APPENDIX E

SPECIALIST STUDIES

APPENDIX E1: Wetland Baseline and Impact Assessment

Wetland Delineation and Risk Assessment for the Proposed Parys Solar PV Development, Free State

June 2022

Client

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Report Name	**Wetland Delineation and Risk Assessment for the Proposed Parys Solar PV, Free State**
Reference	Wetlands Parys Solar PV
Submitted to	NEMAI CONSULTING
Report Writer	Tyron Clark (Meraki Consulting) (Pr. Sci. Nat. 121338)
Report Review	Andrew Husted (Pr. Sci. Nat. 400213/11)
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Ecological Assessment Regulations, 2014 (amended 2017). We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

Main channelled valley-bottom wetland

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Declaration

I, Tyron Clark 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.

Tyron Clark

Pr. Sci. Nat. 121338

June 2022

1 Introduction

This report represents the wetland baseline and impact (risk) assessment for the proposed establishment of Parys solar photovoltaic (PV) development. The presence of wetlands within the development area (hereafter reffered to as the project area) triggers the need for this wetland delineation and risk assesmment. The project area is situated 6 km south-east of Parys in the Free State Province. Access is from the R723.

This assessment was conducted in accordance with the 2014 EIA Regulations (No. R. 982-985, Department of Environmental Affairs, 4 December 2014) emanating from Chapter 5 of the National Environmental Management Act (Act No. 107 of 1998). The findings and information herein is in terms of Appendix 6 of the 2014 NEMA EIA Regulations (amended in 2017). Further to this a risk assessment was conducted in line with Section 21 (c) and (i) of the National Water Act, 1998 (NWA) (Act No 36 of 1998).

Although no protocols are specifically stated for wetlands, this study has also taken cognisance of the requirements for aquatic studies in the recently published Government Notice 320 in terms of NEMA dated 20 March 2020: “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation”.

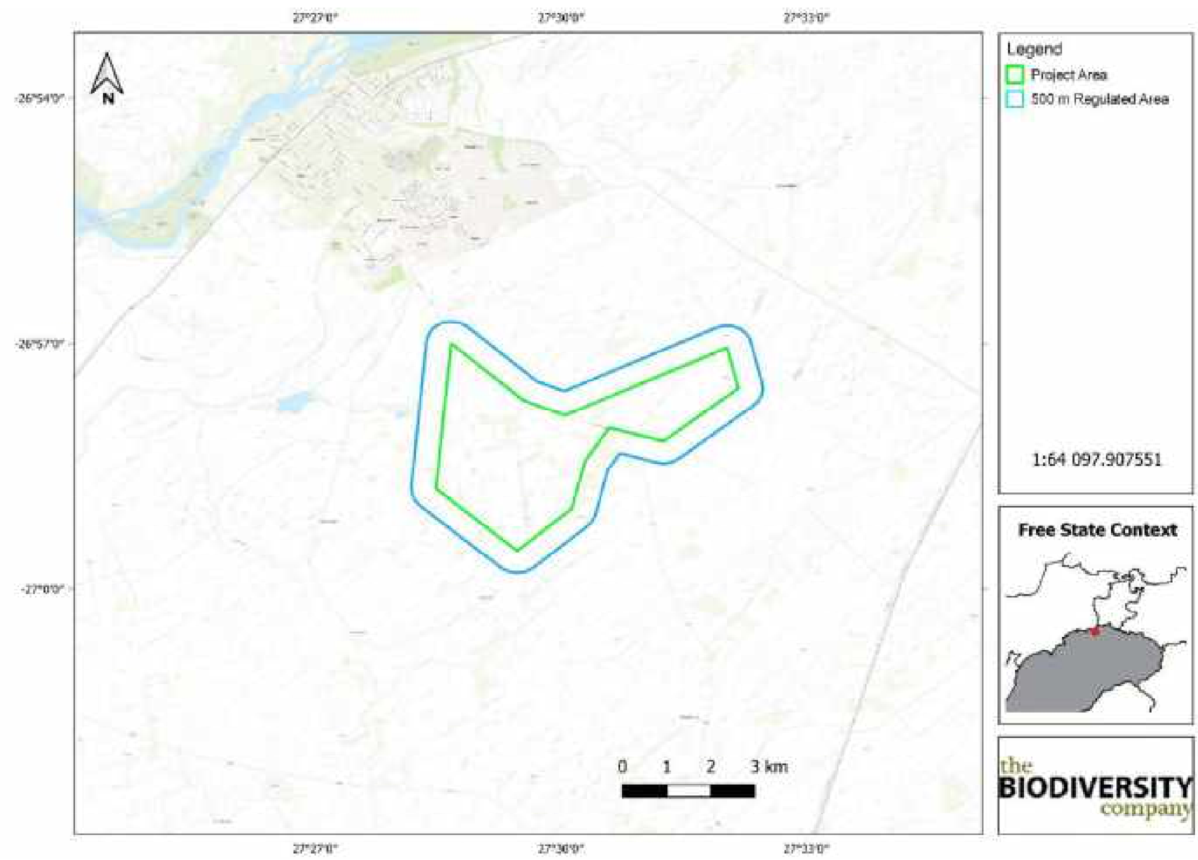

Figure 1-1 Project location

1.1 Terms of Reference

The aim of the study was to provide a wetland and risk assessment for the establishment of the proposed Pistins Race Vodacom Tellecomunication Tower. This was achieved through the following:

- The identification, deliniation and classiication of wetlands within the project area;
- Complete a functional assessment of the wetalnds;
- A risk assessment for the proposed development; and
- The prescription of mitigation measures and recommendations for identified risks.

2 Key Legislative Requirements

2.1 National Water Act (NWA, 1998)

The Department of Human Settlements Water and Sanitation (DHSWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998 – NWA) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means;

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

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

2.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (Act No. 107 of 1998 – NEMA) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation application process needs to be followed. This could follow either the Basic Assessment (BA) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. New regulations were gazetted (43110) on the 20 March 2020 which have replaced the requirements of Appendix 6 of the Environmental Impact Assessment Regulations. These regulations provide the criteria and minimum requirements for specialist's assessments in order to consider the impacts on aquatic biodiversity for activities which require Environmental Authorisation (EA).

3 Receiving Environment

3.1 National Freshwater Ecosystem Priority Area Status

To better conserve aquatic ecosystems, South Africa has categorised its river and wetland systems according to set ecological criteria to identify Freshwater Ecosystem Priority Areas (FEPAs) (Driver *et al.,* 2011). The FEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act (NEM:BA) biodiversity goals (Nel *et al.,* 2011). Figure 5-2 shows the location of the project area in relation to wetland FEPAs. Based on this information, the project area does not overlap with any class 1 FEPA Rivers but does overlap one small FEPA wetland, a small depression in the south-east of the project area (Figure 3-1).

3.2 National Wetland Map 5

The National Wetland Map 5 spatial data was published in October 2019 (Deventer et al. 2019) in collaboration with SANBI with the specific aim of spatially representing the location, type and extent of wetlands in South Africa. The data represents a synthesis of a wide number of official watercourse data including rivers, inland wetlands and estuaries. This database recognises the presence of the small pan in the south-eastern corner of the project area and classifies it as a Least Concern Dry Highveld Grasslands Depression (Figure 3-2).

3.3 Free State Biodivea Dry Highveld Grasslands rsity Conservation Plan

The Free State Conservation Plan classified areas within the province on the basis of its contribution to reach the conservation targets within the province. These areas are classified as Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) to ensure sustainability in the long term. The CBAs are classified as either 'Irreplaceable' (must be conserved), or 'Important'. Critical Biodiversity Areas (CBAs) 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. According to this spatial dataset, part of the valley-bottom wetland and surrounding grasslands near the access gate is classified as CBA 2. Most non-cultivated areas are classified as Other Natural Areas or ONAs while all croplands are classified as Degraded. (Figure 3-3).

