Freshwater Ecology Report for the Great Karoo Renewable Energy Project – Merino Wind Farm

Ubuntu Local Municipality, Northern Cape

December 2021

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savannah environmental

Prepared by:

The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

Report Name	**Freshwater Ecology Report for the Great Karoo Renewable Energy Project – Merino Wind Farm**
Reference	**Merino Wind Farm**
Submitted to	savannah environmental
Report Writer / Reviewer	**Andrew Husted**
	Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

DECLARATION

I, Andrew Husted, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- 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.

Andrew Husted

Freshwater Ecologist

The Biodiversity Company

December 2021

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List of Acronyms

ARC	Agricultural Research Council
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Areas
CR	Critically Endangered
DEM	Digital Elevation Model
EAP	Environmental Assessment Practitioner
EN	Endangered
ESA	Ecological Support Areas
ETS	Ecosystem threat status
FEPA	Freshwater Ecosystem Priority Areas
GN	Government Notices
HGM	Hydrogeomorphic
IS	Importance and Sensitivity
ISCW	Institute for Soil Climate and Water
LT	Least Threatened
MAP	Mean annual precipitation
MASL	Metres Above Sea Level
NASA	National Aeronautics and Space Administration
NEMA	National Environmental Management Act
NEM:BA	National Environment Management Biodiversity Act
NWA	National Water Act
NWCS	National Wetland Classification Systems
NWM5	National Wetland Map 5 (NWM5)
ONA	Other Natural Areas
PES	Present Ecological Status
QGIS	Quantum geographic information system
SAIIAE	South African Inventory of Inland Aquatic Ecosystems
SAGA	System for Automated Geoscientific Analyses
SANBI	South African National Biodiversity Institute
ToR	Terms of Reference
UNFCC	The United Nations Framework Convention on Climate Change
VU	Vulnerable
WEF 2	Merino Wind Farm
WMA	Water Management Areas

1 Introduction

Great Karoo Renewable Energy (Pty) Ltd is proposing the development of a commercial wind farm and associated infrastructure on a site located approximately 35 km south-west of Richmond and 80km south-east of Victoria West, within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province.

The Biodiversity Company was appointed by Savannah Environmental (Pty) Ltd (Savannah) to undertake a freshwater ecology baseline and impact for the Great Karoo Cluster of Renewable Energy Facilities, including the Merino Wind Farm (WEF2). The Merino WEF will comprise 35 turbines, each with a capacity of 4MW to add up to a total contracted capacity of 140MW.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017), as amended of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the published Government Notices (GN) 320 in terms of NEMA, dated 20 March 2020: "Procedures for the Assessment and Minimum Criteria for Reporting on 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" (Reporting Criteria).

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making.

1.1 Project Description

A preferred project site with an extent of ~29 909ha and a development area of ~6 463ha within the project site has been identified by Great Karoo Renewable Energy (Pty) Ltd as a technically suitable area for the development of the Merino Wind Farm with a contracted capacity of up to 140MW that can accommodate up to 35 turbines. The development area consists of the four (4) affected properties, which include:

- Portion 1 of Farm Rondavel 85;
- Portion 0 of Farm Rondavel 85;
- Portion 9 of Farm Bult & Rietfontein 96; and
- Portion 0 of Farm Vogelstruisfontein 84.

The Merino Wind Farm project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 140MW:

- Up to 35 wind turbines with a maximum hub height of up to 170m. The tip height of the turbines will be up to 250m.
- Concrete turbine foundations to support the turbine hardstands.
- Inverters and transformers.
- Temporary laydown areas which will accommodate storage and assembly areas.
- Cabling between the turbines, to be laid underground where practical.
- A temporary concrete batching plant.
- 33/132kV onsite facility substation.
- Underground cabling from the onsite substation to the 132kV collector substation.
- Electrical and auxiliary equipment required at the collector substation that serves that wind energy facility, including switchyard/bay, control building, fences, etc.

- Battery Energy Storage System (BESS).
- Access roads and internal distribution roads.
- Site offices and maintenance buildings, including workshop areas for maintenance and storage.

The wind farm is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to bid the Merino Wind Farm under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme, with the aim of evacuating the generated power into the national grid. This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP) with the Merino Wind Farm set to inject up to 140MW into the national grid.

1.2 Scope of Work

The principle aim of the assessment was to provide information to determine any level of risk posed by the proposed wind farm in regard to local water resources. This was achieved through the following:

- A desktop assessment of all relevant national and provincial datasets. If available, municipal datasets were also considered;
- The delineation, characterisation and functional assessments of freshwater systems; and
- Completion of an impact assessment with supporting mitigation measures.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable for this assessment:

- It is assumed all datasets and information considered for the assessment is representative of the area and is well suited for the intended purposes of this report;
- This assessment has only considered freshwater habitats;
- Freshwater systems within the project area were the focus for the assessment, these systems were ground-truthed as much as possible and further assessed. Systems beyond the project area but within the 500 m regulated area were only considered at a desktop level; and
- No decommissioning phase impacts have been considered for this project. The life of operation is 20 – 25 years.

1.4 Key Legislative Requirements

The legislation, policies and guidelines listed below in Table 1-1 are applicable to the current project. The list below, although extensive, may not be complete and other legislation, policies and guidelines may apply in addition to those listed below.

Table 1-1 A list of key legislative requirements relevant to biodiversity and conservation in the Northern Cape Province

Region	Legislation / Guideline
International	Constitution of the Republic of South Africa (Act No. 108 of 1996)
	The Convention on Wetlands (RAMSAR Convention, 1971)
	The United Nations Framework Convention on Climate Change (UNFCC,1994)
National	The National Environmental Management Act (NEMA) (Act No. 107 of 1998)
	Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, GN 320 of Government Gazette 43310 (March 2020)

	The Environment Conservation Act (Act No. 73 of 1989)
	Natural Scientific Professions Act (Act No. 27 of 2003)
	National Water Act (NWA) (Act No. 36 of 1998)
	Municipal Systems Act (Act No. 32 of 2000)
	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)
	Sustainable Utilisation of Agricultural Resources (Draft Legislation).
Provincial	Northern Cape Nature Conservation act no. 9 of 2009
	Northern Cape Planning and Development Act no. 7 of 1998

1.4.1 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (Act No. 107 of 1998) (NEMA) and the associated Environmental Impact Assessment (EIA) Regulations, as amended in April 2017, state that prior to certain listed activities taking place, an environmental authorisation application (EA) process needs to be followed. This could follow either the Basic Assessment (BA) process or the Scoping and EIA process, depending on the scale of the impact. A Scoping and EIA process is being undertaken for the project.

GN 350 was gazetted on the 20 March 2020, which has replaced the requirements of Appendix 6 of the EIA Regulations in respect of certain specialist reports. These regulations provide the criteria and minimum requirements for specialist's assessments, in order to consider the impacts on soil for activities which require EA.

1.4.2 National Water Act (NWA, 1998)

The Department of Human Settlements Water and Sanitation (DHSWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The NWA allows for the protection of water resources, which includes the:

- Maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- Prevention of the degradation of the water resource; and
- Rehabilitation of the water resource.

A watercourse means;

- 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; and
- Any collection of water which the minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse, unless it is authorised by the DHSWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DHSWS in terms of Sections 21 (c) and (i) of the NWA.

2 Receiving Environment

The project area falls within the Ubuntu Local Municipality which forms part of the Pixley Ka Seme District in the Northern Cape Province. The area is approximately 30 km south west of Richmond, traversed by the national route N1.

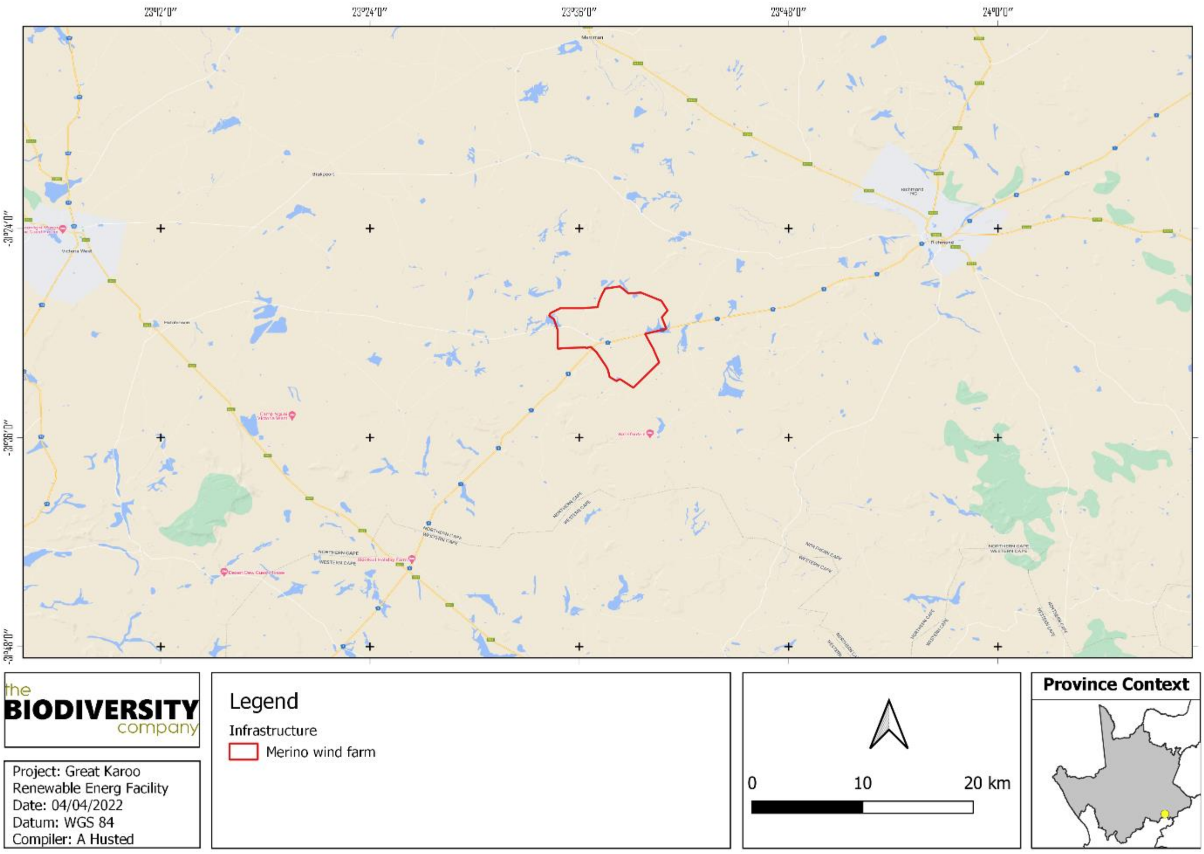


Figure 2-1 The location of the project area in relation to the general setting

2.1 Wetlands

2.1.1 Catchment

The project area extends into two Water Management Areas (WMA), namely the (Lower) Orange WMA (WMA 6) and the Mzimvubu-Tsitsikamma WMA (WMA 7). The locally affected quaternary catchments include D61A, D61D and L21B.

2.1.2 National Freshwater Ecosystem Priority Area Status

In an attempt to better conserve aquatic ecosystems, South Africa has categorised its river systems according to set ecological criteria (i.e. ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs) (Driver *et al.,* 2011). The FEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's (NEM:BA) biodiversity goals (Nel *et al.,* 2011).

Figure 2-2 shows the location of the project area in relation to wetland FEPAs. Based on this information, non-priority systems are located within the extent of the project area.

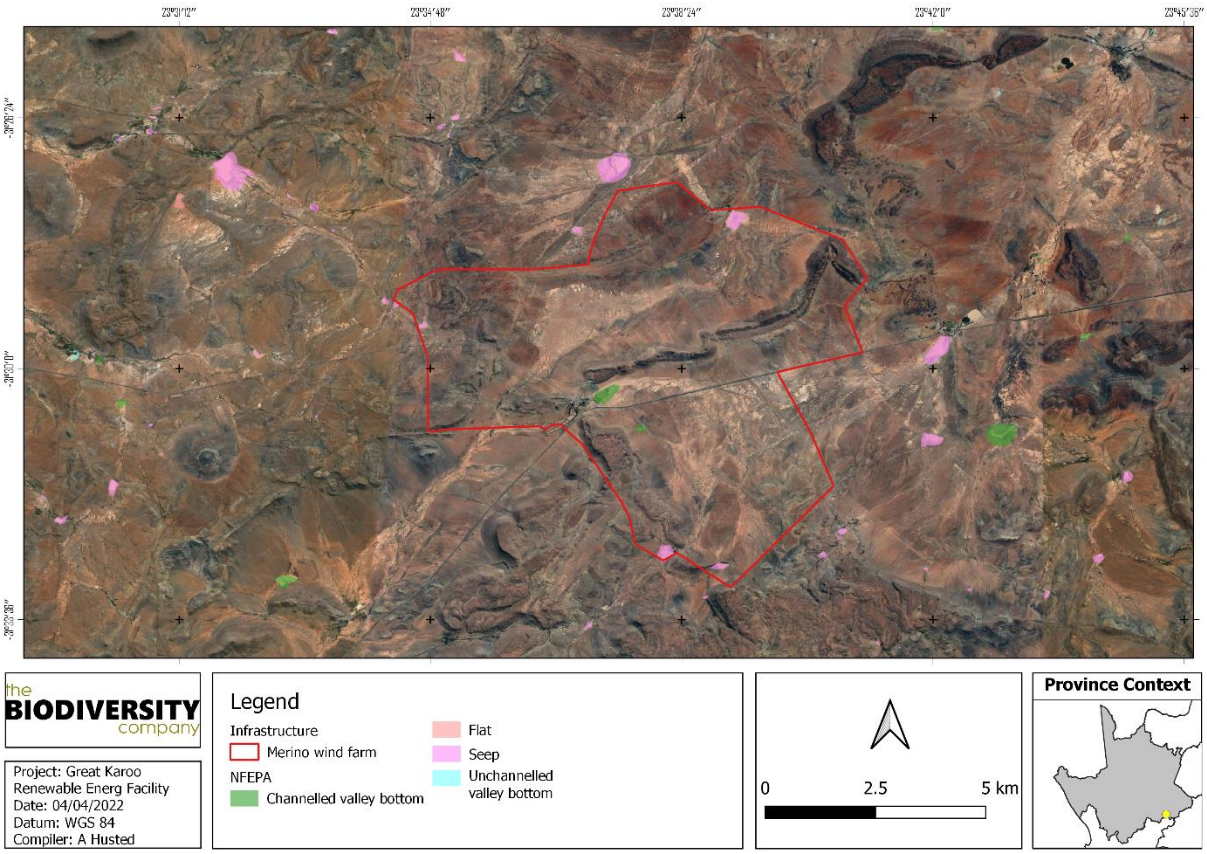


Figure 2-2U The location of NFEPA wetlands in relation to the project area

2.1.3 National Wetland Map 5

The National Wetland Map 5 (NWM5) spatial data was published in October 2019 (Deventer *et al*. 2019), in collaboration with the South African National Biodiversity Institute (SANBI), with the specific aim of spatially representing the location, type and extent of wetlands in South Africa. The data represents a synthesis of a wide number of official watercourse data, including rivers, inland wetlands and estuaries. This database does not recognise the presence of any wetlands within the extent of the project area. However, areas classified as "rivers" are extensive throughout the project area.

