AQUATIC SPECIALIST IMPACT ASSESSMENT REPORT: MERCURY PV FACILITIES (NORTHERN BLOCK) NEAR KLERKSDORP IN THE FREE STATE

Report prepared for:	Report prepared by:
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May 2023

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List of Abbreviations

BA	Basic Assessment
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DWA(F)	Department of Water Affairs (and Forestry)
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EI&ES	Ecological Importance and Ecological Sensitivity
EMPr	Environmental Management Program
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Area
GA	General Authorisation
GG	Government Gazette
GIS	Global Information System
GN	Government Notice
ha	hectare
HI	Habitat Integrity
IUCN	International Union for Conservation of Nature
kW	kilowatt
MMP	Maintenance Management Plan
MW	megawatt
ONA	Other Natural Areas
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Area
NWA	National Water Act
PA	Protected Area
PES	Present Ecological Status
REC	Recommended Ecological Condition
SANBI	South African National Biodiversity Institute
SEA	Strategic Environmental Assessment
SCC	Species of Conservation Concern
WMA	Water Management Area
WUL	Water Use License
WULA	Water Use License Application

Glossary

Definitions	
Aquifer	A geological formation that has structures or textures that hold water or permit appreciable water movement through them.
Catchment	The area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through a surface flow to a common point or common points
Critical Biodiversity Areas	Areas that are required to meet biodiversity targets for species, ecosystems or ecological processes and infrastructure.
Drainage feature	A minor channel down which surface water naturally concentrates and flows that is poorly defined and usually does not contain any distinctive riparian and aquatic vegetation or habitat.
Ecological Importance and Sensitivity	The rating of any given wetland or river reaches that provides an indication of the ecological importance of the aquatic system using criteria such as conservation needy habitat or species, protected ecosystems or unique habitat observed. The sensitivity is then derived by assessing the resilience the habitat exhibits under stress as a result of changes in flow or water quality.
Ecological Support Areas	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of Protected Areas or Critical Biodiversity Areas and are often vital for delivering ecosystem services.
Other Natural Areas	Areas that have not been identified as a priority in the biodiversity spatial plans but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although they have not been prioritised for meeting biodiversity targets, they are still an important part of the natural ecosystem.
Pans or Depression wetlands	A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water. It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.
Perennial / Non-perennial rivers	Perennial rivers are those rivers that exhibit a continuous flow of water throughout the year except during extreme drought conditions. Non-perennial rivers are those rivers that have no flow for at least a part of the year. These rivers are seasonal.
Present Ecological State	The current ecological condition of a watercourse as measured against the deviation from the natural or pre-impacted condition of the system
Protected Areas	Areas that are formally protected by law and recognised in terms of the National Environmental Management: Protected Areas Act. This includes gazetted private Nature Reserves and Protected Environments concluded via a stewardship programme.
Riparian habitat	The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with composition and physical structure distinct from those of adjacent land areas
River FEPA	Rivers currently in a good condition (A or B ecological category) that have been identified to achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species. They should remain in a good condition to contribute to the biodiversity goals of the country.
Watercourse	(a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, lake or dam into which, or from which, water flows; and (d) any collection of water which the Minister of DWS may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;

Water management area	An area established as a management unit in the national water resource strategy within which a catchment management agency will conduct the protection, use, development, conservation, management and control of water resources
Wetland	Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.
Wetland FEPA	Wetlands currently in a good condition (A or B ecological category) that have been identified to achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species. They should remain in a good condition to contribute to the biodiversity goals of the country.

AQUATIC BIODIVERSITY AND SPECIES SPECIALIST IMPACT ASSESSMENT

This report serves as Aquatic Biodiversity and Species Specialist Impact Assessment Report input into the required authorisations for the proposed Mercury PV Facilities (Northern Block) near Klerksdorp in the Free State.

1. Introduction

1.1 Scope, Purpose and Objectives of this Specialist Input to the Scoping Report

Mulilo is investigating the development of renewable energy projects approximately 22 km southeast of Klerksdorp in the Free State. The proposed northern block solar farm is located on the following properties: Farm Vlakfontein No 15, Remainder of Farm Jackalsfontein No 443, Portion 1 of the Farm Kleinfontein No 369, Remainder of the Farm Zaaiplaats, No 190, and Portion 2 of the Farm Fraai Uitzicht No 189, Viljoenskroon. The site lies to the south of the Vaal River within the Middle Vaal Management Area (Quaternary Catchment C24B). This report provides input in terms of the aquatic constraints within the project area and the associated aquatic ecosystem impacts for the proposed activities.

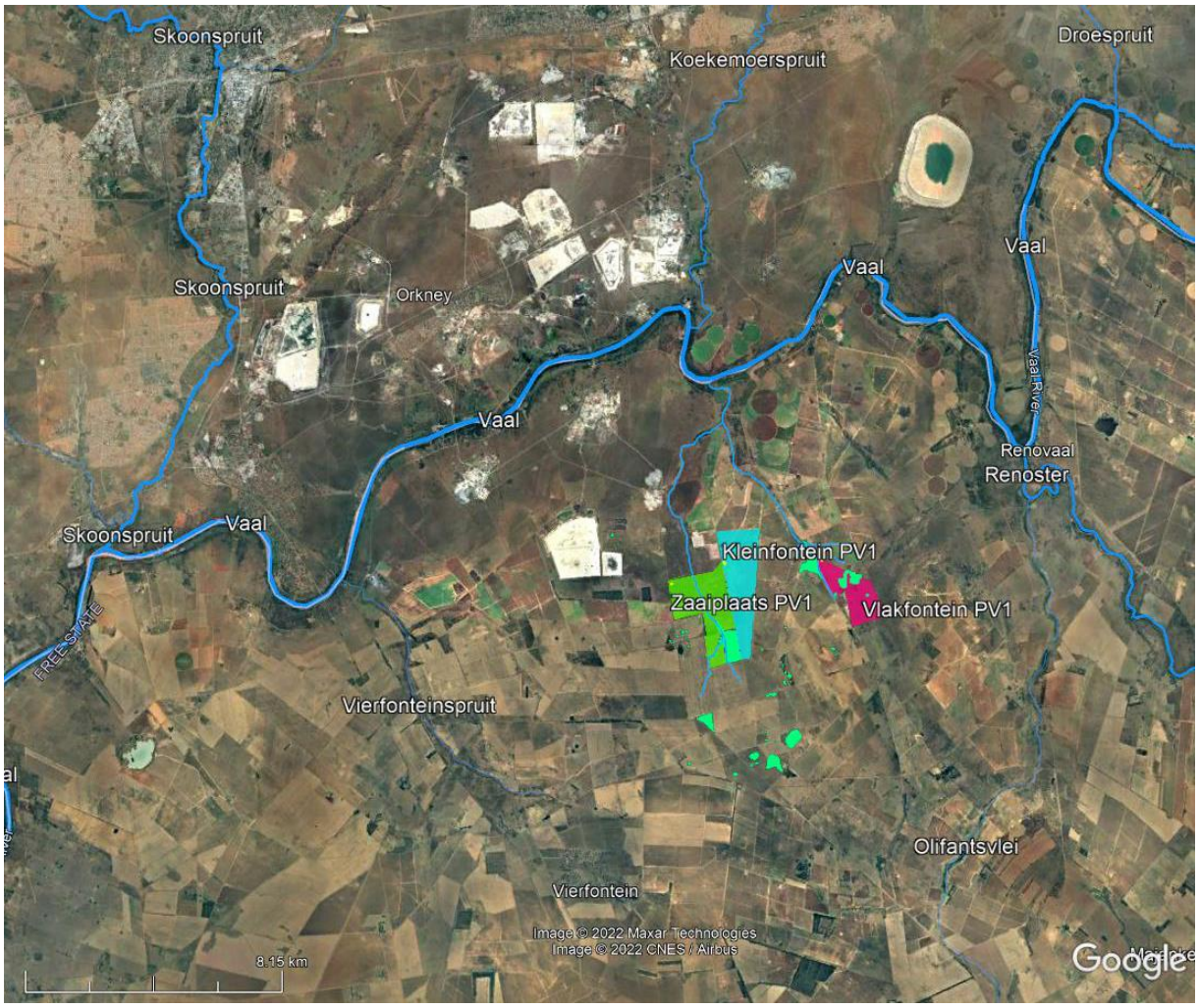

Figure 1. Google Earth image showing the locality for the proposed project

1.2 Details of Specialist

This specialist assessment has been undertaken by Toni Belcher of BlueScience (Pty) Ltd. She is registered with the South African Council for Natural and Scientific Professions (SACNASP), with

Registration Number 400040/10 in the fields of Ecological Science and Environmental Science. A curriculum vitae is included in Appendix A of this specialist assessment.

In addition, a signed specialist statement of independence is included in Appendix B of this specialist assessment.

1.3 Terms of Reference

The scope of work for this specialist impact assessment report is as follows:

- Conduct field surveys and compile specialist studies in adherence to:
    - The gazetted Environmental Assessment Protocols of the NEMA EIA Regulations (2014, as amended), where applicable (**Protocol for the Specialist Assessment and Minimum Report Content Requirements of Environmental Impacts on Aquatic Biodiversity** (GG 43110 / GN 320, 20 March 2020)). This protocol replaces the requirements of Appendix 6 of the 2014 NEMA EIA Regulations (as amended); and
    - any additional relevant legislation and guidelines that may be deemed necessary.
- The Specialist must undertake a site visit to identify the level of sensitivity assigned to the project areas and to verify and confirm this sensitivity and land use as per the national Screening Tool. Provide sensitivities in KMZ or similar GIS format.
- Based on the outcome of the site sensitivity verification, the Specialist must compile an Aquatic Biodiversity Impact Assessment Report, as documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320, that includes:
    - Determine, describe and map the baseline environmental condition and sensitivity of the study areas. Specify setbacks or buffers and provide clear reasons for these recommendations. Also, map the extent of disturbance and transformation of the sites.
    - Provide input on the preferred infrastructure layout i.e. PV modules, on-site substations, etc. following the sensitivity analysis and layout identification.
    - The report must also describe the aquatic ecology features of the project areas, with a focus on features that are potentially impacted by the proposed projects. The description should include the major habitat forms within the study sites, giving due consideration to aquatic fauna and flora, and freshwater ecosystems, in particular natural wetlands.
    - Consider seasonal changes and long-term trends, such as due to climate change.
    - Identify any species of conservation concern (SCC) or protected species on site.
    - The assessment is to be based on existing information, national and provincial databases, and professional experience and fieldwork conducted by the Specialist, as considered necessary and in accordance with relevant legislated requirements. The assessment must also consider the maps generated by the National Screening Tool.
    - Identify and assess the potential direct, indirect and cumulative impacts of the proposed development on aquatic biodiversity and species. Impact significance must be rated both without and with mitigation and must cover the construction, operational and decommissioning phases of the project.
    - Identify and delineate wetlands that may occur on the sites, using the relevant protocols established.
    - Compile a Risk Matrix (Appendix A to GN R509 of 2016) and determine if a Water Use License (WUL) is required and if so, determine the requirements thereof.
    - Identify any additional protocols, legal and permit requirements that are relevant to this project and the implications thereof.
    - Provide recommendations with regards to potential monitoring programmes.
    - Determine mitigation and/or management measures, which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts. Also, identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts. This must be included in the EMPr.

- The Impact Assessment Reports must also be in adherence to any additional relevant legislation and guidelines that may be deemed necessary.

2. Approach and Methodology

Input into this report was informed by a combination of desktop assessments of existing freshwater ecosystem information for the study area and surrounding catchments, as well as by a more detailed assessment of the freshwater features on the various farm portions that comprise the study area.

The site was visited on 18 November 2021 to verify the aquatic features occurring on the site. The field visit comprised of delineation, characterisation and integrity assessments of the aquatic habitats within the site. Mapping of the freshwater features was undertaken using a GPS Tracker and mapped in PlanetGIS and Google Earth Professional.

The following techniques and methodologies were utilised to undertake the assessments:

1. The guideline document, "A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas" document, as published by DWAF (2005) was followed for the delineation of the wetland areas. According to the delineation procedure, the wetlands were delineated by considering the following wetland indicators: terrain unit; soil form; soil wetness; and vegetation indicator.
2. The wetlands were subsequently classified according to their hydro-geomorphic determinants based on a classification system devised by Kotze *et al.* (2004) and SANBI (2009). Notes were made on the levels of degradation in the wetlands based on field experience and a general understanding of the types of systems present.
3. A Present Ecological State (PES) assessment was conducted for each hydro-geomorphic wetland unit identified and delineated within the study area.
4. The functional wetland assessment technique, WET-EcoServices, developed by Kotze *et al.* (2009), was used to indicate the ecological benefits and services provided by delineated wetland habitat. This technique consists of assessing a combination of desktop and infield criteria to identify the importance and level of functioning of the wetland units within the landscape.
5. The present ecological condition of the watercourses was determined using national River Health Programme methodologies as described in this report.
6. The ecological importance and ecological sensitivity (EI&ES) assessment of the wetlands and watercourses was conducted according to the guidelines as developed by DWAF (1999); and
7. Recommendations are made concerning the adoption of buffer zones within the development sites based on the wetlands' functioning and site characteristics.