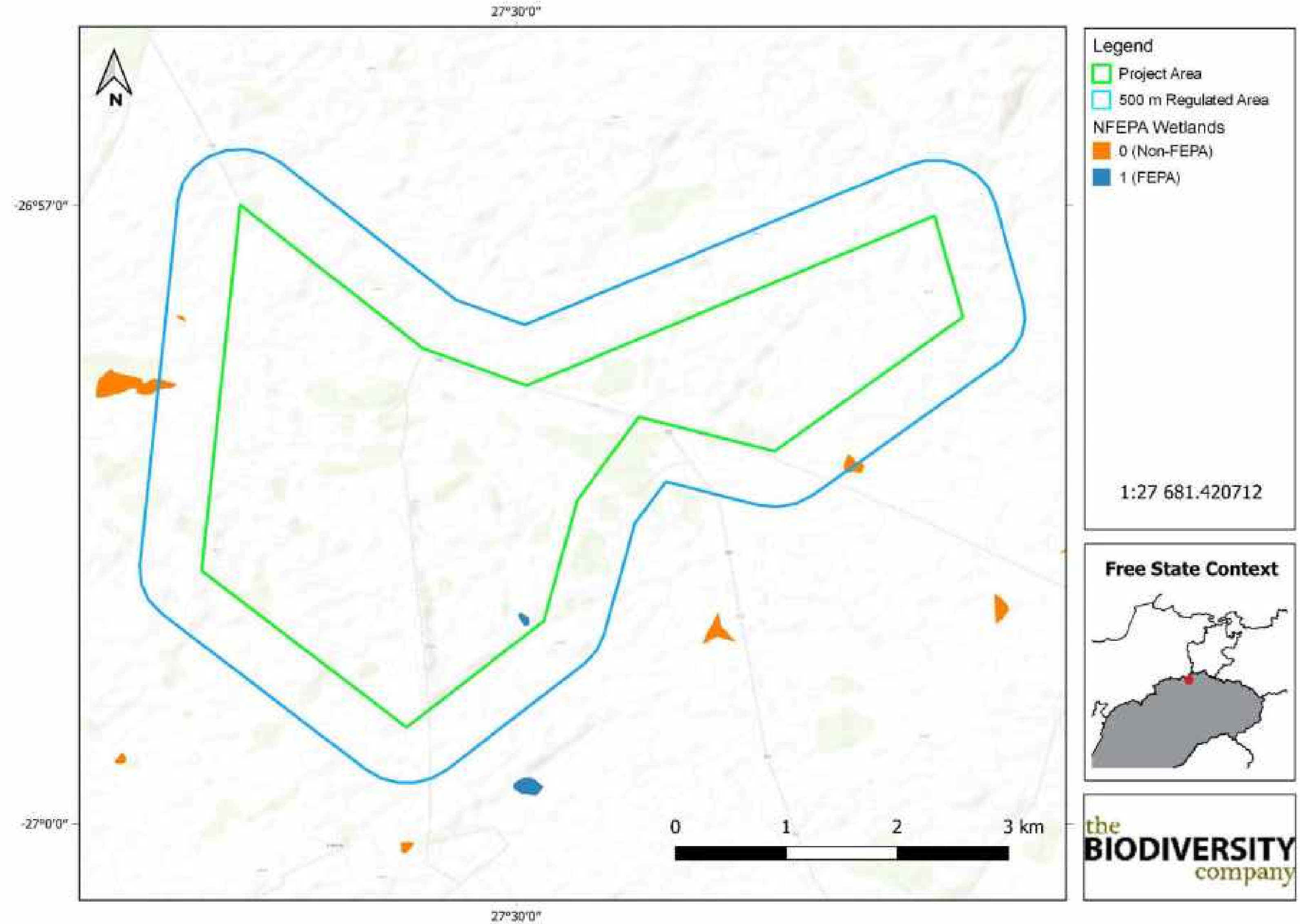

Figure 3-1 *NFEPA Rivers and Wetlands (no NFEPA listed Rivers occur within the 500m regulated area)*