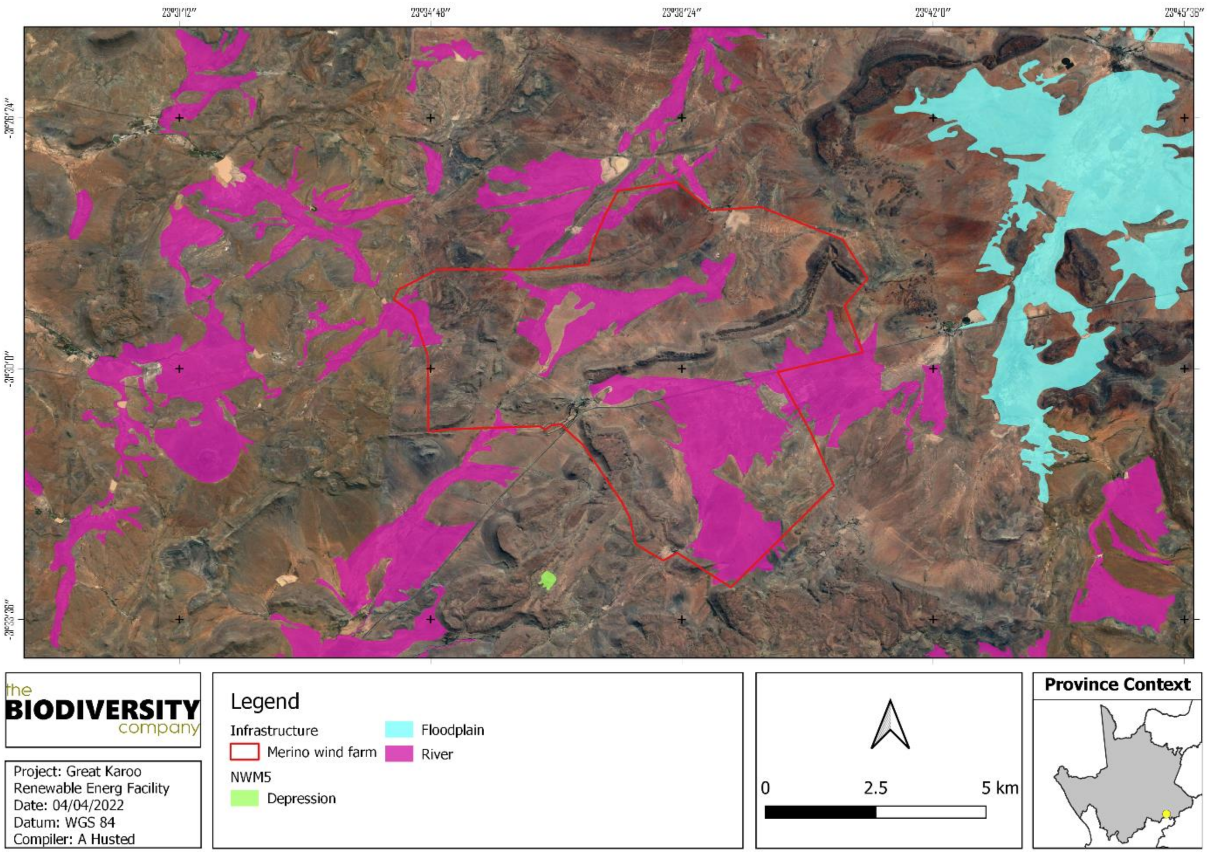


Figure 2-3 Map illustrating the NWM5 for the project area

2.1.4 Aquatic Ecosystems

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was released with the National Biodiversity Assessment (NBA) 2018. Ecosystem threat status (ETS) of river and wetland ecosystem types are based on the extent to which each river ecosystem type had been altered from its natural condition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT), with CR, EN and VU ecosystem types collectively referred to as 'threatened' (Van Deventer *et al.,* 2019; Skowno *et al.,* 2019). No wetlands are present within the extent of the project area.

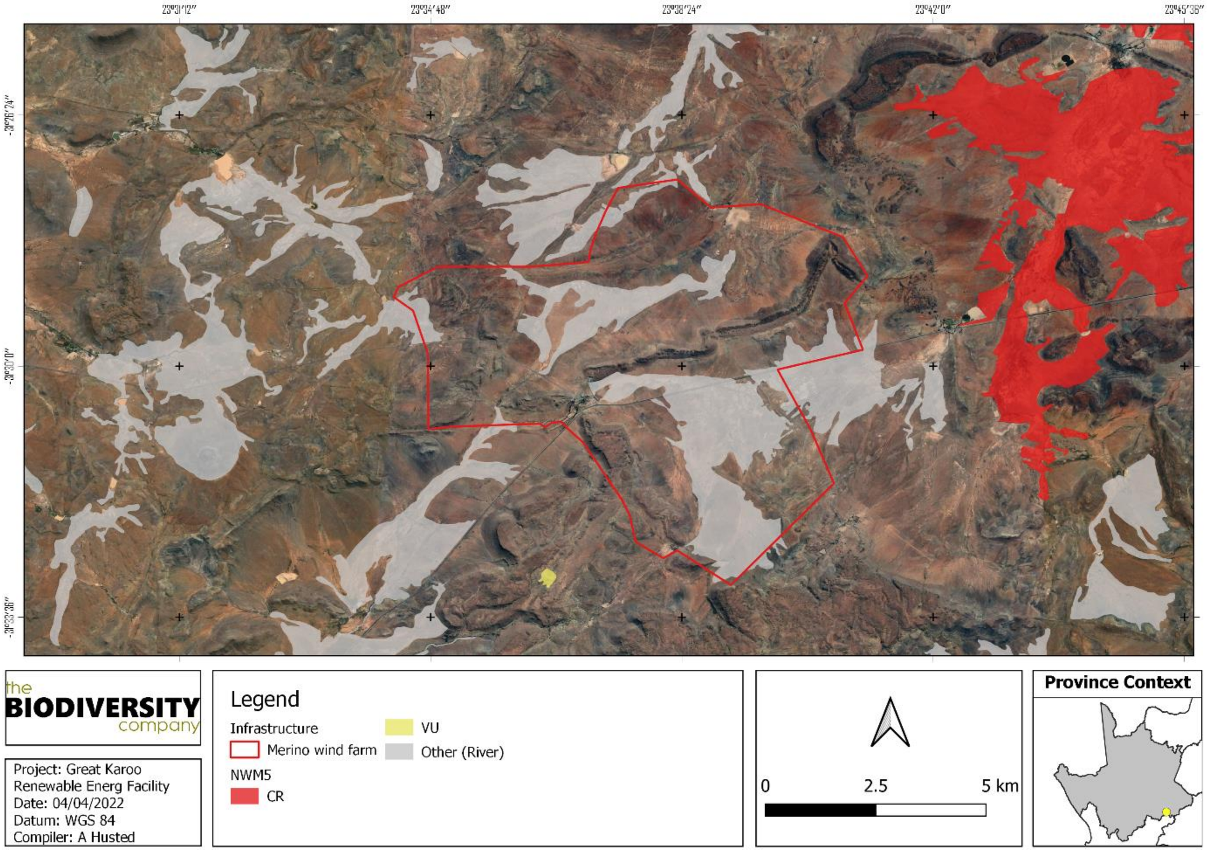
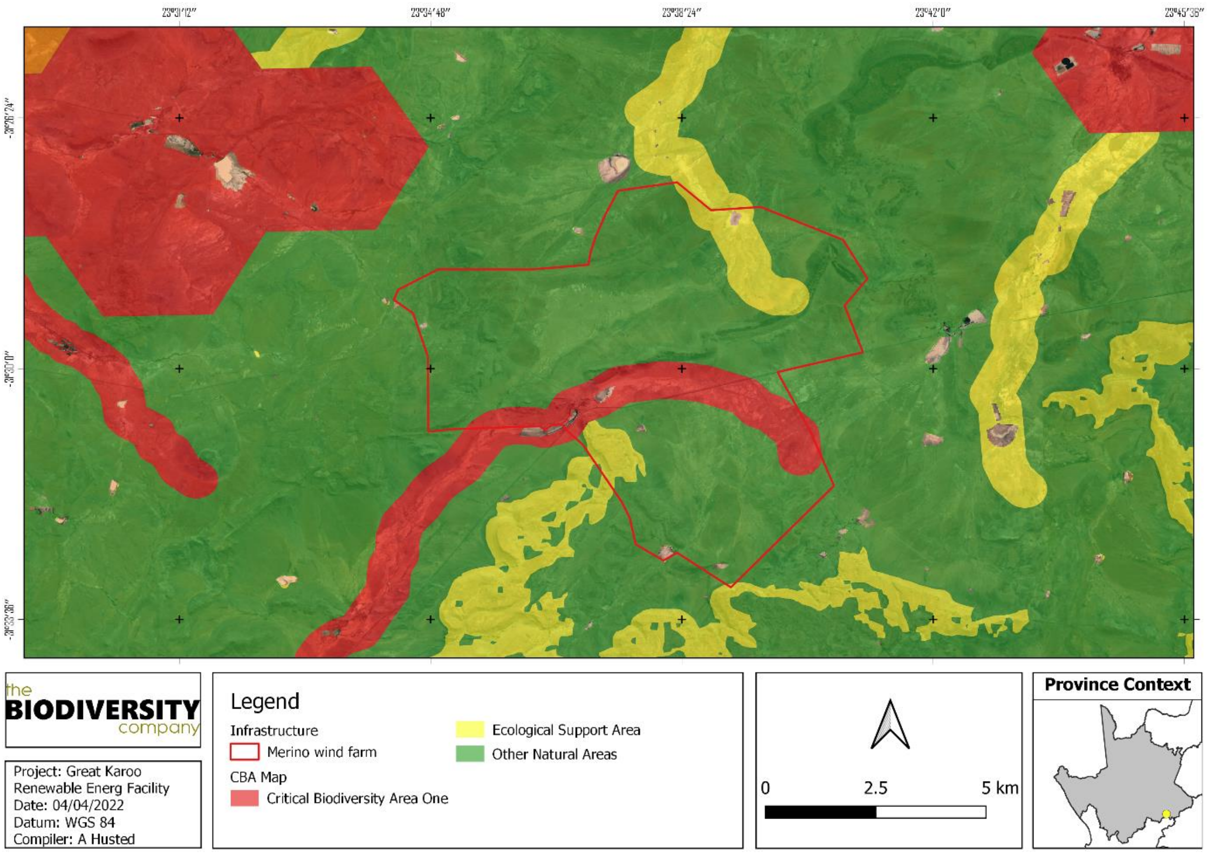


Figure 2-4 Map illustrating ecosystem threat status of wetland ecosystems

2.1.5 Critical Biodiversity Areas and Ecological Support Areas

The Northern Cape Department of Environment and Nature Conservation has developed the Northern Cape CBA Map which identifies biodiversity priority areas for the province, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These biodiversity priority areas, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole.

Error! Reference source not found. shows the project area superimposed on the Terrestrial CBA map. The project area overlaps with a CBA One (CBA 1), Other Natural Areas (ONA) and an ESA area.