2.1 Information Sources

A summary of the main information sources used in this assessment is provided in Table 1 below:

Table 1. Information Sources for the Aquatic Biodiversity Assessment

Data / Information	Source	Date	Type	Description
Satellite imagery	Google Earth	May 2002 to Dec 2020	Spatial	Recent history of aerial imagery for the site
Free State Biodiversity Plan (FSBP)	Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs	2015	Report & Spatial	Spatial conservation planning units and associated management recommendations for the Free State province

National Biodiversity Assessment	South African National Biodiversity Institute (SANBI)	2018	Report and Spatial	Latest assessment of South African biodiversity and ecosystems, including wetlands and rivers.
National Vegetation Map	SANBI	2018	Report and Spatial	Latest national vegetation type mapping
South African Atlas of Climatology and Agrohydrology	R.E. Schulze	2012	Spatial	Climate data
Aquifer classification and Groundwater Resource Assessment information	Department of Water and Sanitation	2005, 2012 and 2013	Spatial	Mapping of aquifer class, type, yields, susceptibility and Vulnerability as well as depths, recharge and quality
National Soil types	ENPAT		Spatial	Mapping of soil types
National Freshwater Ecosystem Priority Areas (FEPA)	CSIR	2011	Report and spatial	Mapping of areas of aquatic ecosystem conservation importance
National River Present Ecological Status, Ecological Importance and Ecological Sensitivity	DWA	2012	Spreadsheets and spatial	River reach assessments of ecological importance, sensitivity and condition
National Wetland Map 5	CSIR and SANBI - South African National Biodiversity Assessment 2018	2018	Spatial	Mapping of wetland habitats

2.2 Assumptions, Knowledge Gaps and Limitations

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. The methodologies and techniques used in this assessment have been developed nationally and are typically of a rapid nature, as is required for this freshwater impact assessment.

Very limited aquatic features occur within the sites and surrounding area. No baseline long-term monitoring was undertaken as part of this assessment. There is also very little existing information available for the aquatic features within the study area. Data was utilised for adjacent aquatic ecosystems where available. The nature of the proposed activities, however, also allows them to be placed some distance from any mapped aquatic features such that the likely impacts would be very low. It is usually the associated infrastructure that has the potential to have a greater impact on the aquatic features. The impacts of roads and powerlines on the aquatic features are, however, well understood and can be effectively mitigated to ensure the impacts remain low. The preferred mitigation measure is to limit the disturbance to aquatic features as far as possible by avoiding and minimising the number of crossings and providing adequate buffer areas. This will also ensure that the cumulative impacts will remain low.

The level of aquatic assessment undertaken was considered to be adequate for this study. No further fieldwork will be required. The ground-truthing of aquatic features was undertaken during winter, after the summer rainfall period and when the use of vegetation as an indicator was possible. As it was not possible to cover the sites in a high level of detail, extrapolation of the areas ground-truthed to those not covered was done using the latest available aerial imagery for the sites.

3. Description of Project Aspects relevant to Aquatic Biodiversity

The components for the Mercury Northern Cluster of PV projects are indicated to include the following components:

- A Solar PV Farm (Kleinfontein Solar PV1, Vlakfontein Solar PV1 and Zaaiplaats Solar PV1, each of up to 120 MW);
- 132kV Grid Connections with switching station/substations for each PV facility;
- Battery Energy Storage Systems (BESS);
- Laydown area for the construction period;
- Diesel storage facility of less than 500m^3;
- Operational & Maintenance Buildings;
- Auxiliary Generator Set (GENSET), if required; and
- Additional infrastructure (Access Roads - new and/or upgraded; stormwater; water pipelines, etc.).

The grid connection for the proposed project is to be assessed as a separate project.

In terms of the potential aquatic ecosystem impacts of the proposed developments, it is typically the footprint of the development areas and their associated infrastructure, placed in or adjacent to aquatic features, that may alter the aquatic habitat, have water quality impacts or modify the runoff in the aquatic ecosystems within the area. The proposed project is shown in Figure 2.

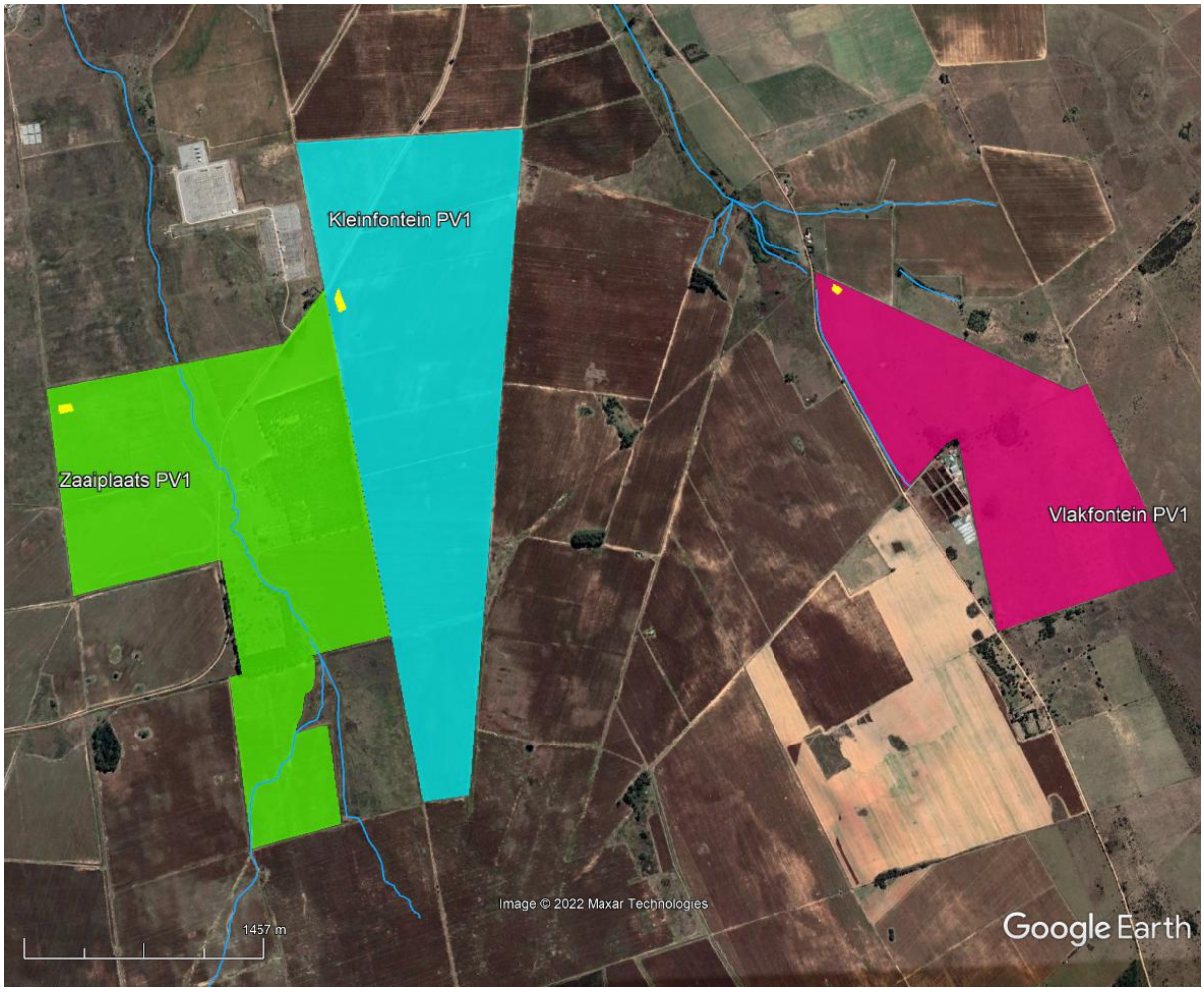

Figure 2. Proposed project elements under consideration in this specialist assessment, where the yellow areas indicate the location of the substations for each PV facility

4. Baseline Environmental Description

4.1. General Description

The proposed area in which the PV facilities and the associated infrastructure under consideration are to be constructed is approximately 22 km southeast of Klerksdorp in the Free State. The wider study area is relatively flat, draining down towards the Vaal River in the north. Table 2 provides an overview and summary of the water resource information for the study area.

Table 2: Key water resources information for the proposed project development areas

Descriptor	Name / details	Notes
Water Management Area (WMA)	Middle Vaal WMA	
Catchment Area	Vaal River	Tributary of the Orange River
Quaternary Catchment	C24B	
Present Ecological state	Vierfontein (C24B): Largely modified (D Category)	DWS (2014) rapid PES and EI&ES assessments
Ecological Importance (EI) and Ecological Sensitivity (ES)	Vierfontein: EI:Moderate; ES: Moderate	
Location of the centre of sites	27° 0'58"S	Latitude
	26°49'44"E	Longitude

4.2. Geology and soils

The southern and central portions of the study area are underlain with deep alluvial sands, boulder gravel, scree and soil, while the northern portion comprises fine to coarse-grained sandstone, shale and coal seems of the Vryheid Formation. In the eastern portion, magnesium-rich tholeiite and melanorite diabase occurs. Ferricrete occurs in the wetland areas and results in perched systems, with inundation occurring as a result of summer rainfall events.

4.3. Climate, Hydrology and Geohydrology

Within the study area, average temperatures vary from 9.3 ^{o}C in June/July to 22.4 ^{o}C in January and February. The wet season occurs from mid-November to mid-April, with February tending to be the wettest month and July the driest month. The mean annual rainfall for the area is 511 mm, with the highest rainfall month on average being January (77mm) and the lowest, July (0mm). The aquatic features in the area are non-perennial. These non-perennial or seasonal aquatic features are thus only inundated in summer during the rainfall period.

A minor intergranular and fractured aquatic occurs in the area that has low yields of less than 0.5 l/s. The groundwater table is generally about 20 m to 22 m below ground level. The water quality is relatively poor, with electrical conductivities of between 150 and 370 mS/m. The aquifer has a medium to high susceptibility to contamination from anthropogenic activities.

The site is not in a Strategic Water Source Area for surface or groundwater.

4.4. Vegetation

The natural vegetation cover indicated to occur in the area is Vaal-Vet Sandy Grassland, an Endangered vegetation type as a result of its loss to agricultural activities. The vegetation type occurs on the aeolian and colluvial sands of the undulating plains of the North West and Free State Provinces (Mucina and Rutherford, 2006). It tends to be dominated by *Themeda triandra* grass, with the grasses*, Elionurus muticus* and *Cymbopogon* spp. dominating where grazing disturbances occur. Within the study area, only small

patches of natural vegetation still occur and tend to be associated with areas where it has been too wet in summer for agriculture.

4.5. Aquatic Habitats and Biota

The freshwater features in the wider study area consist primarily of a small unnamed, non-perennial tributary of the Vaal River and several seeps and depression wetland areas. The tributary of the Vaal River arises as two feed streams within the study area and drains northwards to join the Vaal River approximately 6 km north of the sites. The watercourses and wetland areas are relatively disturbed and are in general surrounded by agricultural activities. As mentioned above, due to the seasonal wetness of the aquatic features, the agricultural activities have largely avoided these areas, and they still comprise mostly indigenous vegetation with localised invasions of alien plants where there has been more disturbance.

Some depression wetlands or pans are scattered within the study area. The wetlands have mostly been severely modified or even lost within the agricultural area, but there are still pockets of wetlands remaining that have also been avoided by agricultural activities due to their seasonal wetness. The wetlands tend to be dominated by moist grassland vegetation. The afore-mentioned freshwater features found on the site have been delineated and are assessed in more detail in Section 5.

According to the Department of Forestry, Fisheries and the Environment (DFFE) Screening Tool, the study area has an overall Low aquatic biodiversity combined sensitivity (Figure 3), with only small areas to the northeast of the sites being mapped as having a Very high sensitivity. These areas are also mapped as being of medium faunal sensitivity and are associated with watercourses and wetland areas. The wetland areas provide habitat for the Giant Bullfrog (*Pyxicephalus adspersus*), a protected amphibian that occurs in the area. The seasonal wetlands at the sites were, however indicated by the faunal specialist for the project to not provide suitable breeding habitat for the frog due to the degraded condition of the wetlands.

4.6. Aquatic Biodiversity Sensitivity and Conservation Importance

As mentioned above, the DFFE Screening Tool mapping for Aquatic Biodiversity Combined Sensitivity has mapped the study area as being mostly of low aquatic biodiversity combined sensitivity, with only the wetland mapping to the northeast of the site below being indicated as very high sensitivity (Figure 3).