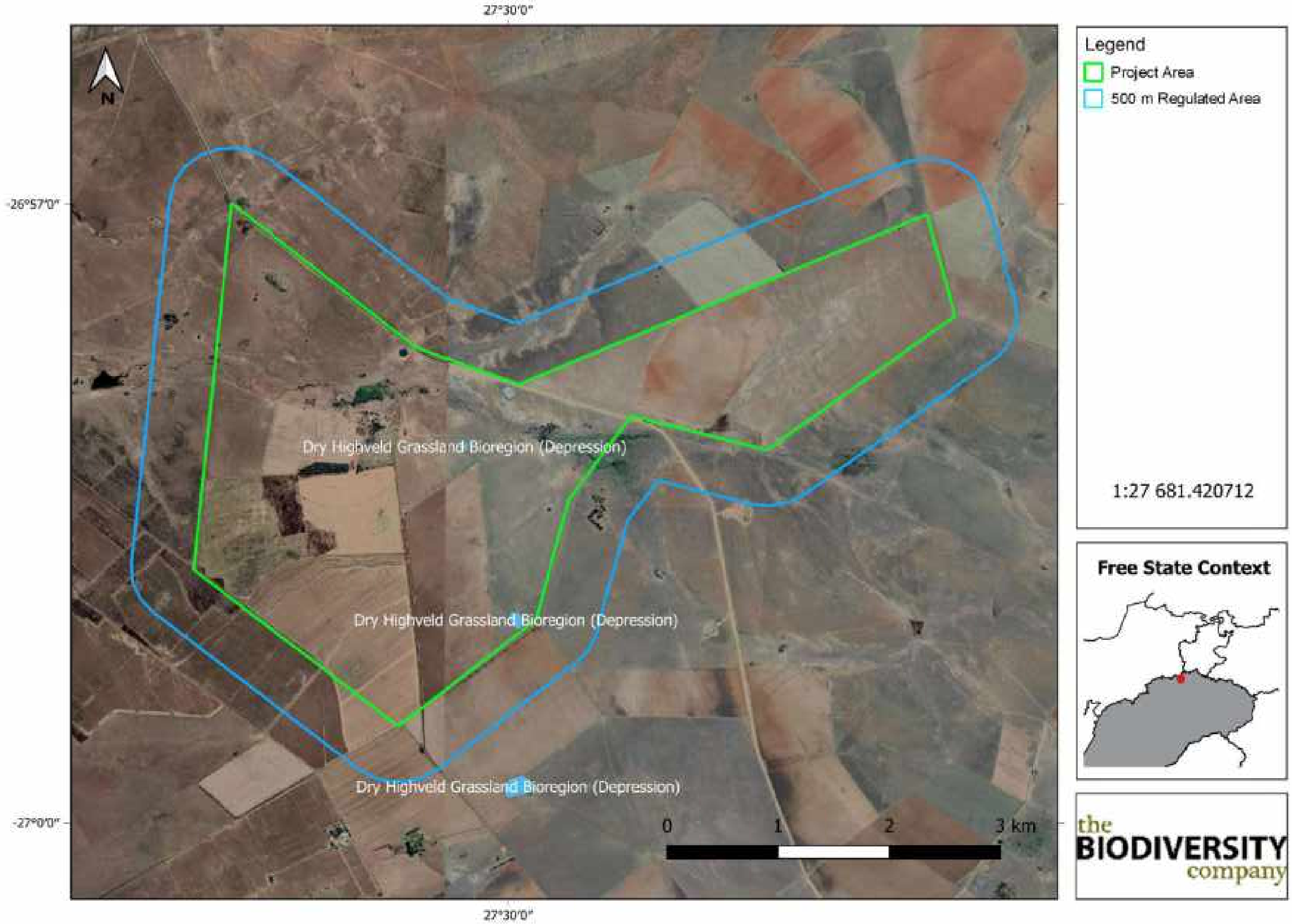

Figure 3-2 National Wetland Map 5

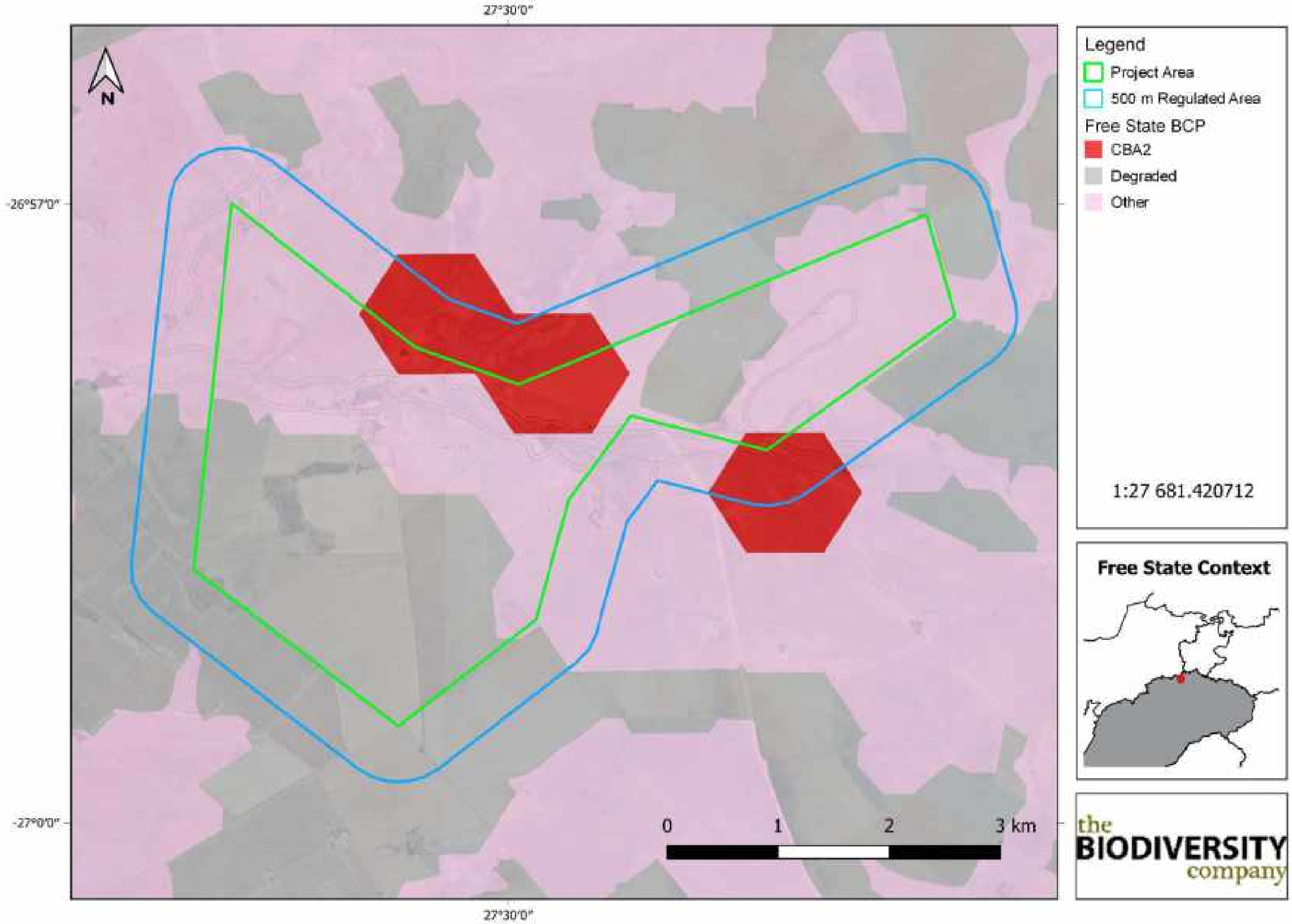

Figure 3-3 *Free State Biodiversity Conservation Plan*

4 Methodology

4.1 Desktop Research

The following spatial datasets were utilised:

- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- South African Inventory of Inland Aquatic Ecosystems (Van Deventer *et al*., 2019);
- The National Freshwater Ecosystem Priority Areas (Nel *et al*., 2011);
- Contour data (5m);
- NASA Shuttle Radar Topography Mission Global 1 arc second digital elevation data; and
- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer, H., et al., 2018).

4.2 Wetland Identification and Mapping

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

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 4-1. The outer edges of the wetland areas were identified by considering the following four specific indicators:

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

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

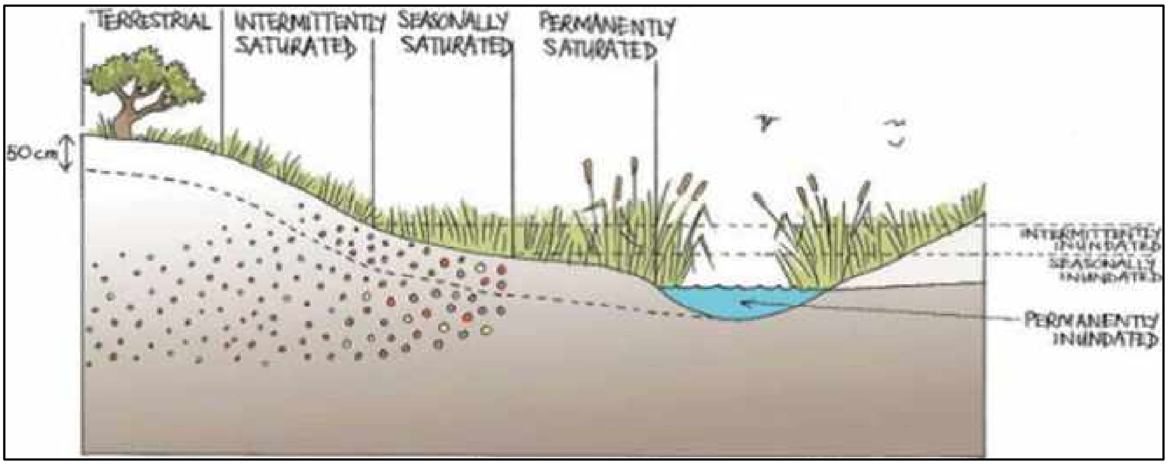

Figure 4-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013).

4.3 Present Ecological Status (PES)

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present State categories are provided in Table 4-1.

Table 4-1 The Present Ecological Status categories (Macfarlane et al., 2009)

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

4.4 Ecological Importance and Sensitivity (EIS)

The method used for the EIS determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 4-2 (Rountree and Kotze, 2013).

Table 4-2 Description of Ecological Importance and Sensitivity categories

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

4.5 Ecological Classification and Description

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this assessment. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and also then includes structural features at the lower levels of classification (Ollis *et al*., 2013).

4.6 Determining Buffer Requirements

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane and Bredin, 2017) was used to determine the appropriate buffer zone for the proposed activity.

4.7 Risk-based Impact Assessment

The risk-based impact assessment was conducted in accordance with the DHSWS risk-based water use authorisation approach and delegation guidelines. The significance of the impact is calculated according to Table 4-3.

