Aquatic Scoping Report for the Pixley Park Renewable Energy Project – Fountain Solar Photovoltaic (PV) Energy Facility

De Aar, Northern Cape

March 2022

Client

Prepared by:

The Biodiversity Company

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany.com

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Specialist Declaration

I, Dale Kindler 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.

Dale Kindler

Aquatic Specialist (M.Sc. Aquatic Health)

Pr. Sci. Nat. registered: 114743

The Biodiversity Company

March 2022

1 Introduction

The modification of land use within a river catchment has the potential to degrade local water resources (Wepener *et al.,* 2005). Altered land use associated with solar developments thus has the potential to negatively impact on local water resources and ecosystem services. To holistically manage water resources in South Africa, the use of standard water quality sampling methods is considered in-effective. Non-point and point source pollutants are dynamic and can fluctuate according to various factors such as rainfall and human error. Aquatic ecology is permanently exposed to the dynamic conditions within waterbodies and can therefore be an effective reflection of the environmental conditions within a management area. Considering this, the monitoring of aquatic ecology is regarded as an effective tool in water management strategies.

The Biodiversity Company (TBC) was appointed by Savannah Environmental (Pty) Ltd (Savannah) to undertake a freshwater scoping level assessment for the Pixley Park Renewable Energy project. The Pixley Park Solar Cluster Project comprises of photovoltaic (PV) facilities and associated powerlines, substations and BESS facilities

The Pixley Park Solar Cluster Project will include the construction and operation of photovoltaic (PV) solar energy facilities and associated infrastructure, located approximately 12 km east of De Aar, in the Northern Cape Province of South Africa.

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998). This study approach has also taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 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) (DWS, 2020).

The purpose of this specialist assessment is to provide environmental sensitivity information for the environmental authorisation process for the proposed activities associated with the Pixley Park Solar Cluster Project. 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 at a scoping level, enabling informed decision making, as to the ecological viability of the proposed project.

1.1 Background

Fountain Solar PV1 (Pty) Ltd is proposing the development of a Photovoltaic (PV) Solar Energy Facility and associated infrastructure on Portion 1 of the Farm Riet Fountain No.6, located approximately 10 km east of De Aar within the Emthanjeni Local Municipality in the Northern Cape Province. The facility will have a contracted capacity of up to 100 MW and will be known as Fountain Solar PV1. The project is planned as part of a cluster of renewable energy facilities known as Pixley Park, which includes three (3) additional 100 MW Solar PV Facilities (Wagt Solar PV1, Fountain PV1, and Rietfontien Solar PV), and grid connection infrastructure connecting the facilities to the existing Hydra Substation. The projects will all connect to the new Vetlaagte Main Transmission Substation (MTS) via the Wag ‘n Bietjie MTS.

Infrastructure associated with the Solar PV Facility will include the following:

- Solar PV array comprising bifacial PV modules and mounting structures, using single axis tracking technology;
- Inverters and transformers;
- Cabling between the panels;
- Battery Energy Storage System (BESS);
- Laydown areas, construction camps, site offices;
- 12 m wide Access Road and entrance gate from the [xx rod] to project site and switching station;
- 6 m wide internal distribution roads;
- Operations and Maintenance Building, Site Offices, Ablutions with conservancy tanks, Storage Warehouse, workshop, Guard House;
- Onsite 132 kV IPP Substation, including the HV Step-up transformer, and MV Interconnection building 132 kV Overhead Power Line (OHPL) – 30 m height from the switching station to the Main Transmission Substation (MTS) located on farms Vetlaagte and Wagt, which is to be handed back to Eskom (a separate EA is being applied for in this regard);
- Extension of the 132 kV Busbar at the MTS;
- 132 kV Feeder Bay at the MTS;
- Extension of the 400 kV Busbar at the MTS; and
- Installation of a new 400/132 kV Transformer and bay at the MTS.

A development footprint of approximately 300 ha has been identified within the broader project site (approximately 8 200 ha in extent), by the developer for the development of the Fountain Solar PV1 Facility, which 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 proposed project under the Department of Mineral Resources and Energy's (DMRE's) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme (or similar 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 Fountain Solar PV1 Facility set to inject up to 100 MW into the national grid.

1.2 Scope of Work

The principle aim of the scoping assessment was to provide information to determine any level of risk posed by the proposed project in regard to local aquatic systems. This was achieved through the following:

- A desktop assessment of all relevant national and provincial datasets. If available, municipal datasets were also considered;
- Completion of a desktop level impact assessment with supporting mitigation measures;

- Presentation of specialist Terms of Reference (ToR) for the impact phase of the process.

1.3 Limitations, Assumptions and Gaps in Knowledge

The following limitations and assumptions are applicable for this study:

- The assessment has only been completed at a desktop level. 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 scoping report;
- This assessment has only considered aquatic resources;
- No decommissioning phase impacts have been considered for this project. The life of operation is unknown and expected for perpetuity; and
- No alternatives were considered for this assessment.

2 Relevant Legislation

The legislation, policies and guidelines listed below in Table 2-1 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 2-1 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

2.1 National Water Act (Act No. 36 of 1998)

The Department of Water & Sanitation (DWS) 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 National Water Act (NWA) (Act No. 36 of 1998) 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;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse comprises:

- 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 DWS.

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 DWS. Any area within a watercourse or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i) of the NWA.

2.2 National Environmental Management Act (Act No. 107 of 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Environmental Impact Assessment (EIA) Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the EIA process depending on the scale of the impact. An EIA process will be 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 aquatic systems for activities which require EA.

3 Project Area and Hydrological Setting (Receiving Environment)

The project area is located approximately 10 km east of De Aar, immediately north-east of the hydra substation and approximately 10 km north of the N10 Highway. As presented in Figure 3-1, the project area is located in the Brak River D62D quaternary catchment, within the Orange Water Management Area (WMA 6) (NWA, 2016), and Nama Karoo Ecoregion (Figure 3-3, Kleynhans *et al*., 2005). The main watercourse that drains the project area is the upper reaches of the Brak River [Sub-Quaternary Reaches (SQRs D62D-5391 and D62D-5332)], a non-perennial river system with an associated low-density network of non-perennial and ephemeral tributaries falling directly within the project area footprint. The Brak River is located immediately east of the project area and approximately 1.5 km downslope of the eastern most portion of the Fountain PV area (Figure 3-1). The Brak River flows in a north westerly direction joining the Orange River approximately 174 km (as the crow flies) downstream of the project area.

The proposed Fountain PV area has a single unnamed ephemeral/secondary non-perennial watercourse draining eastwards into the Brak River. The 132 kV powerline extends from the Fountain PV area in the Brak SQR D62D-5391, across a watershed and into the catchment of a tributary of the Brak River (Brak tributary SQR D62D-5332). The powerline infrastructure traverses a single unnamed ephemeral/secondary non-perennial watercourse draining in a south-westerly direction into the Brak tributary (Figure 3-2).

The land uses surrounding the project area predominantly includes farming (grazing) activities between natural (open – predominantly mountainous areas) land situated between the aforementioned watercourses. Land use within a catchment influences the ecological integrity of the associated watercourses. Due to the limited land and water use modification within the project related catchment areas, the SQRs were considered largely natural to moderately modified at a desktop level (DWS, 2014). Ephemeral watercourses of the arid regions such as the Karoo are typically dependent on groundwater discharge and are particularly vulnerable to changes in hydrology and are known to be slow to recover from any impacts.