In the National FEPA mapping (Figure 4), the catchment at the sites is not considered to be a Freshwater Priority Area River sub-catchment. Two small depression wetlands within Kleinfontein PV1 and Vlakfontein PV1 are mapped as natural FEPA wetland areas (Figure 5), that have been verified through the field assessment to be artificial wetlands associated with farm dams. The National Wetland Map 5 (NWM5) is the same as the FEPA Wetland mapping for the study area (Figure 5).

In terms of biodiversity conservation value that are mapped within the study area in the Free State Biodiversity Plan, there are no aquatic features of note within the study area (Figure 6). Most of the study area is mapped as being degraded and the adjacent watercourse corridors are mapped as ‘other’.

The above-mentioned wetland areas mapped as being of aquatic biodiversity conservation value were ground-truthed and assessed during the site visit and are discussed further in the following section.

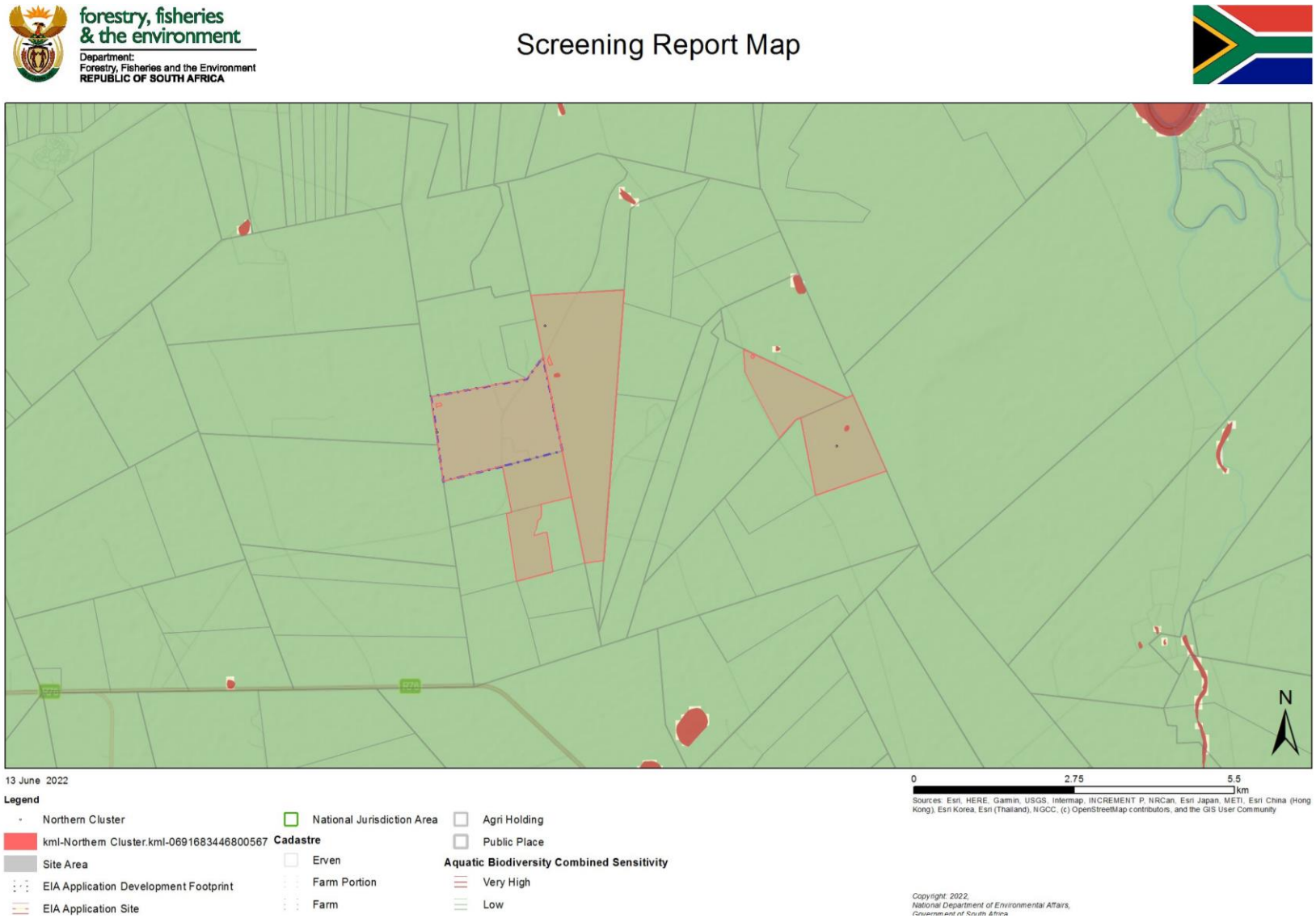

Figure 3. DFFE Screening Tool map for Aquatic Combined Sensitivity for the study area where green areas indicate low sensitivity and red very high sensitivity (obtained from https://screening.environment.gov.za/server, June 2022)

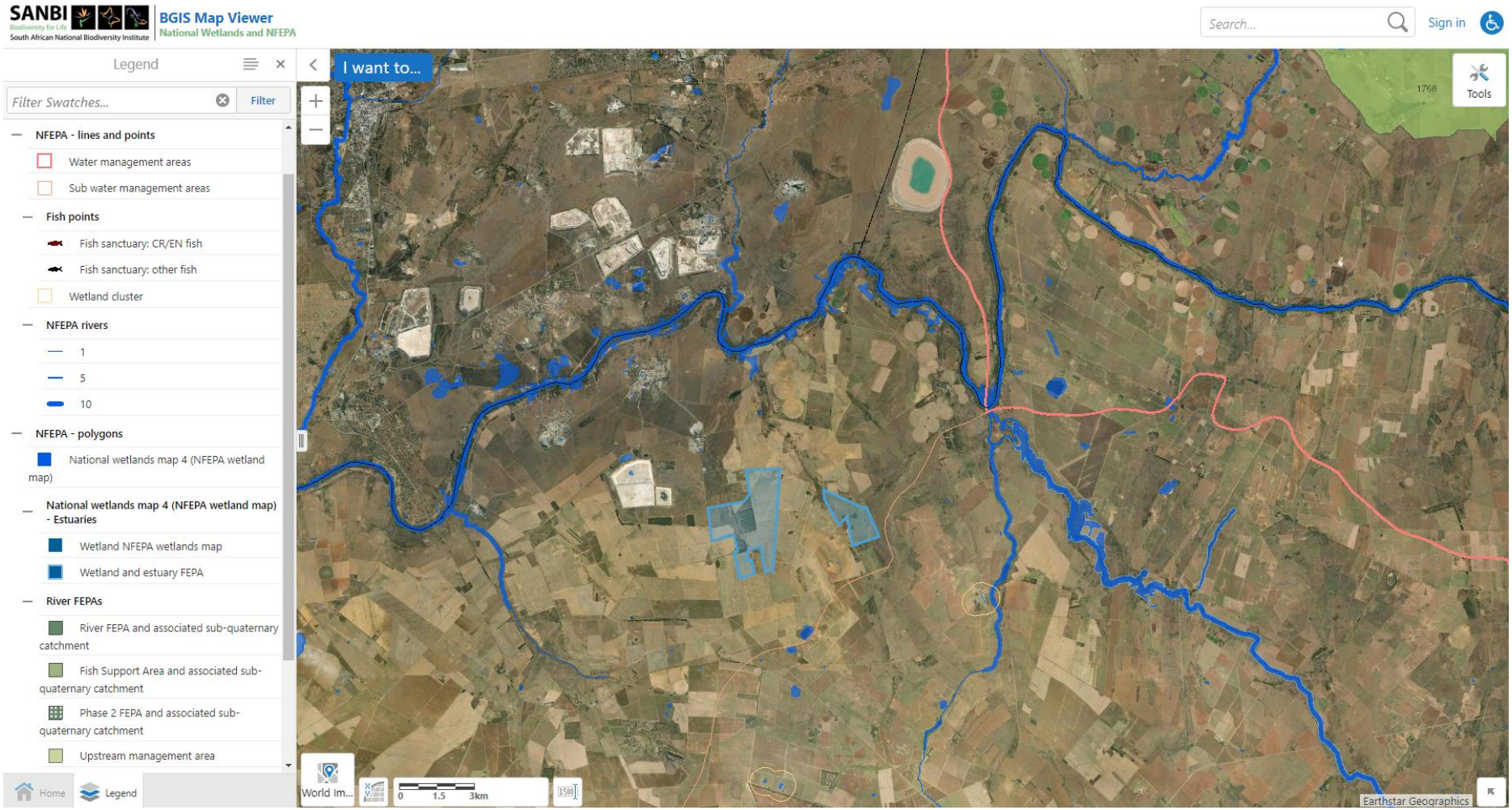

Figure 4. Freshwater Ecosystem Priority Areas within the wider study area (2011 CSIR National Freshwater Ecosystem Priority Areas, obtained from SANBI Biodiversity GIS, June 2022)

Figure 5. FEPA Wetland and National Wetland Map 5 for the study area (obtained from CapeFarmMapper in June 2022)

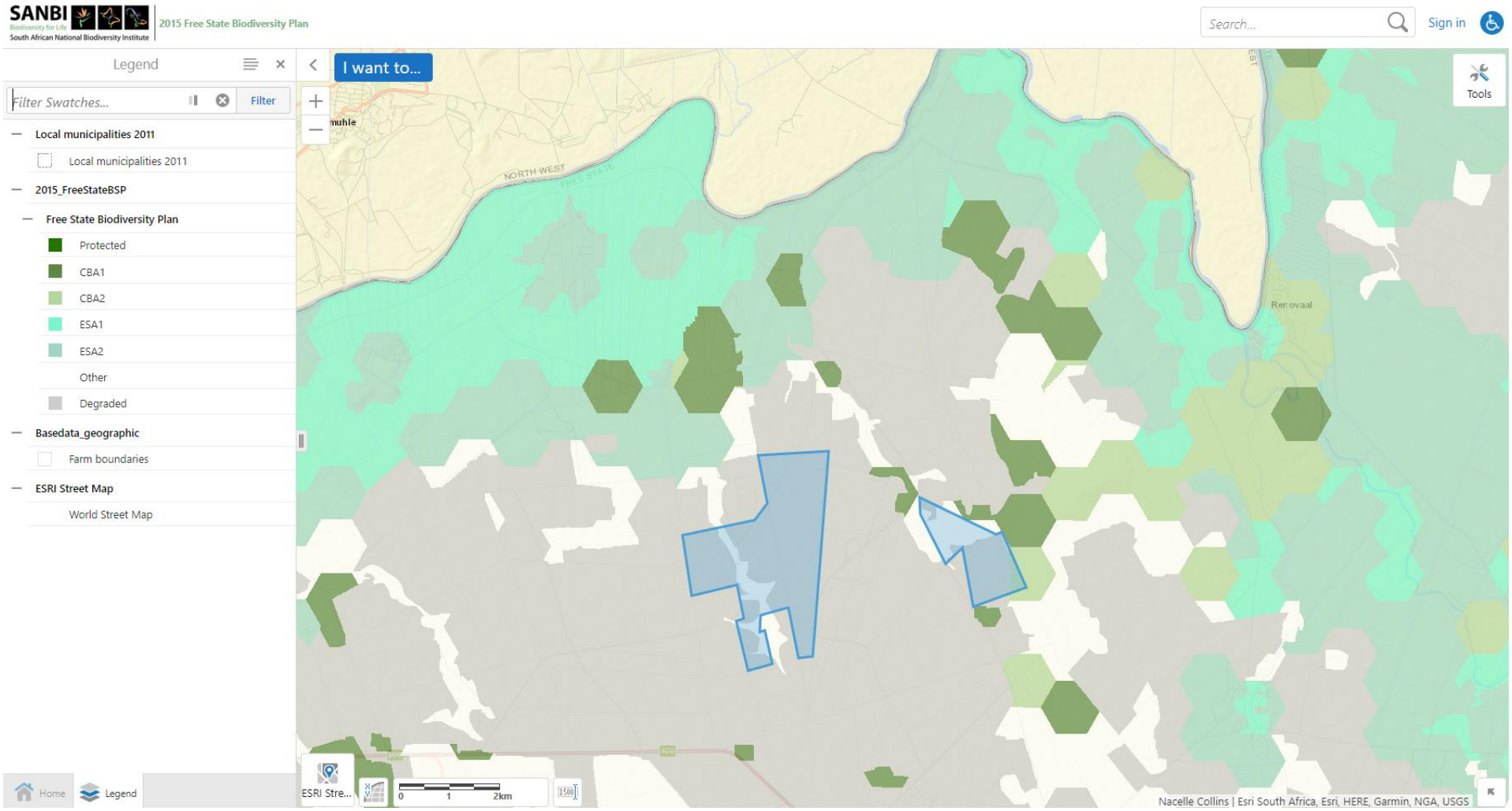

Figure 6. 2015 Free State Critical Biodiversity Areas map for the study area (obtained from SANBI Biodiversity GIS in June 2022)

5. Aquatic Ecological Mapping and Integrity Assessment

The aquatic features within the wider study area comprise two feeder streams of the unnamed tributary of the Vaal River and their associated seep and valley bottom wetland areas. The eastern stream largely occurs outside of the proposed development area for Vlakfontein Solar PVF1, while the western tributary passes through the centre of Zaaiplaats Solar PV1. Some depression wetlands that are mostly associated with farm dams are also located in the study area. Figure 7 provides a Google Earth image of the mapped aquatic features, while Figure 8 and Figure 9 provide views of the watercourses and wetland areas located at the sites.

