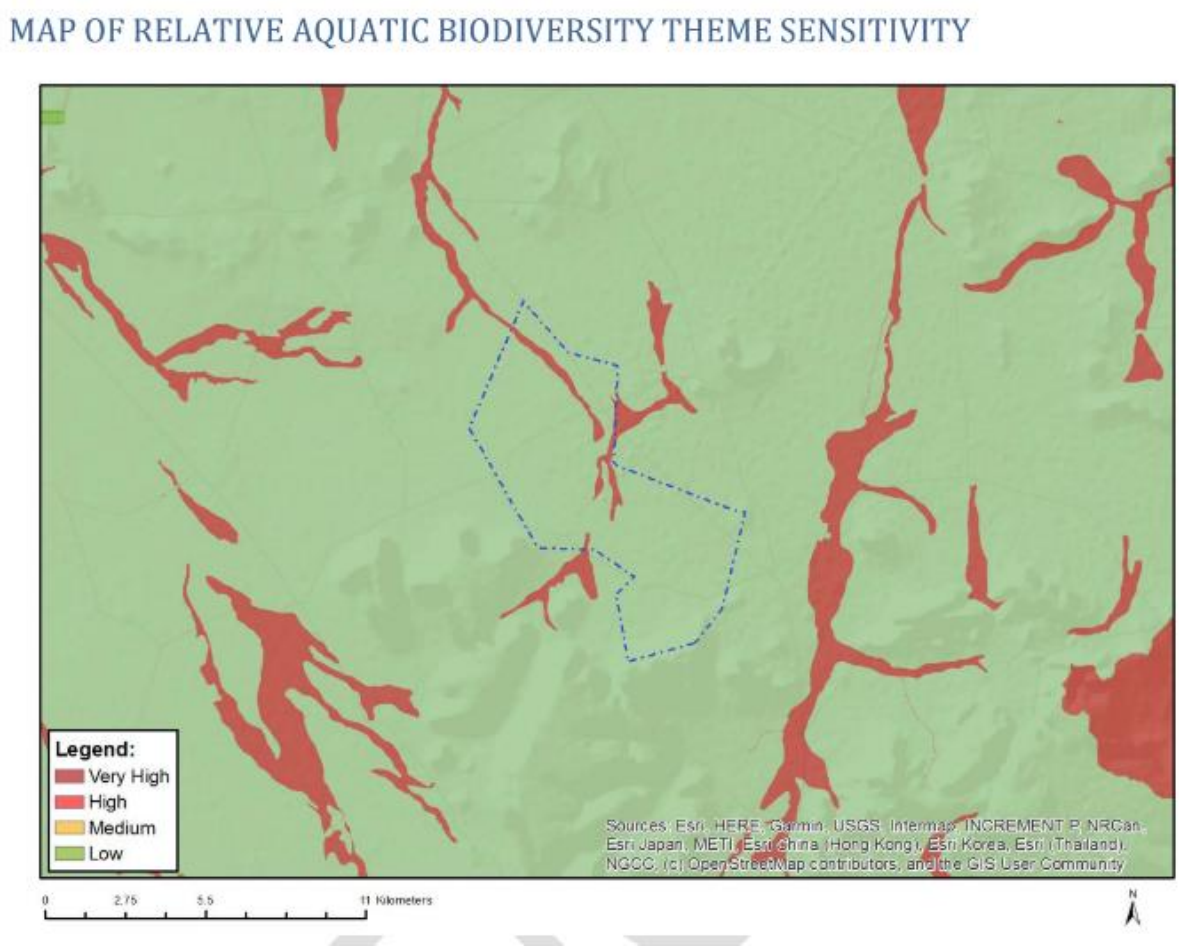

Figure 4-1: Results of the Screening Tool Assessment

4.2 Watercourse Type and Classification

Two HGM types were observed during the survey within the 500m screening area. These HGM types consisted of riverine and depression wetland types (Figure 4-2 and Figure 4-3). A number of artificial wetlands were also identified during the survey and included historical borrow pits and impoundments created to capture surface runoff (Figure 4-5). Additional drainage features associated with the project also include drainage lines (Figure 4-4). The wetland areas could be separated into 3 distinct HGM units as detailed in Table 4-1. The wetland delineations are provided in Figure 4-6.