Map illustrating the locations of CBAs in the project area

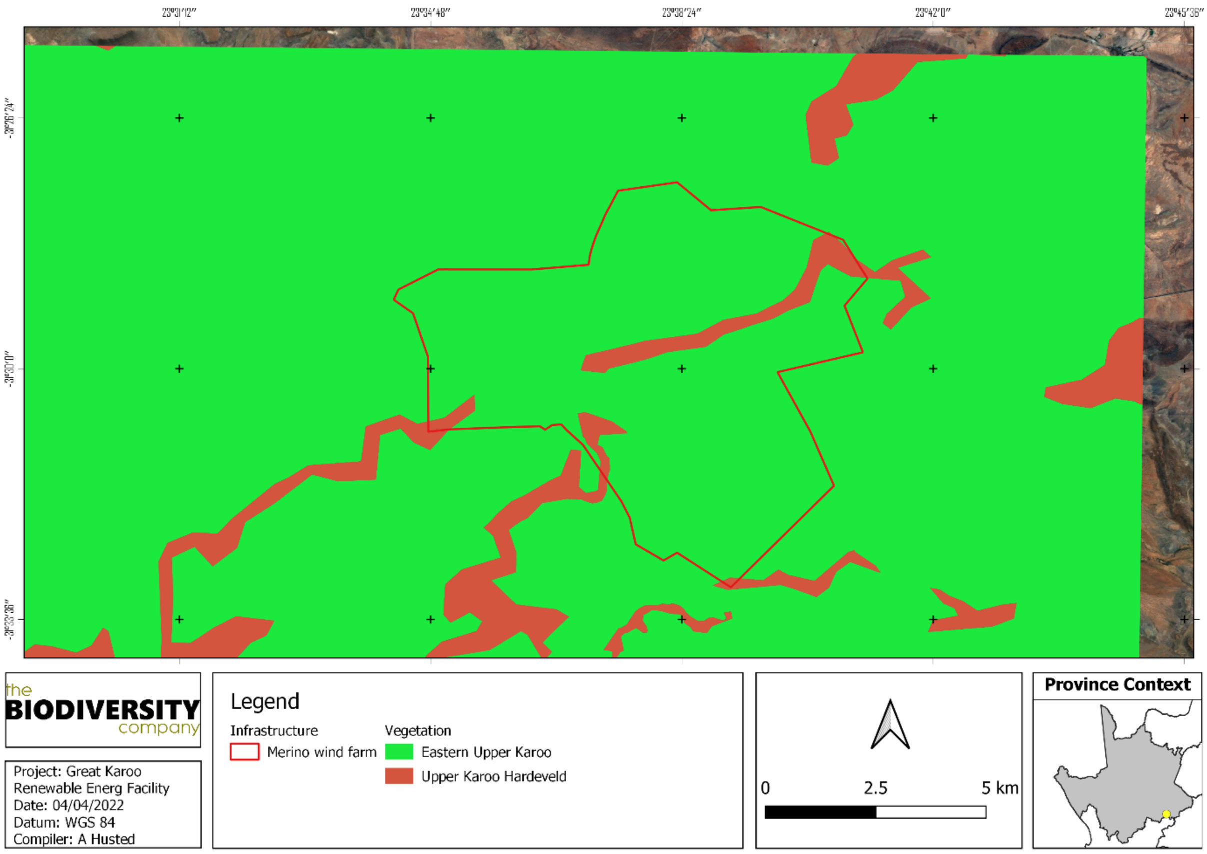
2.1.6 Vegetation Type

The project area is situated within two vegetation types; the Eastern Upper Karoo (NKu 4) and the Upper Karoo Hardeveld (NKu 2), according to Mucina & Rutherford (2006) (**Error! Reference source not found.**).

The Eastern Upper Karoo vegetation type is distributed across the Northern Cape, Eastern Cape and Western Cape Provinces. The vegetation type 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.

The Upper Karoo Hardeveld vegetation type is distributed across the Northern, Western and Eastern Cape Provinces. The vegetation type is characterised by steep slopes of koppies, butts, mesas and parts of the Great Escarpment covered with large boulders and stones supporting sparse dwarf Karoo scrub with drought-tolerant grasses of genera such as Aristida, Eragrostis and Stipagrostis.

The conservation status for both vegetation types is Least Threatened.



Project area showing the vegetation type based on the Vegetation Map of South Africa, Lesotho & Swaziland (BGIS, 2017).

2.1.7 Sensitivity

The Northern Cape does not currently prescribe any buffers for freshwater resources, and due to this the method described by Macfarlane *et al*. (2017) has been used. Owing to the fact that some watercourses in the area are classified as Critically Endangered (CR) and Endangered (EN) (Figure 2-5).

The aquatic biodiversity theme sensitivity as indicated in the screening report indicates predominantly “Very High” sensitivity, with isolated areas of “Low” sensitivity. These “Very High” sensitivities are attributed to the presence of wetlands, rivers and priority area quinary catchments.

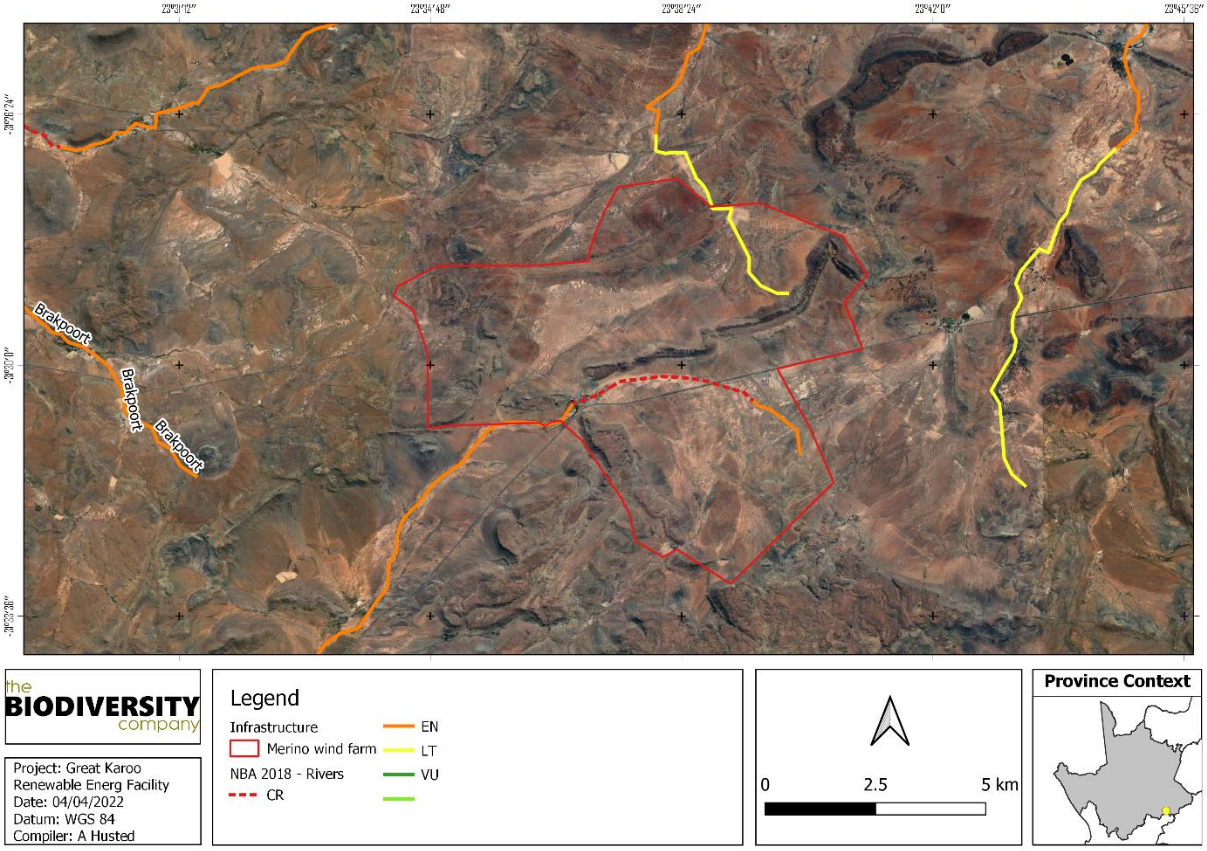


Figure 2-5 The threat status for local river systems

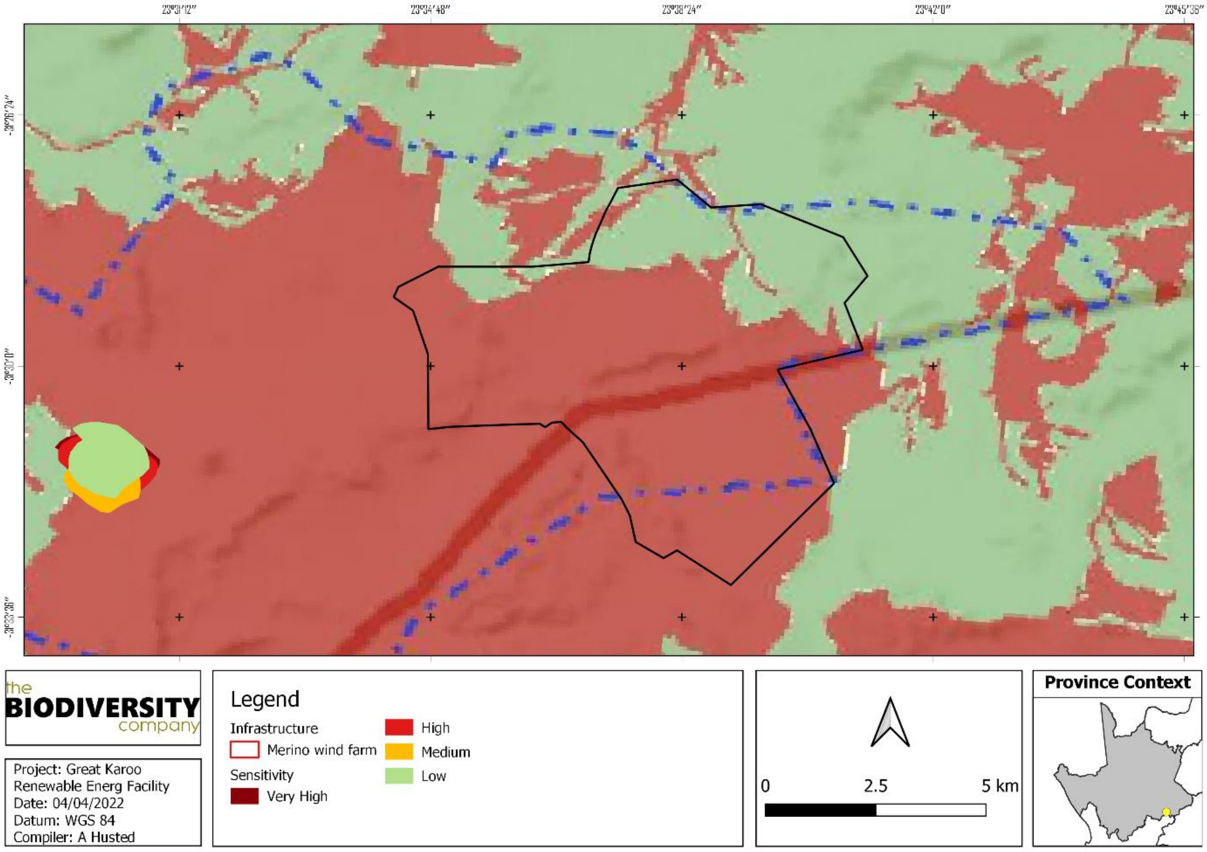


Figure 2-6 The aquatic biodiversity theme sensitivity classification

2.2 Land Capability

As part of the desktop assessment, soil information was obtained using published South African Land Type Data. Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 - 2006). The land type data is presented at a scale of 1:250 000 and comprises the division of land into land types. In addition, a Digital Elevation Model (DEM) as well as the slope percentage of the area was calculated by means of the National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission Global 1 arc second digital elevation data by means of Quantum geographic information system (QGIS) and System for Automated Geoscientific Analyses (SAGA) software.

2.2.1 Climate

This region's climate is characterised by rainfall during autumn and summer months which peaks at a Mean Annual Precipitation (MAP) ranging from 180 to 430 mm (from west to east respectively). This area is characterised by a high frost occurrence rate ranging from just below 30 to 80 days per year (Mucina and Rutherford, 2006). The mean minimum and maximum temperatures in the area are -7.2℃ and 36.1℃ for July and January respectively (also see Figure 2-7 for more information).

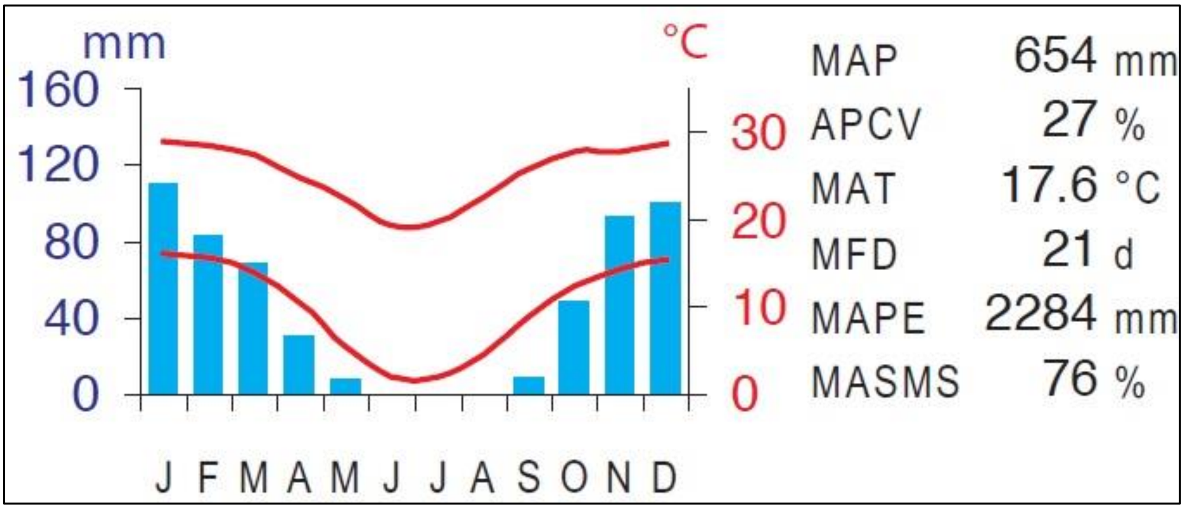


Figure 2-7 Climate for the region

2.2.2 Geology and Soil

The geology of this area is characterised by sandstones and mudstones from the Beaufort Group (including the Tarkastad and Adelaide Subgroups) which supports pedocutanic and prismacutanic diagnostic horizons. Dominant land types include Fb and Fc land types (Mucina and Rutherford, 2006).

