Wetland Baseline & Risk Assessment for the proposed Droogfontein Solar Photovoltaic (PV 5) Project

Kimberley, Sol Plaatje Local Municipality, Northern Cape Province

July 2022 (Updated November 2022)

CLIENT

ENVIRONAMICS

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Report Name	**Wetland Baseline & Risk Assessment for the proposed Droogfontein Solar Photovoltaic (PV) Project PV 5**
Submitted to	ENVIRONAMICS
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Report Writer	**Rian Pienaar**
	Rian Pienaar is an aquatic ecologist with experience in wetland identification and delineations. Rian completed his M.Sc. in environmental science at the North-West University Potchefstroom Campus. Rian has been part of wetland studies for road and culvert upgrades, power station and dam construction.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

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DECLARATION

I, **Rian Pienaar** 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.

Rian Pienaar

Freshwater Ecologist

The Biodiversity Company

July 2022

1 Introduction

1.1 Background

The Biodiversity Company (TBC) was appointed to undertake a wetland baseline and risk assessment for the proposed Droogfontein Solar Photovoltaic (PV) project. The proposed project involves the development of a solar facility and associated infrastructure, located between the towns of Kimberley and Riverton in the Northern Cape province. A 500 m radius has been demarcated for this development to identify water resources within the required regulation area, this area has been referred to as the Project Area of Influence (PAOI). The extent of the development area has also been demarcated and is referred to as the project boundary.

The approach was informed by the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The approach has taken cognisance of the recently published Government Notices 320 (20 March 2020) in terms of NEMA, dated 20 March: "*Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation*" (Reporting Criteria). The National Web based Environmental Screening Tool has characterised the aquatic theme sensitivity of the project area as "Low" and "Very High".

This assessment has been completed in accordance with the requirements of the published General Notice (GN) 509 by the Department of Water and Sanitation (DWS). This notice was published in the Government Gazette (no. 40229) under Section 39 of the National Water Act (Act no. 36 of 1998) in August 2016, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 509 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 509 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM). This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation.

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

1.2 Project Description

The following project description is applicable:

- PV Panel Array - To produce up to 200MW direct current and up to 180MW alternating current, the proposed SEF will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility. The PV panels will be tilted in order to capture the most sun or using axis tracker structures to follow the sun to increase the Yield;

- Wiring to Inverters - Sections of the PV array will be wired to inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency; and

- Connection to the grid - Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is approximately 480V and this is fed into step up transformers to 132kV. An onsite facility substation and switching stations will be required on the site to step the voltage up to 132kV, after which the power will be evacuated into the national grid via the proposed new collector substation and power line. The power line route will be assessed within a 300m wide corridor.

- As there are five alternative development areas proposed for the placement of the project development footprint, the developer has identified a suitable grid connection corridor for each of the development areas which connects the facility to an existing power line located near to the development area. All grid connection corridors have a width of 300m. The respective grid connection solutions proposed for each of the alternative development areas are considered to be feasible from a technical and capacity perspective and provides an opportunity for limited linear disturbance within the landscape based on the limited power line infrastructure proposed to be developed (i.e. no power lines longer than 2.5km are required). Refer to the below.

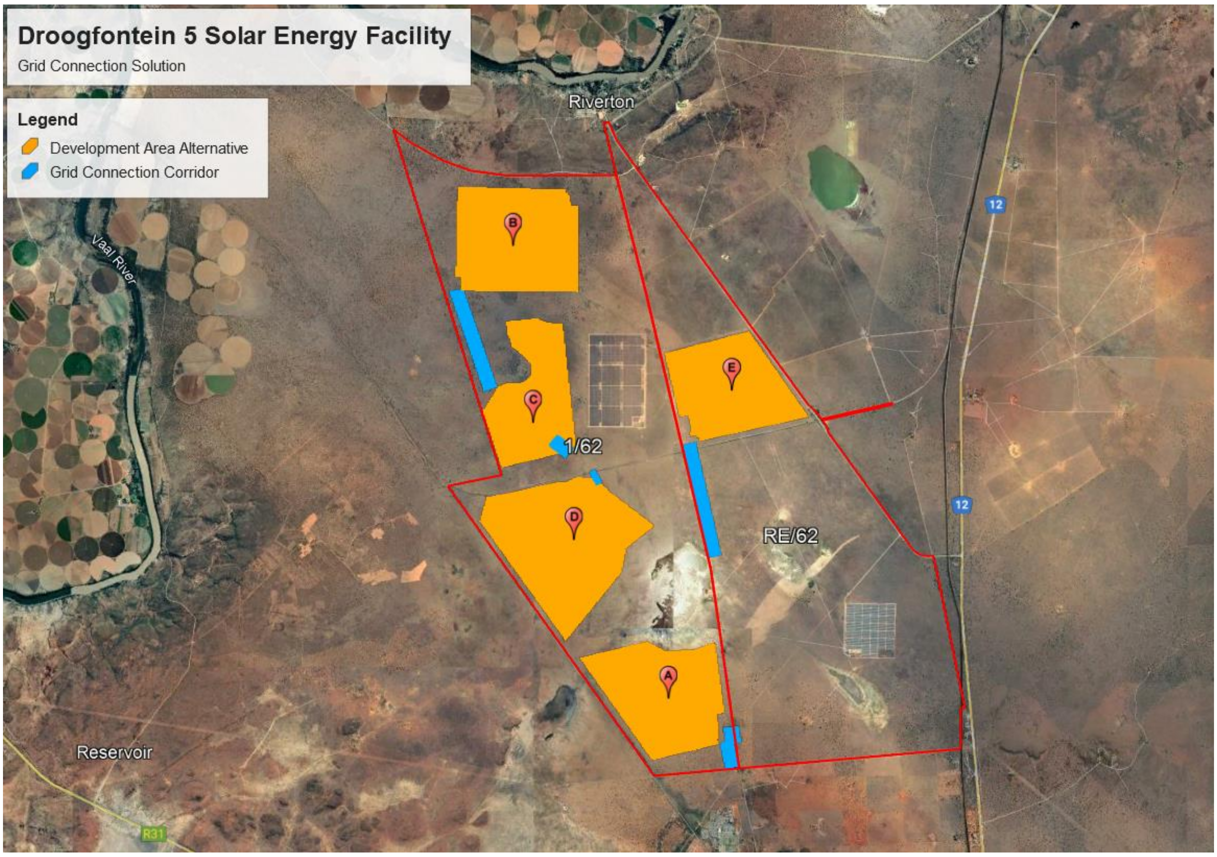

Figure 1-1 Proposed grid connection corridors (indicated in blue) associated with each of the development area options

- <u>Electrical reticulation network</u> – An internal electrical reticulation network will be required and will be lain ~2-4m underground as far as practically possible.

- <u>Supporting Infrastructure</u> – The following auxiliary buildings with basic services including water and electricity will be required:
  - Administration Office (~300m²);
  - Switch gear and relay room (~400m²);
  - Staff lockers and changing room (~200m²);
  - Security control (~60m²);
  - Operations & Maintenance (O&M) room; and
  - Warehouse.

- Battery Energy Storage System (BESS) – The battery energy storage system will make use of Lithium-ion as a preferred technology and will have a capacity of up to 40MW. The extent of the system will be 20m long, 23m high, 2.5m wide. The containers may be single stacked only to reduce the footprint. There may be up to a maximum of 40 containers of BESS. The containers will include cells, HVAC, fire, safety and control systems and will comprise of Lithium-Ion technology providing a maximum capacity of 50MW in total

- Roads – Access will be obtained via the tarred Riverton Road and various gravel farm roads within the area and affected properties. An internal site road network will also be required to provide access to the solar field and associated infrastructure. Roads are expected to be between 8m and 12m wide.

- Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm. Fencing with a maximum height of 3 meters will be used.

Component	Description / dimensions
Height of PV panels	Up to 3 meters
Area of PV Array	Up to 160 hectares (within the up to 500ha development footprint)
Number of inverters required	To be determined as part of the final facility layout design.
Area occupied by inverter / transformer stations / substations	On-site Facility Substation: up to 3ha Collector Substation: up to 3ha BESS: up to 5ha
Capacity of the on-site substation	33kV / 132kV
Capacity of the collector substation	33kV / 132kV
Capacity of the power line	33kV / 132kV
Area occupied by both permanent and construction laydown areas	Up to 3 hectares
Area occupied by buildings	• Administration Office (~300m²); • Switch gear and relay room (~400m²); • Staff lockers and changing room (~200m²); • Security control (~60m²);
Width of internal roads	Between 8 and 12 meters
Grid connection corridor width	300m
Grid connection corridor length – as associated with each development area alternative	• Option A: up to 600m • Option B: up to 2km • Option C: up to 140m (two power lines of 140m is required) • Option D: up to 145m • Option E: up to 2.3km
Power line servitude width	Up to 32m
Height of fencing	Approximately 3 meters

1.3 Project Area

The project area is located in the Northern Cape Province and falls within the Frances Baard District Municipality and Sol Plaatjie Local Municipality. Kimberly is located approximately 20 km south of the proposed development. The project area can be seen in Figure 1-2 and Figure 1-3, the project area contains all expected infrastructure related to the project.