Table 4-1: Wetland classification within 500m screening zone

HGM Name	Hectares	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	HGM Type
HGM1	29.08	Inland	Nama Karoo	Upper Nama Karoo	Valley Bottom	River
HGM2	25.08	Inland	Nama Karoo	Upper Nama Karoo	Valley Bottom	River
HGM3	0.133	Inland	Nama Karoo	Upper Nama Karoo	Flat	Depression

Figure 4-2: The depression unit at HGM3 (August 2023)

Figure 4-3: The riverine geomorphic unit at HGM1 (August 2023)

Figure 4-4: An example of a drainage line in the project area (August 2023)

Figure 4-5: An artificial system including an impoundment in the project area (August 2023)

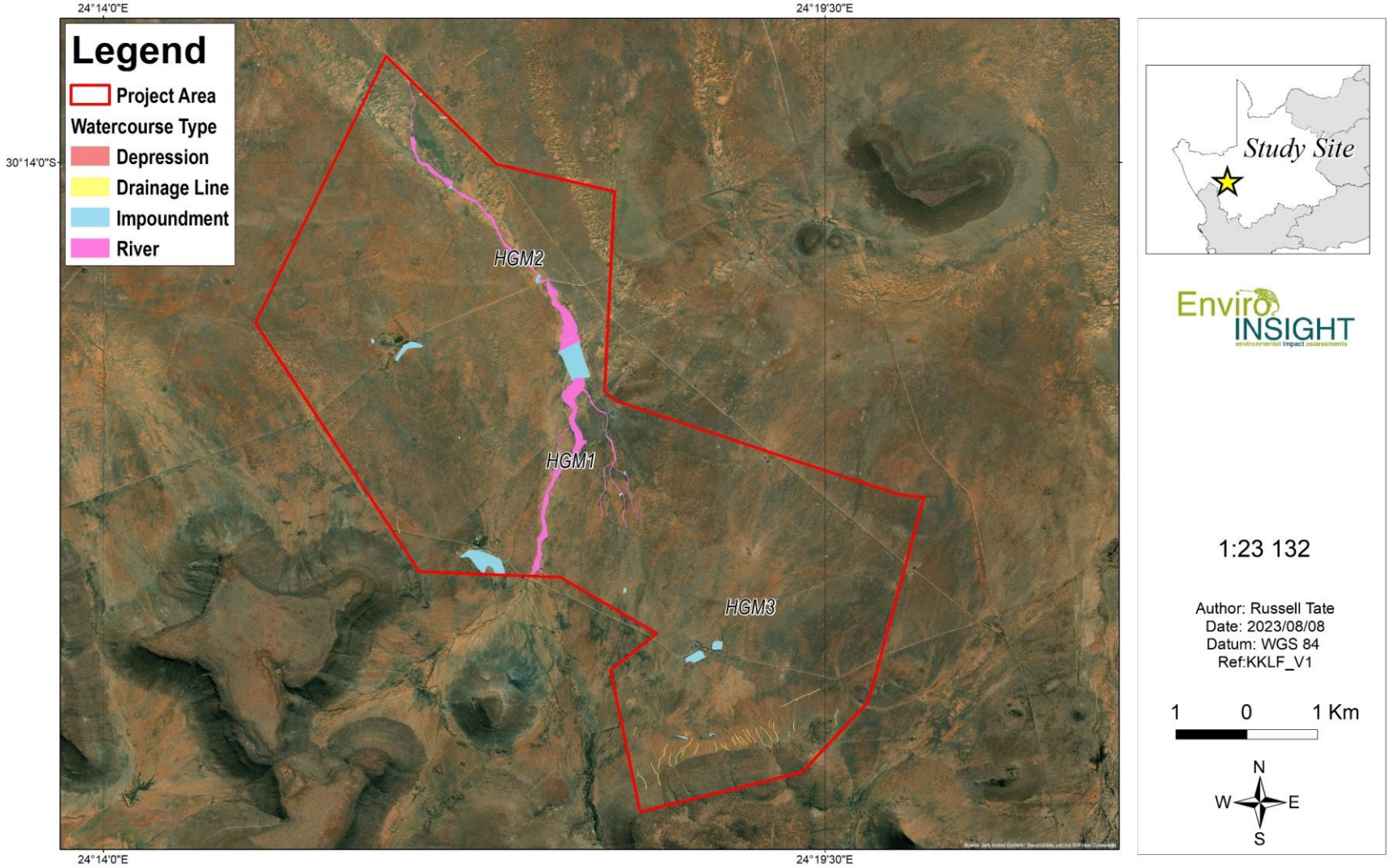

Figure 4-6: Delineation of the watercourses in the project area

4.3 Ecosystem Services, Sensitivity and Importance

The results of the ecoservices assessment are presented in Table 4-2. The results of the ecoservices assessment show that the following ecosystem services are important (moderate and above) within the HGM units:

- Carbon storage
- Biodiversity Maintenance
- Harvestable resources

The wetlands were found to provide moderately high ecosystem services for downstream and in project area users. During the assessment this was effectively illustrated through camera trapping where examples of mammal diversity are provided in Figure 4-7. It is noted that there is no listed obligate aquatic fauna that is associated with the project.

The Ecological Importance and Sensitivity of the watercourses were derived to be very high and moderate as presented in Table 4-3. The riverine watercourses were found to contain alluvial substrates over clay's and are therefore susceptible to erosion. Flow modification within the project was high with a significant impact to local watercourses effectively demonstrating the sensitivity.

Table 4-2: Ecological Function Assessment Results (August 2023)

ECOSYSTEM SERVICE		Depressions	Rivers
REGULATING AND SUPPORTING SERVICES	Flood attenuation	Very Low	Very Low
	Stream flow regulation	Very Low	Very Low
	Sediment trapping	Very Low	Very Low