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Da 76, Da 147, Fc 131, Fb 488, Ib 125, Fb 126 and Fb 397 land types (see Figure 2-8). The Da land type is characterised by prismacutanic and/or pedocutanic horizons with the possibility of red apedal B-horizons occurring. The Fb land type consists of Glenrosa and/or Mispah soil forms with the possibility of other soils occurring throughout. Lime is generally present within the entire landscape. The Ib land type consists of miscellaneous land classes including rocky areas with miscellaneous soils. The Fc land type consists of Glenrosa and/or Mispah soil forms with the possibility of other soils occurring throughout. Lime is rare or absent within this land type in upland soils but generally present in low-lying areas.

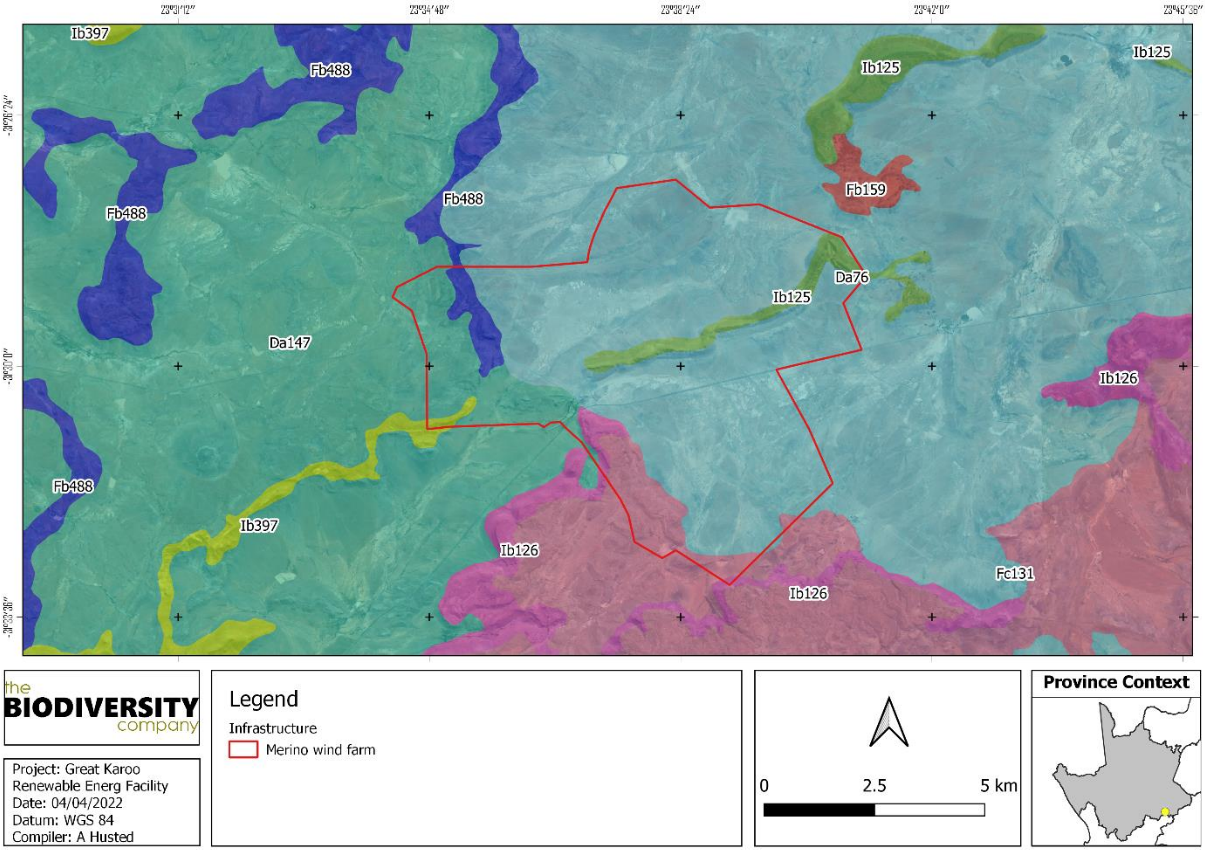


Figure 2-8 Land Types present within the project area

The land terrain units for the featured land types are illustrated from Figure 2-9 to Figure 2-15 with the expected soils listed in Table 2-1 to Table 2-7.

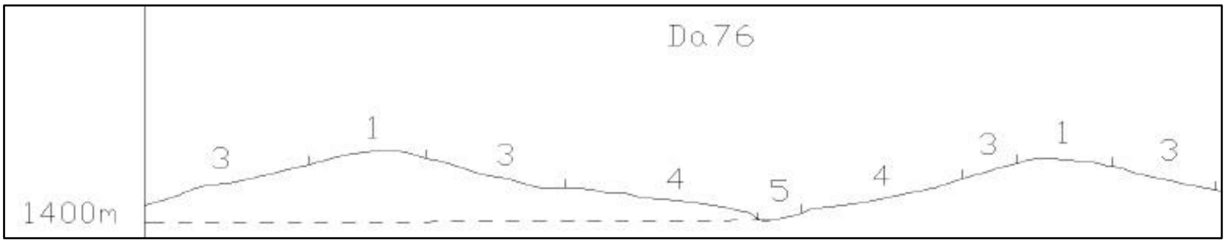


Figure 2-9 Illustration of land type Da 76 terrain unit (Land Type Survey Staff, 1972 - 2006)

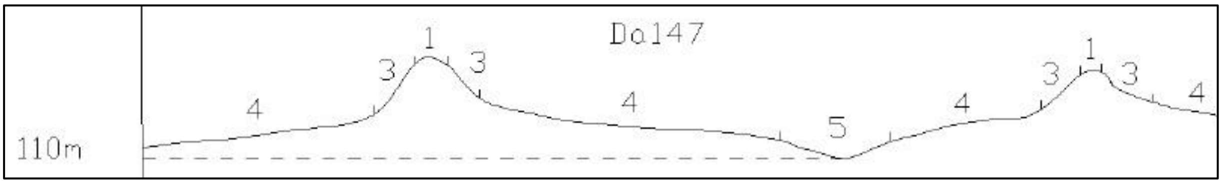


Figure 2-10 Illustration of land type Da 147 terrain unit (Land Type Survey Staff, 1972 - 2006)

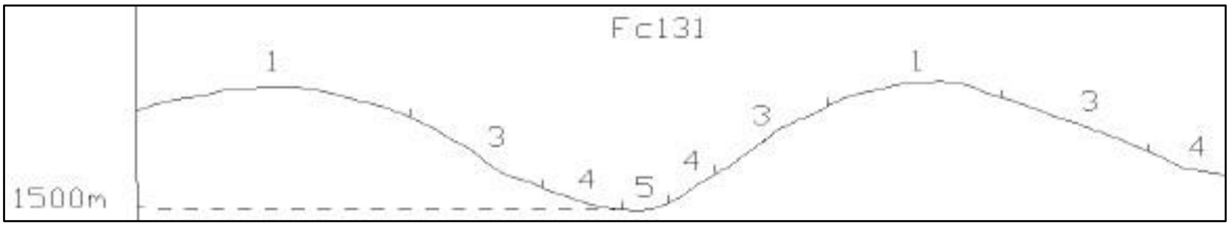


Figure 2-11 ***Illustration of land type Fc 131 terrain unit (Land Type Survey Staff, 1972 - 2006)***

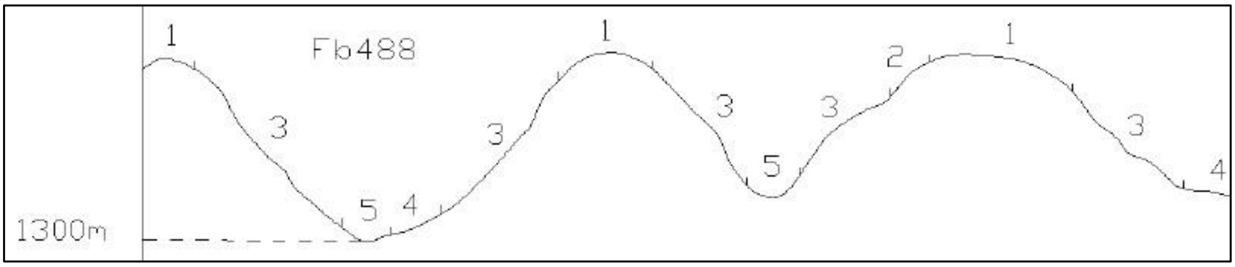


Figure 2-12 ***Illustration of land type Fb 488 terrain unit (Land Type Survey Staff, 1972 - 2006)***

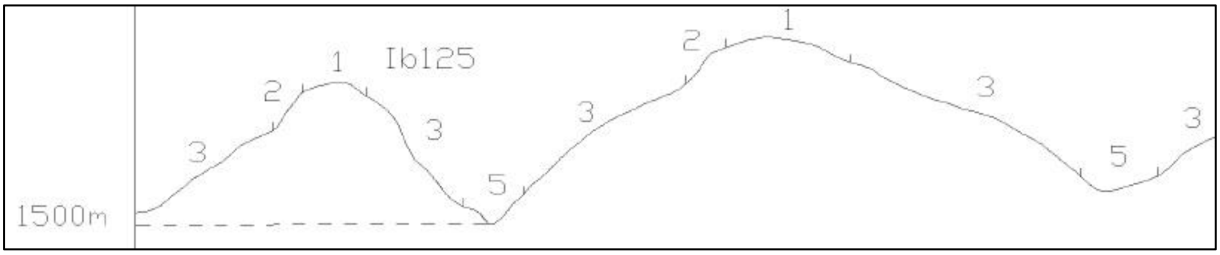


Figure 2-13 ***Illustration of land type Ib 125 terrain unit (Land Type Survey Staff, 1972 - 2006)***

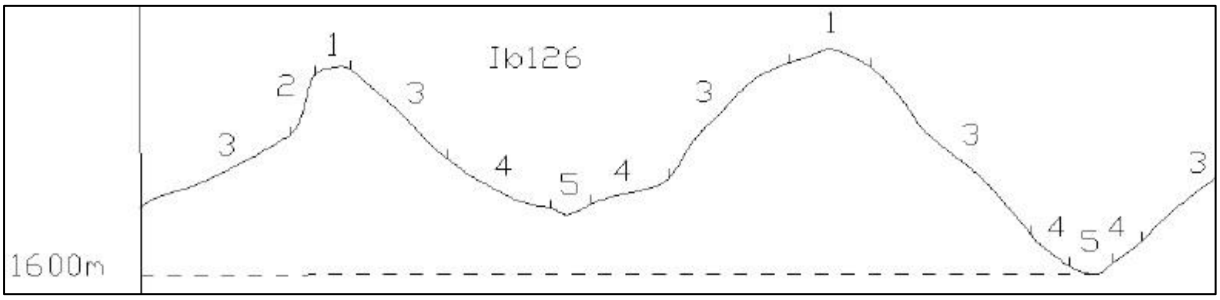


Figure 2-14 ***Illustration of land type Ib 126 terrain unit (Land Type Survey Staff, 1972 - 2006)***

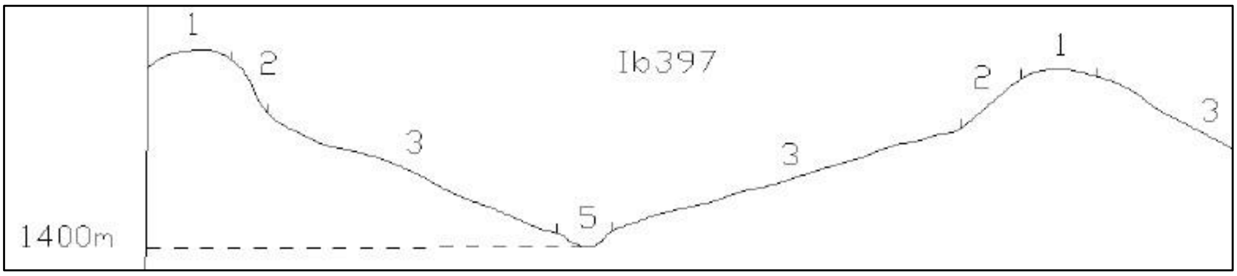


Figure 2-15 ***Illustration of land type Ib 397 terrain unit (Land Type Survey Staff, 1972 - 2006)***

Table 2-1 Soils expected at the respective terrain units within the Da 76 land type (Land Type Survey Staff, 1972 - 2006)

Terrain Units							
1 (2%)		**3 (8%)**		**4 (70%)**		**4 (20%)**	
Mispah	40%	Mispah	40%	Swartland	45%	Valsrivier	35%
Swartland	45%	Swartland	45%	Hutton	25%	Swartland	35%
Hutton	15%	Hutton	15%	Valsrivier	15%	Oakleaf	20%
		Mispah	40%	Mispah	10%	Dundee	5%
				Sterkspruit	5%	Sterkspruit	5%

Table 2-2 Soils expected at the respective terrain units within the Da 147 land type (Land Type Survey Staff, 1972 - 2006)

Terrain Units							
1 (5%)		**3 (15%)**		**4 (60%)**		**4 (20%)**	
Mispah	50%	Mispah	25%	Swartland	30%	Valsrivier	30%
Bare Rock	30%	Swartland	25%	Oakleaf	20%	Oakleaf	25%
Swartland	10%	Bare Rock	20%	Valsrivier	20%	Streambeds	20%
Glenrosa	10%	Glenrosa	20%	Hutton	15%	Mispah	15%
		Hutton	10%	Mispah	10%	Hutton	10%
				Glenrosa	5%		

Table 2-3 Soils expected at the respective terrain units within the Fc 131 land type (Land Type Survey Staff, 1972 - 2006)