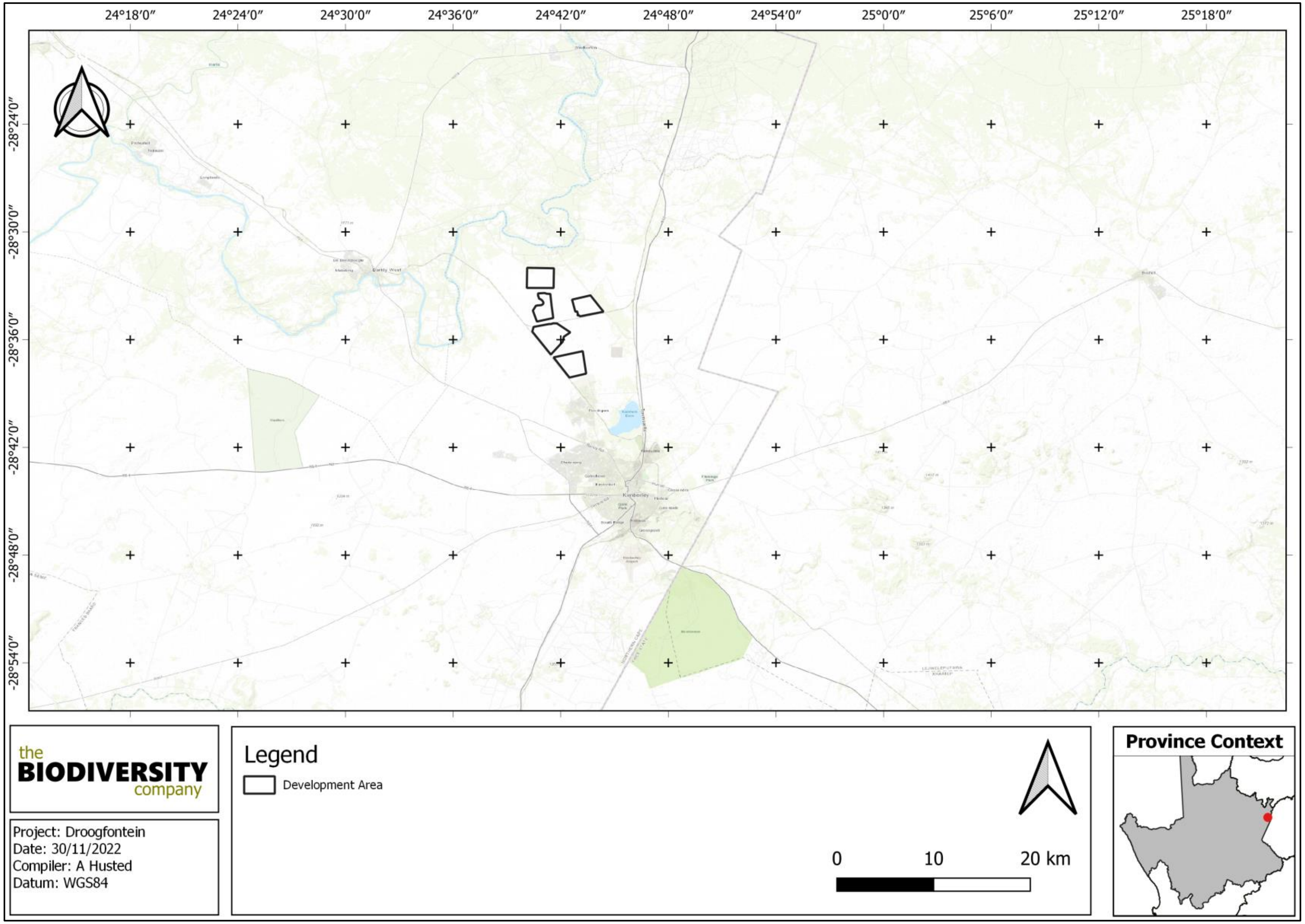

Figure 1-2 ***Location of the project area***

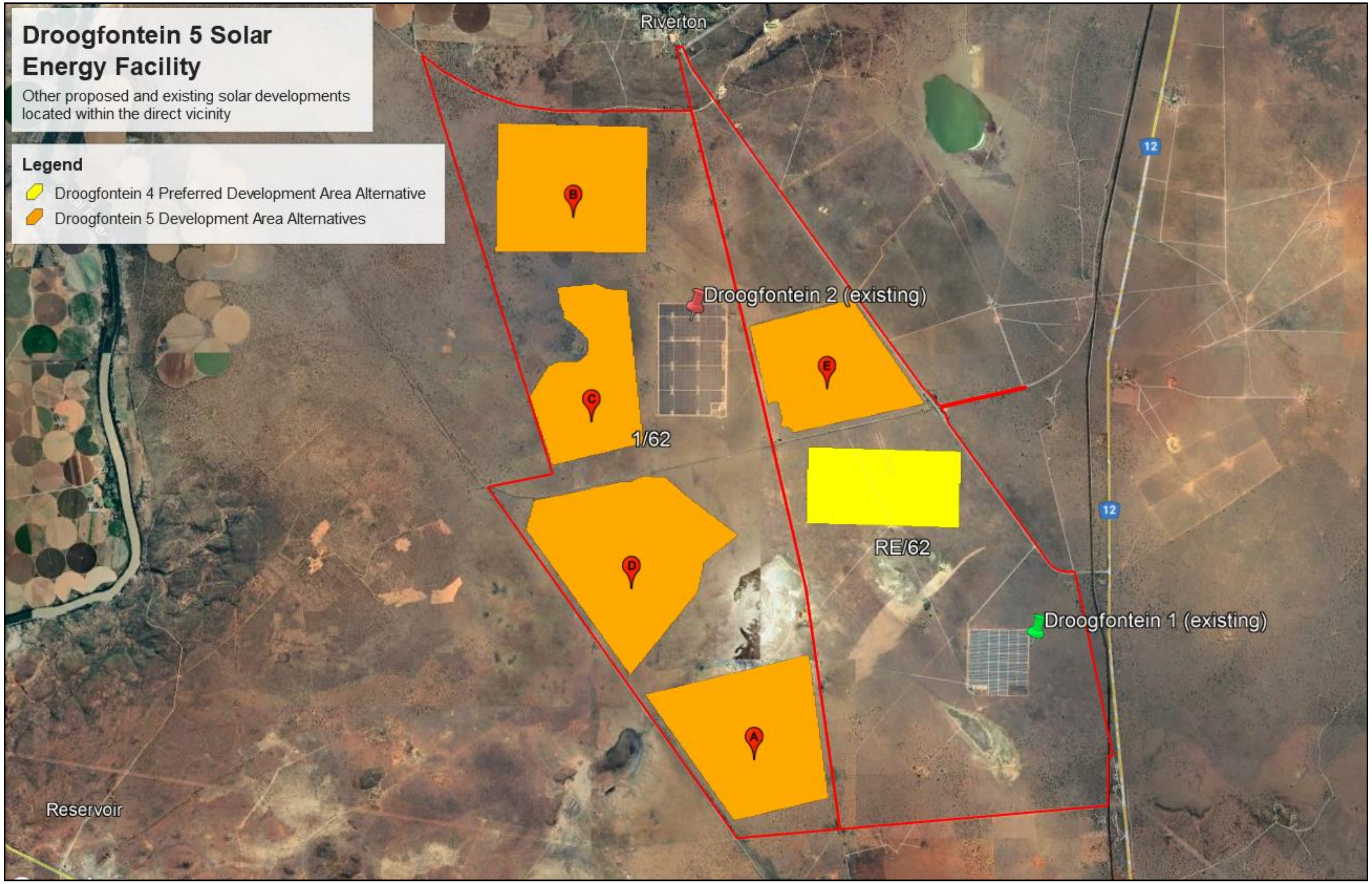

Figure 1-3 ***Map showing the 5 options for the Droogfontein PV 5 development areas in relation to the existing Droogfontein 2 areas as well as the proposed Droogfontein 4 PV area (Provided by Environamics, 2022)***

1.4 Terms of Reference

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- The delineation, classification and assessment of wetlands within 500 m of the project area;
- Conduct risk assessments relevant to the proposed activity;
- Recommendations relevant to associated impacts; and
- Report compilation detailing the baseline findings.

1.5 Assumptions and Limitations

The following assumptions and limitations are applicable for this assessment:

- The focus area was based on the spatial files provided by the client and any alterations to the area and/or missing GIS information would have affected the area surveyed;
- Only the outline area of the proposed site was provided to the specialist; and
- The GPS used for the survey has a 5 m accuracy and therefore any spatial features may be offset by 5 m.Key Legislative Requirements

1.5.1 National Water Act (NWA, 1998)

The DWS is the custodian of South Africa’s water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (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 DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

1.5.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) 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 process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

2 Methods

Two wetland site visits were conducted the first one on 20th – 21st of June 2022, this would constitute a dry season survey. The second site visit was conducted on the 23rd and 24th of November 2022, this would constitute a wet season survey.

2.1 Identification and Mapping

The wetland areas were delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 2-1. 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.

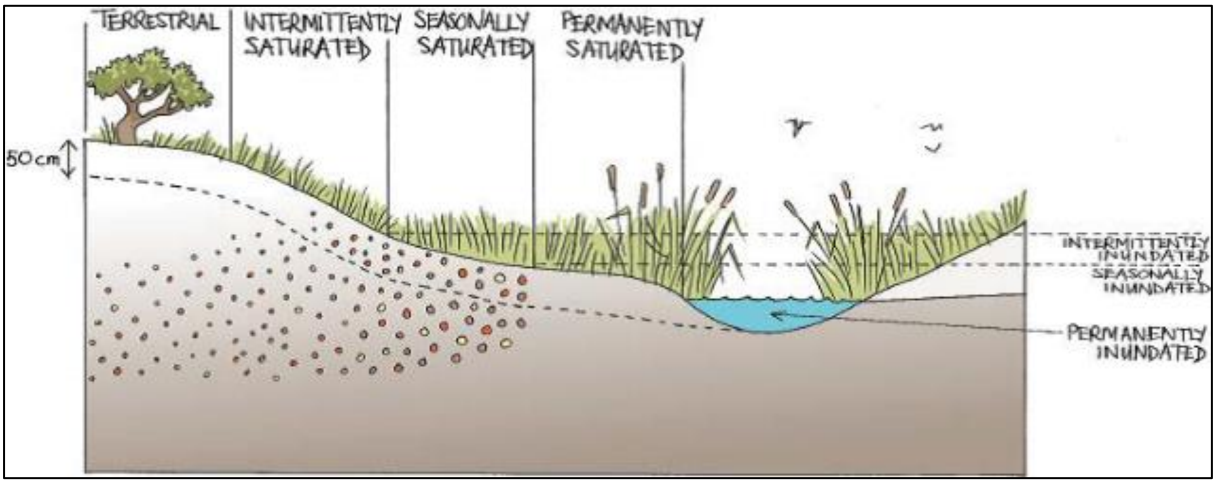

Figure 2-1 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al. 2013)

2.2 Delineation

The wetland indicators described above are used to determine the boundaries of the wetlands within the project area. These delineations are then illustrated by means of maps accompanied by descriptions.

2.3 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands as well as humans. Eco Services serves as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*. 2008). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 2-1).

Table 2-1 Classes for determining the likely extent to which a benefit is being supplied

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

2.4 Present Ecological Status

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

Table 2-2 The Present Ecological Status categories (Macfarlane, et al., 2008)

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

2.5 Importance and Sensitivity

The importance and sensitivity of water resources is determined to establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants is used to assign the Importance and Sensitivity (IS) category as listed in Table 2-3.

Table 2-3 Description of Importance and Sensitivity categories

IS 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**

2.6 Ecological Classification and Description

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

2.7 Buffer Requirements

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

3 Results and Discussion

3.1 Desktop Baseline

3.1.1 Project Area

The proposed solar project is located approximately 7.5 km northwest of Kimberley in the Northern Cape province approximately 2 km south of the little town Riverton. The project area is divided into two quaternary catchments C91E and C91D within the Vaal Water Management Area (WMA) (see **Error! Reference source not found.**).

3.1.2 Vegetation Type

According to Mucina and Rutherford (2006) the project areas fall within the Kimberley Thornveld (SVk 4) vegetation type.

This vegetation type is distributed throughout North-West, Free State and the Northern Cape Provinces and stretches from south of Kimberley, to Bloemhof, Hartswater and Hoopstad The latitude suited for this vegetation type is between 1 050 meters above sea level to 1 400 meters above sea level (Mucina & Rutherford, 2006).

This vegetation type features in areas dominated by plains often irregular with a well- established tree line consisting mostly of *Acacia erioloba, A. tortilis, A. karroo* and *Boscia albitrunca* as well as a shrubs layer consisting of *Tarchonanthus camphoratus* (Mucina & Rutherford, 2006).

The conservation status of this vegetation type is Least Threatened with a target percentage of 16. Only 2% of it being statutorily protected within the Vaalbos National Park as well as in Bloemhof Dam, Sandveld and S.A. Lombard Nature Reserve (Mucina & Rutherford, 2006).

3.1.3 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Ae 15 land type. This land type consists of red-yellow apedal soils which are freely drained. The soils tend to have a high base status and is deeper than 300 mm.

The geology of the region consists of the andesitic lavas of the Allanridge Formation as well as the fine-grained sediments of the Karoo Supergroup. It consists of deep sandy to loamy soils from the Hutton soil form (Ae and Ah land types) on top of undulating sandy plains (Mucina and Rutherford, 2006).

3.1.4 Climate

The SVk 4 vegetation type is characterised by a summer rainfall with a Mean Annual Precipitation (MAP) that ranges between 300 mm and 500 mm. Frost frequently occurs during the winter. Temperatures ranges from 37.5 °C in the summer to -4.1 °C in the winter (Mucina & Rutherford, 2006).