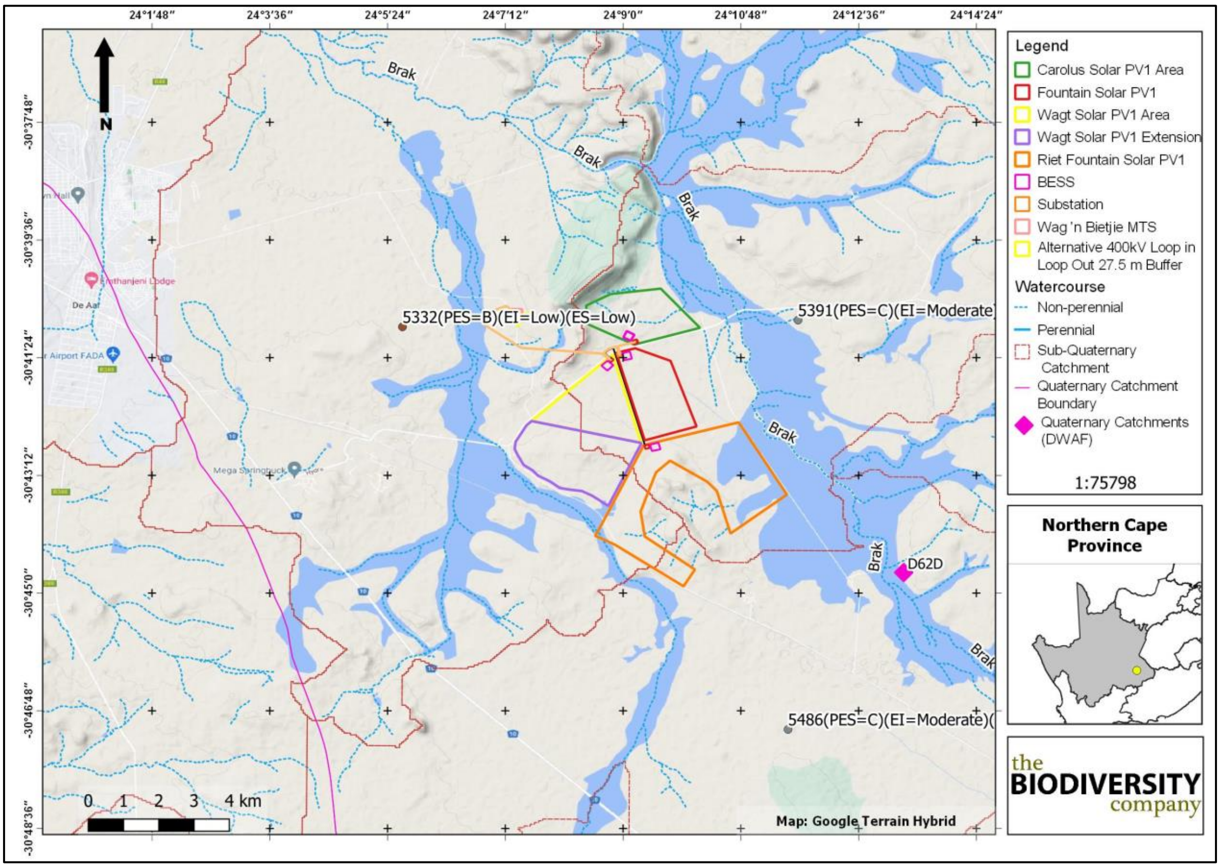

Figure 3-1 Illustration of the watercourses and catchments associated with the project area

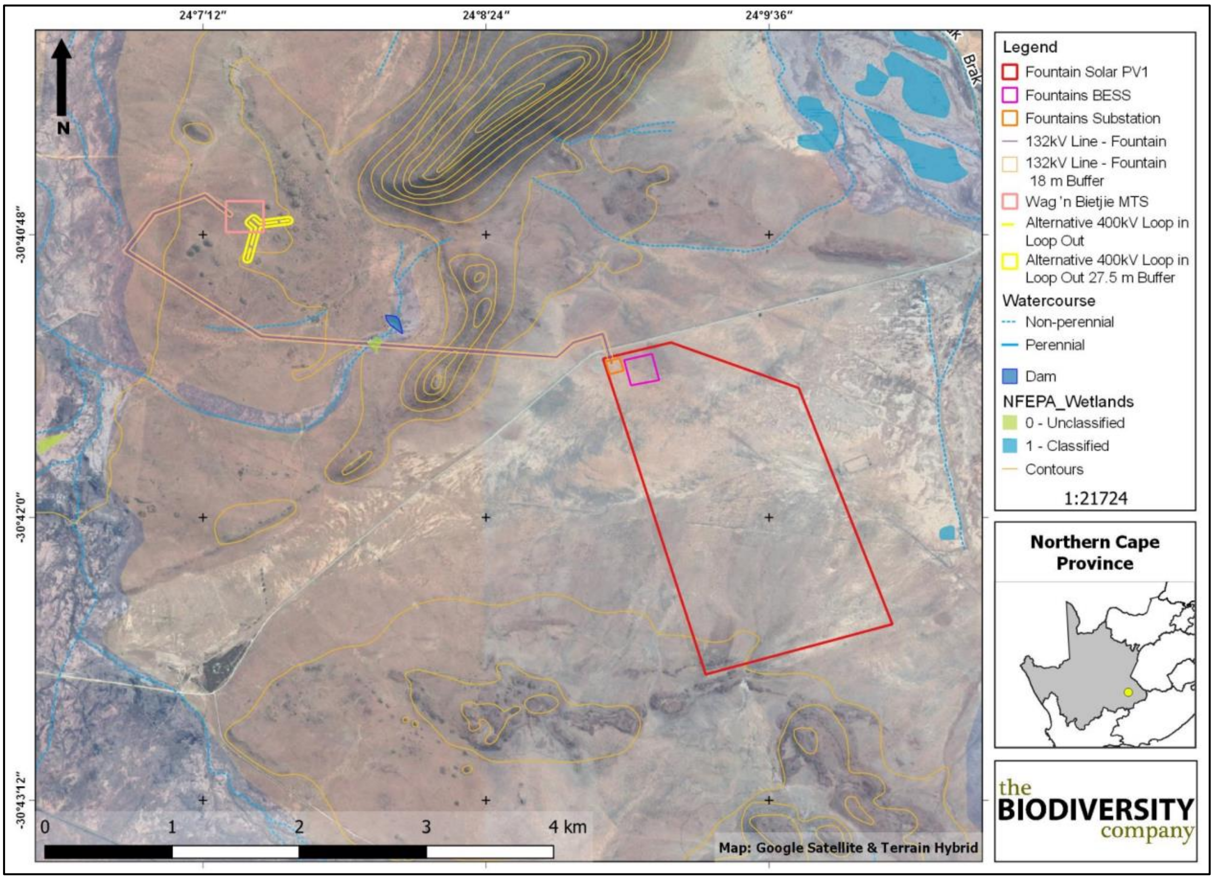

Figure 3-2 Detailed illustration of the local watercourses associated with the project area

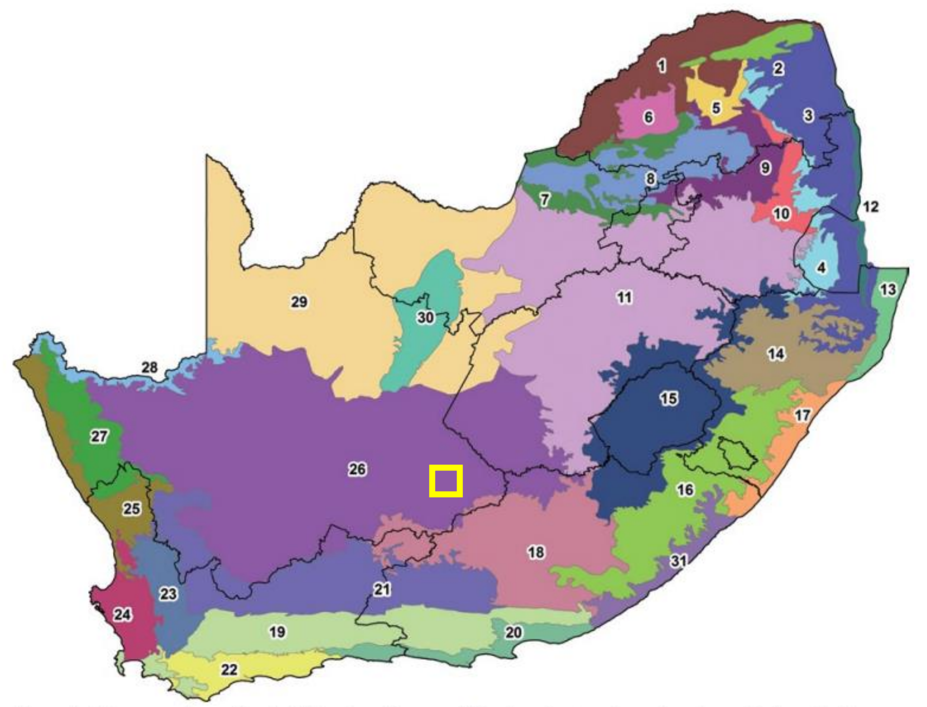

Figure 1.—The ecoregions of South Africa. 1 = Limpopo Plain, 2 = Soutpansberg, 3 = Lowveld, 4 = Northeastern Highlands, 5 = Northern Plateau, 6 = Waterberg, 7 = Western Bankenveld, 8 = Bushveld Basin, 9 = Eastern Bankenveld, 10 = Northern Escarpment Mountains, 11 = Highveld, 12 = Lebombo Uplands, 13 = KwaZulu-Natal Coastal Plain, 14 = Northeastern Uplands, 15 = Eastern Escarpment Mountains, 16 = Southeastern Uplands, 17 = Northeastern Coastal Belt, 18 = Drought Corridor, 19 = Southern Folded Mountains, 20 = Southeastern Coastal Belt, 21 = Great Karoo, 22 = Southern Coastal Belt, 23 = Western Folded Mountains, 24 = Southwestern Coastal Belt, 25 = Western Coastal Belt, 26 = Nama-Karoo, 27 = Namaqua Highlands, 28 = Orange River Gorge, 29 = Southern Kalahari, 30 = Ghaap Plateau, 31 = Eastern Coastal Belt. Black lines represent provincial boundaries.

Figure 3-3 Ecoregions for the project area (yellow square) according to Kleynhans et al. (2005)

3.1 Ecologically Important Landscape Features

The following spatial features describes the general area and associated freshwater resources, this assessment is based on spatial data that are provided by various sources such as the provincial environmental authority and the South African National Biodiversity Institute (SANBI). The desktop analysis and their relevance to this project are listed in Table 3-1.