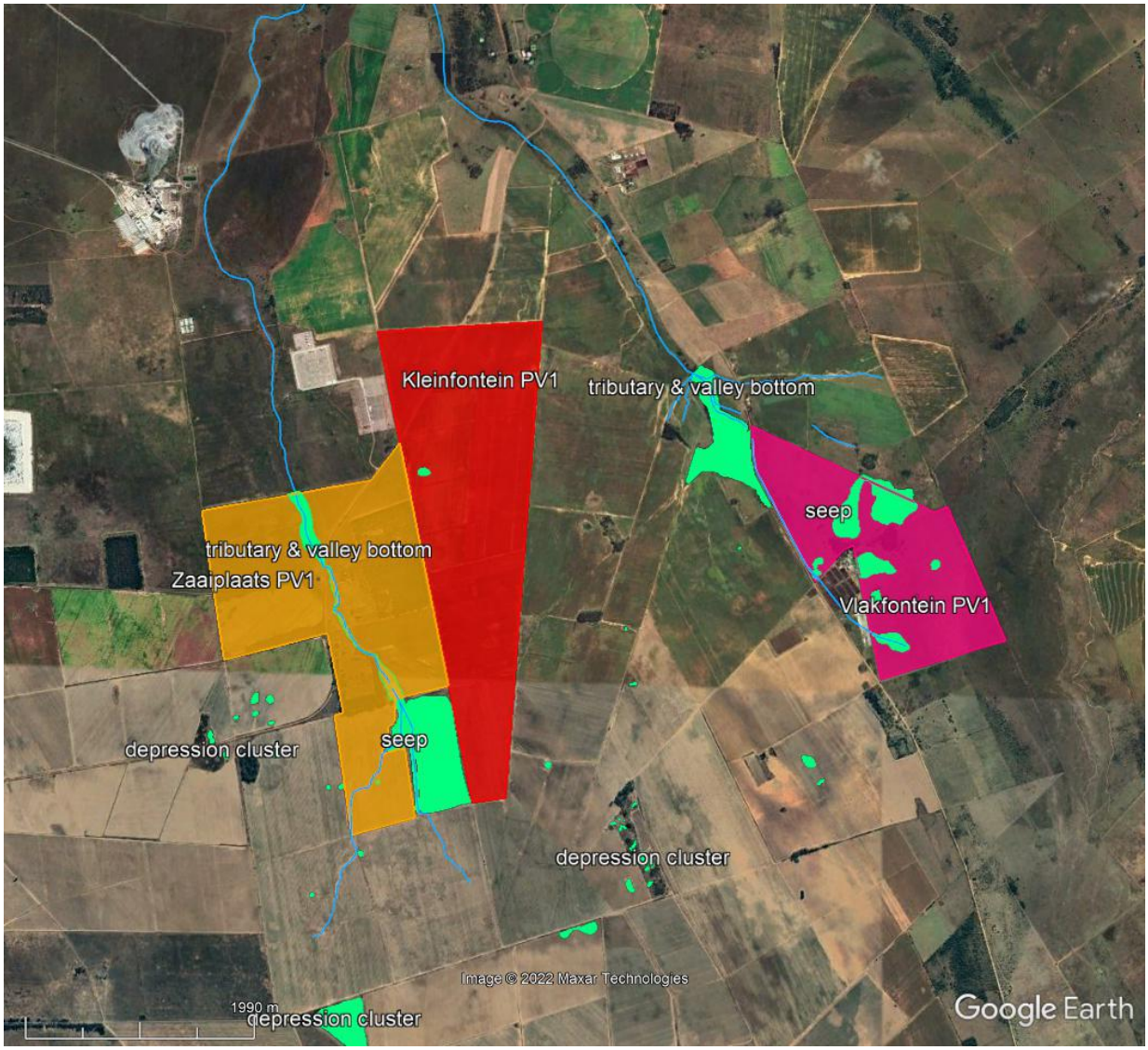

Figure 7. Google Earth image with the mapped aquatic features within the study area

The seasonal stream and its associated wetland areas within the Zaaiplaats Solar PV1 site have been moderately disturbed by the surrounding agricultural activities. The substrate in the watercourse comprises a mix of bedrock and clayey soils. Most of the natural riparian vegetation associated with the stream has been removed and the remaining vegetation tends to be dominated by a mix of indigenous and alien grasses and weedy shrubs such as *Paspalum dilatatum, Agrostis lachnantha, Eragrostis inamoena, Cynodon dactylon, Imperata cylindrica, Typha capensis, Asparagus laricinus Persicaria lapathifolia* and alien thistle *Cirsium vulgare.* Additional seasonal wetland vegetation occurring within the wetland areas includes

Mariscus congestus, Coleochloa setifera, Kyllinga alba, Rorippa nasturtium-aquaticum, Cyperus rupestris, Cyperus congestus, Juncus spp. (Enviroguard, 2022).

Figure 8. View of the seasonal stream and seep wetland that occurs on Zaaiplaats PV1

Figure 9. View of the eastern feeder stream (top) and of the wetland areas (bottom) that occur on Vlakfontein PV1

The purpose of an aquatic ecological assessment is to determine the relative importance, sensitivity, and current condition (ecological state) to assess the impact of proposed development activities on the associated aquatic ecosystems. The assessment is also required to make recommendations in terms of mitigation measures that can be used to prevent or minimise the impact on the freshwater resources. This assessment of the seasonal watercourses and seep wetlands identified within the wider study area is based on existing information as well as the field assessment. The wetland assessment consists of the following aspects: Wetland Integrity; Wetland Ecological Importance and Sensitivity and Ecosystem Services supplied by the wetlands.

5.1. Past imagery of the wetland features within the site

Due to the fact that the aquatic ecosystems and surrounding landscape within the study area have already been significantly modified by past agricultural activities, past aerial imagery for the site was also consulted. Unfortunately, even in the earliest imagery of the area, the area has been significantly modified by agriculture. The images from 1972 are shown in Figure 10, overlaid in Google Earth. These images have assisted in the mapping of distinct wetland areas. In these images, the extent of cultivation of the area was more than that of today; however, the signatures of the wetland habitats were still distinct.

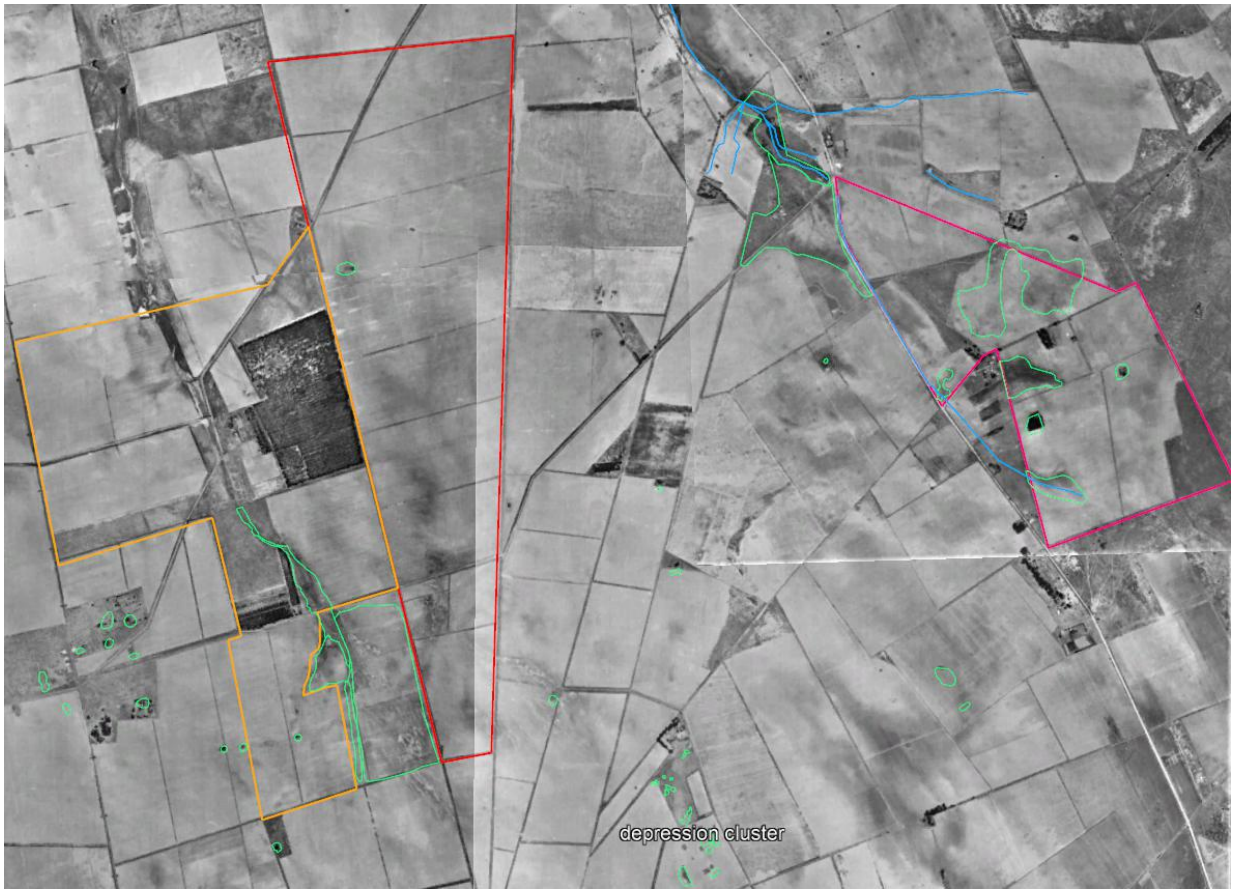

Figure 10. Aerial image taken in 1972, overlaid in Google Earth with the mapped aquatic features (blue lines=watercourses and green polygons=wetland) and the extent of the three PV areas shown

5.2. River integrity

From the Site Characterisation assessment, the geomorphological and physical characteristics of the watercourses and wetlands (shown in Figure 11) associated with the project can be classified as follows:

Figure 11. Mapped rivers (blue lines) and wetlands (green polygons) within the wider study area

Table 3. Characteristics of the watercourses associated with the proposed project

River	Western feeder stream	Eastern feeder stream
Geomorphological Zone	Lowland	Lower foothills
Lateral mobility	Partially confined	Largely unconfined
Channel dimension	±20m, widening downstream	20 - 40 m
Channel pattern	Single thread: moderate sinuosity	Single thread: moderate/low sinuosity
Channel type	Bedrock with alluvium	Alluvium
Channel modification	Moderate to high modification by surrounding agricultural land-use	
Hydrological type	Seasonal	
Ecoregion	Highveld	
DWA catchment	C24B	
Vegetation type	Vaal-Vet Sandy Grassland	
Rainfall region	Summer	

The evaluation of Habitat Integrity (HI) provides a measure of the degree to which a river has been modified from its natural state. The methodology (DWAF, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of the degradation of a river. The severity of each impact is ranked using a scale from 0 (no impact) to 25 (critical impact). The Habitat Integrity Assessment is based on an assessment of the impacts of two components of

the river, the riparian zone and the instream habitat. The total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category (Table 4).

Table 4. Habitat Integrity categories (From DWAF, 1999)

Category	Description	Score (%)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. Small change in natural habitat 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. Large loss of natural habitat, biota and ecosystem function.	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. .	0

Table 5. Index of Habitat Integrity Assessment for the minor Vaal River Tributaries at the site

Instream Habitat Integrity	Tributaries	Riparian Zone Habitat Integrity	Tributaries
Water Abstraction	7	Vegetation Removal	14
Flow Modification	12	Exotic Vegetation	12
Bed Modification	7	Bank Erosion	6
Channel Modification	9	Channel Modification	10
Water Quality	11	Water Abstraction	7
Inundation	5	Inundation	4
Exotic Macrophytes	8	Flow Modification	10
Exotic Fauna	0	Water Quality	10
Rubbish Dumping	6		
Integrity Class	**C**	**Integrity Class**	**D**

The habitat integrity of both watercourses is largely to seriously modified as a result of direct habitat modification within the river reaches with the associated loss of indigenous vegetation and invasion with alien plants as well as flow and water quality impacts. The instream habitat is slightly less impacted as the largest impact on the habitat integrity is the encroachment of agricultural activities into the riparian zones.

5.3. Wetland integrity

The wetland features within the study area have the characteristics described in Table 6.