Table 4-3 Significance ratings matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s)impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

4.8 Limitations and Assumptions

The following aspects were considered as limitations and assumptions;

- Fieldwork and consequently the results of this assessment were limited to the area for which access was made possible;
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side; and
- All information provided by the client was taken as both truthful and correct.

5 Results and Discussion

5.1 Wetland Classification and Extent

In total six wetland hydrogeomorphic (HGM) units belonging to four HGM types (channelled valley-bottom, unchanneled valley-bottom, hillslope seeps and depressions) were identified both within the 500 m regulated area and the project area. Although all six wetland HGMs within the 500 m regulated area were identified and mapped only HGMs 1-3 have the potential to be adversely impacted by the solar PV development and as such they are assessed in detail in this report.

Figure 5-1 Wetland HGMs in the project area: A) HGM1, B)HGM2 and C) HGM3

The most prominent wetland feature is the relatively wide channelled valley-bottom that flows east to west across the central portion of the project area. The wetland is a tributary of the Skulpspruit. This wetland is an upper catchment system and exhibits a very weekly defined and discontinuous channel, and in many respects functions more like an unchanneled valley-bottom. The level 1-4 classification for these HGM units as per the national wetland classification system (Ollis *et al.,* 2013) is presented in (

Table 5-1). A map showing the extent of these wetlands is shown in Figure 5-2.

Table 5-1 Wetland classification as per SANBI guideline (Ollis et al. 2013).

Wetland System	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	Highveld	Dry Highveld Grasslands Group 4	Valley Floor	Channelled valley-bottom	NA	N/A
HGM 2	Inland	Highveld	Dry Highveld Grasslands Group 4	Slope	Seep	Without Channelled Outflow	N/A
HGM 3	Inland	Highveld	Dry Highveld Grasslands Group 4	Bench	Depression	Endorheic	Without channelled inflow
HGM 4	Inland	Highveld	Dry Highveld Grasslands Group 4	Valley Floor	Unchannelled valley-bottom	NA	N/A
HGM 5	Inland	Highveld	Dry Highveld Grasslands Group 4	Slope	Seep	Without Channelled Outflow	N/A
HGM 6	Inland	Highveld	Dry Highveld Grasslands Group 4	Bench	Depression	Endorheic	Without channelled inflow

A summary of the extent (ha) of each wetland HGM unit as well as the extent of the buffers and terrestrial (non-wetland) habitat is given in

Table 5-1 for both the project area (site) as well as the broader 500 m regulated area surrounding it. From this table it is immediately apparent that wetlands occupy 123.44 ha within the project area, which represent a relatively small proportion (10.09%) of the available land within the project area. When including the prescribed wetland buffers this increases to 172.44 ha or 14.10%. The excavations do accumulate water periodically but are dry for most of the year, are largely devoid of hydromorphic vegetation and have limited to no wetland functionality and could be considered as terrestrial habitats. Given the size and spatial arrangement of wetlands, complete avoidance should be possible and any development within wetland areas is discouraged.

Table 5-2 A summary of the extent (ha) of each wetland and non-wetland resources

Feature	HGM type	Area (ha) 500 m	Area (ha) Site	Proportion of Site (%)
HGM1	Channelled valley-bottom	131.32	73.804	6.03
HGM2	Seep	62.377	46.36	3.79
HGM3	Depression	2.134	2.134	0.17
HGM4	Unchannelled valley-bottom	25.648	1.137	0.09
HGM5	Seep	6.089	0	0.00
HGM6	Depression	0.971	0	0.00
Wetland Buffer	-	99	49	4.01
Excavations		0.967	0.967	0.08
Terrestrial	-	1938.273	1049.921	85.83
Total		**2266.779**	**1223.269**	
		Summary		
Terrestrial and Excavations		**1939.24**	**1050.888**	**85.91**

All Wetlands	**228.539**	**123.435**	**10.09**
All Wetlands & Buffers	**327.539**	**172.435**	**14.10**

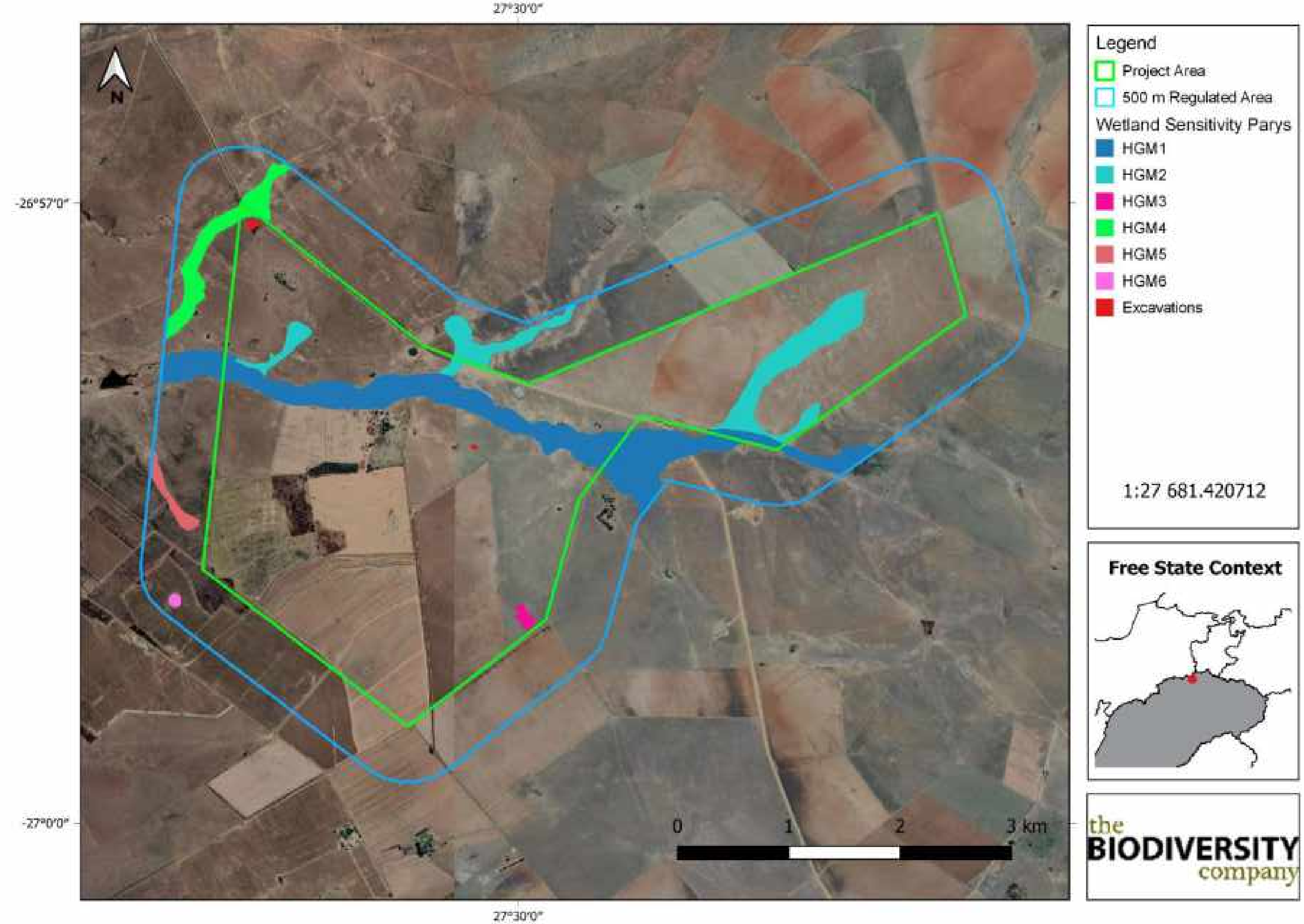

Figure 5-2 *Wetlands delineated within the 500 m regulation area around the proposed project area*

5.2 Wetland Description

5.2.1 Soils

The geology of the project area is characterised by its position within the core zone of the Vredefort Dome, an area of upliftment caused by a meteorite impact at 2.02 Ga. The lithology is comprised of a mix of igneous and sedimentary rocks. The project area is situated in the core zone, an area comprised of Archaean granitic basement rocks (Fagareng et al. 2007). These include primarily migmatite, gneiss and ultrametamorphic rocks of the Transvaal-Northern Cape Belt of Metamorphism and Granitization (Archaean Complex).