Table 3-1 Summary of the proposed project to ecologically important landscape features

Desktop Information Considered	Features	Section
SQR	Located in Brak SQR D62D-5391 and Brak tributary SQR D62D-5332	3.8
NFEPA Rivers	Both SQRs form river FEPA features (Upstream management area) within the 500 m regulated area surrounding the project area, while each SQR contains several wetland ecosystem FEPA features.	3.2
Strategic Water Source Areas (SWSA)	Irrelevant – 300 km to the closest SWSA.	0
Ecosystem Threat Status	Relevant – Overlaps with tributaries of the Endangered Brak River ecosystem.	3.4
Ecosystem Protection Level	Relevant – Overlaps mainly with the Poorly Protected Brak River ecosystem.	3.4
Conservation Plan	Relevant – Overlaps with Ecological Support Areas	3.5

3.2 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach for the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA. This directly applies to the NWA, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*. 2011). The NFEPAs 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 biodiversity goals (Act No.10 of 2004) (NEM:BA), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

Figure 3-4 represents freshwater priority areas for the D62D catchment. As presented by the purple square, the Brak (D62D-5391) and Brak tributary (D62D-5332) river reaches are considered as important upstream management areas as per NFEPAs designation (Nel *et al*., 2011). Upstream management areas are SQR's in which human activities need to be managed to prevent further degradation of downstream river FEPA's while still serving as fish support areas that serve as migration corridors for threatened fish species. These areas need to be managed to maintain water quality for downstream river NFEPA's and water users which includes aquatic and terrestrial biota, and associated freshwater ecoregional areas (Figure 3-3). The Brak (D62D-5391) further contains the following NFEPA biodiversity features: 1 WetCluster FEPA, Upper Nama Karoo_Channelled valley-bottom wetland, Upper Nama Karoo_Unchannelled valley-bottom wetland, and Upper Nama Karoo_Valleyhead seep, while the Brak tributary (D62D-5332) contains the following NFEPA biodiversity features: 1 WetCluster FEPA, Upper Nama Karoo_Channelled valley-bottom wetland, Upper Nama Karoo_Depression, and Upper Nama Karoo_Unchannelled valley-bottom wetland.

Based on Google Earth imagery and the listed NFEPA biodiversity features, the project area presented channelled valley bottom wetland characteristics, which is typical for the gentle sloped reaches of many river systems. Typically, wetlands offer a host of ecosystems services which includes purification of water quality through phytoremediation by the wetland vegetation. The wetlands are expected to provide cleansing effects from surface runoff associated with the proposed solar development and must be maintained and protected from degradation notably erosion and sedimentation during the proposed project activities.

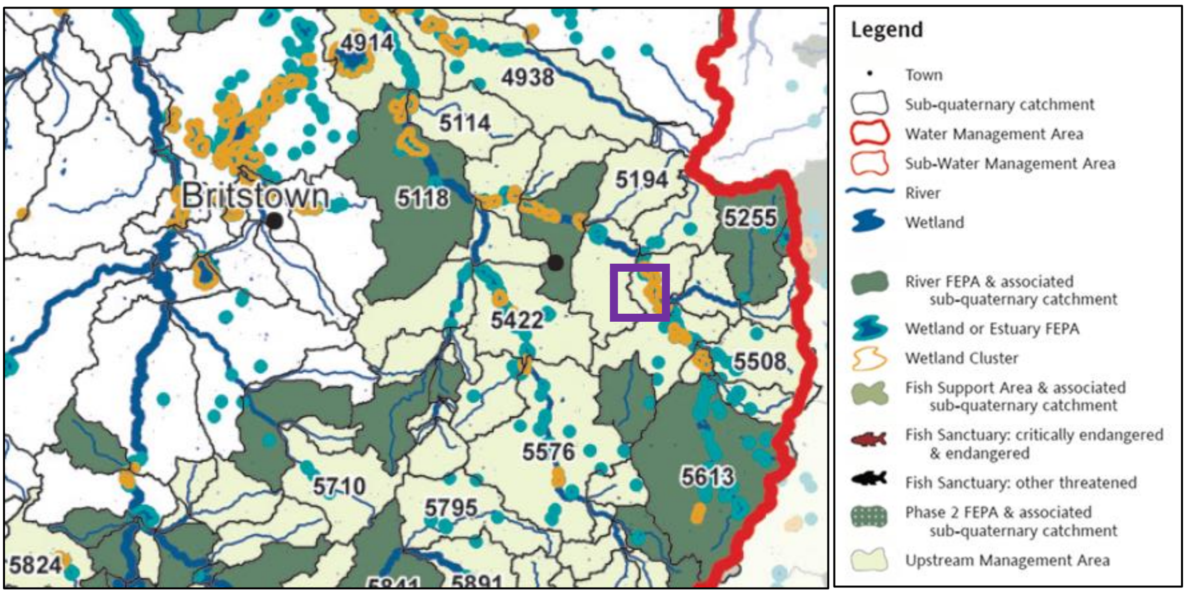

Figure 3-4 NFEPAs for the project area (highlighted by purple square) (Nel et al., 2011)

3.3 Strategic Water Source Areas

Strategic Water Source Areas (SWSAs) are areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest. The areas supplying ≥ 50% of South Africa's water supply (which were represented by areas with a mean annual runoff of ≥ 135 mm/year) represent national Strategic Water Source Areas (SANBI, 2013). According to the SWSAs of South Africa, Lesotho and Swaziland, the project area is not located within the SWSAs. The nearest SWSA is approximately 300 km to the east of the project area. The project area is considered to have a semi-arid (local steppe) climate that receives limited rainfall. This region's rainfall peaks during autumn months, especially March. The Mean Annual Precipitation (MAP) ranges from 190 to 400 mm with the mean minimum and maximum monthly temperatures for Britstown being -3.6 ℃ and 37.9 ℃ for July and January respectively (also see Figure 3-5 for more information, Mucina & Rutherford, 2006). As illustrated in Figure 3-6, these arid climate systems receive majority of their rainfall during short rainfall events and likely present surface flow for limited time periods while some rainfall events can be considered as immense with resultant flooding.

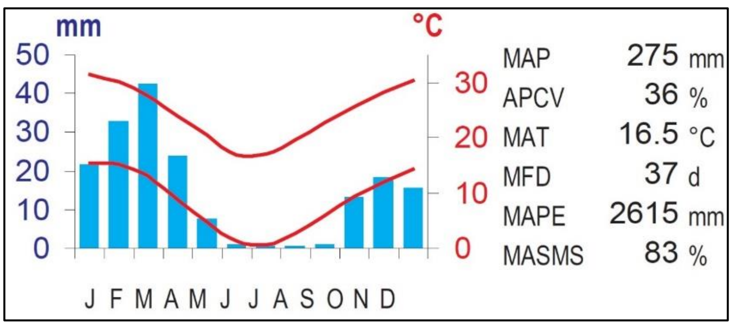

Figure 3-5 Climate for the region (Mucina & Rutherford, 2006)

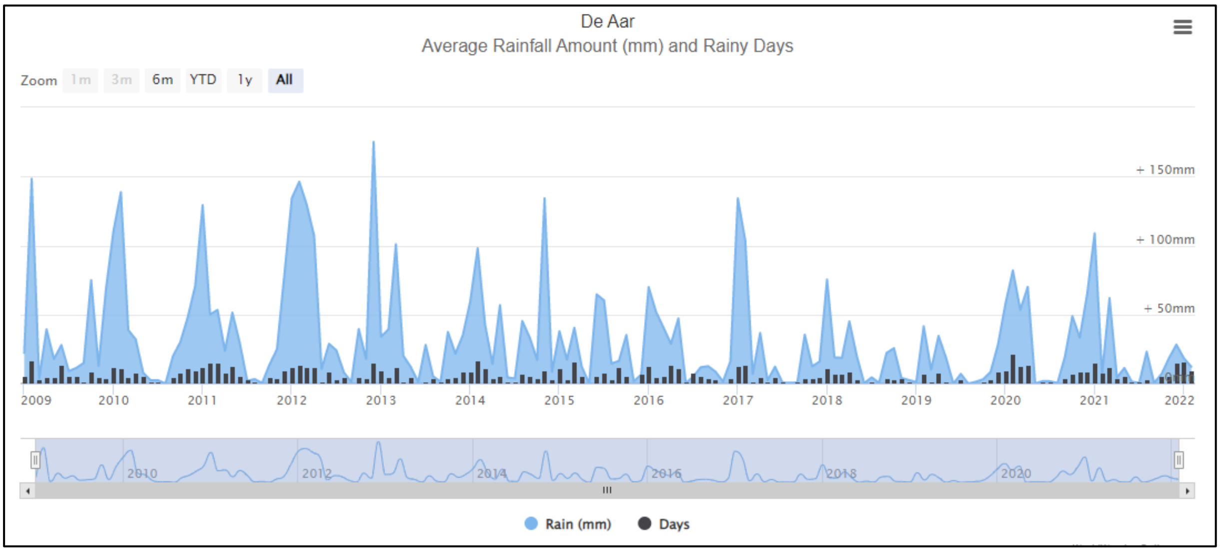

Figure 3-6 Illustration of average precipitation and rainy days (obtained from Worldweather.com)

3.4 South African Inventory of Inland Aquatic Ecosystems

This spatial dataset is part of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the National Biodiversity Assessment (NBA) 2018. National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) 2018. According to the SAIIAE dataset, several wetland areas were identified in the general project area, which included several rivers (Figure 3-7). The wetland units were largely indirectly associated with the project (outside of the 500 m regulated area) warranting no further ecological assessment of the wetland systems for this project, with emphasis rather afforded to the aquatic assessment of the rivers possibly at risk from the proposed project infrastructure.

According to the SAIIAE, the Ecosystem Threat Status (ETS) of aquatic ecosystem types is based on the extent to which each aquatic ecosystem type had been altered from its natural condition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Concern (LC), with CR, EN and VU ecosystem types collectively referred to as 'threatened' (Van Deventer *et al*., 2018; Skowno *et al.*, 2019). Figure 3-7 shows that the Brak River has an ecosystem threat status of EN which has a poorly protected status (Figure 3-8).