Terrain Units							
1 (15%)		**3 (40%)**		**4 (30%)**		**5 (15%)**	
Mispah	50%	Mispah	45%	Mispah	25%	Valsrivier	35%
Bare Rock	25%	Hutton	15%	Valsrivier	20%	Oakleaf	25%
Hutton	10%	Bare Rock	15%	Oakleaf	20%	Mispah	20%
Glenrosa	5%	Glenrosa	10%	Hutton	15%	Glenrosa	5%
Swartland	5%	Swartland	5%	Swartland	10%	Dundee	5%
Shortlands	5%	Shortlands	5%	Glenrosa	5%	Estcourt	5%
		Clovelly	5%	Clovelly	5%	Inhoek	5%

Table 2-4 Soils expected at the respective terrain units within the Fb 488 land type (Land Type Survey Staff, 1972 - 2006)

Terrain Units									
1 (18%)		**2 (2%)**		**3 (60%)**		**4 (10%)**		**5 (10%)**	
Bare Rock	40%	Bare Rock	100%	Mispah	35%	Mispah	30%	Oakleaf	60%
Mispah	40%			Swartland	20%	Swartland	20%	Bare Rock	15%
Hutton	10%			Hutton	20%	Oakleaf	20%	Mispah	15%

Glenrosa	10%			Bare Rock	15%	Glenrosa	10%	Swartland	10%
				Glenrosa	10%	Hutton	10%		
						Bare Rock	10%		

Table 2-5 ***Soils expected at the respective terrain units within the Ib 125 land type (Land Type Survey Staff, 1972 - 2006)***

Terrain Units							
1 (20%)		**2 (5%)**		**3 (73%)**		**5 (2%)**	
Hutton	30%	Bare Rock	100%	Bare Rock	70%	Bare Rock	60%
Bare Rock	20%			Mispah	10%	Hutton	10%
Mispah	20%			Hutton	10%	Mispah	10%
Swartland	20%			Swartland	5%	Valsrivier	8%
Glenrosa	10%			Glenrosa	5%	Glenrosa	5%
						Dundee	5%
						Oakleaf	2%

Table 2-6 ***Soils expected at the respective terrain units within the Ib 126 land type (Land Type Survey Staff, 1972 - 2006)***

Terrain Units									
1 (20%)		**2 (5%)**		**3 (70%)**		**4 2%)**		**5 (3%)**	
Bare Rock	60%	Bare Rock	100%	Bare Rock	65%	Oakleaf	30%	Valsrivier	45%
Mispah	25%			Mispah	20%	Valsrivier	15%	Oakleaf	40%
Glenrosa	5%			Glenrosa	5%	Bare Rock	10%	Inhoek	5%
Swartland	5%			Swartland	3%	Glenrosa	10%	Sterkspruit	5%
Hutton	5%			Hutton	2%	Swartland	10%	Estcourt	5%
						Inhoek	10%		
						Mispah	5%		
						Hutton	5%		
						Sterkspruit	5%		

Table 2-7 ***Soils expected at the respective terrain units within the Ib 397 land type (Land Type Survey Staff, 1972 - 2006)***

Terrain Units							
1 (10%)		**2 (5%)**		**3 (80%)**		**5 (5%)**	
Bare Rock	80%	Bare Rock	100%	Bare Rock	75%	Bare Rock	50%
Mispah	10%			Mispah	10%	Hutton	20%
Hutton	5%			Hutton	5%	Mispah	20%
Glenrosa	5%			Swartland	5%	Swartland	5%
				Glenrosa	5%	Oakleaf	5%

2.2.3 Terrain

The slope percentage of the project area has been calculated and is illustrated in Figure 2-16. Most of the project area is characterised by a slope percentage between 0 and 20%, with some smaller patches within the project area characterised by a slope percentage up to 82%. This illustration indicates a non-uniform topography with alternating hills and steep cliffs surrounding flatter areas at high elevation. The DEM of the project area (Figure 2-17) indicates an elevation of 1 340 to 1 480 Metres Above Sea Level (MASL).

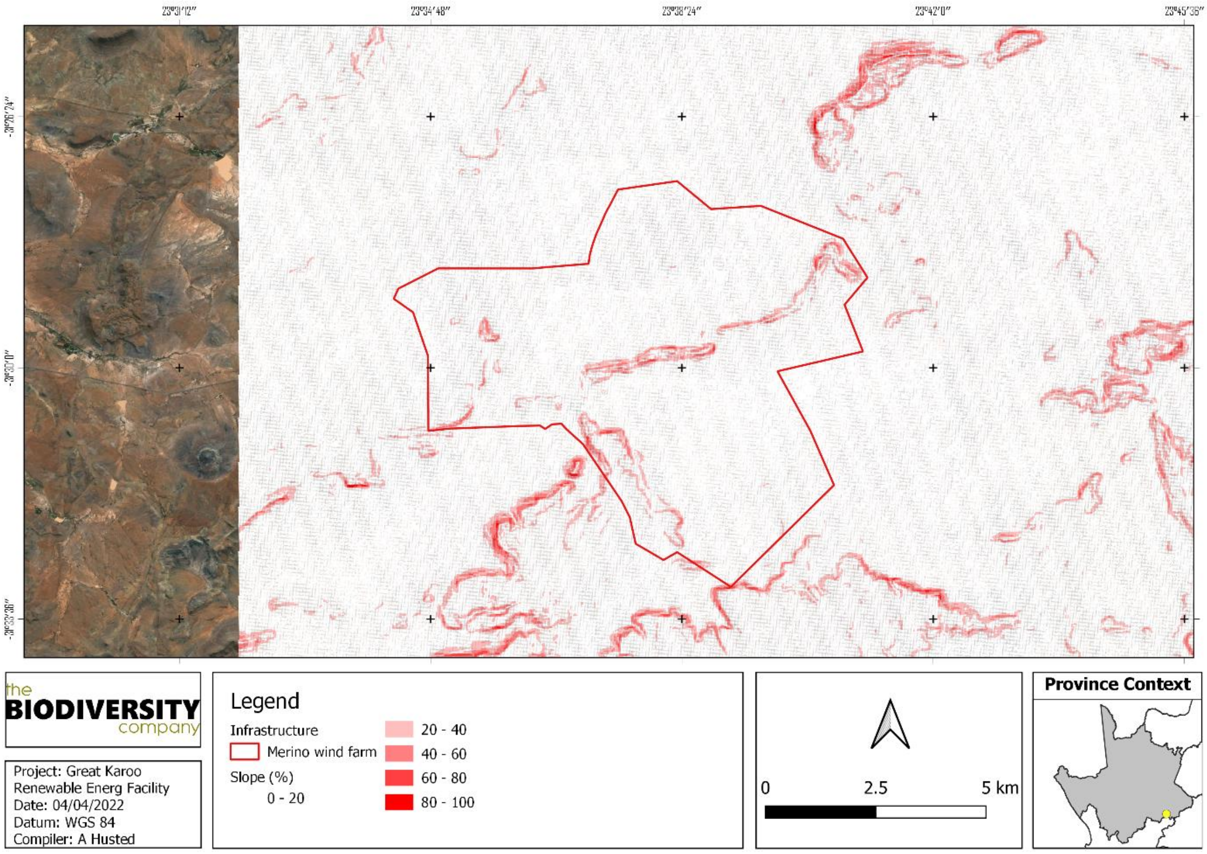


Figure 2-16 The slope percentage calculated for the project area

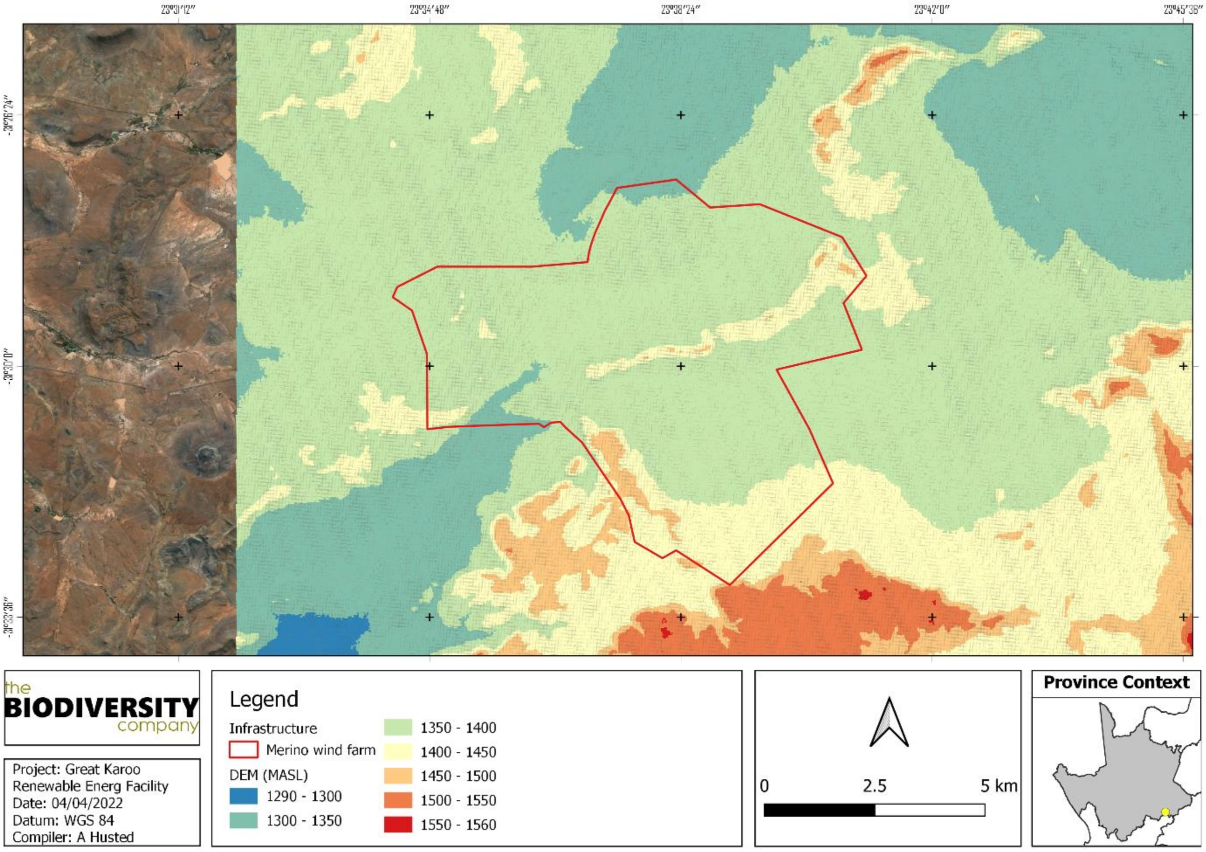


Figure 2-17 The DEM generated for the project area

3 Methodology

3.1 Wetland Assessment

3.1.1 Wetland Identification and Mapping

The National Wetland Classification Systems (NWCS) developed by the SANBI was considered for this assessment. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels. In addition, the method also includes the assessment of structural features at the lower levels of classification (Ollis *et al*., 2013).

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 3-1. The outer edges of the wetland areas were identified by considering the following four specific indicators, the:

- Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
    - The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile due to prolonged and frequent saturation; and
- Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

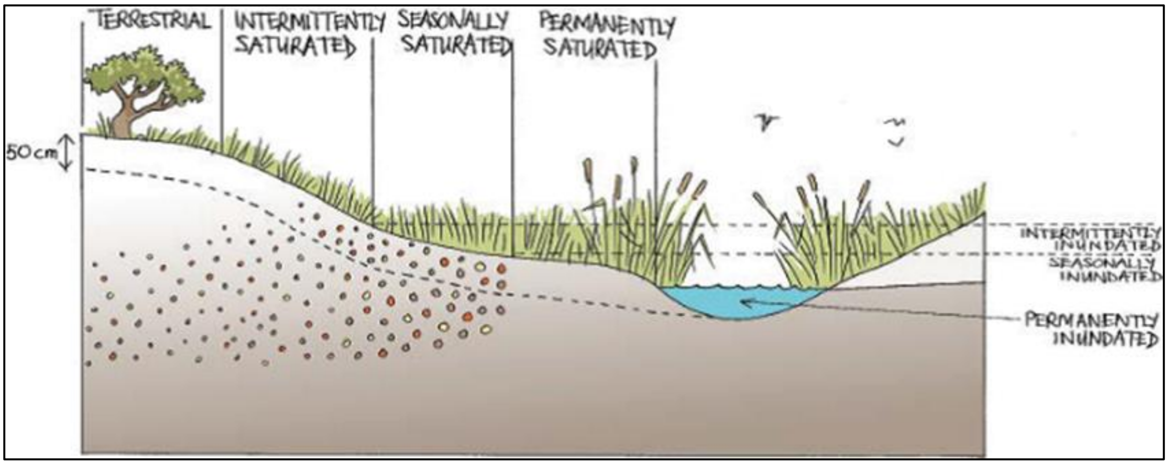


Figure 3-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013).

3.1.2 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands and humans. EcoServices serve as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*. 2008). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 3-1).

Table 3-1 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

3.1.3 Present Ecological Status

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present State categories are provided in Table 3-2.

Table 3-2 The Present Ecological Status categories (Macfarlane et al., 2009)

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

3.1.4 Importance and Sensitivity

The importance and sensitivity of water resources is determined to establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants is used to assign the Importance and Sensitivity (IS) category, as listed in Table 3-3 (Rountree and Kotze, 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

3.1.5 Determining Buffer Requirements

The "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane *et al*., 2014) was used to determine the appropriate buffer zone for the proposed activity.