3.1.5 Topographical Inland Water and River Line Data

Multiple non-perennial streams have been identified within the proposed project area by means of the “2824” quarter degree square topographical river line dataset. Multiple inland water area has also been identified which were classified as being non-perennial pan wetlands or dams within the 500 m regulated area (see Figure 3-1).

3.1.6 NFEPA Wetlands

Six types of NFEPA wetlands were identified within the MRA, namely channelled valley bottom wetlands, depressions, wetland flats, hillslope seeps, valleyhead seeps as well as unchannelled valley bottoms (see Figure 3-2). All the NFEPA wetlands identified within the 500 m regulated area are classified as natural with a condition of largely natural (A/B).

3.1.7 South African Inventory of Inland Aquatic Ecosystems

This spatial dataset is part of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the National Biodiversity Assessment (NBA 2018). National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other datasets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE, 2018).

Multiple areas were identified using the SAIIAE database all of which are classified as being depression wetlands (see Figure 3-3). The conditions of these wetlands are classified as “A/B” (largely natural).

3.1.8 Terrain

The terrain of the 500 m regulated area has been analysed to determine potential areas where water is more likely to accumulate (due to convex topographical features, preferential pathways, or more gentle slopes).

3.1.8.1 Digital Elevation Model (DEM)

A Digital Elevation Model (DEM) has been created to identify lower laying regions as well as potential convex topographical features which could point towards preferential flow paths. The 500 m regulated area ranges from 1 103 to 1 210 metres above sea level (MASL). The lower laying areas (generally represented in dark blue) represent the area that will have the highest potential to be characterised as wetlands (see Figure 3-4).

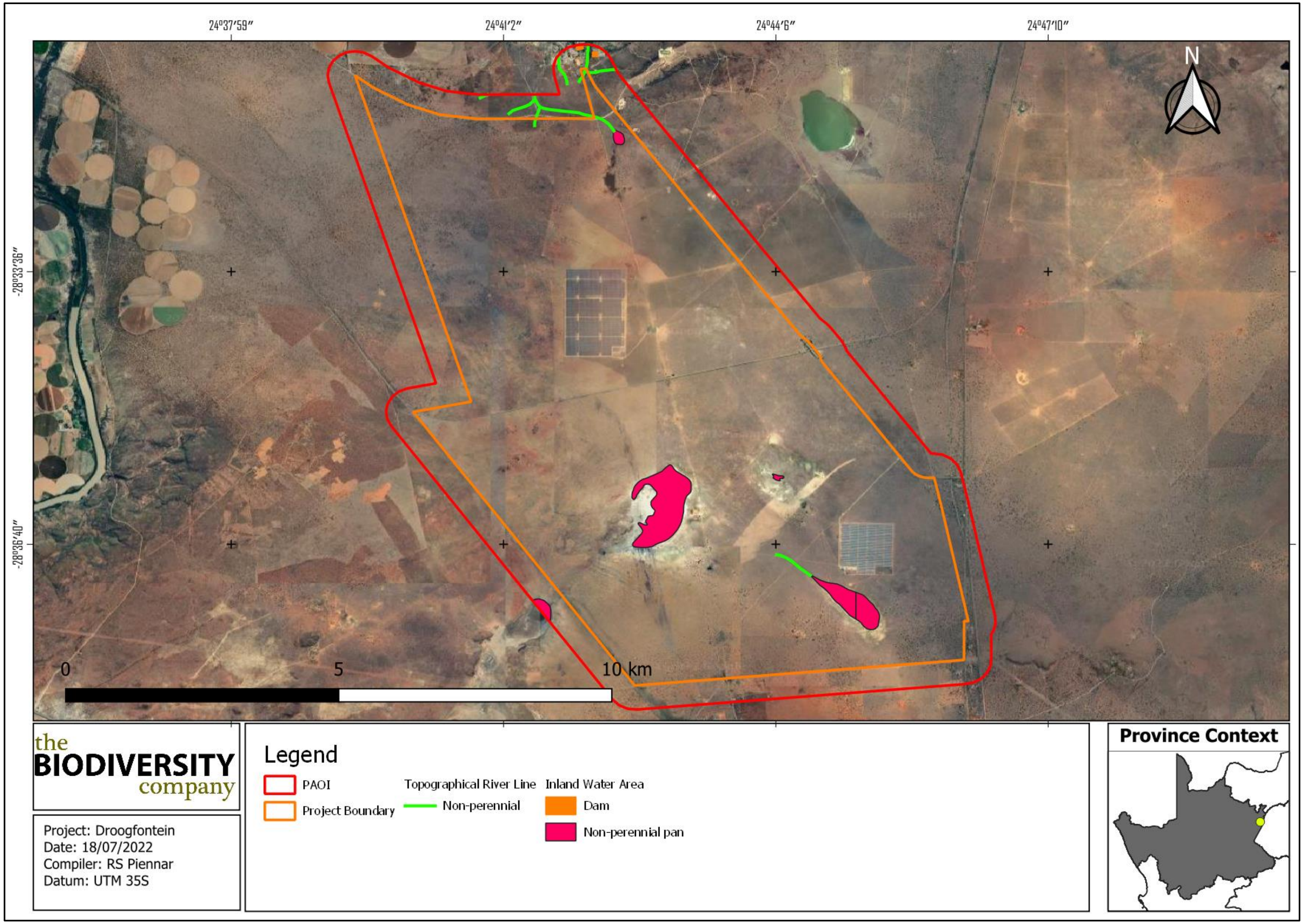

Figure 3-1 Illustration of topographical river lines and the inland water area located within the 500 m regulated area