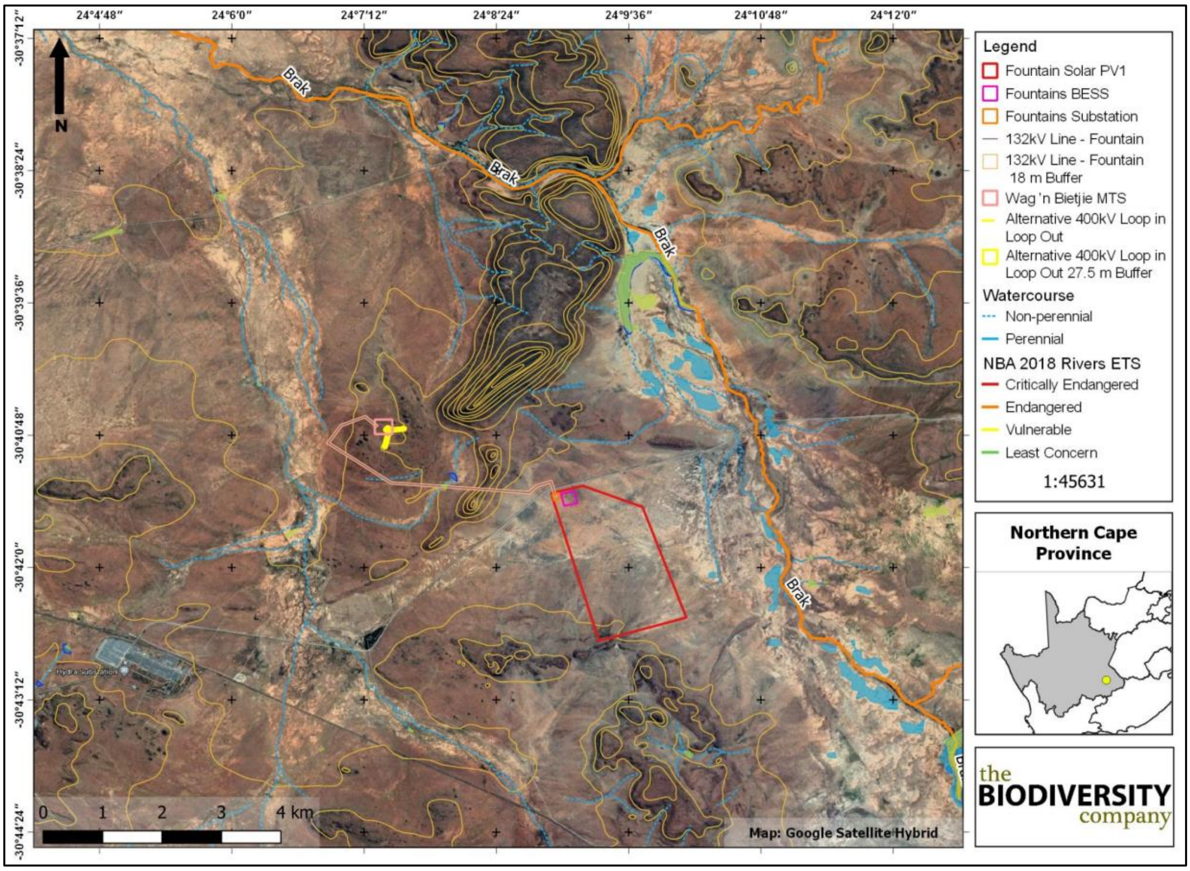

Figure 3-7 Map of the riverine ecological threat status associated with the project area

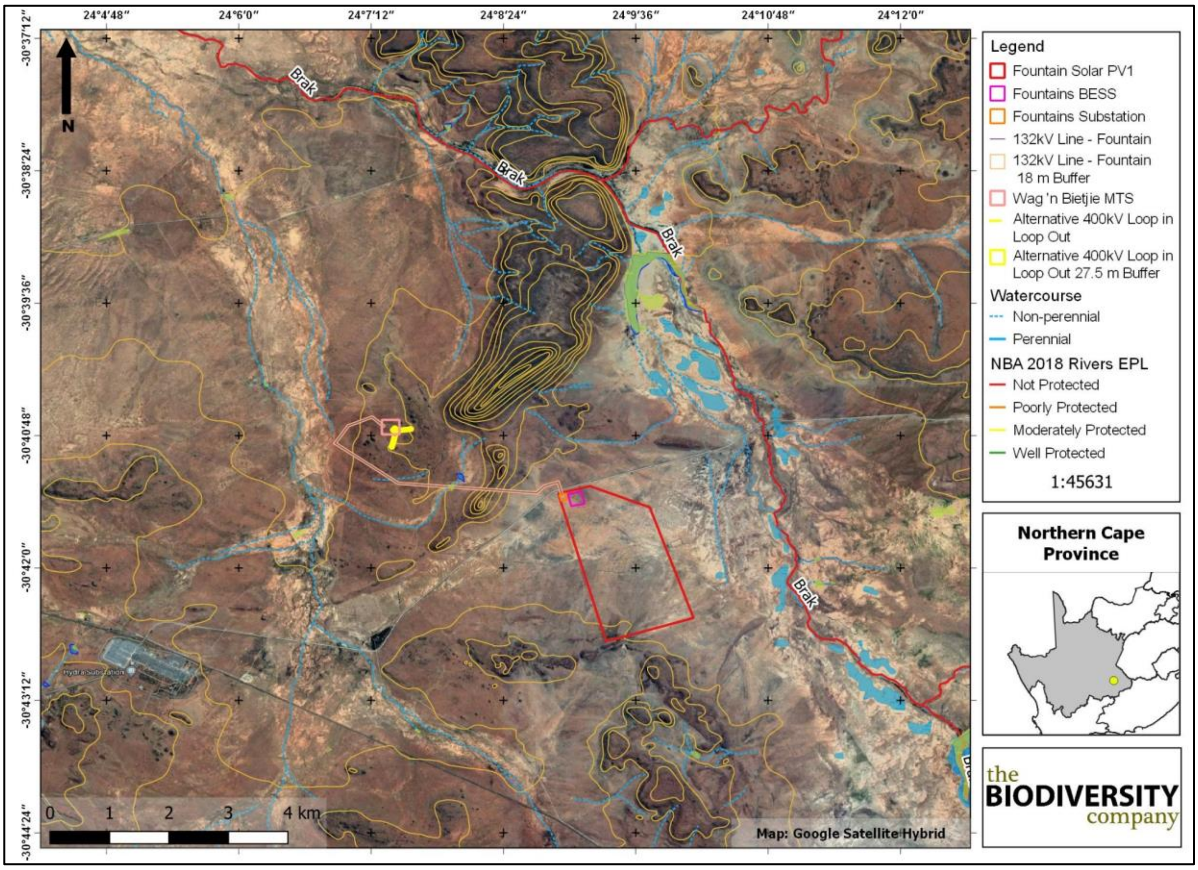

Figure 3-8 Map of the riverine ecological protection level associated with the project area

3.5 Critical Biodiversity Areas and Ecological Support Areas

Northern Cape Critical Biodiversity Areas (CBAs) (SANBI, 2016) - The identification of Critical Biodiversity Areas for the Northern Cape was undertaken using a Systematic Conservation Planning approach. Available data on biodiversity features (incorporating both pattern and process, and covering terrestrial and inland aquatic realms), their condition, current Protected Areas and Conservation Areas, and opportunities and constraints for effective conservation were collated. Priorities from existing plans such as the Namakwa District Biodiversity Plan, the Succulent Karoo Ecosystem Plan, National Estuary Priorities, and the National Freshwater Ecosystem Priority Areas were incorporated. Targets for terrestrial ecosystems were based on established national targets, while targets used for other features were aligned with those used in other provincial planning processes. CBA categories are based on their biodiversity characteristics, spatial configuration and requirement for meeting targets for both biodiversity pattern and ecological processes:

Critical Biodiversity Areas are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (Desmet *et al.,* 2018).

Ecological Support Areas (ESA's) are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services (SANBI, 2017). Critical Biodiversity Areas and Ecological Support Areas may be terrestrial or aquatic.

Figure 3-9 illustrates that the proposed development overlaps with an Ecological Support Area. The nature of the development, i.e., a solar cluster and associated infrastructure, will lead to destruction of the ESA and consequently, the footprint area will be no longer be congruent with an ESA. The adjacent landscape immediately to the east is classified as a CBA1 and CBA2. The eastern border verges on the edge of the CBA2 area. The presence of ESA, CBA1 and CBA2 highlights the Brak River as natural areas requiring ecological integrity maintenance.