Table 6: Classification of wetland areas within the study area

Name	Seep wetlands	Valley bottom wetlands	Depressions
System	Inland		
Ecoregion	Dry Highveld Grassland		
Landscape setting	On slopes	Within valley floor	On the flats and plains
Longitudinal zonation	Foothill reach	Foothill and lowland reaches	-
Drainage	Groundwater seep with surface runoff	Along watercourse, baseflow from groundwater	Endorheic (water via infiltration and evaporation)
Seasonality	Seasonal		
Anthropogenic influence	Some disturbances due to farming (livestock grazing) and infrastructure development (roads, power lines and fences), as well as growth of invasive plants		
Geology	Alluvium, colluvium, boulder gravel, sand, soil, debris		Ferricrete
Vegetation	Vaal-Vet Sandy Grassland		
Substrate	Sand/loam and clays		
Salinity	Fresh		

The Present Ecological Status (PES) Method (DWAF 2005) was used to establish the integrity of the wetlands in the wider study area and was based on the modified Habitat Integrity approach developed by Kleynhans (DWAF, 1999; Dickens *et al*, 2003). Table 5 shows the criteria and results from the assessment of the habitat integrity of the pans. These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland. The scoring guidelines and ecological categories used are described in the table below.

Table 7. Relation between scores given and ecological categories

Scoring Guidelines	Interpretation of Scores for all Attributes: Rating of Present Ecological Status
Natural, unmodified score=5.	CATEGORY A >4; Unmodified or approximates natural condition.
Largely natural - score=4.	CATEGORY B >3 and <4; Largely natural with few modifications, but some loss of natural habitats.
Moderately modified- score=3.	CATEGORY C >2 and <3; moderately modified, but with some loss of natural habitats.
Largely modified - score=2.	CATEGORY D <2; largely modified. A large loss of natural habitats and basic ecosystem function.
Seriously modified - rating=1.	CATEGORY E >0 and <2; seriously modified. Extensive loss of natural habitat & ecosystem function.
Critically modified - rating=0.	CLASS F 0; critically modified. Almost complete loss of natural habitat.

Table 8. Habitat integrity assessment criteria for palustrine wetlands (Dickens *et al*, 2003)

Criteria	Relevance	Seep	Valley bottom	Depressions
Hydrologic				
Flow Modification	Abstraction, impoundments or increased runoff from settlements or agricultural land	3.0	2.6	2.1
Permanent Inundation	Impoundment result in destruction of natural wetland habitat and cues for wetland biota	3.5	3.4	1.8
Water Quality				
Water Quality Modification	Point or diffuse sources from upstream activities	3.2	2.8	2
Sediment Load Modification	Reduction in impoundments or increase due to land use practices such as overgrazing.	2.4	3.2	1.8
Hydraulic/Geomorphic				
Canalisation	Changes to inundation patterns and changes in habitats. River diversions or drainage.	3.0	3.2	2
Topographic Alteration	Infilling, ploughing, trampling, bridges and other substrate disruptive activities	2.5	3	2.5
Biota				
Terrestrial Encroachment	Encroachment of terrestrial plant species due to changes in hydrology or geomorphology	2.5	2.8	2
Indigenous Veg Removal	Destruction of habitat through farming activities, grazing or firewood collection	2.4	2.6	2.2
Invasive Plant Encroachment	Changes in community structure and water quality changes	3	3.2	2.4
Alien Fauna	Presence of alien fauna affecting	2.6	3	2.6
Over utilisation	Overgrazing, overfishing, etc.	2.6	2.8	2.6
Category		**B/C**	**C**	**C**

The wetlands have been subjected to physical habitat disturbance with some flow and water quality modification largely as a result of the surrounding farming activities. In terms of the current ecological state

of the larger depression wetlands are considered to be in a moderately modified state. The smaller wetlands tend to be more degraded.

5.4. River and Wetland Ecological Importance and Sensitivity and Ecosystem Services

The Ecological Importance and Sensitivity (EIS) assessment for the rivers and wetlands considers several biotic and habitat determinants surmised to indicate either importance or sensitivity. In addition, the assessment of wetland areas includes an assessment of the ecosystem services supplied by the wetland areas (divided into Hydrological Functional Importance and Direct Human Benefits). The determinants are rated according to a four-point scale (Table 9). The median of the resultant score is calculated to derive the EIS category (Table 10). The results of the EIS assessment for the rivers and wetlands are shown in Table 11 and Table 12.

Table 9. Scale used to indicate either ecological importance or sensitivity

Scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale

Table 10. Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General description	Median
Very high	Quaternaries/delineations unique on a national and international level based on unique biodiversity. These rivers are usually very sensitive to flow.	>3-4
High	Quaternaries/delineations unique on a national scale based on biodiversity. These rivers may be sensitive to flow modifications and have some capacity for use.	>2-≤3
Moderate	Quaternaries/delineations unique on a provincial/ local scale. These rivers are not very sensitive to flow modification and have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations not unique on any scale. These rivers are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Table 11. Results of the EIS Assessment for the tributary

Biotic and Aquatic Habitat Determinants	Vaal River Tributaries
Rare and endangered biota	2
Unique biota	1
Intolerant biota	2
Species/taxon richness	1.5
Diversity of aquatic habitat types or features	2
Refuge value of habitat type	2.5
Sensitivity of habitat to flow changes	3
Sensitivity of flow related water quality changes	2.5
Migration route/corridor for instream & riparian biota	2.5
National parks, wilderness areas, Nature Reserves & areas, PNEs	1.5
EIS CATEGORY	**High/Moderate**

The watercourse is considered of moderate to high ecological importance and sensitivity. This is due to the ecological corridor that it provides from the low hills to the east of the site to the Vaal River in the north.

Table 12. Results of the EIS assessment for the wetlands

Ecological Importance	Depression	Seeps	Valley bottom
Biodiversity support	**1.33**	**2.00**	**1.50**
Presence of Red Data species	1.5	2	1
Populations of unique species	1.5	2	1
Migration/breeding/feeding sites	1.0	2	2.5
Landscape scale	**1.8**	**1.60**	**1.40**
Protection status of the wetland	2.0	1	1
Protection status of the vegetation type	2.5	2.5	2.5
Regional context of the ecological integrity	1.5	2	1.5
Size and rarity of the wetland type/s present	1.5	1.5	1
Diversity of habitat types	1.5	1	1
Sensitivity of the wetland	**2.0**	**1.00**	**2.00**
Sensitivity to changes in floods	2.0	1	2
Sensitivity to changes in low flows	2	1	2
Sensitivity to changes in water quality	2.0	1	2
Ecological Importance & Sensitivity	**2.0**	**1.83**	**2.00**
Flood attenuation	1.5	1	2
Streamflow regulation	1.0	2	2
Sediment trapping	1.5	2	2.5
Phosphate assimilation	1.0	1.5	2
Nitrate assimilation	1.5	1.5	2
Toxicant assimilation	1.0	1	2
Erosion control	1.5	1	2
Carbon storage	1.0	1	1
Hydrological/Functional Importance	**1.25**	**1.38**	**1.94**
Water for human use	1.0	1.5	2
Harvestable resources	0	1	1
Cultivated foods	0	***0***	0
Cultural heritage	0	0	0
Tourism and recreation	0	0	0
Education and research	1.0	1.5	1
Importance of Direct Human Benefits	**0.33**	0.67	0.67
OVERALL IMPORTANCE (highest score of ecological, hydrological and direct human benefits)	**2.0 (Moderate)**	**2.0 (Moderate)**	**2.0 (Moderate)**

The larger depression wetland clusters provide some habitat for aquatic life as well as providing some flood attenuation and sediment trapping functionality, while some of the smaller wetlands are degraded and have lost much of their sensitive and ecological important character. The larger and still relatively unimpacted wetlands are considered of moderate ecological importance and sensitivity

5.5. Recommended Ecological Condition of Aquatic Ecosystems

Considering the moderately to largely modified ecological condition of the aquatic ecosystems within the wider study area and their moderate ecological importance and ecological sensitivities, the recommended ecological condition (REC) of these features would be that they at least remain or be improved to a moderately modified ecological condition and are rehabilitated where the opportunity occurs.

5.6. Aquatic Species

The Vaal-Vet Sandy Grassland vegetation type is classified as Endangered (only 0.3% statutorily conserved of the target of 24%, with more than 60% transformed due to cultivation and overgrazing.). Vegetation within the sites is largely a mixed grassland of *Themeda triandra,* with *Eragrostis curvula* and *Cynodon dactylon* occurring in the more disturbed areas. These grasslands are interspersed with cultivated areas, alien bush clumps and seasonal depression wetlands.

Few amphibian species are known from the region. The amphibian species of conservation concern that occurs in the study area is *Pyxicephalus adspersus* (Giant Bull Frog), which is protected at a national level. Other amphibians occurring in the wider area include the V*andijkophrynus gariepensis* (Karoo Toad), *Sclerophrys gutturalis* (Guttural Toad), *S. powerii* (Power's Toad), *Cacosternum boettgeri* (Boettger's Caco), *Tomopterna cryptotis* (Tremolo Sand Frog), *T. natalensis* (Natal Sand Frog) and common Platanna (*Xenopus laevis*) that are all considered Least Concern. An ecological and faunal assessment was undertaken for the project by Enviroguard Ecological Services (2022), which has assessed this aspect in greater detail.

6. Project-Specific Aquatic Ecosystem Assessment

As mentioned in the previous sections, the aquatic features occurring within the wider study area comprise seasonal watercourses and wetlands that have been moderately modified and are of moderate ecological importance and sensitivity.

6.1. Identification of Environmental Sensitivities

6.1.1 Sensitivities identified by the National Web-Based Environmental Screening Tool

The Screening Tool, downloaded in June 2022, indicated the sites to be in an area mapped as being of low Aquatic Biodiversity Combined Sensitivity (Section 4.6 and Figure 3).

6.1.2 Specialist Sensitivity Analysis and Verification

The aquatic constraints of the wider study area are shown below in Figure 12, along with the aquatic ecosystem sensitivities and recommended setback areas. The aquatic ecosystem sensitivity for the proposed project is discussed in more detail below.

Based on the present ecological condition (moderately modified) and ecological importance and sensitivity (moderate), as well as the recommended ecological condition of the watercourses (moderately modified), buffers have been recommended to protect these ecosystems. The recommended buffer area between the aquatic features and the project components to ensure these aquatic ecosystems are not impacted by the proposed activities ranges between 20m and 100m from the delineated edge of the larger wetlands. The small or degraded (low sensitivity) wetlands are not deemed a constraint to the proposed project as they have already been significantly modified by agricultural activities and are of very low aquatic sensitivity.

If the construction and operation of the PV modules does not require modification to the topography, topsoils or removal of indigenous grassland such that wetland functionality within these degraded wetland areas could be retained, the modules could be placed within the wetland areas mapped as being of low sensitivity in Figure 12.

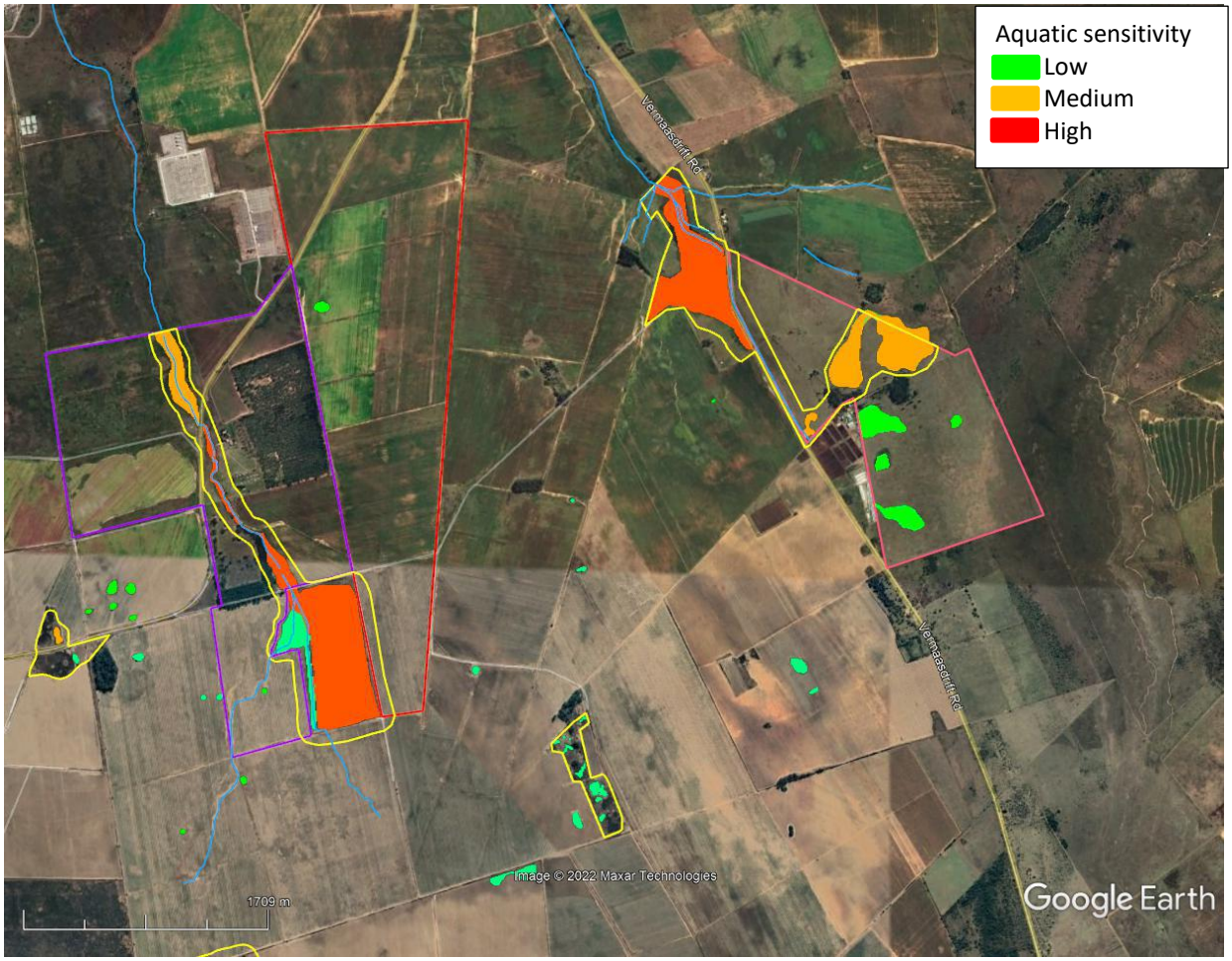

Figure 12. Google Earth image showing the aquatic ecosystem sensitivity and recommended setback areas (yellow lines) within the project areas