4 Results

Freshwater systems were delineated in accordance with the DWAF (2005) guidelines. Vegetation is used as the primary wetland indicator. However, whilst wetland vegetation is adapted to life in saturated soil under normal circumstances, such features are not always present in arid to semi-arid environments such as the Northern Cape (based on experience within the region) due to the typically arid conditions of the region, additional indicators, as provided by Day *et al* (2010) were utilised, relevant conclusions include:

- No one indicator provides adequate information about wetland presence, type, hydroperiod, biodiversity, function and principle ecological and hydrological drivers to be useful on its own – particularly with regard to actual or suspected cryptic and/or temporary wetlands;
- The absence of an indicator does not necessarily equate to the absence of a wetland;
- Indicators that a wetland is present are usually associated with a higher level of confidence than interpretation of indicators of specific wetland character/habitat type;
- Seasonally/ephemerally inundated wetlands may be identifiable to a higher level of confidence than seasonally saturated systems; and
- Detailed delineation of cryptic wetlands is unlikely to be achievable with any useful degree of confidence based on a dry season assessment only.

Based on a combination of desktop and in-field delineation, three (3) forms of a watercourse were identified and delineated within the 500 m regulated area applied (Figure 4-2). These include episodic rivers, drainage lines and dams. No natural wetland systems, or even cryptic wetlands were identified for the project area. Episodic river refers to systems formed from run-off channels in very dry regions. The rivers and drainage lines are both classified as a river HGM type system (Table 4-1). The dams are regarded as artificial systems and typically formed / created in the preferential flow paths of the river HGM type. The drainage lines are not characterised by riparian vegetation and grasses, these systems represent bare surfaces with evidence of surface run-off.

The level 1-4 classification of the HGM units as per the national classification system (Ollis *et al*., 2013) is presented in Table 4-1. The systems were classified as Inland Systems falling within the Nama Karoo Aquatic Ecoregion.

Table 4-1 Characterization of the watercourses for the project according to the Classification System (Ollis et al., 2013)

System	Level 3: Landscape unit	Level 4: Hydrogeomorphic Unit
		HGM Type
Rivers	Plain: an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.	River: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
Drainage line	Valley floor: The base of a valley, situated between two distinct valley side-slopes.	

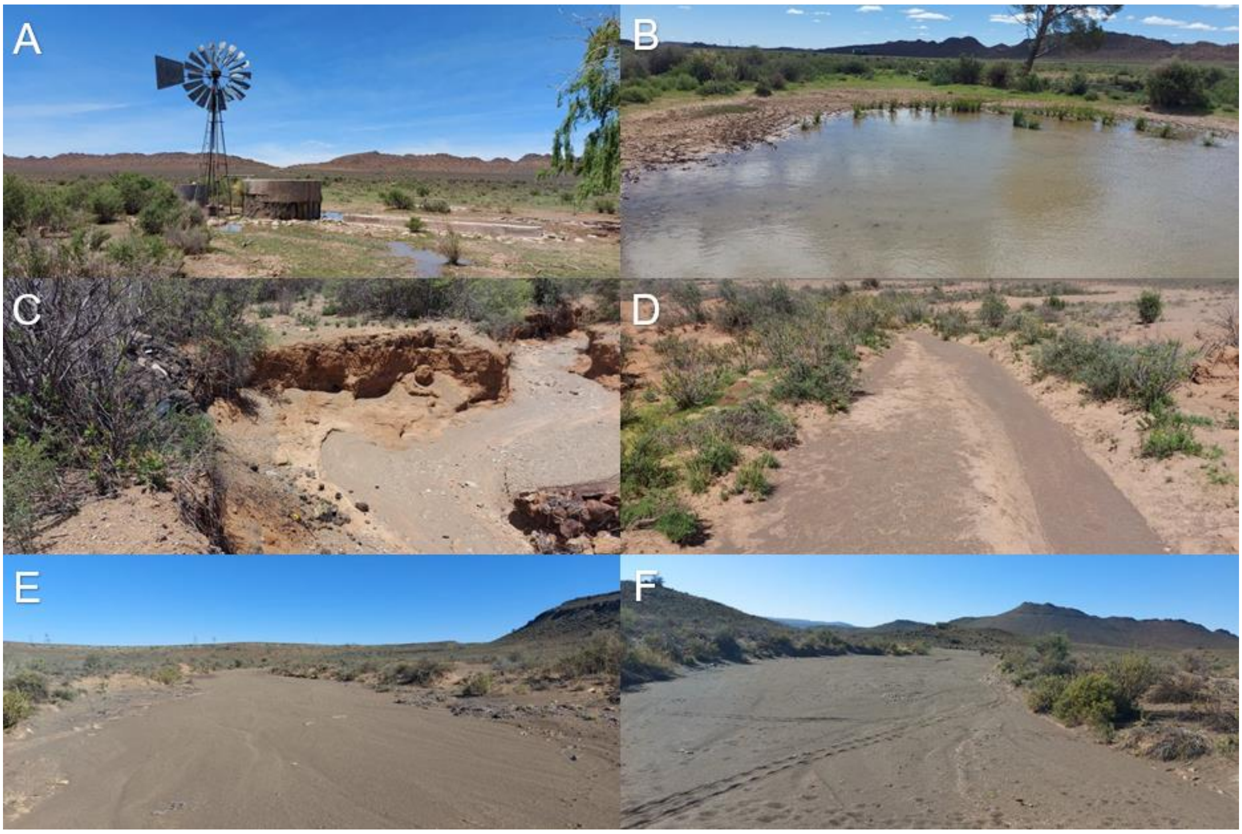


Figure 4-1 Photographs of identified systems for the area. A) Artificially saturated areas B) A dam. C & D) Drainage line. E & F) Episodic river

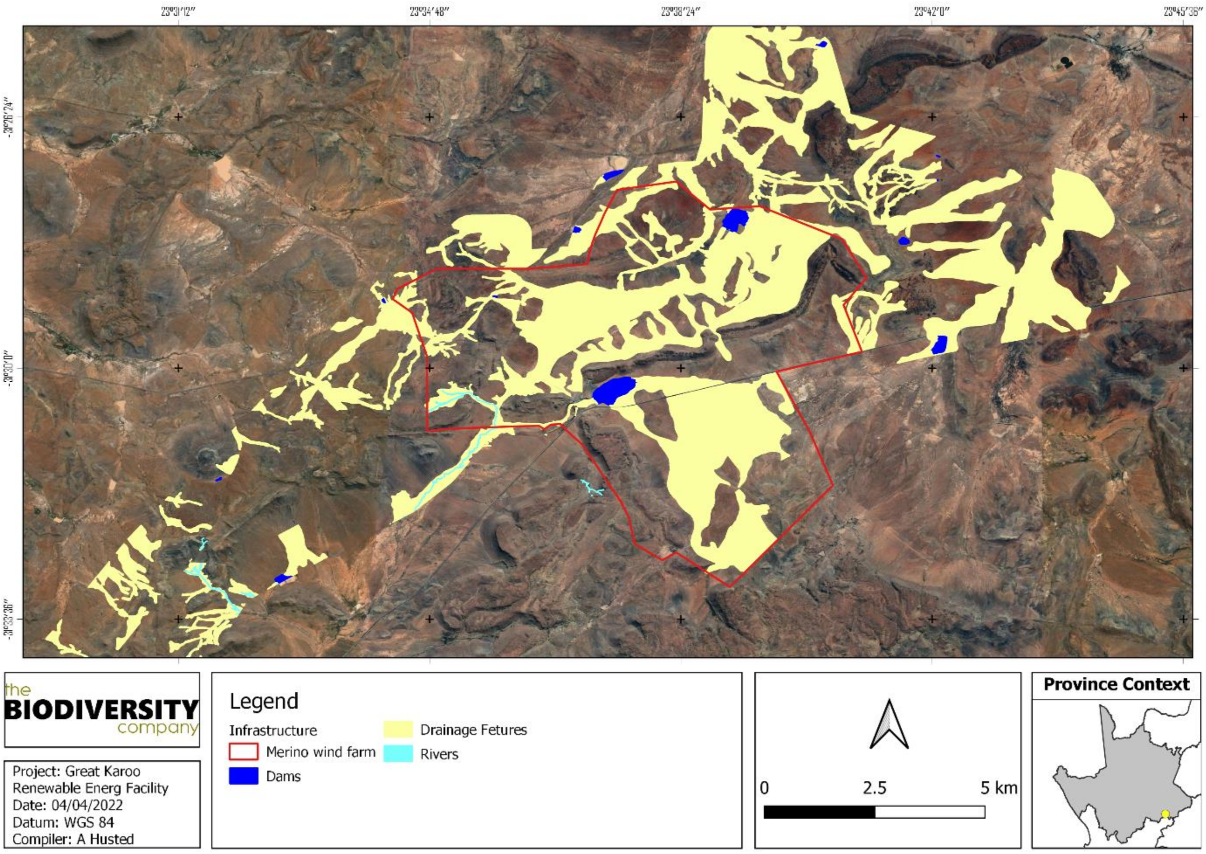


Figure 4-2 The delineated systems in relation to the project area

4.1 Inland Rivers

The NBA (2018) spatial rivers dataset is part of the SAIIAE which was released with the National Biodiversity Assessment (NBA) 2018. In the NBA 2018 the NFEPA rivers GIS layer was used to represent the diversity of rivers nationally. The extent of rivers associated with the project area, and the corresponding threat status and protection level are presented in Figure 4-3. The river system to the north is classified as Least Threatened, and Not Protected. The river system located centrally is classified as Critically Endangered / Endangered and is also Not Protected.

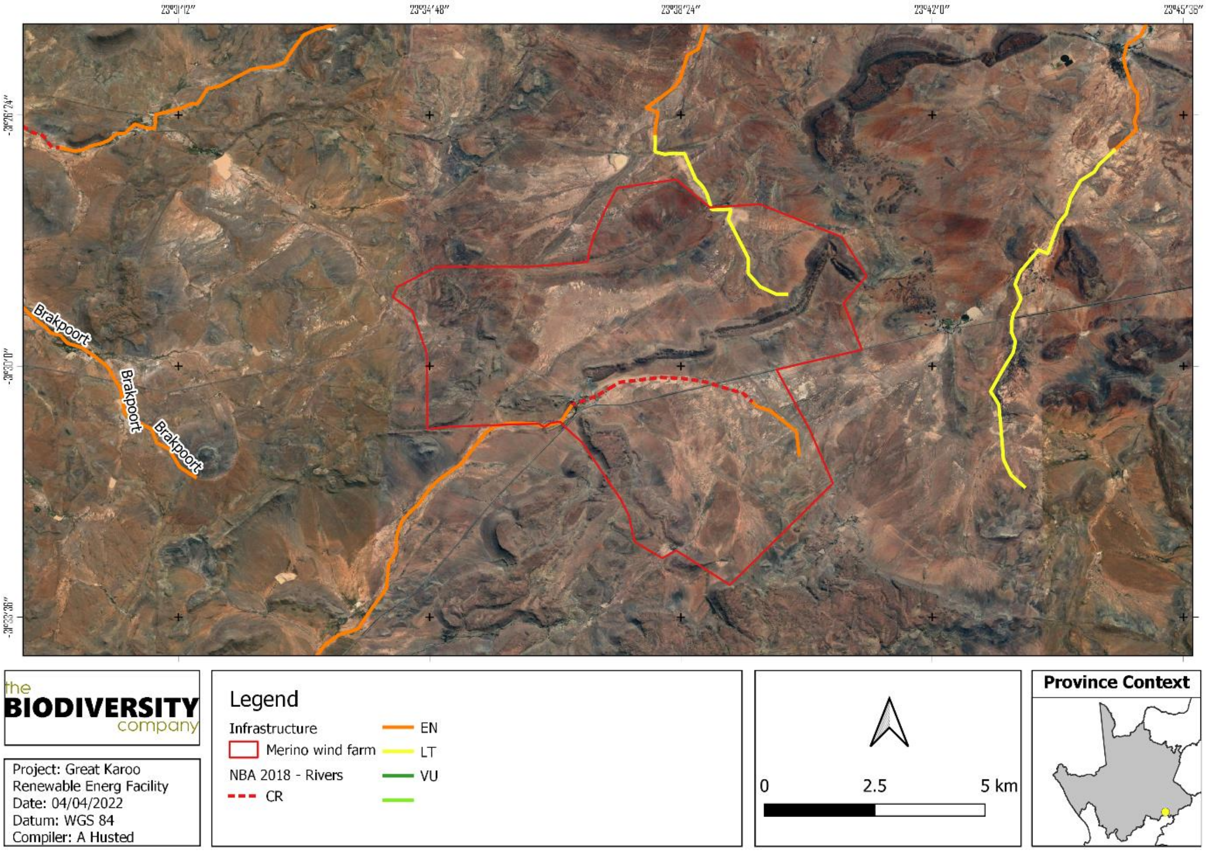


Figure 4-3 The NBA (2018) rivers in relation to the project area

4.2 Catchment Level Habitat Assessment

Due to the absence of wetland systems for the area, approaches for the assessment of river systems were adopted.

The Intermediate Habitat Integrity Assessment (IHIA) model was used to assess the integrity of the habitats from a riparian and instream perspective as described in Kleynhans (1996). The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale which are comparable to the characteristics of natural habitats of the region (Kleynhans, 1996).

This model compares current conditions with reference conditions that are expected to have been present. Specification of the reference condition follows an impact-based approach where the intensity and extent of anthropogenic changes are used to interpret the impact on the habitat integrity of the system. To accomplish this, information on abiotic changes that can potentially influence river habitat integrity are obtained from surveys or available data sources. These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology and physico-chemical conditions and how these changes would impact on the natural riverine habitats.

The spatial framework for each IHIA was 5 km up and downstream of the respective area of interest, from the highest elevation to the lowest elevation within the watercourse. The results of the IHIA for the catchment are provided in Table 4-2.