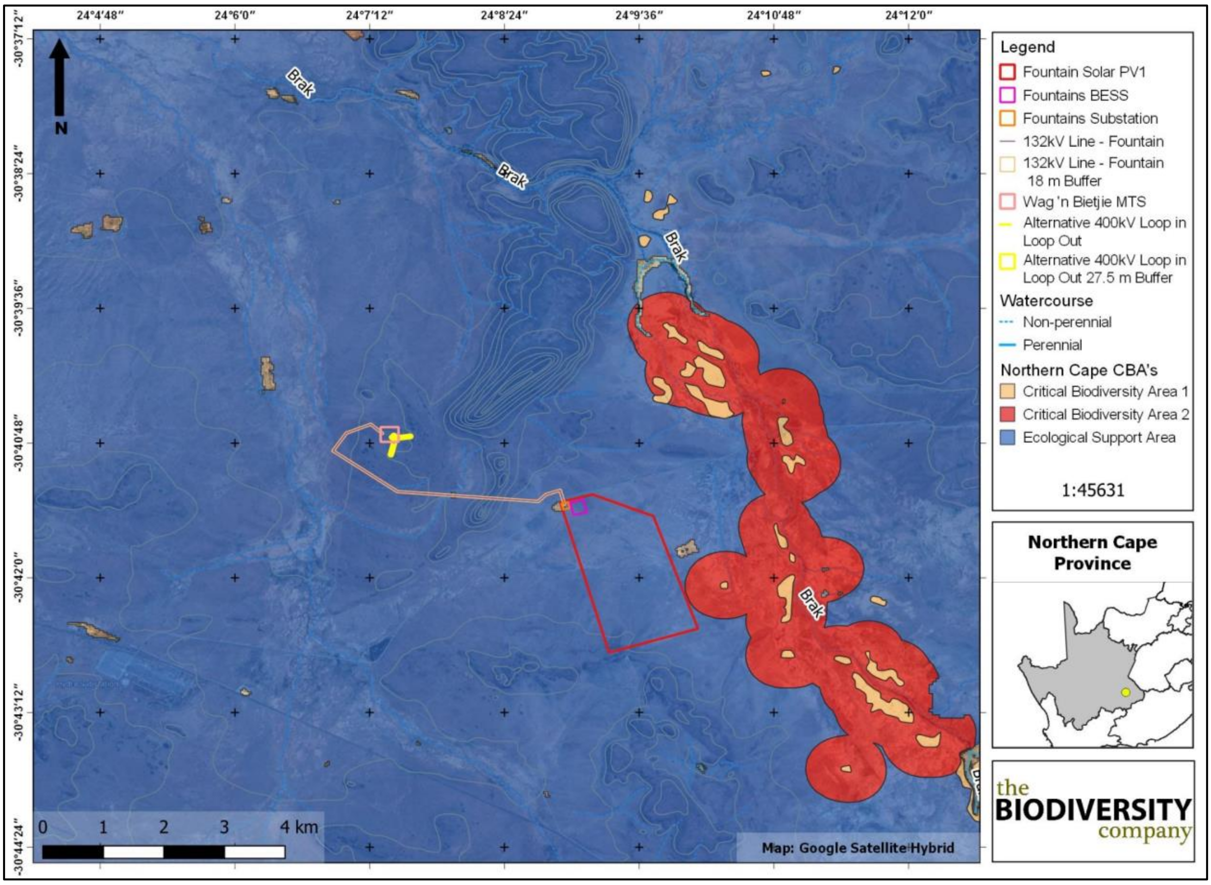

Figure 3-9 Map illustrating the locations of Critical Biodiversity Areas proximal to the proposed project area

3.6 Spatially Sensitive Mapping

The National Web based Environmental Screening Tool has characterised the combined aquatic biodiversity sensitivity of the solar cluster project area as "very high"(Table 3-2 and Figure 3-10) requiring a water resources study of the project area.

Table 3-2 Sensitivity features associated with Aquatic Biodiversity Combined Sensitivity (National Web based Environmental Screening Tool)

Sensitivity	Features	Specialist Verification
Very High	Rivers	Yes
Very High	Wetlands	Yes
Very High	Strategic water source area	Irrelevant – 300 km to the closest SWSA.

The freshwater ecology of the immediate project area and further downstream is sensitive to disturbance from a hydrological and biological perspective, however due to the ephemeral nature of the watercourses, this sensitivity applies more to the watercourses physical characteristics that influence the hydrological and biological aspects in times of flow.

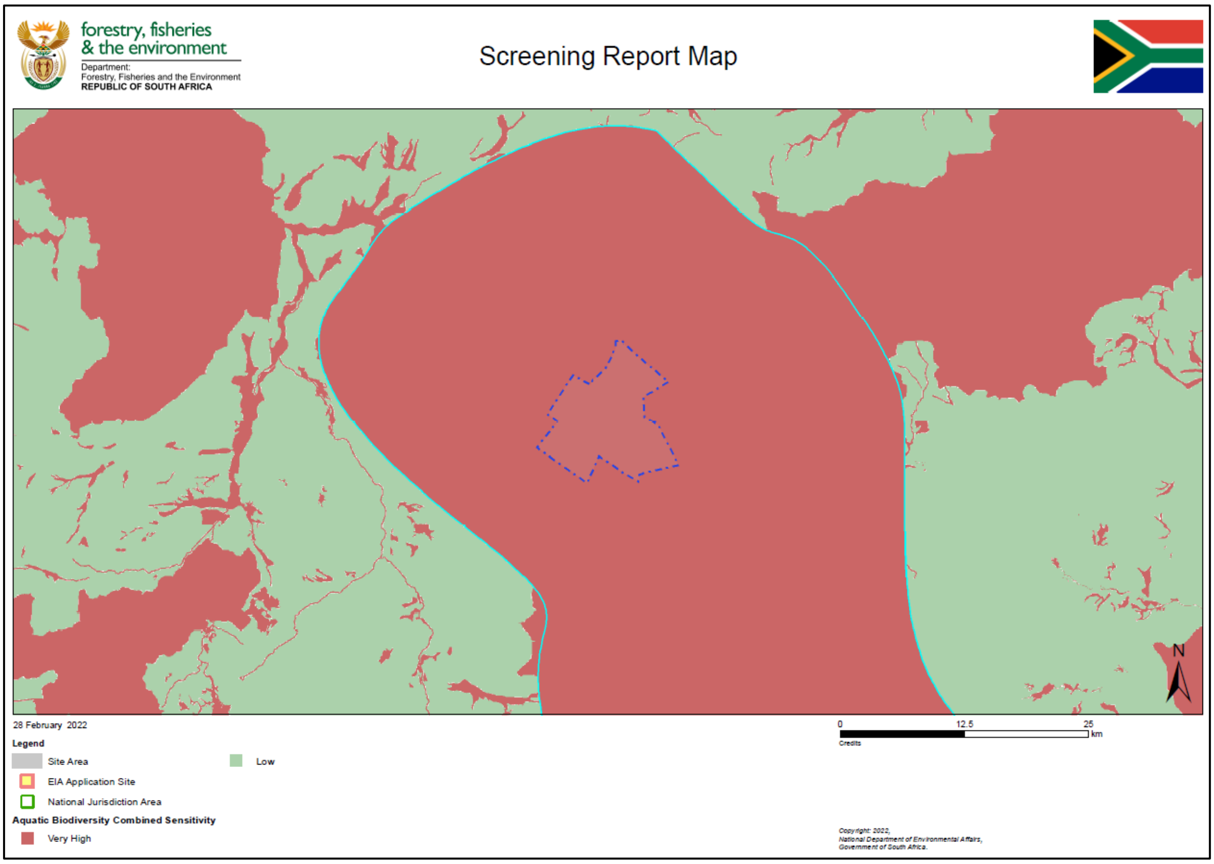

Figure 3-10 Aquatic Biodiversity Combined Sensitivity (National Web based Environmental Screening Tool)

3.7 Resource Water Quality Objectives

The NWA sets out to ensure that water resources are used, managed and controlled in such a way that they benefit all users. In order to achieve this, the Act has prescribed a series of measures such as Resource Water Quality Objectives (RWQOs) to ensure comprehensive protection of water resources so that they can be used sustainably (DWA, 2011).

In absence of a designated RWQO biophysical node for the Brak Quaternary Catchment D62D for the project area, the RWQOs for the downstream Orange River catchment was referred to for river monitoring data (DWAF, 2009). The Brak River drains into the Orange River in close proximity to site OS08 (Hydro ID D7H008) on the Orange River at Prieska (Orange River Quaternary Catchment D72A) (DWAF, 2009). The Present Ecological Status (PES) of OS08 is moderately modified (class C), while the Recommended Ecological Category (REC) to be maintained is a largely natural (class B). The Ecological Importance and Sensitivity Category for this catchment is rated as Moderate.

The project area activities should be aligned with the RWQOs for the Orange WMA in order to limit impacts to local watercourses while maintaining biodiversity goals for the directly associated Brak River catchment and those watercourses downstream of the project area.

3.8 Desktop Present Ecological Status of Sub-Quaternary Reach

This section provides desktop information regarding the local project related SQR(s) with regards to the PES including the Ecological Importance, Ecological Sensitivity and anthropogenic impacts within the SQR. The desktop PES information was obtained from DWS

(2014) for the two SQRs associated with the project area and the relevant information is presented in Table 3-3.

The desktop PES of the Brak SQR D62D-5391 is moderately modified (class C), and that of the Brak tributary SQR D62D-5332 is largely natural (class B). The ecological importance and sensitivity of the two river reaches are rated as moderate and low, respectively. The factors influencing the current desktop PES status for the Brak SQR D62D-5391 includes: Livestock, roads network and crossings infrastructure, and instream weirs. The factors influencing the current PES status for the Brak tributary SQR D62D-5332 includes: Livestock, roads network and crossings infrastructure, cultivation and instream weirs.