6.1.3 Sensitivity Analysis Summary Statement

This assessment has found the larger aquatic features on-site to be of moderate sensitivity and the smaller or degraded features to be of low sensitivity. The **low** Aquatic Biodiversity Combined Sensitivity mapping of the screening tool differs as it has not included the FEPA and NWM5 wetland features considered to be of more aquatic ecological importance and sensitivity by this assessment. The proposed activities should avoid impacting the larger aquatic features considered of moderate sensitivity.

6.2. Issues, Risks and Impacts

The potential impacts of the proposed project's activities that were identified during this basic freshwater assessment are as follows:

Construction Phase: **Direct Impacts**: Disturbance of aquatic habitat and associated biota; increased water use and water quality; **Indirect Impacts**: Hydraulic and habitat modification and growth of invasive alien riparian vegetation
*Operational Phase***:** **Direct Impacts:** Aquatic habitat disturbance **Indirect Impacts:** Degradation of the ecological condition of aquatic ecosystems; modification of flow and water quality, erosion; and alien vegetation invasion in aquatic features
*Decommissioning Phase***:** **Direct Impacts:** Disturbance of aquatic habitats and water quality impacts.

Cumulative impacts: **Indirect Impacts:** Degradation of the ecological condition of aquatic ecosystems.

Most of the potential aquatic ecosystem impacts of the proposed activities are likely to take place during the construction phase. These potential impacts and the associated issues identified include:

1. Disturbance of aquatic habitats within the watercourses and wetlands with the associated impacts to sensitive aquatic biota. During construction, activities within the wetlands could result in the disturbance or destruction of sensitive habitats and any listed and or protected plant or animal species. The proposed activities should thus be placed outside of the aquatic features mapped as being of moderate sensitivity as well as their recommended setback areas. No Resource Quality Objectives exist for the watercourses and wetlands concerned however, the proposed activities, with the recommended setback areas, are unlikely to prevent these objectives from being met.

2. Any removal of indigenous wetland vegetation will reduce the ecological integrity and functionality of the watercourses and wetlands. Construction works, in particular, could result in the loss of aquatic vegetation that provides ecosystem services within the sites.

3. Demand for water for construction could place stress on the existing available water resources. During construction, more water is required than during the operation phase. This water would be required for a 1–2-year period while construction works are ongoing. Given the limited water availability in the area, it is advised that water be obtained off-site for construction.

4. Alien vegetation infestation within the aquatic features due to disturbance. The current presence of alien vegetation on the sites is limited. Sources of alien seed should be prevented from being brought onto the sites with imported materials. Monitoring post-construction for the growth of alien vegetation can mitigate this potential impact.

5. Increased sedimentation and risks of contamination of surface water runoff during construction. During construction, the earthworks near the watercourses and wetlands will expose and mobilise soil as well as construction materials and chemicals that may end up in the wetlands. If works are undertaken during the drier periods of the year, this impact would be unlikely.

During the operational phase, potential impacts of the proposed project activities would include:

1. Ongoing disturbance of aquatic features and associated vegetation adjacent to infrastructure that needs to be maintained. As for the disturbance of aquatic features described under construction impacts, the disturbance of aquatic habitat is unlikely.

2. Modified runoff characteristics from hardened surfaces have the potential to result in the erosion of aquatic habitats. Limited hardening of surfaces will take place as a result of the proposed project.

3. Any structures within the watercourse associated with the proposed project, such as at the road crossings must not impede flow in the watercourse.

4. Water supply (and possibly sanitation services) may be required for the operation phase. The water could potentially be provided from groundwater without any aquatic ecosystem impacts. This aspect would need to be investigated; however, boreholes should not be sited within or immediately adjacent to the watercourses and wetlands.

The cumulative impact of the project activities, together with the existing activities in the area, could have the potential to reduce the integrity of the watercourses if not properly mitigated and managed. By implementing suitable buffers (as reflected in Figure 12) along the watercourse/wetlands and minimising the works within

the river/stream corridors, the impact of the proposed project activities would be low and unlikely to impact the integrity of the aquatic ecosystems. The proposed activities are all some distance away from the delineated aquatic features.

No consultation process was deemed to be required while preparing this freshwater specialist report.

7. Impact Assessment

The potential aquatic biodiversity impacts of the proposed activities are likely to be very low in terms of any potential impact on aquatic habitat, biota, water quality, or flow for all phases of the proposed developments if mitigated as recommended.

7.1 Potential Impacts during the Construction Phase

Degradation of the ecological condition of aquatic ecosystems and water quality impacts

Construction Phase: Construction of the Vlakfontein Solar PV1, Kleinfontein Solar PV1 and Zaaiplaats Solar PV1 Facilities and associated infrastructure will require disturbance of the surface area and some removal of vegetation cover for the preparation of the various project component footprints at each of the sites. The potential for these activities to impact aquatic ecosystems is more likely to occur within the proposed Vlakfontein and Zaaiplaats Solar PV1 facilities than for Kleinfontein Solar PV1 where there are no aquatic constraints within the site.

Only a limited amount of water is utilised during construction. Concrete foundations will need to be constructed. A construction camp with a temporary laydown area and the concrete batching plant would likely need to be placed within the sites for the construction works. There is thus also the potential for some water quality impacts associated with the batching of concrete from hydrocarbon spills or associated with the other construction activities on the sites. The location of the works should be located sufficiently far from the delineated aquatic features (outside the recommended setback areas) that they do not pose any significant risk to the aquatic features.

Proposed mitigation:
The recommended buffers between the delineated aquatic ecosystems and all the proposed project activities should be maintained. Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers. The existing road infrastructure should be utilised to access new infrastructure as far as possible to minimise the overall disturbance.

If the construction and operation of the PV modules does not require modification to the topography, topsoils or removal of indigenous grassland such that wetland functionality within these degraded wetland areas could be retained, the modules could be placed within the wetland areas mapped as being of low sensitivity.

During the construction phase, site management must be undertaken at the laydown and construction sites. This should specifically address on-site stormwater management and prevention of pollution measures from any potential pollution sources during construction activities such as hydrocarbon spills. Any stormwater that does arise within the construction sites must be handled appropriately to trap sediments and reduce flow velocities.

Table 13: Impact for the Construction Phase

Impact Description • Disturbance of aquatic habitat; water quality impacts
Cumulative impact description • Aquatic ecosystem deterioration

Mitigation

- The recommended buffers between the delineated aquatic ecosystems and all the proposed project activities should be maintained.
- If the construction and operation of the PV modules does not require modification to the topography, topsoils or removal of indigenous grassland such that wetland functionality within these degraded wetland areas could be retained, the modules could be placed within the wetland areas mapped as being of low sensitivity.
- Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers.
- The existing road infrastructure should be utilised as far as possible to minimise the overall disturbance. This also relates to the existing road that crosses the mapped seep area in Vlakfontein PV1 where the seep comprises marginal wet areas and use of the existing access road would have a potential impact of low significance on the wetland.
- During the construction phase, site management must be undertaken at the laydown and construction sites. This should specifically address on-site stormwater management and prevention of pollution measures from any potential pollution sources during construction activities such as hydrocarbon spills.
- Any stormwater that does arise within the construction sites must be handled appropriately to trap sediments and reduce flow velocities.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Disturbance of aquatic habitat; water quality	Site	Short term	Possible	High	Moderate to Low	Low

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO

Cumulative impact rating (*after* mitigation) If high, please explain	Low

7.2. Potential Impacts during the Operational Phase

Degradation of the ecological condition of aquatic ecosystems; modification of flow and water quality; erosion; and alien vegetation invasion in aquatic features

During the operation phase, the PV Facilities will operate largely unattended and with low maintenance required for more than 20 years. The hard surfaces created by the developments may lead to increased runoff, in particular on surfaces with a steeper gradient. This may lead to increased erosion and sedimentation of the downslope areas. A localised long-term impact (more than 20 years) of low intensity could be expected that would have a very low overall significance post-mitigation in terms of its impact on the identified aquatic ecosystems in the area.

The only potentially toxic or hazardous materials which would be present in relatively small amounts would be lubricating oils and hydraulic and insulating fluids. Therefore, contamination of surface or groundwater or soils is highly unlikely. There are low to no water consumption impacts associated with the operation of the proposed PV infrastructure.

Proposed mitigation:

Alien plant growth and signs of erosion should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants or eroded. Observed invasive alien plant growth should be cleared from the sites regularly according to measures as laid out in the Environmental Management Programme (EMPr) for the project.

Stormwater runoff infrastructure must be designed to mitigate both the flow and water quality impacts of any stormwater leaving the developed areas. The runoff should be dissipated over a broad area covered by natural vegetation or managed using appropriate shaping with berms or channels and swales adjacent to hardened surfaces where necessary. Should any erosion features develop, they should be stabilised as soon as possible. Any water supply, sanitation services as well as solid waste management services required for the sites should preferably be provided by an off-site service provider.

Table 14: Impact table for the Operation Phase

Impact Description

- Degradation of the ecological condition of aquatic ecosystems; modification of flow and water quality; erosion; and alien vegetation invasion in aquatic features

Cumulative impact description

- Aquatic ecosystem deterioration

Mitigation

- Alien plant growth and signs of erosion should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants or eroded. Observed invasive alien plant growth should be cleared from the sites regularly according to measures as laid out in the EMPr for the project.
- Stormwater runoff infrastructure must be designed to mitigate both the flow and water quality impacts of any stormwater leaving developed areas. The runoff should rather be dissipated over a broad area covered by natural vegetation or managed using appropriate shaping with berms, channels and swales.
- Should any erosion features develop, they should be stabilised as soon as possible.
- Any water supply, sanitation services as well as solid waste management services required for the sites should preferably be provided by an off-site service provider.

Impact Assessment

Name of Impact	Extent	Duration	Probability	Reversibility of impact	Significance without mitigation	Significance after mitigation
Degradation of ecological condition; modification of flow and water quality; erosion; and alien vegetation invasion	Site	Short term	Possible	High	Low	Low to None

Impact on Irreplaceable Resources (*after* mitigation) If yes, please explain	NO

Cumulative impact rating (*after* mitigation) If high, please explain	Low

7.3. Consideration of Alternatives

The No-Go Alternative would imply that the proposed development sites would not be utilised for the proposed PV Facility but would continue to be utilised for agriculture. Currently, it would appear that the wetland areas within the sites are largely avoided as they are too wet in summer for agricultural activities and thus mostly left undisturbed. They are, however, periodically utilised and hence their current modified ecological condition. It could be expected that this practice would continue to occur and would result in an ongoing degradation of the wetlands. From an aquatic ecosystem perspective, there could thus be expected would be little difference in the potential aquatics ecosystem impacts for either the no-go alternative and the proposed project, provided that there is an ongoing clearing of alien vegetation according to measures as laid out in the EMPr for the project.

7.4. Cumulative Impacts

The potential cumulative aquatic ecosystem impacts of the proposed development relate to the combined impact of that development with the incremental impacts of other past, present or reasonably foreseeable future activities on the same aquatic ecosystems (i.e. a small unnamed, non-perennial tributary of the Vaal River and several seeps and depression wetland areas). These aquatic ecosystems are in a moderately modified ecological condition with a moderate ecological importance and ecological sensitivities as a result of the current activities and their cumulative impact on them. The REC of these features would be that they at least remain in a moderately modified ecological condition and are rehabilitated where the opportunity occurs. The proposed activities associated with the projects has been mitigated to ensure that there is no further degradation of these aquatic ecosystems and that the REC is achievable. There would be no net loss of aquatic habitat or functionality as a result of the cumulative impact associated with this project. In terms of the renewable energy projects in a 30km radius, none of these activities would impact further on the mentioned aquatic ecosystems than those activities assessed in this section as they are located far from these aquatic ecosystems and would also not result in any net loss of these aquatic ecosystems.