Table 4-2 Results for the habitat assessment

Instream	Average Score	Impact Score
Water abstraction	0	0

Flow modification	3	1.56
Bed modification	2	1.04
Channel modification	5	2.6
Water quality	3	1.68
Inundation	2	0.8
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total Instream		**92.32**
Category		**A**
Riparian	**Average Score**	**Impact Score**
Indigenous vegetation removal	**5**	2.6
Exotic vegetation encroachment	**4**	1.92
Bank erosion	**3**	1.68
Channel modification	**3**	1.44
Water abstraction	**0**	0
Inundation	**0**	0
Flow modification	**3**	1.44
Water quality	**0**	2.6
Total Riparian		**88.32**
Category		**B**

The results of the IHIA indicates natural (class A) and largely natural (class B) instream and riparian conditions for the catchment respectively. Modifications to instream habitat, albeit limited, are attributed to channel modification, and also flow and bed modification. Modifications to the riparian areas are attributed to vegetation clearing, limited alien vegetation establishment, and also bank and channel changes.

4.3 Importance and Sensitivity

The Importance and Sensitivity ratings for the HGM type is provided below. Several factors were considered when establishing the IS of the systems. Regional to national scale considerations included NFEPA river or wetland status, protected areas as well as Ramsar wetlands. Local considerations included habitat integrity and diversity, likelihood of supporting conservation important species and potential for hosting significant congregations of local or migratory species. The overall IS for the area was determined to be high.

At a regional scale the NFEPA Wetveg database recognises seeps and valley bottom wetlands within the Upper Nama Karoo as Critically Endangered and Endangered respectively, both also classified as Not Protected (Nel *et al.*, 2011). The NBA (2018) dataset recognised river in the area as Least Threatened and Not Protected. The following was also considered for the IS description for each AOI:

- David Hoare (2010) classifies drainage features within the area as high sensitivity;
- The area is not located in a Strategic Water Source Area;
- The Upper Karoo Hardeveld vegetation type is Least Threatened;

- The areas do overlap with Critical Biodiversity Areas; and
- The project area does overlap any Ecological Support Areas.

Table 4-3 Ecological importance and sensitivity for the area

HGM Type	Wet Veg			NBA Rivers		SWSA (Y/N)	Calculated IS
	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018		
Rivers (incl drainage lines)	Upper Nama Karoo	Critically Endangered / Endangered	Not Protected	A/B	Critically Endangered / Endangered	No	High

4.4 Ecosystem Services

The ecosystem services provided by the system identified were assessed and rated using the WET-EcoServices method (Kotze *et al*. 2008) (Table 4-4). The overall ecosystem service benefit for the system is intermediate.

Overall, the systems generally provide moderately important indirect regulating and supporting services relating to flood attenuation, streamflow regulation, sediment trapping and nutrient and toxicant removal. This may be attributed to the ephemeral characteristics of the systems. As the systems are not situated in a rural community setting (prevailing land use being agriculture) the systems are not considered important from a cultural perspective nor in terms the direct provision of water and harvestable resources on a subsistence level.

The systems are also generally considered relatively important from a biodiversity maintenance perspective, supporting a unique and diverse floral assemblage while providing important foraging, shelter and movement corridors for a wide diversity of associated fauna. David Hoare (2010) states that these systems have the potential to provide habitat for Red List species that have a high occurrence within natural habitats.

Table 4-4 The ecosystem services being provided by the HGM type

Wetland Unit					HGM 1
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits		Flood attenuation	1.3
				Streamflow regulation	1.2
			Water Quality enhancement benefits	Sediment trapping	1.3
				Phosphate assimilation	1.4
				Nitrate assimilation	1.4
				Toxicant assimilation	1.3
				Erosion control	1.3
				Carbon storage	0.7
	Direct Benefits	Biodiversity maintenance			2.6
		Provisioning benefits		Provisioning of water for human use	0.0
				Provisioning of harvestable resources	0.0
				Provisioning of cultivated foods	0.3
		Cultural benefits		Cultural heritage	1.1
				Tourism and recreation	2.8
				Education and research	2.9

Overall	**19.6**
Average	**1.3**

4.5 Sensitivity and Buffer Analysis

In accordance with General Notice (GN) 509 of 2016 as it relates to the NWA (1998), a regulated area of a watercourse for Section 21 (c) and 21 (i) of the NWA, 1998 means the outer edge of the 1 in 100 year flood or where no flood line has been determined it means 100 m from the edge of a watercourse or a 500 m radius from the delineated boundary (extent) of any wetland or pan.

Listed activities in terms of the NEMA (1998), (Act 107 of 1998) EIA Regulations as amended in April 2017 must be taken into consideration if any infrastructure is to be placed within the applicable zone of regulation, which in this case is a 32 m zone of regulation.

Additionally in order to determine a more “site specific” buffer zone for the proposed activity the “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane, *et al*., 2014) was used during this assessment.

The buffer guideline of Macfarlane *et al*. (2014) enables the user to take into account the level of assessment as well as the proposed development and then generate a preliminary threat rating and buffer. In order to improve the buffer to be more site specific the tool enables the user to describe the sensitivity of the system, the site-based modifiers and whether there is any species of conservation concern. Furthermore, it enables the application of additional mitigation measures before determining the outcome of the buffer model.

According to the buffer guideline (Macfarlane *et al*., 2014) a high-risk activity would require a buffer that is 95% effective to reduce the risk of the impact to a low-level threat. The tool is regarded as a guideline, adjustments have been made to provide a better suited buffer width. According to the Macfarlane *et al*. (2014) buffer tool the required pre-mitigation buffer is 42 m for the construction phase and 35 m for the operational phase.

Other case studies completed by Macfarlane *et al*. (2009) focused on reviewing the functions, values and limitations of buffer zones. This study indicated that there are specific characteristics or variables that affect a buffer’s ability to perform various functions, in this case sediment trapping/removal. According to Macfarlane *et al*. (2009) sediment removal begins with a reduction in the flow rate, mainly through the presence of vegetation which increases the surface roughness. The relationship between the length covered by the runoff (buffer width) and sediment removal is not linear, which indicated that most sediment are deposited in outer portions of a buffer. According to Macfarlane *et al*. (2009) based on a range of studies between 1973 and 2005 and according to various authors there are various proposed buffer zone widths for sediment removal. According to Ghaffarzadeh *et al*. (1992) 85% of sediment were removed in 9.1 m buffers. Several other authors also indicated a maximum buffer width of 15 m to be sufficient in removing/trapping sediment.

Based on the above-mentioned case studies it is, nevertheless, important to focus on the width of the buffer, but also imperative that the focus be shifted to the effectiveness of the buffer. Subsequently, it is important that when implementing the 15 m buffer in this development it be done in a proactive and consistent manner in order to continuously attain its purpose.

The expected risks were reduced to Low with the prescribed mitigation measures and therefore the recommended buffer was calculated to be 22 m for the drainage lines and rivers (Table 4-5), for the construction and operational phases.

Table 4-5 Post-mitigation buffer requirement

Required Buffer after mitigation measures have been applied

Phase	Drainage Line	Rivers
Construction Phase	22 m	22 m
Operational Phase	22 m	22 m

The buffer zone will not be applicable for proposed infrastructure that traverse the systems, however, for all secondary activities such as laydown yards and storage areas, the buffer zone must be implemented. Only aspects essential for the construction and operation of watercourse crossings are permitted within the watercourses and associated buffer area. All other aspects must adhere to the buffer width, avoiding impacts to these areas. The sensitivity of the drainage lines and rivers was determined to be High, with the dams and 22 m buffer area classified as Medium sensitivity (Figure 4-4).

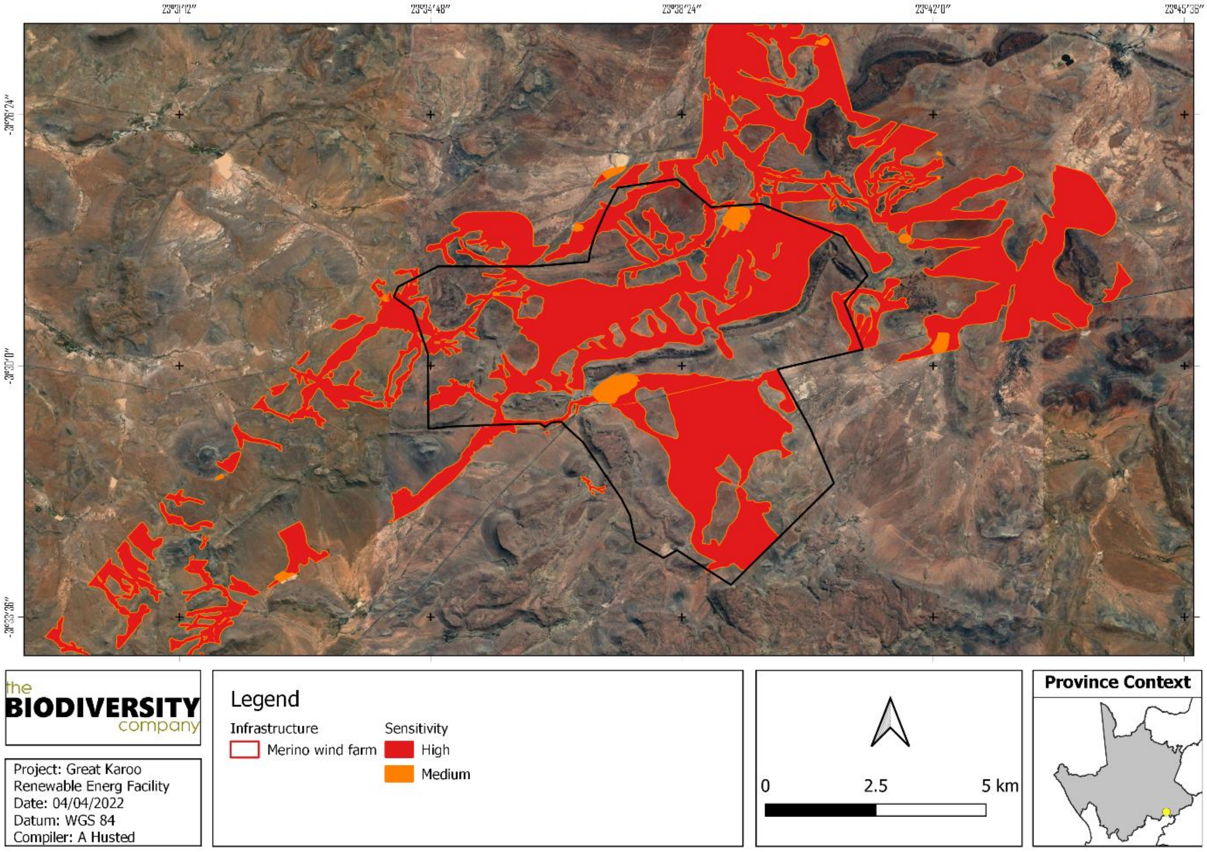


Figure 4-4 The delineated habitat sensitivity

5 Impact Assessment

Figure 5-1 presents the preliminary layout for the proposed facility, which has been considered for the impact assessment. This assessment has considered both direct and indirect risks to the wetland and soil attributes for the area.

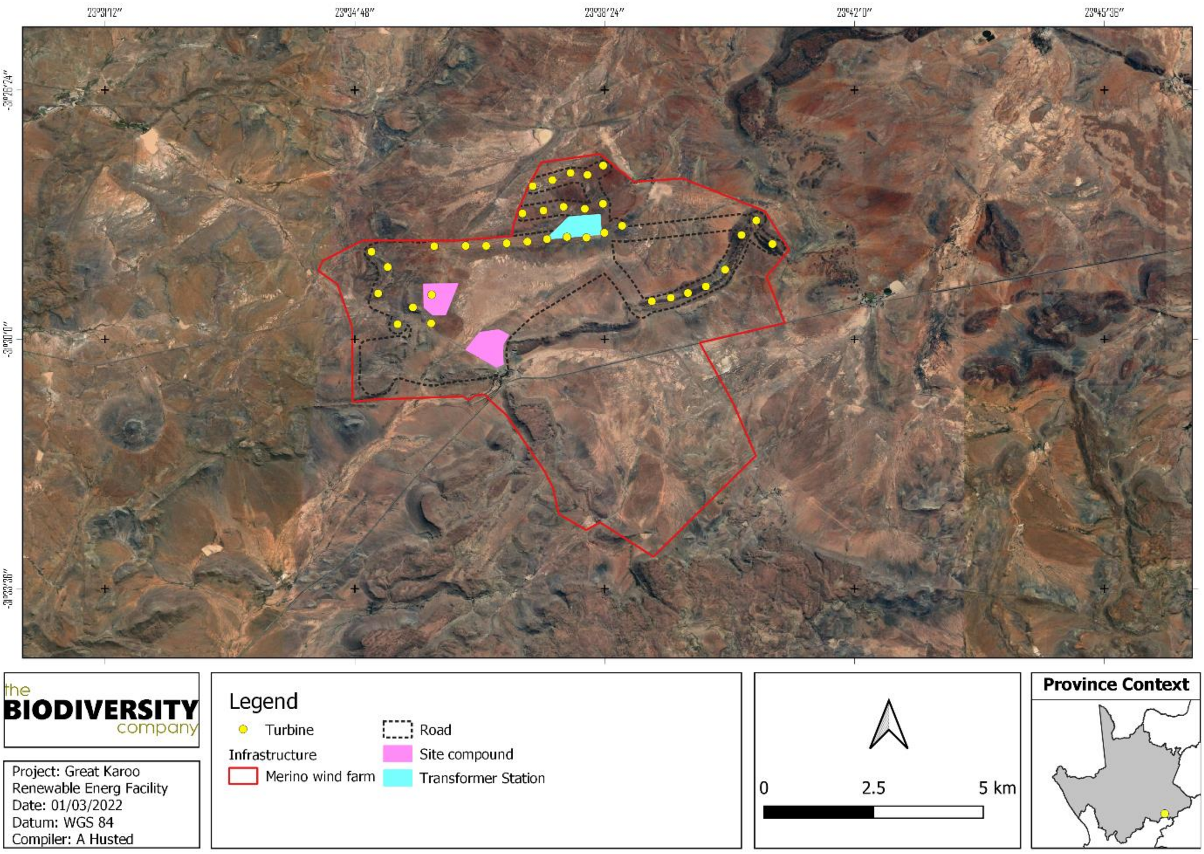


Figure 5-1 Preliminary layout for the proposed facility

Proposed activities will disturb these areas through direct impacts during construction activities during the installation of the turbines, access roads and additional infrastructure. During the operational phase, impacts due to stormwater runoff from hard surfaces may result in erosion of channels, and sedimentation of downstream systems. The development area was classified as overall medium sensitivity from an aquatic ecosystem's perspective, however, the downstream water resources are likely susceptible to changes in hydrology. It is recommended that a stormwater management plan be implemented for the project.