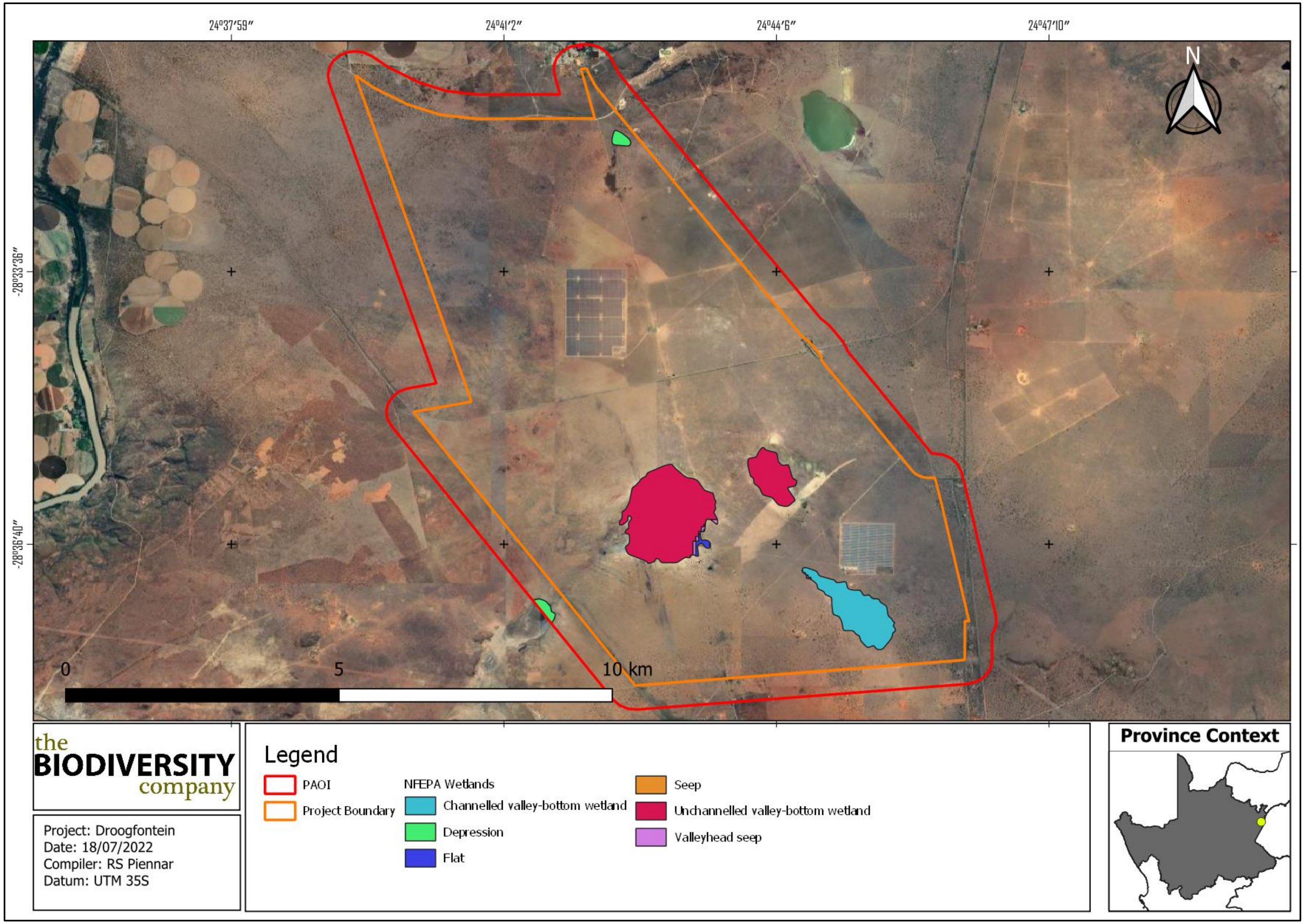

Figure 3-2 NFEPA wetlands located within the project area

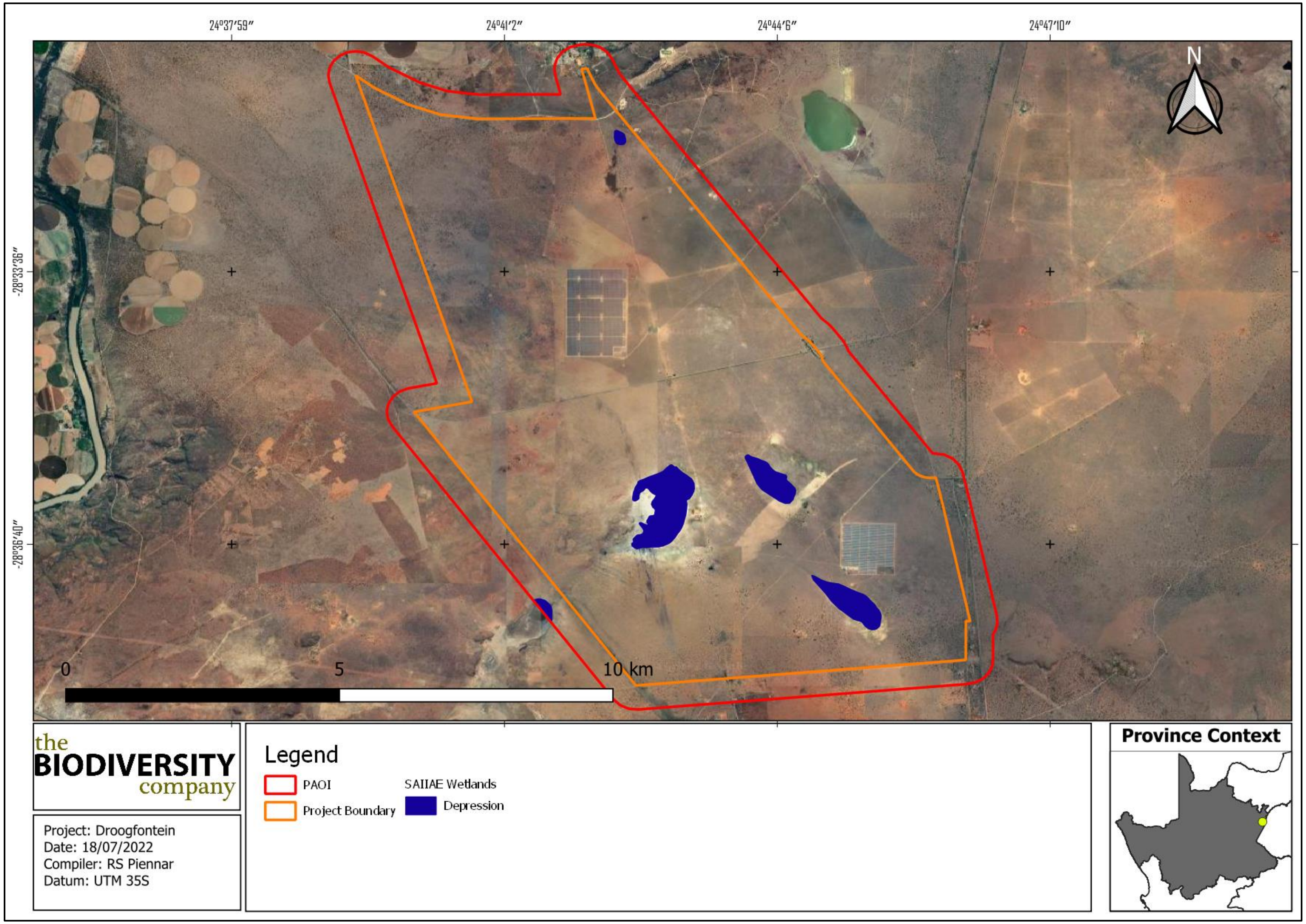

Figure 3-3 ***SAIIAE wetlands located within the 500 m regulated area***

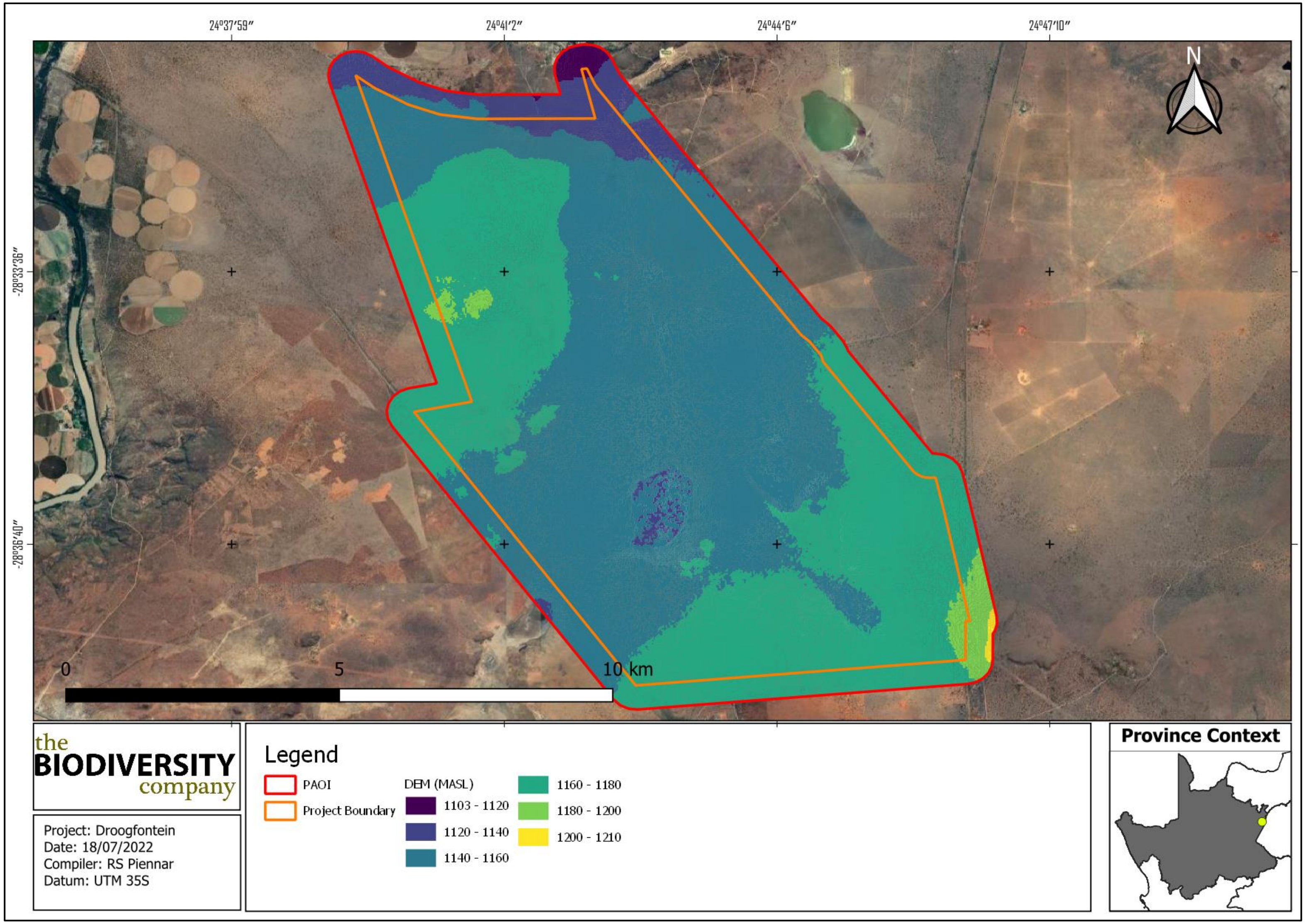

Figure 3-4 Digital Elevation Model of the 500 m regulated area

4 Field Assessment

4.1 Delineation and Description

During the site visit, four HGM units were identified within the 500 m regulated area (see Figure 4-2). The wetland areas were delineated in accordance with the DWAF (2005) guidelines (see Figure 4-1 and Figure 4-2). All the HGM units have been identified as depression wetlands