The project area comprises two Land Types, both of which are dominated by sandy soils overlying a plinthic horizon. The main channelled valley-bottom wetland forms the boundary between the two. Land to the north of the wetland is classified as Land Type Ba38 which is characterised by dystrophic and/or mesotrophic; red soils. In contrast land to the south of this wetland represents Land Type Bd17, characterised by deep sandy soils, plinthic catena and general lack of eutrophic red soils.

In the project area, soil sampling in wetlands revealed clay rich Rensburg soils. These soils consisted of a gritty dark grey to black vertic A horizon underlain by a calcerous G horizon. In contrast, soil sampling in terrestrial areas yielded sandier Hutton soils. Examples of these soil form are shown in Figure 5-3.

Figure 5-3 Wetland soils observed in the project area A) clay rich A horizon over B) calcerous G horizon

5.2.2 Vegetation

Aquatic plants occupying permanently inundated zones included *Marsilea* sp. and *Persicaria* sp. Emergent hydrophytes in the permanent to seasonal zones fringing the active channel of HGM 1 included mainly *Cyperus fastigiatus, Paspalum* cf. *scrobiculatum* and *Cyperus longus* with small patches of *Cyperus congestus*, *Juncus effuses*, *Schoenoplectus brachyceras* and *Crinum bulbispermum*. Portions of HGM 1 are encroached by dense stands of *Salix babylonica* and *Populus* x *canescen*s. Some of these plants are shown in Figure 5-4.

Figure 5-4 Wetland associated vegetation observed on site *A) Cyperus longus, B) Cyperus fastigiatus C)* Marsilea *sp, D) Paspalum cf. scrobiculatum, E) Crinum bulbispermum*

5.3 Wetland Ecosystem Services

The ecosystem services provided by each wetland HGM unit identified within the project area were assessed and rated using the latest WET-EcoServices Version 2 system and associated spreadsheets (Kotze *et al*. 2021). The summarised results of this assessment are shown in Table 5-3. Overall the wetlands provide mainly provisional (water, and food for livestock) and regulating services (sediment trapping and water quality enhancement) but provide little in the way of cultural benefits (other than providing fair-good reference sites for research and medicinal plants).

Table 5-3 Summary of the ecosystem services scores

	Ecosystem Service	Importance Score		
		HGM1	HGM2	HGM3
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.3	0.0	0.0
	Stream flow regulation	1.3	1.2	0.0
	Sediment trapping	3.3	1.4	0.3
	Erosion control	1.5	0.7	0.7
	Phosphate assimilation	3.3	1.9	0.2
	Nitrate assimilation	3.2	1.8	0.3
	Toxicant assimilation	2.3	0.9	0.0
	Carbon storage	2.4	1.3	1.6
	Biodiversity maintenance	3.4	2.5	3.0
PROVISIONING SERVICES	Water for human use	3.2	0.3	0.0
	Harvestable resources	1.7	0.0	0.0
	Food for livestock	2.0	2.7	1.7
	Cultivated foods	1.0	1.4	0.8
CULTURAL SERVICES	Tourism and Recreation	1.8	0.0	0.0
	Education and Research	1.5	0.4	1.0
	Cultural and Spiritual	1.7	0.5	0.5

Rating Categories		Very Low	0-0.79
Low	0.8 – 1.29	Mod-Low	1.3 – 1.69
Moderate	1.7 – 2.29	Mod-High	2.3 – 2.69
High	2.7 – 3.19	Very High	3.2 - 4.0

Table 5-3 highlights the significance of the main channelled valley-bottom wetland (HGM 1) in providing a wide diversity of highly important ecosystem services. The shallow longitudinal gradient, broad cross-sectional profile, presence of small dams and high channel sinuosity of this wetland makes it very effective in trapping sediments received from croplands in the catchment. This together with a dense covering of hydromorphic vegetation across a broad permanent-seasonal zone makes the wetland very effective at water quality enhancement through trapping and assimilating organic nutrients (e.g. nitrates and phosphates) and toxicants. Given the largely undeveloped nature of the catchment, the water purification benefits, periodicity of supply and dependency of people on this water for agricultural purposes this wetland is considered highly important in terms of water provision for human use. Although the wetland is not likely to support viable populations of any Threatened species, it is considered very important from a general biodiversity maintenance perspective. This is based on the ecological connectivity with other wetlands and aquatic habitats, the general intactness of the vegetation (barring one alien bushclump) and its statedgic importance interms of meeting national and regional conservation plan targets (Endangered threat status with a portion zoned as CBA2)

In contrast, the seeps (HGM 2) are much drier and more sparsely vegetated. As such, the magnitude of their ecosystem service provision is lower. However, these wetlands are still considered important from a biodiversity maintenance (Critically Endangered) and livestock grazing perspective (mostly grassed).

Lastly the depression (pan) in the south-western corner of the project area (HGM 3) is too small and hydrologically isolated to provide any appreciable levels of ecosystem services other biodiversity maintenance (as it remains in a largely natural state).

5.4 Wetland Health

The present ecological state (PES) of the wetlands identified within the project area is provided in Table 5-4. Overall, the NFEPA listed depression (HGM 3) was found to be the most intact wetland with a PES of Largely Natural (Class B) while the channelled valley-bottom (HGM 2) and seeps (HGM 3) were rated as Moderately Modified (Class C).

Although most of the channelled valley-bottom (HGM 1) remains in a largely intact and natural state the wetland has been somewhat degraded by a number of minor impacts. These include crop farming in the catchment, flow impediment (small dam at the confluence near the eastern boundary and a narrow road crossing) as well as patches of alien and invasive vegetation which includes one large clump of *Salix babylonica* and *Populus* x *canescens* near the farmstead. The flow impeding features are, however, minor and appear to have had little effect on the geomorphology of the wetland and the sediment regime remains in a stable to very slightly erosive state.

The seeps (HGM 2) are, for the most part, closely surrounded by current or past croplands. Additionally these wetlands are heavily utilised for cattle grazing and predominantly dry and only temporarily inundated. Hydromorphic vegetation is sparse or missing altogether. The hydrological regime of the seeps remains relatively intact but some impacts from increased floodpeaks and sedimentation following heavy rainfall is anticipated. Otherwise the geomorphology remains largely intact and no signs of erosion are evident, which is likely aided by the clay rich soils and low inundation levels. The main impact to these wetlands is from significant encroachment by croplands and utilisation by cattle.

The NFEPA listed depression in the south-west (HGM3) remains in a largely natural state. It has been excluded from crop farming and is only negligibly impacted by cattle grazing.