The two major aspects determining the status of the SQRs are water quality and habitat conditions. The physico-chemical (water quality) modifications within the two SQRs have been rated as small with low volumes of return water (effluent) input expected from the agricultural and urban activities (altered land use) present in the catchment areas. Modifications to instream/riparian/wetland habitat continuity, and flow modification were rated to range from small to large within the two SQRs. Additionally, the habitat diversity classes of the SQRs were rated as very low with a low diversity of fish (*Enteromius anoplus* - Chubbyhead Barb and *Labeo umbratus* – Moggel) and macroinvertebrate species expected within these systems. Despite this these taxa maintain a moderate sensitivity to altered flows and water quality, highlighting the need for the project to limit impacts to these aspects.

Table 3-3 The desktop information pertaining to the associated Sub Quaternary Reaches

Component/Catchment	Brak (D62D-5391)	Brak tributary (D62D-5332)
Freshwater Ecoregion	Nama Karoo (29)	Nama Karoo (29)
Dominant slope class	Lower foothills (class E)	-
River flow type/ Seasonality	Non-perennial	Non-perennial
Present Ecological Status	**Moderately Modified (class C)**	**Largely Natural (class B)**
Length of SQR Assessed	11.22 km	12.91 km
Ecological Importance Class	Moderate	Low
Ecological Sensitivity	Low	Low
Expected Fish Species	2	1
Expected Macroinvertebrate Species	4	4
RWQOs - Recommended Ecological Category	**Largely Natural (class B)**	

The current gradient of the considered river reaches in proximity to the project area are found to be a class E geoclass, which places the reaches as lower foothills river reaches (Rountree *et al.,* 2000). Typically, lower foothill reaches are associated with a moderately gentle gradient comprising pools and runs with limited riffles/rapids within a narrow to wide channel. A floodplain is a common associated feature. The instream habitat composition includes mixed alluvial substrates dominated by gravel and sand while some systems are dominated by bedrock. Stones and mud may be present between sand bars due to the flow characteristics associated with the aforementioned gradient.

3.9 Developable and Non-developable Areas

As highlighted in the previous sections, the project area has various ecological characteristics highlighting their sensitivity to degradation. In context of the proposed Fountain Solar PV1 Facility development the project area was assessed for non-developable areas (areas where no infrastructure or development is to occur) and potentially developable areas (areas more suitable for development) as illustrated in Figure 3-11. The non-developable areas were delineated based on the 50 m buffer of the drainage lines which are recommended for maintaining species diversity (Macfarlane *et al*, 2009), as well as the dolerite koppies and sills. The potentially developable areas are still subject to the outcomes of the Biodiversity Impact Assessment.

Figure 3-11 Map illustrating the developable and non-developable areas within the proposed development area

4 Impact Assessment

This section represents the risk / impact assessment for the proposed facility and associated infrastructure. Figure 4-1 presents the layout for the proposed facility, which has been considered for the scoping level impact assessment. This assessment has considered both direct and indirect risks to freshwater aquatic resources. Potential impacts were evaluated against the data captured during the desktop assessment to identify relevance to the project area. The relevant impacts associated with the proposed solar development were then subjected to the prescribed impact assessment methodology provided by Savannah Environmental as presented in the next section. No decommissioning phase was considered based on the nature of the development.

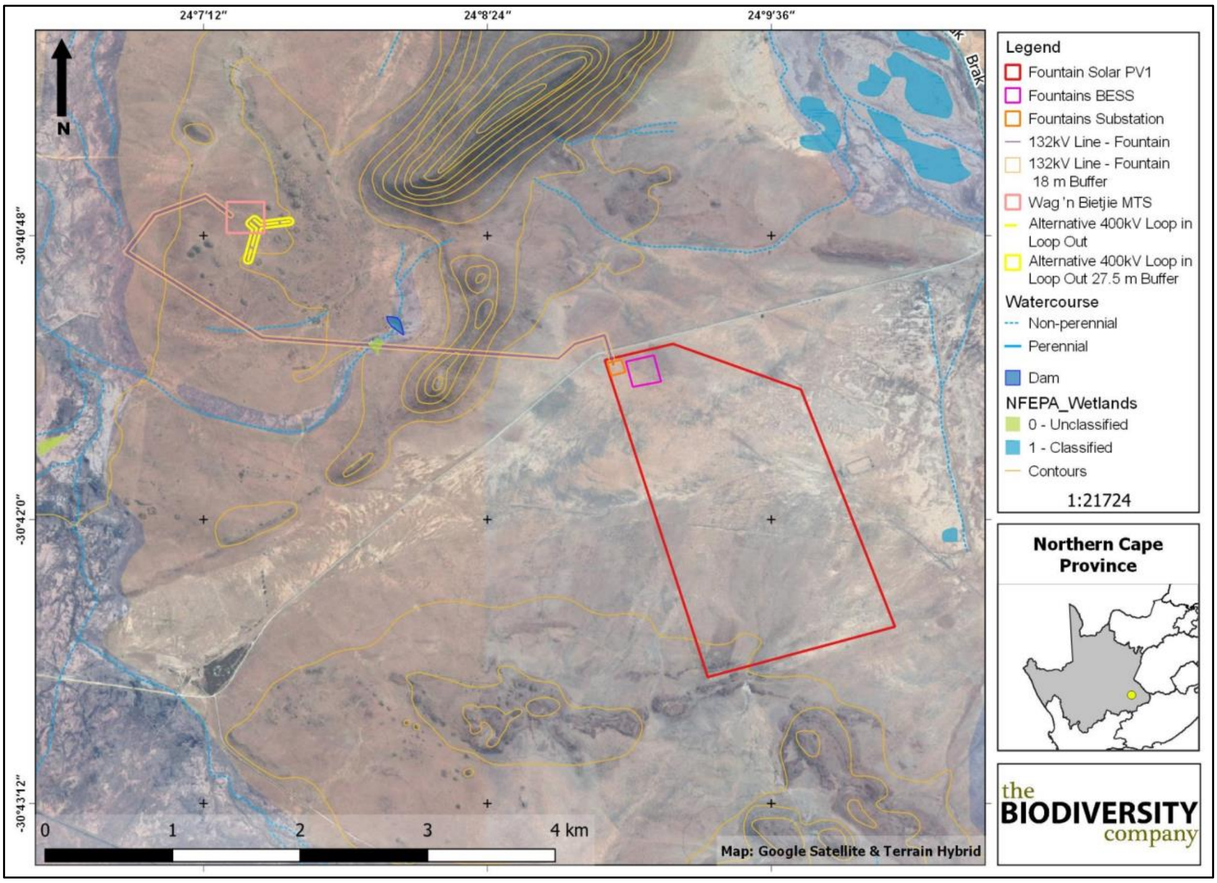

Figure 4-1 The layout for the proposed Fountain Solar PV1 facility and aquatic features

Anthropogenic activities drive habitat destruction causing habitat fragmentation and displacement of fauna and flora and possibly direct mortality through altered water quality. Land clearing destroys local habitat and alters the topography and associated hydrology which and can lead to the degradation and/or loss of local rivers, streams and drainage lines, or other locally important biological features. The removal of natural vegetation surrounding drainage features is known to reduce the buffering capacity of the watercourses to impacts from adjacent land use activities, notably with a lowered resilience against erosion and water quality impacts. This in turn is likely to reduce aquatic fauna and flora populations and species compositions within the local area and potentially those downstream.

4.1 Alternatives considered

No alternatives were provided for the development.

4.2 Loss of Irreplaceable Resources

The project overlaps with the following features that may be lost:

- An ESA; and
- Loss of drainage features.

4.3 Anticipated Impacts

The impacts anticipated for the proposed Fountain Solar PV1 Facility are considered in order to predict and quantify these impacts and assess and evaluate the magnitude on freshwater resources as summarised in Table 4-1.

The topography of the proposed Fountain PV1 development area has a gentle gradient that drains to the centre of the PV1 area with no obvious system, however the area does drain eastwards into the Brak River. Additionally, a portion of the 132 kV powerline traverses an ephemeral drainage line as well as an instream dam at the same location. Impacts would therefore be expected directly within the tributary network through the physical loss of drainage features as well as damage to the remaining bed and banks.

Impacts include changes to the hydrological regime such as alteration of surface run-off patterns, runoff velocities and or volumes associated with vegetation clearing, earthworks, levelling, soil stockpiling and the establishment of infrastructure (powerline pylons, BESS and substation) and road network. This would include watercourse crossing infrastructure for the powerline maintenance road and potential watercourse crossing infrastructure within the PV1 development area. The presence of solar panels and associated compacted road network increases hard surfaces within the catchment, resulting in an increase in runoff during high precipitation events and may be significant if poorly designed stormwater management infrastructure is implemented. The aforementioned alterations will have a direct result on the sediment movement and drainage characteristics both locally within the influenced tributaries and associated downslope areas such the Brak River. Altered surface run-off patterns, runoff velocities and or volumes above the natural flow regime of the likely ephemeral drainage lines is expected to cause potentially extensive damage to the bed and banks through erosion, scouring and bank collapse with associated sedimentation of instream habitat. Powerline pylons constructed within the tributaries and associated riparian and buffer zone will result in direct loss or the disturbance of watercourse habitat with associated alteration of hydrology. In turn, habitat disturbance may degrade habitat quality and produce watercourse and surrounding corridor (Ecological Support Area) fragmentation. A negative shift in the biotic integrity and PES of the tributaries would be expected based on the severity of alterations or losses. It should be taken into account that the Karoo may take decades to rehabilitate, therefore rehabilitation may be challenging.