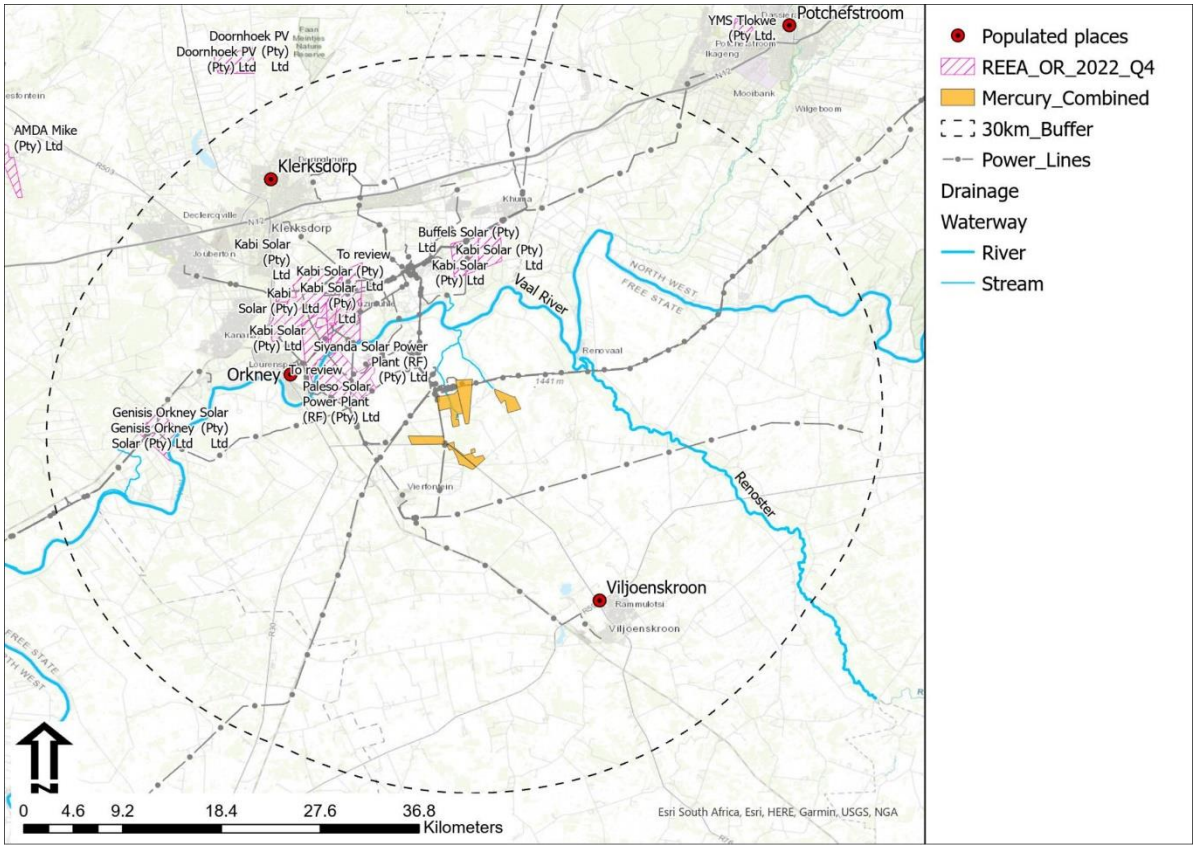

Figure 13. Map showing the renewable energy projects within a 30km radius of the proposed project

According to the DFFE database (Figure 13), there are seven other renewable energy projects within a 30 km radius. There are also another four projects associated with this project. All these projects are considered in terms of the potential cumulative aquatic ecosystem impacts, where all of these projects have very similar aquatic ecosystem impacts and mitigation measures. As discussed in the above impact assessment, the proposed project poses a low risk of causing degradation or loss of aquatic ecosystems within the wider study area. By implementing suitable buffers (100m for the larger wetlands) and minimising the works adjacent to the wetlands, the impact of the proposed project activities would be low and unlikely to impact the integrity of the aquatic ecosystems. Any other impacts arising from the proposed projects can be adequately and fairly easily managed by standard best practice mitigation management actions included in the EMPr. If the risk for each individual development is low, then the cumulative risk is also low.

Due to all of the considerations discussed above, the cumulative impact on aquatic ecosystem habitat, integrity and functionality in the area will not have an unacceptable negative impact. The proposed project is therefore acceptable in terms of its associated cumulative impact, and therefore from this perspective, there is no reason why it should not be approved.

7.5. Scoping Level Impact Assessment Summary

The overall impact significance of the proposed activities is provided in the table below for the lifespan of the project. These impact significant ratings relate to largely to Vlakfontein and Zaaiplaats Solar PV1 as there are no aquatic features of any significance associated with Kleinfontein Solar PV1.

Table 15: Overall Impact Significance (Post Mitigation)

Phase	Overall Impact Significance
Construction	Low
Operational	None
Cumulative Impact	Overall Impact Significance
Cumulative - Construction	Low
Cumulative - Operational	Low

8. Legislative and Authorisation Requirements

The main legislation associated with the protection of aquatic ecosystems and water resources over and above the National Environmental Management Act, Act 107 of 1998, is the National Water Act, Act No. 36 of 1998. The purpose of the National Water Act, 1998 (NWA) is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual and rights which are not automatically coupled to land rights, but for which prospective users must apply for authorisation and register as users. The NWA also provides measures to prevent, control and remedy the pollution of surface and groundwater sources.

The Act aims to regulate the use of water and activities (as defined in Part 4, Section 21 of the NWA), which may impact water resources through the categorisation of 'listed water uses' encompassing water abstraction and flow attenuation within catchments as well as the potential contamination of water resources, where the Department of Water and Sanitation (DWS) is the administering body in this regard. Defined water use activities require the approval of DWS in the form of a General Authorisation (GA) or a Water Use Licence (WUL). There are restrictions on the extent and scale of listed activities for which General Authorisations apply.

According to the preamble to Part 6 of the NWA, 1998, "*This Part established a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing general authorisations in the Gazette*…" and further states that "*The use of water under a general authorisation does not require a licence until the general authorisation is revoked, in which case licensing will be necessary*…"

The GAs for Section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA were revised in 2016 (Government Notice R509 of 2016). Determining if a water use licence is required for these water uses is now associated with the risk of degrading the ecological status of a watercourse. A low risk of impact could be authorised in terms of a GA. The risk of the proposed developments altering the ecological integrity of the adjacent aquatic ecosystems, if mitigated as recommended, is likely to be low such that the associated water use activities in

terms of Section 21 c (impeding or diverting flow in a watercourse) or Section 21 i (changing the bed, banks, course or characteristics of a watercourse) would fall within the ambit of the General Authorisations.

As some of the proposed activities are located near the delineated aquatic features, they pose a risk of changing the bed, banks or characteristics of the watercourses or impeding or diverting flow in the watercourses, with the associated Section 21 (c) and (i) water use activities. A preliminary risk assessment is thus deemed to be required for the proposed project and is included in the appendices of this report. Provided the recommended mitigation measures are implemented, the risk of the activities degrading the adjacent aquatic features will be low such that the water use activities would fall within the ambit of the General Authorisations for Section 21 (c) and (i) water use activities. See Appendix E for risk assessment.

Additional water use activities that may occur would be associated with groundwater abstraction, should that need to take place or the use of conservancy tanks within the sites. The threshold for the storage of domestic and biodegradable industrial wastewater for the purpose of disposal is 10 000 m^3 per property. The General Authorisations for groundwater abstraction within Quaternary Catchment C24B is limited to 45 m^3/ha for the extent of the associated property.

9. Environmental Management Programme Inputs

The proposed layout plan for the sites should take into consideration the aquatic ecosystem constraints and needs to avoid the delineated aquatic ecosystems as well as the recommended buffer between the significant aquatic features and the proposed project activities. If the construction and operation of the PV modules does not require modification to the topography, topsoils or removal of indigenous grassland such that wetland functionality within these degraded wetland areas could be retained, the modules could be placed within the wetland areas mapped as being of low sensitivity.

Very limited impact mitigation, monitoring or management actions and outcomes would then be necessary for inclusion in the Environmental Management Programme (EMPr).

The recommended mitigation measures are as follows:

- Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers, while retaining the topography and covering vegetation within the wider drainage areas through the sites is preferred to reduce the potential modification to the way in which water drains through these areas.
- The existing road infrastructure should be utilised as far as possible to minimise the overall disturbance. This also relates to the existing road that crosses the mapped seep area in Vlakfontein PV1 where the seep comprises marginal wet areas and use of the existing access road would have a potential impact of low significance on the wetland.
- During the construction phase, site management must be undertaken at the laydown area and the individual construction areas. This should specifically address on-site stormwater management and prevention of pollution measures from any potential pollution sources during construction activities such as hydrocarbon spills. Any stormwater that does arise within the construction sites must be handled appropriately, where necessary, to trap sediments and reduce flow velocities.
- Developments within the minor wetland areas of low significance will, however, need to consider stormwater management measures and should avoid impacting the movement of water through the more important seasonally wet areas. Minimal disturbance to the topography and cover vegetation in these areas is recommended.
- Any disturbance during the operation phase should be limited to the approved development footprints and should avoid disturbance of the soil and natural vegetation cover.
- Alien plant growth and signs of erosion should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants or eroded. Observed invasive alien

plant growth should be cleared from the sites regularly according to measures as laid out in the EMPr for the project.

- Stormwater runoff infrastructure must be maintained to mitigate both the flow and water quality impacts of any stormwater leaving developed areas.
- Any water supply, sanitation services as well as solid waste management services that should be required for the sites should preferably be provided by an off-site service provider. In a scenario where services are installed, these systems need to be adequately installed and maintained to prevent any potential contamination of the water resources on site.
- During decommissioning of each project, disturbance to the freshwater ecosystems should be limited as far as possible. Disturbed areas may need to be rehabilitated and revegetated. Mitigation and follow-up monitoring of residual impacts (alien vegetation growth and erosion) may be required.

10. Final Specialist Statement and Authorisation Recommendation

10.1. Statement and Reasoned Opinion

Based on the findings of this aquatic biodiversity assessment report, there should be no reason why the proposed PV facilities and their associated activities, with the recommended mitigation, cannot be approved from an aquatic ecosystem point of view if mitigated as recommended.

10.2. Environmental Authorisation Condition Recommendations

The conditions required to be included in the environmental authorisation from an aquatic ecosystem perspective are provided under Section 8 of this report.

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Appendix A - Specialist Expertise

TONI BELCHER

Full Name	Antonia Belcher
Cell Number	083 883 8055
Email	toni@bluescience.co.za
Address	53 Dummer St, Somerset West, 7130
Profession	Aquatic Ecologist and Environmental Management (P. Sci. Nat. 400040/10)
Years in Profession	31+ years

Toni Belcher worked for the Department of Water Affairs and Forestry for more than 17 years. During this period, she worked for the Directorate Water Quality Management, the Institute for Water Quality Studies and the Western Cape Regional Office and has built up a wide skills base on water resource management and water resource quality for rivers, estuaries and the coastal marine environment. Since leaving the Department in 2007, she has been working in her private capacity and was co-owner of BlueScience (Pty) Ltd, working in the field of water resource management and has been involved in more than 500 aquatic ecosystem assessments for environmental impact assessment and water use authorisation purposes. In 2006 she was awarded a Woman in Water award for Environmental Education and was a runner up for the Woman in Water prize for Water Research.

Professional Qualifications:

1984 Matriculation Lawson Brown High School
1987 B.Sc. – Mathematics, Applied Mathematics University of Port Elizabeth
1989 B.Sc. (Hons) – Oceanography University of Port Elizabeth
1998 M.Sc. – Environmental Management (*cum laude*) Potchefstroom University

Key Skills:

Areas of specialisation: Aquatic ecosystem assessments, Monitoring and evaluation of water resources, Water resource legislation and authorisations, River classification and Resource Quality Objectives, River Reserve determination and implementation, Water Quality Assessments, Biomonitoring, River and Wetland Rehabilitation Plans, Catchment management, River maintenance management, Water education.