Table 5-4 Summary of the scores for the wetland PES

Wetland	Hydrology	Geomorphology	Vegetation	Overall
HGM 1	C: Moderately Modified (3)	C: Moderately Modified (2.2)	C: Moderately Modified (3.2)	C: Moderately Modified (2.9)
HGM 2	C: Moderately Modified (2.5)	C: Moderately Modified (2)	B: Largely Natural (1.8)	**C: Moderately Modified (2.2)**
HGM 3	B: Largely Natural (1.5)	B: Largely Natural (1.3)	B: Largely Natural (1.9)	B: Largely Natural (1.6)

5.5 The Ecological Importance and Sensitivity

The results of the ecological and importance (EIS) assessment are shown in Table 5-5. At a regional scale the NFEPA Wetveg database recognises Dry Highveld Grassland Group 4 channelled valley-bottoms (HGM1) and seeps (HGM2) as Critically Endangered, while depressions (HGM3) are classified as Least Threatened (Nel and Driver, 2012). None of the wetlands within the project area or the 500 m regulated surrounding it are recognised as NFEPA rivers. However, the depression (HGM3) is recognised as a wetland FEPA. Portions of HGM1 is zoned as CBA 2. The National Wetland Map 5 does not list updated conservation statuses for any the wetlands in the project area nor does it recognise any wetland other than the depression.

At a more local scale, only HGM1 is rated as having a High EIS on account of its largely natural vegetation, large size, high saturation levels and importance for general biodiversity maintenance. The seeps (HGM2) are considered to have a Moderate EIS as they are intermediary in size and intactness, have a moderate to low habitat diversity and are only temporarily inundated and thus are only considered to have a Moderately-High importance in terms of maintaining biodiversity. Although largely natural the depression (HGM3) is small, isolated and lacks habitat diversity and is thus considered to have a low ecological importance.

Table 5-5 The Ecological Importance and Sensitivity results for the wetland area

Aspect	HGM 1	HGM 2	HGM 3
Ecological Importance & Sensitivity	H (2.5)	M (1.5)	L (0.8)

6 Sensitivity and Buffer Analysis

A map was produced to visually represent the sensitivity of the wetlands based on the findings of the wetland assessment (Figure 6-1). With the exception of the highly degraded HGMs 5 and 6 which occur outside project area but within 500 m regulated area (rated as Moderate sensitivity) all wetlands were classified as having a High sensitivity. All wetland buffers were assigned a Moderate sensitivity. All other non-wetland areas including excavations within the 500 m regulated area were assigned a Low sensitivity from a wetland perspective.

The "*Buffer zone guidelines for wetlands, rivers and estuaries*" (Macfarlane and Bredin 2017) was used to determine the appropriate wetland buffer zone for the proposed activity, in this case renewable energy. The channelled valley-bottom (HGM1) and unchanneled valley-bottom (HGM4, outside project area) was assigned a minimum development buffer of 41 m. This was based primarily on their Moderately Modified PES and High EIS combined with the potential for increased sediments and turbidity as a result of the construction of the PV farm.

The seeps (HGM2 and 5), depressions (HGM3 and 6) and western-most unchanneled valley-bottom (HGM 5) were assigned a buffer of 29 m. The main impacts influencing the buffer determination tool, in all instances, included increase in sediment inputs & turbidity as well alteration of floodpeaks.

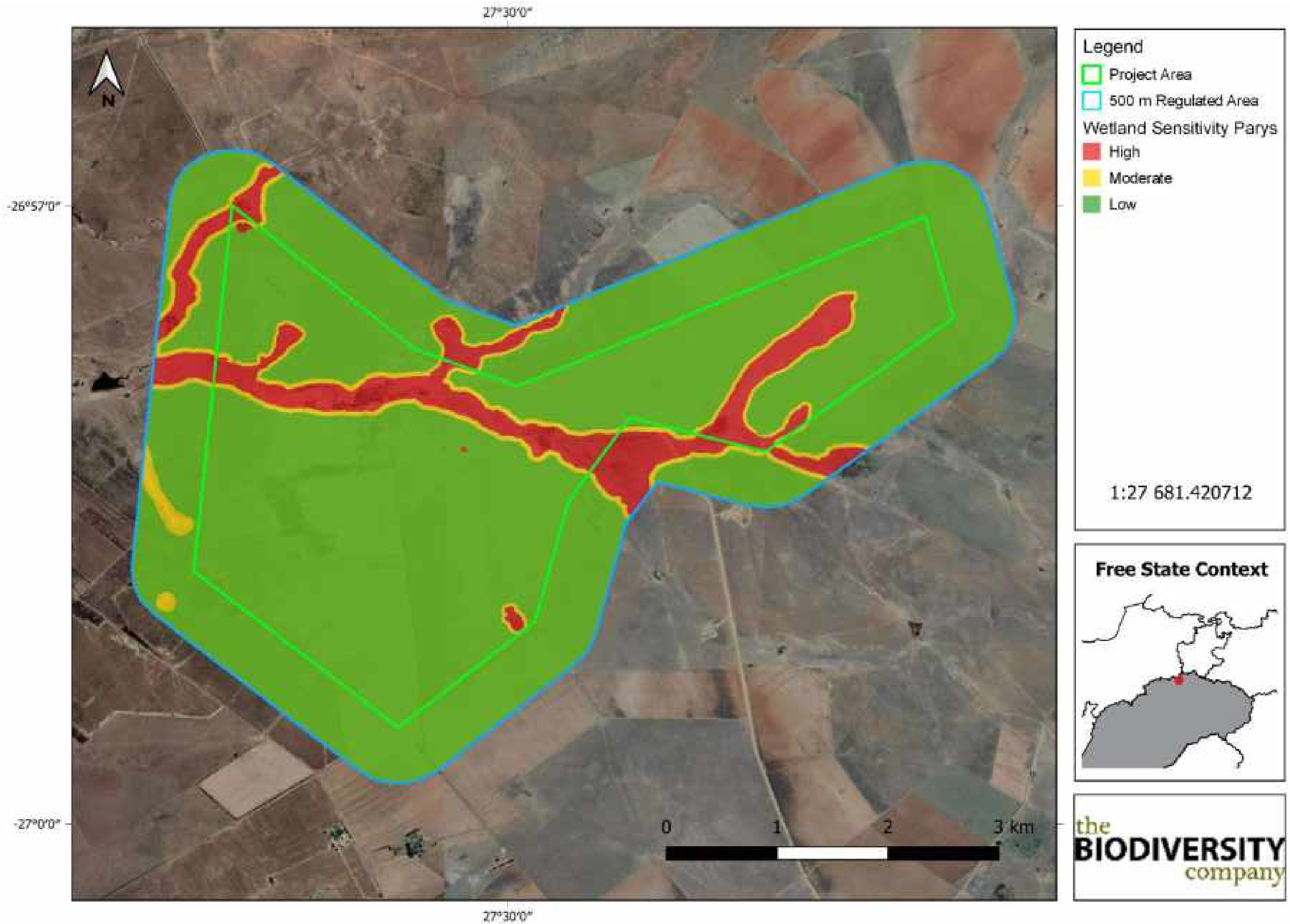

Figure 6-1 Wetland sensitivity map

7 Risk-based Impact Assessment

This risk-based impact assessment was conducted in line with Section 21 (c) and (i) of NWA to investigate the level of risk posed by the construction and operation of the proposed solar PV farm. Table 7-1 lists the potential risks posed by the development to the identified wetlands (HGMs 1-6). Significance ratings for each identified risk are given for scenarios with and without mitigation.

It is mentioned that the solar PV panels will be bifacial and that, as a consequence, the ground beneath the PV grid will be completely cleared. Although the vegetation in most of the seeps is short, sparse, heavily overgrazed and in most places devoid of obligate hydrophytes (if not completely cleared by agriculture), the clearing of what little vegetation exists beneath the PV grids introduces a number of challenges. This is because vegetation plays an important role in the maintenance of hydrological and sediment regimes in wetlands. Removal of vegetation, particularly in the seep zones has the potential to decrease infiltration and increase surface runoff. It also has the potential to result in erosion of the seep zones while at the same time increasing sediment loads and potentially toxicants delivered to the valley-bottom wetlands.