It is important to highlight that these arid climate systems receive majority of their rainfall during short rainfall events and only present surface flow for limited time periods. Some rainfall events can be considered as massive with resultant flooding. Therefore, careful consideration should be given to the hydrology of these systems with special attention given to stormwater and watercourse crossing designs and resultant discharge velocities.

These disturbances will be the greatest during the construction phase as the related disturbances could result in direct loss and/or damage, while to a lesser degree in the operation phase (i.e. as and when maintenance occurs).

Table 4-1 Anticipated impacts of the proposed Fountain Solar PV1 Facility on freshwater resources

Aspect	Activity	Secondary Impacts to Watercourses
Construction		
Destruction, fragmentation and degradation of habitats and ecosystems integrity & Sediment balance	Clearing and establishment of road network, watercourse crossings, powerline pylons, BESS and substation and laydown yards	Alteration of catchment hydrology
		Increased runoff and sediment input into the watercourses
		Smothering and subsequent loss of instream habitat due to sediment inputs
		Input of toxicants
	Clearing and establishment for PV areas	Loss of riparian habitat and drainage features
		Alteration of catchment hydrology
		Increased runoff and sediment input into the watercourses
	Earth works and stockpiling of soil	Increased runoff and sediment input into the watercourses
		Smothering and subsequent loss of instream habitat due to sediment inputs
		Flow path modification
		Input of toxicants
Altered flow dynamics	Construction of stormwater management infrastructure notably around PV Area	Alteration to flow patterns and velocities
		Erosion of exposed surfaces and bank collapse
		Increased sedimentation and associated smothering of habitat
		Loss and disturbance of aquatic habitat (riparian zones)
Water quality pollution	Contamination of surface water (influx of pollutants through runoff) due to erosion, construction materials, fuel and machinery leaks and improper storage of chemicals	Physical changes (e.g. turbidity)
		Chemical changes (e.g. pH, salinity toxicants and heavy metals)
		Degradation of ecological integrity and aquatic biota community (sensitive species are lost first).
Rehabilitation	Final landscaping and post-construction rehabilitation	Indiscriminate dumping of rubble and construction material
		Improper re-establishment of flow paths
		Increased erosion from exposed surfaces
		Increased sedimentation and associated smothering of habitat
Operation		
Flow dynamics & Stormwater management	Increased hard surfaces due to solar panels and roads and stormwater infrastructure	Flow alteration/concentrations during heavy precipitation events
		Flow concentration leading to increased erosion and scouring downstream systems
		Increased runoff and flow velocities entering the watercourse
	Reduced vegetation on ground due to loss of sunlight penetration	Increased flow concentration
		Increased erosion and scouring of bed and banks, especially in discharge areas
		Increased sedimentation and turbidity
Anthropogenic disturbance	Increased traffic and human disturbance	Watercourse and water quality impairment

Aspect	Activity	Secondary Impacts to Watercourses
		Increased exposed and hardened surfaces
	Establishment of alien plants on disturbed areas	Degradation of watercourse flora and fauna through the spread of alien and invasive species
Water quality pollution	Contamination, dumping of solid wastes and input associated with surface runoff from roads	Increased litter and refuse within the channel
		Input of toxicants
		Degradation of ecological integrity and aquatic biota community (sensitive species are lost first).
		Nutrient loading

4.3.1 Identification of Additional Potential Impacts

The impacts provided in Table 4-2 are expected for the proposed development and will be assessed for the impact phase of the process.

Table 4-2 Scoping evaluation table summarising the impacts identified to freshwater resources

Issue	**Nature of Impact**	**Extent of Impact**	**No-Go Areas**
Loss of drainage features and loss/disturbance to habitat and buffer zone within development footprint	Direct impacts: » Disturbance / degradation / loss of drainage feature(s). » Altered catchment hydrology with associated erosion and sedimentation. Indirect impacts: » Erosion and sedimentation of downstream watercourse(s). » Habitat disturbances and fragmentation of downstream watercourse(s). » Water quality degradation. » Degradation of ecological integrity and aquatic biota community (sensitive species are lost first).	Regional	Non-developable Areas

Impact

Description of expected significance of impact

The following potential main impacts on the watercourses were considered for the construction phase of the proposed development. This phase refers to the period during construction when the proposed features are constructed; and is considered to have the largest direct impact on watercourses. The following potential impacts to freshwater resources were considered:

- Disturbance / degradation / loss of drainage features;
- Destruction and fragmentation of the habitats (instream and riparian) and aquatic community; and
- Degradation of ecological integrity and aquatic biota community (sensitive species are lost first).

Gaps in knowledge & recommendations for further study

- This is completed at a desktop level only.
- Identification, delineation and characterisation of watercourses and biotic community.
- Undertake a sensitivity assessment of systems where applicable.

Recommendations with regards to general field surveys

- Field surveys to prioritise the development areas.
- Beneficial to undertake fieldwork during the wet season period.

4.4 Cumulative impacts

Cumulative impacts are assessed in context of the extent of the proposed project area; other developments in the area; and general watercourse loss and transformation resulting from other activities in the region. There are a number of existing renewable energy developments with existing electrical infrastructure and grid connections in the greater De Aar regional area, with additional energy developments proposed.

The expected post-mitigation risk significance for the project in isolation is expected to be low, but in consideration of the larger project area the overall cumulative impact is expected to be medium (Table 4-3). This is expected owing to the fact that the project extends into two quaternary catchment areas.

Table 4-3 Cumulative impacts to watercourses associated with the proposed project

Impact Nature: Cumulative loss/ disturbance of habitat and ecological functioning of watercourses in the region		
The development of the proposed infrastructure will contribute to cumulative habitat loss within ESAs together with the potential for increased contaminants and sediment entering the watercourses, with negative impacts on the ecological processes of the associated watercourses in the region.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project together with the existing and proposed projects in the area**
Extent	Low (2)	Very high (5)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	High (8)
Probability	Improbable (2)	Probable (3)
Significance	**Low**	**Medium**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes, avoidance of watercourses/drainage network is possible	
Mitigation:		
• Ensure that an adaptive EMP be compiled and effectively implemented. • Key focus should be placed on stormwater and erosion prevention strategies.		
Residual Impacts:		
Watercourse deterioration over time caused by altered hydro-dynamics, and alien vegetation infestation. Loss / deterioration of ecosystem services.		

5 Assessment Approach

5.1 Aquatic Ecology Field Assessment

The fieldwork will be placed within targeted areas perceived as ecologically sensitive based on the preliminary interpretation of satellite imagery (Google Corporation) and GIS analysis (which included the latest applicable freshwater resources datasets) available prior to the fieldwork. The focus of the fieldwork is therefore to maximise coverage and navigate to each target site in the field, to perform a rapid aquatic habitat and ecological assessment at each sample site. Emphasis will be placed on sensitive habitats, especially those overlapping with the proposed project area.

Standard methodologies applied in the River Eco-Status Monitoring Programme (REMP) of South Africa will be applied during the aquatic study to establish the Present Ecological Status (PES) of the aquatic ecosystems associated with the project. The fieldwork will include the assessment of water quality, habitat integrity and suitability, and macroinvertebrate and fish assemblages.

5.1.1 *In Situ* Water Quality

During the survey a portable calibrated multiparameter water quality will be used to measure the following parameters *in situ*: pH; electrical conductivity (dissolved solids); dissolved oxygen (DO); and water temperature.

Water quality has a direct influence on aquatic life forms. Although these measurements only provide a “snapshot”, they can provide valuable insight into the characteristics and interpretation of a specific sample site at the time of the survey.

5.1.2 Habitat Assessment

Habitat availability and diversity are major attributes for the biota found in a specific ecosystem, and thus knowledge of the quality of habitats is important in an overall assessment of ecosystem health. Habitat assessment can be defined as the evaluation of the structure of the surrounding physical habitat that influences the quality of the water resource and the condition of the resident aquatic community (Barbour *et al*. 1996). Both the quality and quantity of available habitat affect the structure and composition of resident biological communities (USEPA, 1998). Habitat quality and availability plays a critical role in the occurrence of aquatic biota. For this reason, habitat evaluation is conducted simultaneously with biological evaluations to facilitate the interpretation of results.

5.1.2.1 Intermediate Habitat Integrity Assessment

The aim of the Intermediate Habitat Integrity Assessment (IHIA) is to make an intermediate assessment of the habitat integrity of rivers according to a modified Habitat Integrity approach which can be applied in intermediate determination of the ecological Reserve for rivers in South Africa (DWS, 1999). The methodology is based on the qualitative assessment of a number of pre-weighted criteria which indicate the integrity of the in-stream and riparian habitats available for use by riverine biota.

The criteria considered indicative of the habitat integrity of the river will be selected on the basis that anthropogenic modification of their characteristics can generally be regarded as the primary causes of degradation of the integrity of the river (Table 5-1) (DWS, 1999). The study assesses 5 km of the associated watercourses making use of latest Google Earth imagery of the catchment (desktop) together with visual assessments (ground truthing) at the associated monitoring sites.

Table 5-1 Criteria used in the assessment of habitat integrity (from Kleynhans, 1996)

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon *et al*., 1993 in: DWS, 1999). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993 in: DWS, 1999) is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon *et al*., 1992 in DWS, 1999)).
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon *et al*., 1992). Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

The assessment of the severity of impact of modifications is based on six descriptive categories which are described in Table 5-2.