and have been access accordingly. Along with the two wetlands a few artificial wetlands (municipality water pipe leaking) and multiple drainage features were identified within the 500 m regulated area. Although the artificial wetlands are not regarded to be 'natural' systems, it is important to note where they are located for any planned development in the area.

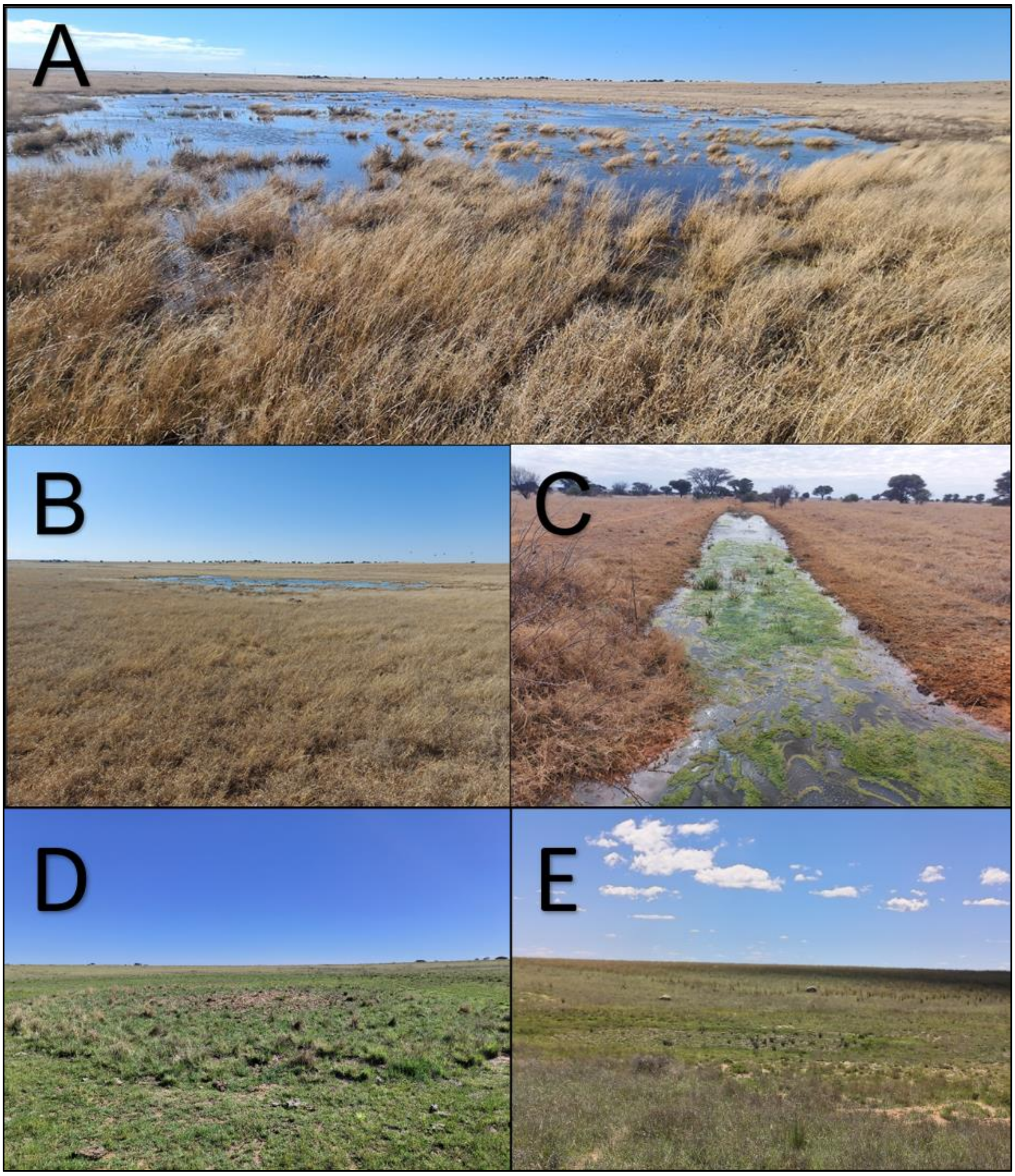

Figure 4-1 ***Photographical evidence of the different wet areas found within the 500 m regulated area, A) HGM 1 - Depression, B) HGM 2 – Depression, C) Artificial wetland drainage system, D) HGM 3 – Depression and E) HGM 4 - Depression.***