However, given the small spatial extent of wetlands relative to the total project area and their amicable spatial arrangement within the project area, complete avoidance of wetlands and their buffers is entirely possible and is strongly advocated in this case. Excluding the wetlands and their prescribed buffers 1050.88 ha developable land remains representing 85.91 % of the project area. This risk assessment thus assumes full avoidance of the identified wetlands and their prescribed buffers (Figure 7-1). Any development within the wetlands would require strong motivation, would constitute a Very High residual impact rating and would warrant a full water use licence application and the development and implementation of a comprehensive wetland offset strategy.

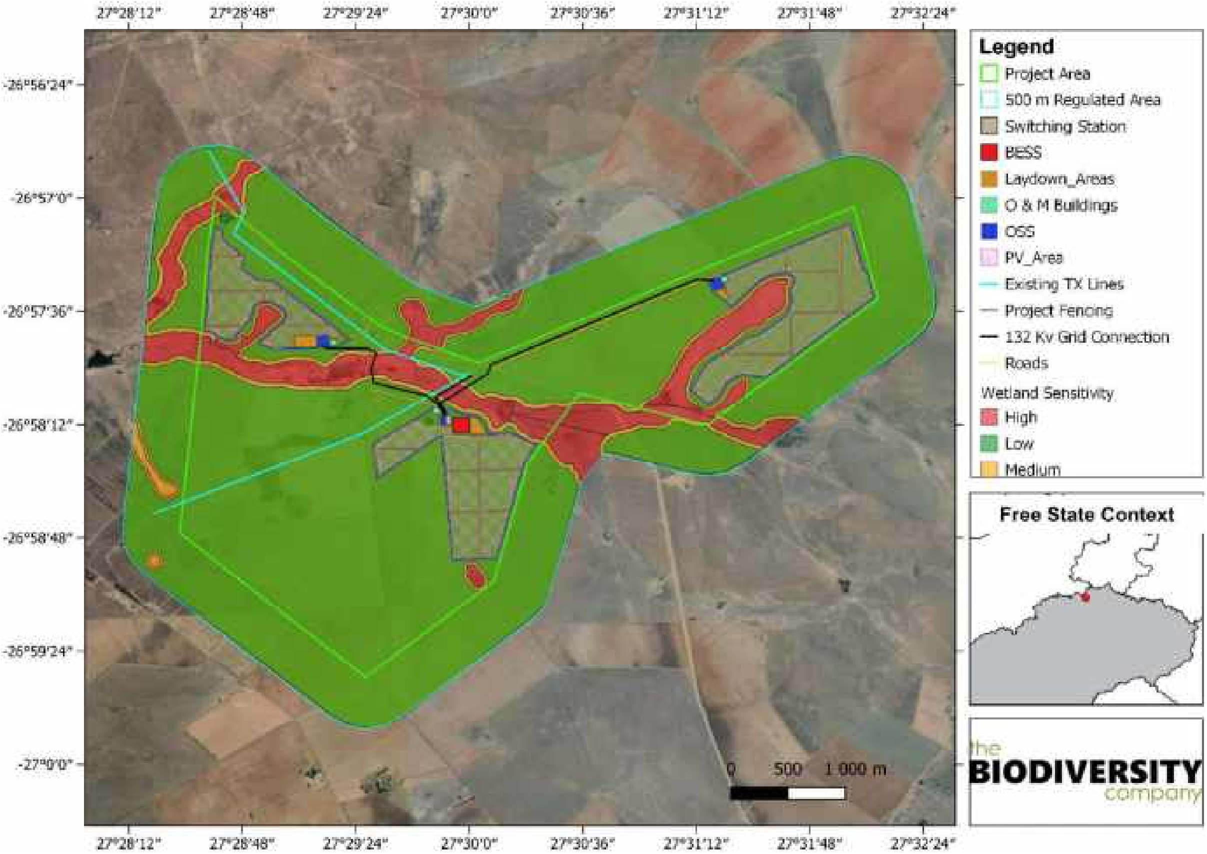

Figure 7-1 The delineated wetlands in relation to the proposed layout

Considering full avoidance the main risks which remain centre on increased floodpeaks, sedimentation and erosion especially to HGM1. This risk is likely to stem from the exposed soil surfaces created during clearing in the construction phase but also during operation from maintaining cleared surfaces beneath the bifacial solar panels. The key objective should be to as far as possible increase the permeability and drainage of the soil beneath the solar panels while reducing the loss of sediments from this area during rainfall. The following mitigation measures are proposed in light of the above:

- Use the wetland shapefiles provided by TBC to clearly demarcate (on the ground) the edge of the buffer on valley-bottom (41 m buffer) and seep (29 m) wetlands. Regard all wetlands and their buffers as strict no-go areas and sign post as environmentally sensitive.
- Use existing farmers access road and crossing point across the main channelled valley-bottom wetland (HGM 1) to access the PV farm. All new roads and activities (including driving and equipment storage) must remain outside of the wetlands identified. Avoid constructing any new crossings by accessing other PV areas via new gates along the main regional sand road.
- Hold off on the clearing of vegetation as long as possible, ensuring that all environmental authorisations are in place, the site construction materials are in place and the PV infrastructure is sourced and ready prior to clearing.

- Take every measure to ensure that the bulk of the site clearing and earth moving activities take place in winter when rainfall is lowest (and the grass sward is thinnest) to minimize environmental damage, erosion, sedimentation and contamination.
- Minimize the disturbance footprint and the unnecessary clearing of vegetation outside of this area.
- Develop a sound stormwater management plan that is engineered to promote rainfall infiltration, maintain diffuse subsurface flows in seep areas, minimise the development of preferential flow paths. The stormwater plan would also benefit from Lidar based topography maps and / or site-specific contours that allow for the identification of flow paths.
- Stormwater leaving the PV areas should not be concentrated in a single exit drain but spread across multiple exit drains, each fitted with energy dissipaters (e.g. slabs of concrete with rocks cemented in).
- Consider the use of a coarse gravel beneath the solar panels to promote infiltration and minimize surface run-off and erosion during high rainfall events. The gravel should be free of heavy metal contaminants.
- Educate staff and relevant contractors on the location and importance of the identified wetlands through toolbox talks and by including them in site inductions as well as the overall master plan.
- Promptly remove / control all alien and invasive plant species that may emerge during construction (i.e. weedy annuals and other alien forbs) must be removed.
- Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash.