Table 5-2 Descriptive classes for the assessment of modifications to habitat integrity (from Kleynhans, 1996)

Impact Category	Description	Impact Score
None	No discernible impact, or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	**0**
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	**1 - 5**
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	**6 - 10**
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	**11 - 15**
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	**16 - 20**
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	**21 - 25**

The habitat integrity assessment takes into account the riparian zone and the instream channel of the river. Assessments are made separately for both aspects, but data for the riparian zone are primarily interpreted in terms of the potential impact on the instream component (Table 5-3). The relative weighting of criteria remain the same as for the assessment of habitat integrity (DWS, 1999).

Table 5-3 Criteria and weights used for the assessment of habitat integrity and habitat integrity (from Kleynhans, 1996).

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
Total	**100**	**Total**	**100**

The negative weights are added for the instream and riparian facets respectively and the total additional negative weight subtracted from the provisionally determined intermediate integrity to arrive at a final intermediate habitat integrity estimate. The eventual total scores for the instream and riparian zone components are then used to place the habitat integrity in a specific intermediate habitat integrity category (DWS, 1999). These categories are indicated in Table 5-4.

Table 5-4 Intermediate habitat integrity categories (From Kleynhans, 1996)

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

5.1.2.2 Integrated Habitat Assessment System

The quality of the instream and riparian habitat influences the structure and function of the aquatic community in a stream; therefore, assessment of the habitat is critical to any assessment of ecological integrity. The Integrated Habitat Assessment System (IHAS, version 2) was applied at each of the macroinvertebrate sampling sites in order to assess the availability of habitat biotopes for macroinvertebrates. The IHAS was developed specifically for use with the SASS5 index and rapid biological assessment protocols in South Africa

(McMillan, 1998). The index considers sampling habitat and stream characteristics. The sampling habitat is broken down into three sub-sections namely Stones-In-Current (SIC), Vegetation (VEG), Gravel Sand & Mud (GSM) and other habitat/ general. It is presently thought that a total IHAS score of over 65% represents good habitat conditions, while a score over 55% indicates adequate/fair habitat conditions (McMillan, 1998) (Table 5-5).

Table 5-5 Integrated Habitat Assessment System Scoring Guidelines

IHAS Score	Description
> 65%	Good/ Diverse
55-65%	Adequate/Fair
< 55%	Poor

5.1.3 Aquatic Macroinvertebrates

Macroinvertebrate assemblages are good 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.

5.1.3.1 South African Scoring System

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Chironomidae) to highly sensitive families (e.g. Perlidae). Taxa fall into three sensitivity categories; tolerant taxa (Intolerance Rating < 5), semi-intolerant taxa (Intolerance Rating 6 - 10) and intolerant taxa (Intolerance Rating 11 - 15). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made to family level (Thirion *et al.,* 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002).

Reference conditions reflect the best conditions that can be expected in rivers and streams within a specific area and reflect natural variation over time. These reference conditions are used as a benchmark against which field data can be compared. Modelled reference conditions for the associated Ecoregion are obtained from the SASS5 Data Interpretation Guidelines (Dallas, 2007). The biological bands illustrate ecological categories for the Ecoregion based on SASS5 scores (total sensitivity score) and ASPT value (average macroinvertebrate sensitivity) for the sampled site. Ecological categories based on biological banding are presented in Table 5-6.

Table 5-6 Biological Bands / Ecological categories for interpreting SASS data (adapted from Dallas, 2007)

Class	Ecological Category	Description
A	Natural	Unimpaired. High diversity of taxa with numerous sensitive taxa.
B	Largely natural	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.
C	Moderately modified	Moderately impaired. Moderate diversity of taxa.
D	Largely modified	Considerably impaired. Mostly tolerant taxa present.
E/F	Seriously Modified	Severely impaired. Only tolerant taxa present.

5.1.3.2 Macroinvertebrate Response Assessment Index

The Macroinvertebrate Response Assessment Index (MIRAI) is used to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community from the calculated reference conditions for the SQR. This does not preclude the calculation of SASS5 scores if required (Thirion, 2007). The major components of a stream system that determine productivity for aquatic macroinvertebrates are as follows:

- Flow regime;
- Physical habitat structure;
- Water quality; and
- Energy inputs from the watershed in the form of allochthonous and instream inputs.

The results of the MIRAI will provide an indication of the current ecological category and therefore assist in the determination of the PES. Ecological categories for MIRAI are based on those presented in Table 5-6.

5.1.4 Fish Community Assessment

The information gained using the Fish Response Assessment Index (FRAI) gives an indication of the PES of the river based on the fish assemblage structures observed (Kleynhans, 2007). According to Kleynhans (2007), "the FRAI is an assessment index based on the environmental intolerances and preferences of the reference fish assemblage and the response of the constituent species of the assemblage to particular groups of environmental determinants or drivers" as illustrated in Figure 5-1. Fish will be captured through electroshocking and visual observations. All fish will be identified in the field and released at the point of capture. Fish species will be identified using the guide Freshwater Fishes of Southern Africa (Skelton, 2001). The identified fish species will be compared to those expected to be present for the quaternary catchment. An expected fish species list will be developed from a literature survey and included sources such as DWS (2014), Kleynhans *et al.* (2007) and Skelton (2001). It is noted that the FRAI Frequency of Occurrence (FROC) ratings are calculated based on the habitat present at the sites.

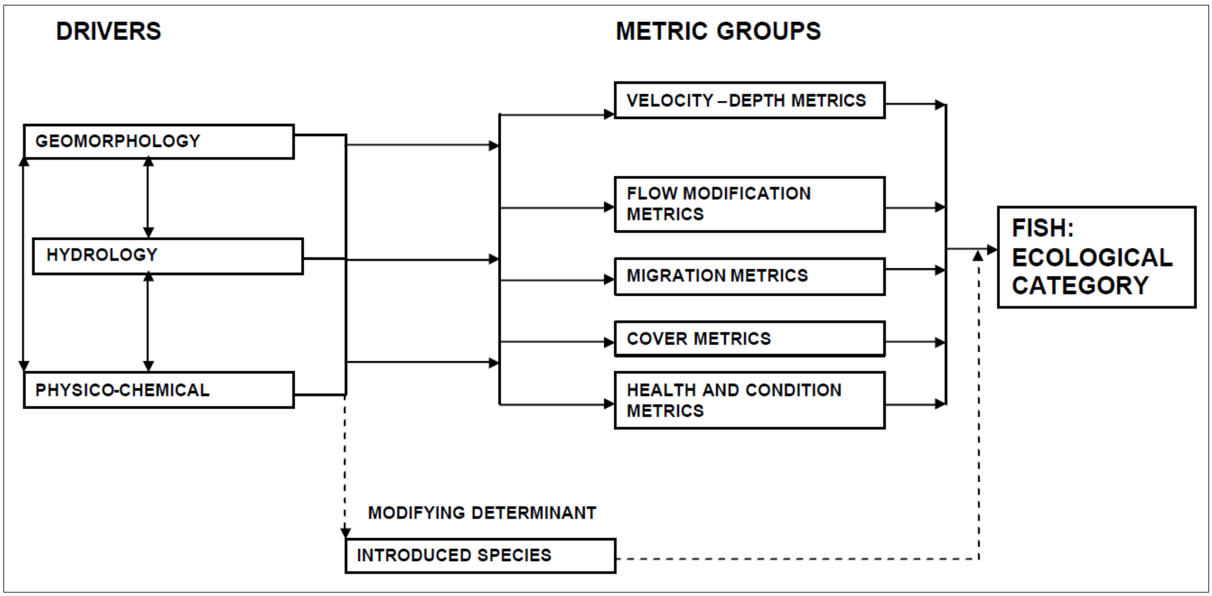

Figure 5-1 The relationship between drivers and fish metric groups (Kleynhans, 2007)

5.1.5 Present Ecological Status

Ecological classification refers to the determination and categorisation of the integrity of the various selected biophysical attributes of ecosystems compared to the natural or close to natural reference conditions (Kleynhans and Louw, 2007). For the purpose of this project ecological classifications will be determined for biophysical attributes for the associated watercourse. This was completed using the river ecoclassification manual by Kleynhans and Louw (2007).

6 Conclusions

Desktop information associated with the proposed Fountain Solar PV1 development indicates that the indirectly affected downstream Brak River system and directly associated ephemeral tributaries within the project area have sensitivity to modification. These systems serve as ESA's, CBAs and important NFEPA upstream management areas. The desktop PES of the Brak SQR D62D-5391 is moderately modified (class C), and that of the Brak tributary SQR D62D-5332 is largely natural (class B) with an associated ecological importance and sensitivity of moderate and low, respectively. The Recommended Ecological Category (REC) to be maintained is a class B which can be achieved through the responsible management of the tributary network and associated catchment.

As a result of the ephemeral nature of the watercourses and susceptibility to erosion, the construction and operation phase activities would influence the hydrology, water quality and soil movement within the affected watercourses. The significance ratings ranged from medium to high, however, following mitigation these were reduced to low ratings. The expected post-mitigation risk significance for the project in isolation is expected to be low, however in consideration of the greater De Aar regional area with existing and proposed renewable energy developments the overall cumulative impact is expected to be medium.

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