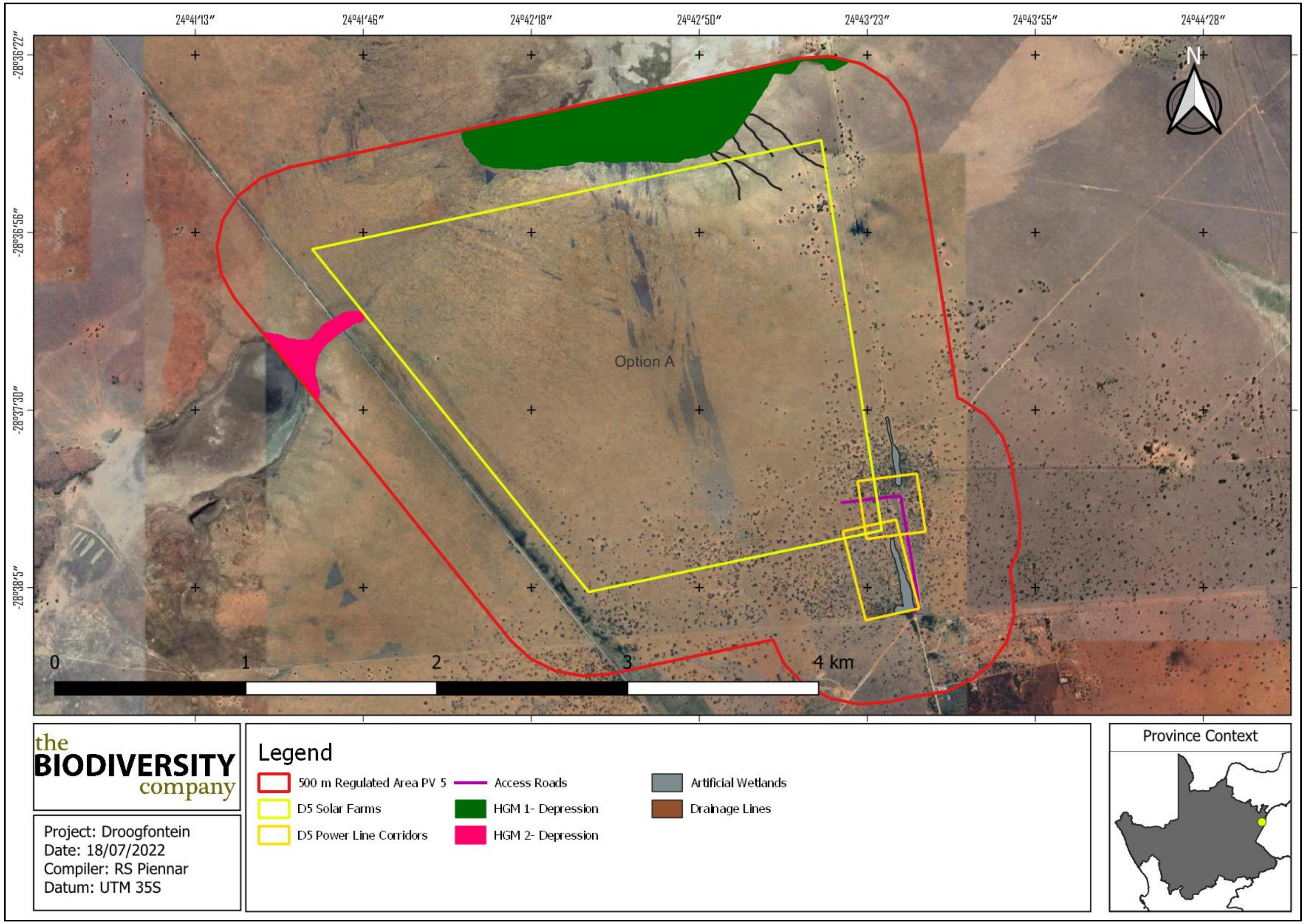

Figure 4-2 ***Delineation and location of the different HGM units identified within the 500 m regulated area***

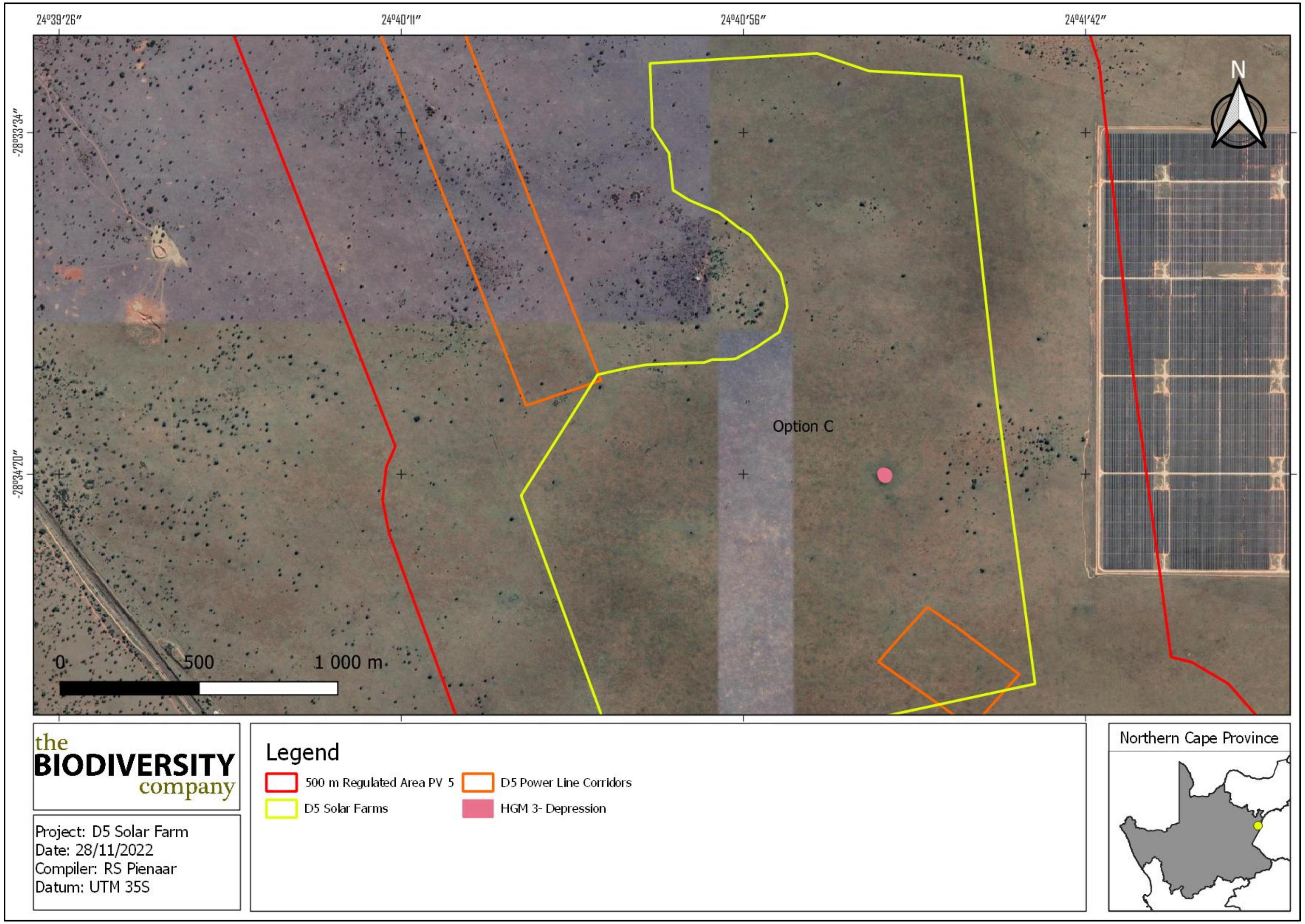

Figure 4-3 ***Delineation and location of the different HGM units identified within the 500 m regulated area***