	Erosion control	Very Low	Very Low
	Phosphate assimilation	Very Low	Very Low
	Nitrate assimilation	Very Low	Very Low
	Toxicant assimilation	Very Low	Very Low
	Carbon storage	Moderately High	Moderately High
	Biodiversity maintenance	Moderate	Moderate
PROVISIONING SERVICES	Water for human use	Very Low	Very Low
	Harvestable resources	Moderately Low	Moderately Low
	Food for livestock	Very Low	Very Low
	Cultivated foods	Very Low	Very Low
CULTURAL SERVICES	Tourism and Recreation	Very Low	Very Low
	Education and Research	Very Low	Moderately Low
	Cultural and Spiritual	Very Low	Very Low

Figure 4-7: Examples of mammals observed in the watercourses in the project area over the three night period (Top left: *Raphicerus campestris*, Top right: *Sylvicapra grimmia*, Bottom left: *Galerella sanguinea*, bottom right *Vulpes chama*)

Table 4-3: Ecological Importance and Sensitivity

Wetland Importance and Sensitivity	Depression Systems Isolated	Non-Perennial Rivers
Ecological Importance and Sensitivity	3.3	2.4
Hydrological/functional importance	2.4	1.2
Direct human benefits	1.1	1.0
Highest Value	**3.3**	**1.7**
EIS Category	**Very High**	**Moderate**

4.4 Buffers and Regulated Areas

It is important to note that the proposed project falls within the legislated 500m regulated area as per the following definition:

Regulated area of a watercourse for Section 21 (c) or (i) of the Act water uses in terms of the Notice means:

- (c) A 500m radius from the delineated boundary (extent) of any wetland or pan.

According to the National Environmental Management Act (Act no. 107 of 1998), Amendment of the Environmental Impact Assessment Regulations listing notice 1 of 2014, should no existing setback be defined, an area of 32 metres from the edge of the watercourse must not be developed (buffered).

Wetland buffer zones were defined according to Macfarlane et al. (2009). It is noted that the proposed project is to take place within the regulated areas within 500m from the delineated wetland areas. The proposed project will be a development of a PV facility.