A key consideration for the impact assessment is the presence of the CR/EN river and associated CBA1 located centrally in regards to the project area. The proposed development area is situated within a catchment dominated by drainage features. The dams are artificial and regarded as man-made features. These dams are not expected to be characterised by hydromorphic properties or hydrophytic vegetation. These systems, considering their artificial nature are assigned an overall low sensitivity. Collectively the systems within the project area were classified as overall medium sensitivity from an aquatic ecosystem's perspective, however, the downstream water resources are likely susceptible to changes in hydrology. A network of drainage features, comprising of channels and networks are present in the area. These systems should be granted some level of protection considering the roles that these systems play in ensuring the functionality of the Section A river systems.

Areas indicated as river systems are ephemeral and display alluvial soils and riparian vegetation within and surrounding the direct channel. Section A river systems are characterised by zero-baseflow conditions given the fact that the zone of saturation is not in contact with the base of the stream channel (DWAF, 2005). A Section A system is the least sensitive of the three (section A, B and C) systems in regard to water yield from catchments and is often also referred to as non-perennial systems. The overall sensitivity of these systems is moderate.

5.1 Impact Assessment Method

The assessment of the significance of direct, indirect and cumulative impacts was undertaken using the method as developed by Savannah. The assessment of the impact considers the following, the:

- Nature of the impact, which shall include a description of what causes the effect, what will be affected, and how it will be affected;
- Extent of the impact, indicating whether the impact will be local or regional;
- Duration of the impact, very short-term duration (0-1 year), short-term duration (2-5 years), medium-term (5-15 years), long-term (> 15 years) or permanent;
- Probability of the impact, describing the likelihood of the impact actually occurring, indicated as improbable, probable, highly probable or definite;
- Severity/beneficial scale, indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit with no real alternative to achieving this benefit); severe/beneficial (long-term impact that could be mitigated/long-term benefit); moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit); slight; or have no effect;
- Significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low medium or high;
- Status, which will be described as either positive, negative or neutral;
- Degree to which the impact can be reversed;
- Degree to which the impact may cause irreplaceable loss of resources; and
- Degree to which the impact can be mitigated.

5.2 Construction Phase

The following potential main impacts on the watercourses were considered for the construction phase of the proposed project. Similar impacts are expected for the decommissioning phase, and can be jointly considered. This phase refers to the period when the proposed features are constructed. Construction could result in the encroachment into watercourses and result in the loss or degradation of these systems, most of which are functional and provide ecological services. Watercourses are also likely to be traversed by roads and other linear infrastructure which might create a barrier to flow and biotic movement across the systems. These disturbances could also result in the infestation and establishment of alien vegetation would affect the functioning of the systems. During construction earthworks will expose and mobilise earth materials which could result in sedimentation of the receiving systems. A number of machines, vehicles and equipment will be required for the phase, aided by chemicals and concrete mixes for the project. Leaks, spillages or breakages from any of these could result in contamination of the receiving water resources. Contaminated water resources are likely to have an effect on the associated biota. The following potential impacts during site clearing and preparation were considered:

- Watercourse disturbance / loss.
  - Direct disturbance / degradation / loss to soils or vegetation due to the construction of the facility and associated infrastructure; and
- Water runoff from construction site;
  - Increased erosion and sedimentation; and
  - Contamination of receiving water resources.

Table 5-1 Impacts to watercourses associated with the proposed construction phase.

Impact Nature: Watercourse disturbance / loss

Direct disturbance / degradation / loss to soils or vegetation due to the construction of the facility and associated infrastructure, such as crossings		
	Without mitigation	**With mitigation**
Extent	High (4)	Moderate (3)
Duration	Moderate term (3)	Moderate term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (52)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, avoidance of watercourses is possible.	
Mitigation:		
• Avoid direct impacts to the water resources and their associated 22 m buffer width. This avoidance is not required for watercourse crossings (i.e. roads, pipelines, cables etc), but the number and size of the crossings must be kept to a minimum. Only essential services and equipment are permitted within the watercourse crossings and their associated 22 m buffer during the construction phase. • Prioritise construction of the crossings during the dry season period (Mat to September). • Clearly demarcate the construction footprint and restrict all construction activities to within the proposed infrastructure area. • When clearing vegetation, allow for some vegetation cover as opposed to bare areas. • Minimize the disturbance footprint and unnecessary clearing of vegetation outside of this area. • Use the shapefiles to signpost the edge of the watercourses closest to site. Place the sign 22 m from the edge (this is the buffer zone). Label these areas as environmentally sensitive areas, keep out. • Educate staff and relevant contractors on the location and importance of the identified watercourses through toolbox talks and by including them in site inductions and the overall master plan. • All activities (including driving) must adhere to the respective demarcated areas. • Promptly remove / control all AIPs that may emerge during construction (i.e. weedy annuals and other alien forbs). • All alien vegetation should be managed in terms of the Regulation GNR.1048 of 25 May 1984 (as amended) issued in terms of the CARA and IAP regulations. • Landscape and re-vegetate all denuded areas as soon as possible. • Implement a suitable stormwater management plan for the facility. Priority must be the return of clean water to the resources, and avoiding scouring or erosion at any discharge locations.		
Residual Impacts:		
Notable disturbances are expected for the construction phase. However, with correctly placed mounted infrastructure the hydrology of the system will recover to some extent during the operational phase. The residual impact is expected to be low.		

Table 5-2 Impacts to watercourses associated with the proposed construction phase.

Impact Nature: Water runoff from construction site		
Increased erosion and sedimentation & contamination of resources the drainage features and rivers		
	Without mitigation	**With mitigation**
Extent	High (4)	Moderate (3)
Duration	Moderate term (3)	Moderate term (3)

Impact Nature: Water runoff from construction site		
Increased erosion and sedimentation & contamination of resources the drainage features and rivers		
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (52)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation:		
• The contractors used for the construction phase should have spill kits available prior to construction to ensure that any fuel, oil or hazardous substance spills are cleaned-up and discarded correctly. • All construction activities must be restricted to the development footprint area. This includes laydown and storage areas, ablutions, offices etc. • During construction activities, all rubble generated must be kept in a skip (or similar) and removed from the site to a licensed facility. • Construction vehicles and machinery must make use of existing access routes as much as possible. • All chemicals and toxicants to be used during construction must be stored in a bunded area. • All machinery and equipment should be inspected regularly for faults and possible leaks; these should be serviced off-site at designated areas. • All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping".. • Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation). • All removed soil and material stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds. • No dumping of material on site may take place. • Implement a suitable stormwater management plan for the facility. Ensure the separation of clean and dirty water. • All waste generated on site during construction must be adequately managed. Separation and recycling of different waste materials should be supported. • No activities are permitted within the watercourses and their associated 22 m buffer areas unless these are for crossings. • Landscape and re-vegetate all unnecessarily denuded areas as soon as possible.		
Residual Impacts:		
Long term broad scale erosion and sedimentation, and contamination of watercourses. The residual impact is expected to be low.		

5.3 Operation Phase

The operational phase refers to the phase when construction has been completed and the infrastructure is functional. It is anticipated to increase stormwater runoff due to the hardened surfaces and the crossings which will result in an increase in run-off volume and velocities, resulting in altered flow regimes. The changes could result in physical changes to the receiving systems caused by erosion, run-off and also sedimentation, and the functional changes could result in changes to the vegetative structure of the systems. The reporting of surface run-off to the systems could also result in the contamination of the systems, transporting (in addition to sediment) diesel, hydrocarbons and soil from the operational areas.

The following potential impacts were considered:

- Hardened surfaces;
    - Potential for increased stormwater runoff, leading to increased erosion and sedimentation (Table 5-3); and
- Contamination;
    - Potential for increased contaminants entering the watercourses (Table 5-4).

Table 5-3 Impacts to watercourses associated with the proposed operational phase

Impact Nature: Hardened surfaces		
Potential for increased stormwater runoff leading to increased erosion and sedimentation		
	Without Mitigation	With Mitigation
Extent	High (4)	Moderate (3)
Duration	Long term (4)	Moderate term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (56)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, with proper management and avoidance, this impact can be mitigated to a low level.	
Mitigation:		
• Design and implement an effective stormwater management plan. • Promote water infiltration into the landscape. • Release only clean water into the environment. • Stormwater leaving the site should not be concentrated in a single exit drain but spread across multiple drains around the site, each fitted with energy dissipaters (e.g. slabs of concrete with rocks cemented in). • Re-vegetate denuded areas as soon as possible. • Regularly clear drains. • Minimise the extent of concreted / paved / gravel areas. • A covering of soil and grass (regularly cut and maintained) around infrastructure is ideal for infiltration. If not feasible, then gravel is preferable over concrete or paving.		
Residual Impacts		
Long-term broad scale erosion and sedimentation		

Table 5-4 Impacts to watercourses associated with the proposed operational phase.

Impact Nature: Contamination		
Potential for increased contaminants entering the systems		
	Without mitigation	**With mitigation**
Extent	High (4)	Moderate (3)
Duration	Long term (4)	Moderate term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (56)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation:		
• Design and implement an effective stormwater management plan. • Release only clean water into the environment. • The contractors used should have spill kits available to ensure that any fuel, oil or hazardous substance spills are cleaned-up and discarded correctly. • All chemicals and toxicants to be used during construction must be stored in a bunded area. • All machinery and equipment should be inspected regularly for faults and possible leaks; these should be serviced off-site at designed areas. • All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping". • Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation). • All waste generated on site during construction must be adequately managed. Separation and recycling of different waste materials should be supported.		
Residual Impacts:		
Watercourse deterioration over time		

5.4 Cumulative Impacts

Cumulative impacts are assessed in context of the extent of the proposed project area; other developments in the area; and general water resource loss and transformation resulting from other activities in the area.

The expected post-mitigation risk significance for the project in isolation is expected to be low, but in consideration of the larger Great Karoo Renewable Energy Project and also the larger surrounding area, the overall cumulative impact is expected to be medium (Table 5-5). This is expected owing to the fact that the larger project extends into two WMAs and three quaternary catchment areas.

Table 5-5 Cumulative water resource impact assessment

Impact Nature: Contamination		
Potential for increased contaminants entering the watercourse		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and the proposed projects in the area**
Extent	Local (2)	Regional (4)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	High (8)
Probability	Improbable (2)	Probable (3)
Significance	**Low (24)**	**Medium (51)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	As presented in the respective project phases	
Residual Impacts:		
Watercourse deterioration over time caused by altered hydro-dynamics, and alien vegetation infestation. Loss / deterioration of ecosystem services.		

5.5 Recommendations

The following recommendations should be considered for the authorisation:

- A stormwater management plan must be developed and implemented for the project. This plan must advise on watercourses and their associated 22 m buffer areas to be avoided by the development, and the corresponding buffer will apply. Preferential flow paths should be avoided as much as feasible;
- The terrestrial ecologist must inform which watercourses are to be avoided. The sensitivities and associated buffers prescribed by the terrestrial ecologist must take preference for the design of the project; and
- Priority should be the avoidance of the CR/EN river and associated CBA1 area. The terrestrial ecology assessment should advise on a suitable buffer with from the edge of the CBA area.

6 Conclusion

Based on a combination of desktop and in-field delineation, three (3) forms of a watercourse were identified and delineated within the 500 m regulated area. These include episodic rivers, drainage lines and dams. No natural wetland systems were identified for the project area. The rivers and drainage lines are both classified as a river HGM type system. The dams are regarded as artificial systems and typically formed / created in the preferential flow paths of the river HGM type. The drainage lines are not characterised by riparian vegetation and grasses. These systems represent bare surfaces with evidence of surface run-off.

The results of the habitat assessment indicate natural (class A) and largely natural (class B) instream and riparian conditions for the catchment respectively. The overall ecological importance and sensitivity for the area was determined to be moderate. The overall ecosystem service benefit for the system is high.

The recommended buffer was calculated to be 22 m for the drainage lines and rivers respectively for the construction and operational phases.

The pre-mitigation impact significance for all considered aspects is expected to be medium. The expected post-mitigation impact significance is expected to be low should all mitigation measures and recommendations be implemented.

The expected post-mitigation risk significance for the project in isolation is expected to be low, but in consideration of the larger Great Karoo Renewable Energy Project the overall cumulative impact is expected to be medium. This is expected owing to the fact that larger project extends into two WMAs and three quaternary catchment areas.

It is the opinion of the specialist that no fatal flaws are presented for the proposed project. The project may be considered favourably by the issuing authority, but all mitigation measures and recommendations must be considered for the authorisation.

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