Summary of Experience:

1987 – 1988 Part-time field researcher, Department of Oceanography, University of Port Elizabeth
1989 – 1990 Mathematics tutor and administrator, Master Maths, Randburg and Braamfontein Colleges, Johannesburg
1991 – 1995 Water Pollution Control Officer, Water Quality Management, Department of Water Affairs, Pretoria
1995 – 1999 Hydrologist and Assistant Director, Institute for Water Quality Studies, Department of Water Affairs and Forestry, Pretoria
1999 – 2007 Assistant and Deputy Director, Water Resource Protection, Western Cape Regional Office, Department of Water Affairs, Cape Town
2007 – 2012 Self-employed
2013 – 2020 Senior Aquatic Specialist and part owner, BlueScience
2020 – present Self employed, Associate of BlueScience

Appendix B - Specialist Statement of Independence

I, Antonia Belcher, 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 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist: 

Name of Company: BlueScience (Pty) Ltd

Date: 15 June 2022

Appendix C: Site Sensitivity Verification

Prior to commencing with the Aquatic Biodiversity Specialist Assessment in accordance with the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity (Government Notice 320, dated 20 March 2020), a site sensitivity verification was undertaken to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

The details of the site sensitivity verification are noted below:

Date of Site Visit	18 November 2021
Specialist Name	Toni Belcher
Professional Registration Number	400040/10
Specialist Affiliation / Company	BlueScience (Pty) Ltd

The proposed Vlakfontein, Zaaiplaats and Kleinfontein Solar PV1 projects (form part of the **Mercury PV (Northern Cluster) Project)** near Klerksdorp in the Free State Province were assessed in terms of their aquatic biodiversity sensitivity using a desktop analysis using available aquatic ecosystem mapping, aerial imagery and a site visit, undertaken on 18 November 2021. A literature survey was also undertaken to determine any aquatic biodiversity sensitivities that may occur in the surrounding area.

The field visit comprised of delineation, characterisation and integrity assessments of the aquatic habitats within the sites. Mapping of the freshwater features was undertaken using a GPS Tracker and mapped in PlanetGIS and Google Earth Professional.

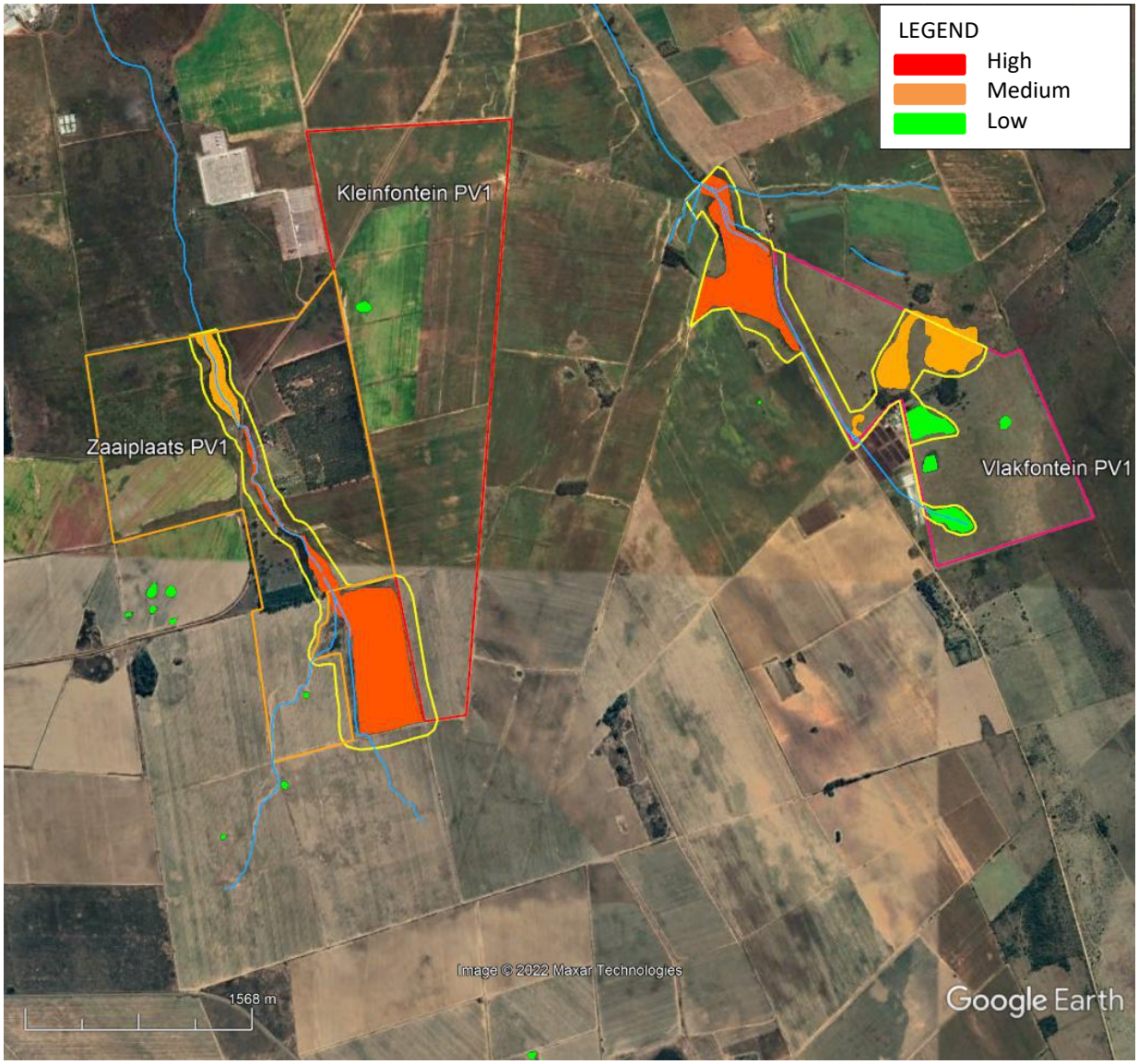
The following techniques and methodologies were utilised to undertake the assessments:

- The guideline document, “A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas” document, as published by DWAF (2005) was followed for the delineation of the aquatic habitats;
- The present ecological condition of the watercourses was determined using the national River Health Programme and Wet-Health methodologies;
- The ecological importance and ecological sensitivity (EI&ES) assessment of the watercourses were conducted according to the guidelines as developed by DWAF (1999); and
- Recommendations are made concerning the adoption of buffer zones within the sites were based on watercourse functioning and site characteristics as well as the DWS buffer tool.

The freshwater features in the wider study area consist primarily of a minor non-perennial tributary of the Vaal River and several valley bottom, seep and depression wetland areas. The tributary of the Vaal River arises as two feeder streams within the study area and drains northwards to join the Vaal River approximately 6 km north of the sites. The watercourses and wetland areas are relatively disturbed and are in general surrounded by agricultural activities. As mentioned above, due to the seasonal wetness of the aquatic features, the agricultural activities have largely avoided these areas, and they still comprise mostly indigenous vegetation with localised invasions of alien plants where there has been more disturbance.

Some depression wetlands are scattered within the sites, together with seeps and valley bottom wetlands largely associated with the streams. Vegetation associated with the watercourse and wetland areas comprises largely of grasses such as *Eragrostis inamoena, Eragrostis plana, Cynodon dactylis* and *Paspalum dilatatum,* with sedges and rushes such as *Kyllinga alba, Cyperus congestus, Cyperus rupestris,* and *Juncus spp.* The watercourse and wetlands vary slightly in condition but tend to be impacted by the surrounding agricultural activities. Only the larger wetlands within and adjacent to the site are mapped as FEPA Wetlands as well as the National Wetland Map and the Free State Biodiversity Plan.

The DFFE Screening Tool mapping for Aquatic Biodiversity Combined Sensitivity has mapped the wider study area as being of low sensitivity, with only the larger wetlands mapped as being of very high sensitivity. This assessment has found the larger aquatic features on-site to be of moderate sensitivity and the smaller features to be of low sensitivity. The proposed activities should avoid impacting the larger aquatic features considered of moderate and moderate to high sensitivity.



Google Earth image with the Aquatic Ecosystem Sensitivity mapping where the green area indicates low sensitivity and the orange the medium sensitivity areas. The recommended setback areas of 100m are indicated by the yellow polygons and the entire area by the pink polygon.

The overall impact significance of the proposed PV facilities is provided in the table below for the lifespan of the project.

Overall Impact Significance (Post Mitigation):

Phase	**Overall Impact Significance**
Construction	Low
Operational	None
Cumulative Impact	**Overall Impact Significance**
Cumulative - Construction	Low
Cumulative - Operational	Low

Appendix D: Impact Assessment Methodology

Impacts are evaluated and assessed in terms of the following criteria:

Extent of impact	***Explanation of extent***
Site	*Impacts limited to construction site and direct surrounding area*
Local	*Impacts affecting environmental elements within the local area / district*
Regional	*Impacts affecting environmental elements within the province*
National	*Impacts affecting environmental elements on a national level*

Duration of impact	***Explanation of duration***
Short term	*0 - 5 years. The impact is reversible in less than 5 years.*
Medium term	*5 - 15 years. The impact is reversible in less than 15 years.*
Long term	*>15 years, but where the impacts will cease if the project is decommissioned*
Permanent	*The impact will continue indefinitely and is irreversible.*

Probability of impact	***Explanation of Probability***
Unlikely	*The chance of the impact occurring is extremely low*
Possible	*The impact may occur*
Probable	*The impact will very likely occur*
Definite	*Impact will certainly occur*

Reversibility of impact	***Explanation of Reversibility Ratings***
Low	*The affected environment will not be able to recover from the impact - permanently modified*
Medium	*The affected environment will only recover from the impact with significant intervention*
High	*The affected environmental will be able to recover from the impact*

Significance of impact	***Explanation of Significance***
None	*There is no impact at all*
Low	*Impact is negligible or is of a low order and is likely to have little real effect*
Moderate	*Impact is real but not substantial*
High	*Impact is substantial*
Very high	*Impact is very high and can therefore influence the viability of the project*

Appendix E: Risk Assessment

ASPECTS AND IMPACT REGISTER/RISK ASSSESSMENT FOR WATERCOURSES INCLUDING RIVERS, PANS, WETLANDS, SPRINGS,DRAINAGE LINES: Mercury PV (Northern Cluster) Facilities, Free State
COMPILED BY:Toni Belcher (SACNASP 400040/10)
DATE: June 2022

					Severity																	
Nr.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+ Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures	Confidence	Type Watercourse
	Construction	Construction of PV facility and associated infrastructure	Construction adjacent to aquatic features (assumes recommended buffers are implimented)	Direct Impacts: Disturbance of aquatic habitat and water quality; Indirect Impacts: Habitat modification and growth of invasive alien riparian vegetation	1	2	2.5	2	1.875	1	2	**4.875**	1	2	5	3	**11**	**53.625**	**L**	Construction: •A buffer of at least 100 m between the significant aquatic ecosystems (larger wetlands) and all the proposed project activities should be maintained (noting that this is already honoured in the proposed layout for all facilities). Only the PV modules be placed near the delineated wetland areas of medium to high sensitivity. If the construction and operation of the modules does not require modification to the topography or removal of indigenous grassland, the modules could be placed within or immediately adjacent to wetland areas mapped as being of low sensitivity. •Clearing of indigenous vegetation should not take place within the aquatic features and the recommended buffers, while retaining the topography and cover vegetation within the wider drainage areas through the site is preferred to reduce the potential modification to the way in which water drains through these areas. •The existing road infrastructure should be utilised as far as possible to minimise the overall disturbance. •During the construction phase, site management must be undertaken at the laydown and construction areas. This should specifically address on-site stormwater management and prevention of pollution measures from any potential pollution sources during construction activities such as hydrocarbon spills. The solar panels will be washed with water and a biodegradable/ green detergent. •Any stormwater that does arise within the construction sites must be handled appropriately to trap sediments and reduce flow velocities where necessary. •Development within the wetland areas, where located within a proposed facility, will however need to consider stormwater management measures and should avoid impacting on the movement of water through the more seasonally wet areas. Minimal disturbance to the topography and cover vegetation in these areas is recommended. Operation: •Any disturbance during the operation phase should be limited to the approved development footprints and should avoid disturbance of the soil and natural vegetation cover. •Invasive alien plant growth and signs of erosion should be monitored on an ongoing basis to ensure that the disturbed areas do not become infested with invasive alien plants. •Stormwater run-off infrastructure must be maintained to mitigate both the flow and water quality impacts of any stormwater leaving developed areas. •Any water supply, sanitation services as well as solid waste management services that should be required for the site should preferably be provided by an off-site service provider. In a scenario where services are installed, these systems need to be adequately installed and maintained to prevent any potential contamination of the water resources on site.	High	Minor tributary of the Vaal River PES: C/D; EIS: Moderate to high; Seep, Valley bottom and Depression wetlands: moderately modified ecological condition and moderate to low ecological importance and ecological sensitivity
	Operation	Operation of PV facility and associated infrastructure	Operation, maintenance and management of site	Direct Impacts: Aquatic habitat disturbance Indirect Impacts: Degradation of the ecological condition of aquatic ecosystems; modification of flow and water quality, erosion; and alien vegetation invasion in aquatic features	1	1	2	1	1	1	1	**3**	1	2	5	3	**11**	**33**	**L**			