The buffer tool does not currently cater for PV projects and therefore the mixed-use business land use impact sub sector was therefore utilised. The threat assessment for the proposed project is indicated in Table 4-4. The results of the buffer analysis are presented in Table 4-5 and Table 4-6 whilst this is mapped in Figure 4-8. The buffer analysis indicated a 15m buffer requirement for delineated rivers, whilst 20m were provided for depression systems. This analysis however does not effectively demonstrate the high levels of sensitivity and variability of the watercourses. Thus, to cater for this larger, more appropriate buffer zones have been recommended. Buffer zones for artificial impoundments and drainage lines have also been recommended at 5m and 10m respectively.

Table 4-4: The pre-and post- mitigation threat analysis defined for the project

Phase	Threat	Before Mitigation	After mitigation
Construction Phase	1. Alteration to flow volumes	VL	VL
	2. Alteration of patterns of flows (increased flood peaks)	L	L
	3. Increase in sediment inputs & turbidity	H	H
	4. Increased nutrient inputs	VL	VL
	5. Inputs of toxic organic contaminants	VL	VL
	6. Inputs of toxic heavy metal contaminants	L	VL
	7. Alteration of acidity (pH)	N/A	N/A
	8. Increased inputs of salts (salinization)	N/A	N/A
	9. Change (elevation) of water temperature	VL	VL
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL
Operational Phase	1. Alteration to flow volumes	M	L
	2. Alteration of patterns of flows (increased flood peaks)	M	L
	3. Increase in sediment inputs & turbidity	L	L
	4. Increased nutrient inputs	VL	VL
	5. Inputs of toxic organic contaminants	VL	VL
	6. Inputs of toxic heavy metal contaminants	L	L
	7. Alteration of acidity (pH)	VL	VL
	8. Increased inputs of salts (salinization)	VL	VL
	9. Change (elevation) of water temperature	VL	VL
	10. Pathogen inputs (i.e. disease-causing organisms)	L	L

Table 4-5: Buffer requirements before and after mitigation Rivers

Phase	Before mitigation	After mitigation	Recommended Buffer
Construction	15	15	30
Operation	15	15	30

Table 4-6: Buffer requirements before and after mitigation Depressions

Phase	Before mitigation	After mitigation	Recommended Buffer
Construction	20	20	40
Operation	20	20	40