Table 7-1 *DWS Risk Impact Matrix for the proposed development*

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Activity	Aspect	Impact	Wetland Type	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
Construction																			
Clearing and preparation of PV footprint and access roads	Disturbance of wetland habitat.	Loss or degradation of wetland vegetation.	Without	4	4	4	5	4.3	2	5	11	4	4	5	3	16	180	H	• Use the wetland shapefiles provided by TBC to clearly demarcate (on the ground) the edge of the buffer on the valley-bottom (41 m buffer) and seep (29 m) wetlands. Regard these as strict no-go areas and sign post as environmentally sensitive. • All activities (including driving and equipment storage) must remain outside of the wetlands identified. • Use existing farmer's access road and crossing point across the main channelled valley-bottom wetland (HGM 1) to access the PV farm. All new roads and activities (including driving and equipment storage) must remain outside of the wetlands identified. Avoid constructing any new crossings by accessing other PV areas via new gates along the main regional sand road.
			With	1	1	2	2	1.5	2	5	8.5	2	2	1	1	6	51	L	
		Increased bare surfaces, floodpeaks and potential for erosion	Without	4	5	4	4	4.3	2	5	11	4	4	5	1	14	158	H	• Hold off on the clearing of vegetation as long as possible, ensuring that all construction materials are in place and the PV infrastructure is sourced and ready prior to clearing. • Take every measure to ensure that the bulk of the site clearing and earth moving activities take place in winter when rainfall is lowest (and the grass sward is thinnest) to minimize environmental damage, erosion, sedimentation and contamination. • Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash. • Scrape the area where mixing and storage of
			With	3	3	2	2	2.5	2	2	6.5	3	3	1	1	8	52	L	

																			sand and concrete occurred to clean and re-grass once finished. • Revegetate all accidentally cleared areas beyond the buildings as soon as possible
		Introduction and spread of alien and invasive vegetation	Without	2	2	4	4	3	2	5	10	3	3	5	1	12	120	M	• Promptly remove all alien and invasive plant species that may emerge during construction (i.e. weedy annuals and other alien forbs) . • Appropriately stockpile topsoil cleared from the site. • Minimize unnecessary clearing of vegetation beyond the infrastructure footprints. • Lightly till any disturbed soil around the development to avoid compaction.
			With	1	1	1	1	1	1	2	4	2	1	1	1	5	20	L	
Excavation and installation of PV infrastructure.	Alteration of Hydrological Regime	Decreased flow inputs to wetlands and altered floodpeaks	Without	3	3	4	4	3.5	2	5	11	4	4	5	1	14	147	M	• Aim to maximise infiltration of rain water and maintain diffuse subsurface drainage below PVs. • Develop a sound stormwater management plan that is engineered to promote rainfall infiltration, maintain diffuse subsurface flows in seep areas, minimise the development of preferential flow paths. The stormwater plan would also benefit from Lidar based topography maps and / or site-specific contours that allow for the identification of flow paths. • Stormwater leaving the site should not be concentrated in a single exit drain but spread across multiple drains around the site each fitted with energy dissipaters (e.g. slabs of concrete with rocks cemented in). • Minimise the extent of concreted / paved / gravel areas. • Avoid excessively compacting the ground beneath the solar panels. • Introduce coarse, preferably washed, gravel beneath PV arrays.
			With	3	3	1	1	2	2	2	6	3	3	1	1	8	48	L	
	Soil disturbance	Increased sediment loads to downstream reaches	Without	4	5	4	4	4.3	2	5	11	4	4	5	1	14	158	H	• See mitigation for increased bare surfaces, runoff and potential for erosion • Introduce coarse, preferably washed, gravel beneath PV arrays.
			With	2	2	2	2	2	2	2	6	3	3	1	1	8	48	L	
Operation																			
Routine operation and maintenance	Residual vegetation disturbance	Proliferation of alien and invasive species	Without	1	1	2	2	1.5	2	5	8.5	2	2	5	1	10	85	M	• Continue to remove all alien and invasive plant species as they arise (i.e. weedy annuals and other alien forbs) . • Attempt to plant only locally indigenous plant species within the gardens.
			With	1	1	1	1	1	2	5	8	2	2	1	1	6	48	L	

	Increased contamination	Nutrient enrichment of wetlands	Without	1	5	4	4	3.5	2	5	11	4	4	5	2	15	158	H	• Make sure all excess consumables and building materials / rubble is removed from site and deposited at an appropriate waste facility. • Do not store any construction materials or equipment within any of the identified wetlands or their buffers. • Mixing of concrete must under no circumstances take place within any wetland. • Release only clean water into the environment.
			With	1	1	1	1	1	1	2	4	2	1	1	1	5	20	L	
	Altered sediment regime	Increased sedimentation from cleared ground beneath solar PV areas	Without	1	1	4	4	2.5	2	5	9.5	3	3	5	1	12	114	M	• Develop a sound stormwater management plan that is engineered to promote rainfall infiltration, maintain diffuse subsurface flows in seep areas, minimise the development of preferential flow paths. The stormwater plan would also benefit from Lidar based topography maps and / or site-specific contours that allow for the identification of flow paths. • Consider the use of a coarse heavy metal-free gravel beneath the solar panels to promote infiltration and minimize surface run-off and erosion during high rainfall events. The gravel should be free of heavy metal contaminants.
			With	1	1	1	1	1	2	2	5	3	3	1	1	8	40	L	
Decommissioning																			
Demolition	Vehicle access	Degradation of vegetation and proliferation of alien and invasive species	Without	1	4	4	4	3.3	5	3	11	3	1	1	1	6	68	M	• Decommissioning is unlikely for the foreseeable future, however, if the water supply infrastructure ever needs upgrading and needs to be moved the following is recommended: • See mitigation for the impacts on degradation of downslope wetlands and spread of alien and Invasive plants. • Alien and invasive species control should continue for a minimum of three years following decommissioning.
			With	1	1	1	1	1	1	2	4	2	1	1	1	5	20	L	
	Soil and vegetation disturbances	Increased bare surfaces, runoff and potential for erosion	Without	4	5	4	4	4.3	2	5	11	4	4	5	1	14	158	H	• See mitigation for increased bare surfaces, runoff and potential for erosion and increased sediment loads during construction • Landscape and rehabilitate project area.
			With	1	1	1	1	1	2	2	5	3	1	1	1	6	30	L	

8 Conclusion

Of the six wetland HGMs identified within the 500 m regulated area only HGMs 1-3 have the potential to be adversely impacted by the solar PV development. These wetlands were assessed in terms of their present ecological state (PES), ecosystem services and ecological importance. The anticipated impacts to these wetlands were then rated. Overall, the most prominent wetland in the project area is the relatively wide channelled valley-bottom (tributary of the Skulpspruit) that flows east to west, but seeps and a small NFEPa listed depression also occur. Of the various wetland units in the project are HGM 1 provides the most important ecosystem services (mainly relating to biodiversity maintenance sediment trapping, nutrient assimilation and provision of water for human use) and is considered to have a high ecological importance (especially in terms of meeting provincial conservation targets). This wetland is slightly impacted by alien bushclumps and flow impediments and was thus rated as Moderately Modified (Class: C). The seeps (HGM3) are very temporarily inundated and sparsely vegetated which limits their ecosystem services provision (mainly restricted to biodiversity maintenance and food for livestock). Impacts from cattle grazing and cropland encroachment affords HGM3 seeps a PES of Moderately Modified (Class: C). The most intact wetland is the small NFEPA depression (Class: B) but this wetland is small and isolated to provide meaningful ecosystem services and is considered to be of low overall ecological importance.

It is mentioned that the solar PV panels will be bifacial and that, as a consequence, the ground beneath the PV grid will be completely cleared. However, given the small spatial extent of wetlands relative to the total project area and their amicable spatial arrangement within the project area, complete avoidance of wetlands and their buffers is entirely possible and is strongly advocated in this case. This assessment assumes full avoidance of the identified wetlands and their prescribed buffers. Any development within the wetlands would require strong motivation, would constitute a Very High residual impact rating and would warrant a full water use licence application and the development and implementation of a comprehensive wetland offset strategy.

Considering full avoidance, the main risks which remain centre on increased floodpeaks, sedimentation and erosion especially to HGM1. The key objective should be to as far as possible increase the permeability and drainage of the soil beneath the solar panels while reducing the loss of sediments from this area during rainfall.

Overall, provided development of wetlands and their associated buffers is avoided and effective measures are put in place to promote infiltration below solar PVs and control run-off, sedimentation and erosion to the nearby wetlands, the project is likely to have a low overall residual risk for wetlands and should be considered viable from a wetland perspective.

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