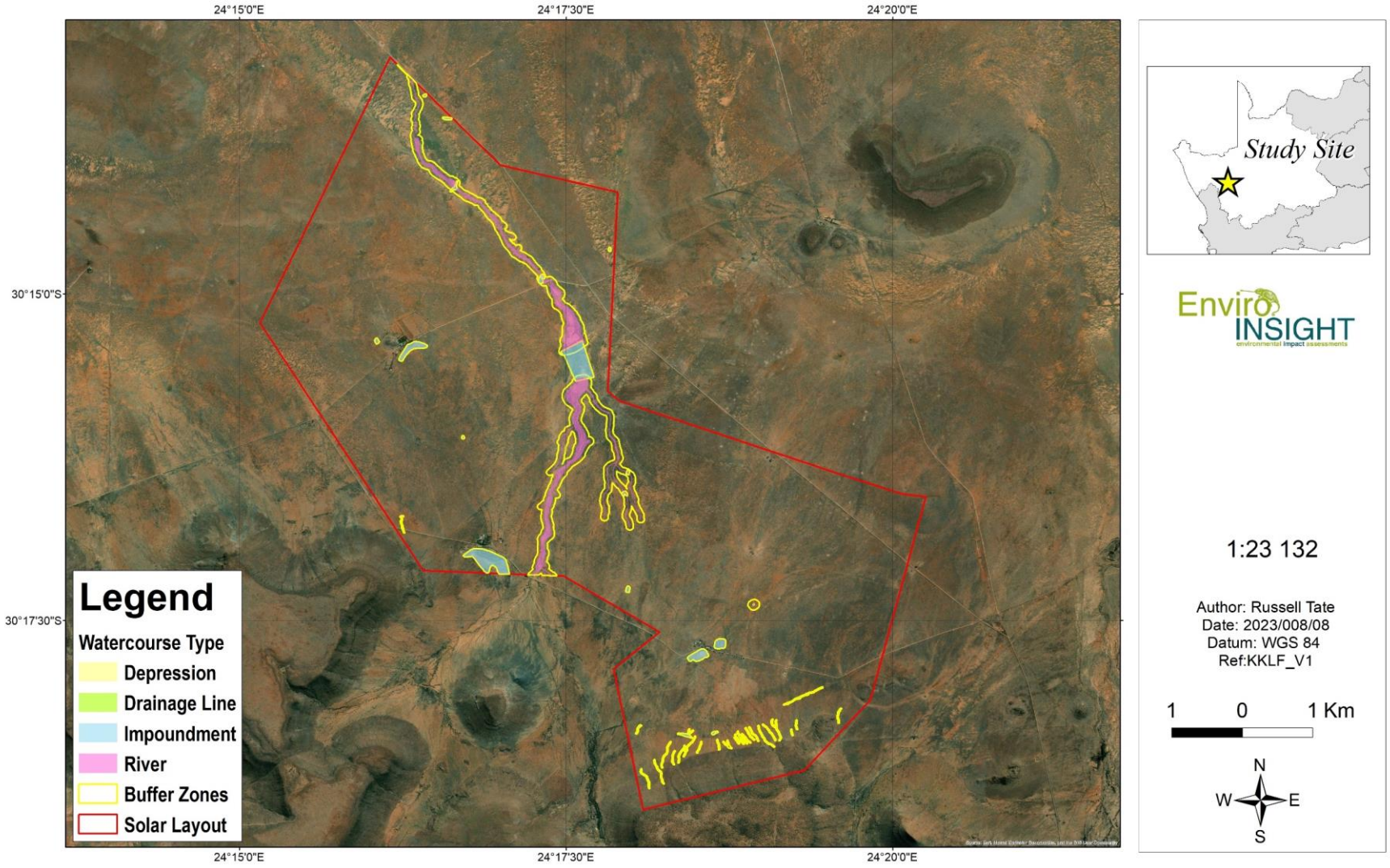

Figure 4-8: Buffer zones recommended for the watercourses in the project area

5 Anticipated Impacts

There are two primary impacts which are expected from the project:

1. Direct impacts attributed to linear road infrastructure which may require the implementation of culverts and drifts.
2. Indirect hydrological process impacts stemming from watershed roughness change.

Given the arid climate and low runoff potential soils in the project area, the anticipated significance of the above impacts is expected to be low and can be effectively mitigated through the implementation of the mitigation hierarchy.

5.1 Avoidance

At this stage of the proposed project it is recommended that the avoidance action is implemented. This is achieved by the avoidance of the established buffer zones recommended in this study. Furthermore, where possible the creating of roadway crossings should be limited to existing crossing points where required.

5.2 Mitigation

The following important mitigation actions should be considered at this stage of the project:

1. The design and implementation of concrete drift crossing points as opposed to culverts.
2. The implementation of runoff velocity reduction measures off roadways
3. The monitoring for and identification of preferential flow path formation, river bank erosion post construction phase.

5.3 Anticipated Cumulative Impacts

The expected cumulative impacts for the proposed project on aquatic biodiversity are minimal should the avoidance and mitigation measures be implemented. The nature of the soils, gentle topography and aridity of the region has significant effects on the runoff potential during storm events whereby anticipated impacts are minimal.

6 Conclusion and Professional Opinion

The outcome of this assessment delineated 3 watercourse units within the AoI. The Presence Ecological Status (PES) assessments of the watercourses is not yet completed. Based on the preliminary results however these are expected to be within the largely natural (class B) and moderately modified (class C) ranges. The watercourses were classified as having Very High and Moderate EIS ratings. A scientific buffer was calculated for the watercourses, however inline with the precautionary principle, and given the importance and highly sensitive nature of the riverine habitats,

it was proposed that a 40m buffer for depressions and a 30m riverine buffer was utilised to protect these sensitive environments.

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