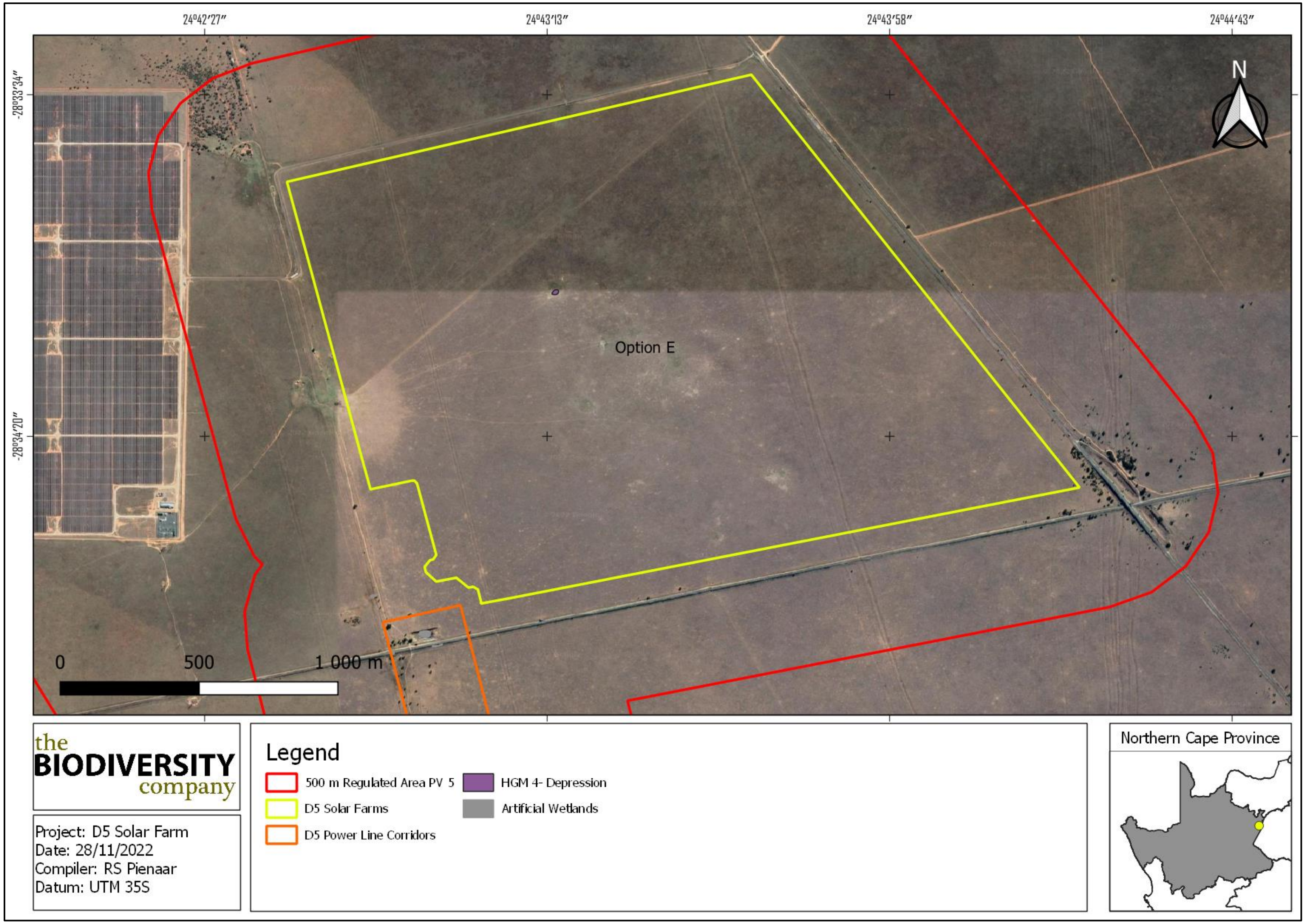

Figure 4-4 ***Delineation and location of the different HGM units identified within the 500 m regulated area***

4.2 Unit Setting

Depression wetlands are located on the "slope" landscape unit. Depressions are inward draining basins with an enclosing topography which allows for water to accumulate within the system. Depressions, in some cases, are also fed by lateral sub-surface flows in cases where the dominant geology allows for these types of flows. Figure 4-5 presents a diagram of a typical depression wetland, showing the dominant movement of water into, through and out of the system.

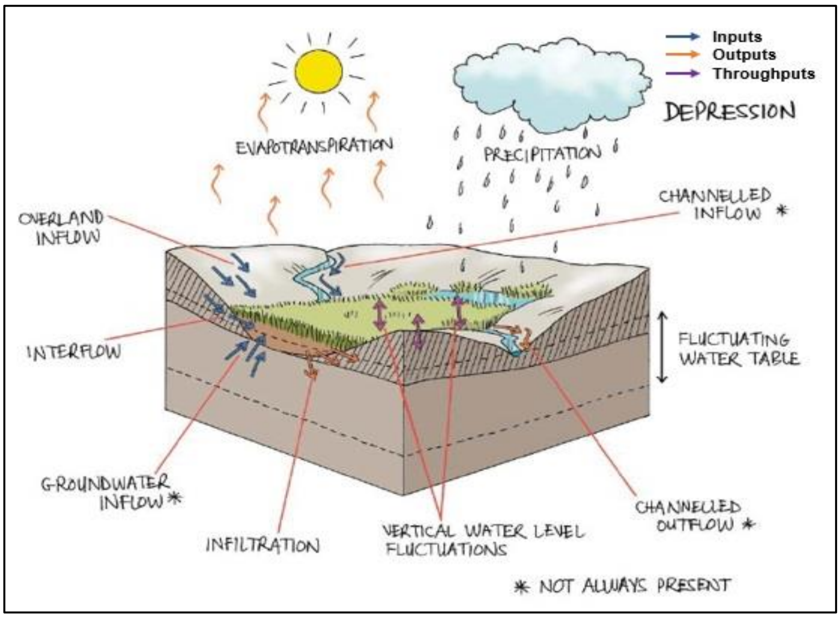

Figure 4-5 Amalgamated diagram of atypical depression wetland, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

4.3 General Functional Description

The generally impermeable nature of depressions and their inward draining features are the main reasons why the streamflow regulation ability of these systems is mediocre. Regardless of the nature of depressions in regard to trapping all sediments entering the system, sediment trapping is another Eco Service that is not deemed as one of the essential services provided by depressions, even though some systems might contribute to a lesser extent. The reason for this phenomenon is due to winds picking up sediments within pans during dry seasons which ultimately leads to the removal of these sediments and the deposition thereof elsewhere. The assimilation of nitrates, toxicants and sulphates are some of the higher rated Eco Services for depressions. This latter statement can be explained the precipitation as well as continues precipitation and dissolving of minerals and other contaminants during dry and wet seasons respectively, (Kotze et al., 2009).

It is however important to note that the descriptions of the above-mentioned functions are merely typical expectations. All wetland systems are unique and therefore, the ecosystem services rated high for these systems on site might differ slightly to those expectations.

4.4 Ecological Functional Assessment

The ecosystem services provided by the wetland units identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). HGM unit 1 scored "High" for ecosystem service benefits due to pollution flowing into the wetlands from a burst and dilapidated sewerage pipe. The wetland also provides a high variety of habitats for birds, amphibians and mammals. The system has a high density of hydrophytes which helps with the assimilation of nutrients and toxicants from the water column.

HGM 2 scored "Intermediate" for ecosystem service benefits. The reason for the lower score is due to the lower density of hydrophytes associated with the wetlands. This will lower the ability of the wetland to provide habitat and resources for both human and animals. The HGM units have little to no signs of erosion and functions well for sediment trapping and flow attenuation. The average ecosystem service scores for the delineated systems are illustrated in Table 4-1 and Figure 4-6.

HGM 3 and 4 scored "Low" ecosystem services scores due to the size and location of the wetlands. The wetlands have very little hydrophyte vegetation and thus do not play a major role in the assimilation of toxicants, nitrates of phosphates. The HGM units also does not supply any resources for human use.

Ecosystem services contributing to these scores include flood attenuation, streamflow regulation, sediment trapping, phosphate assimilation, nitrate assimilation, toxicant assimilation, erosion control, biodiversity maintenance and tourism and recreation.

Table 4-1 Average ecosystem service scores for delineated wetlands

High	Intermediate	Low
HGM 1	HGM 2	HGM 3
		HGM 4

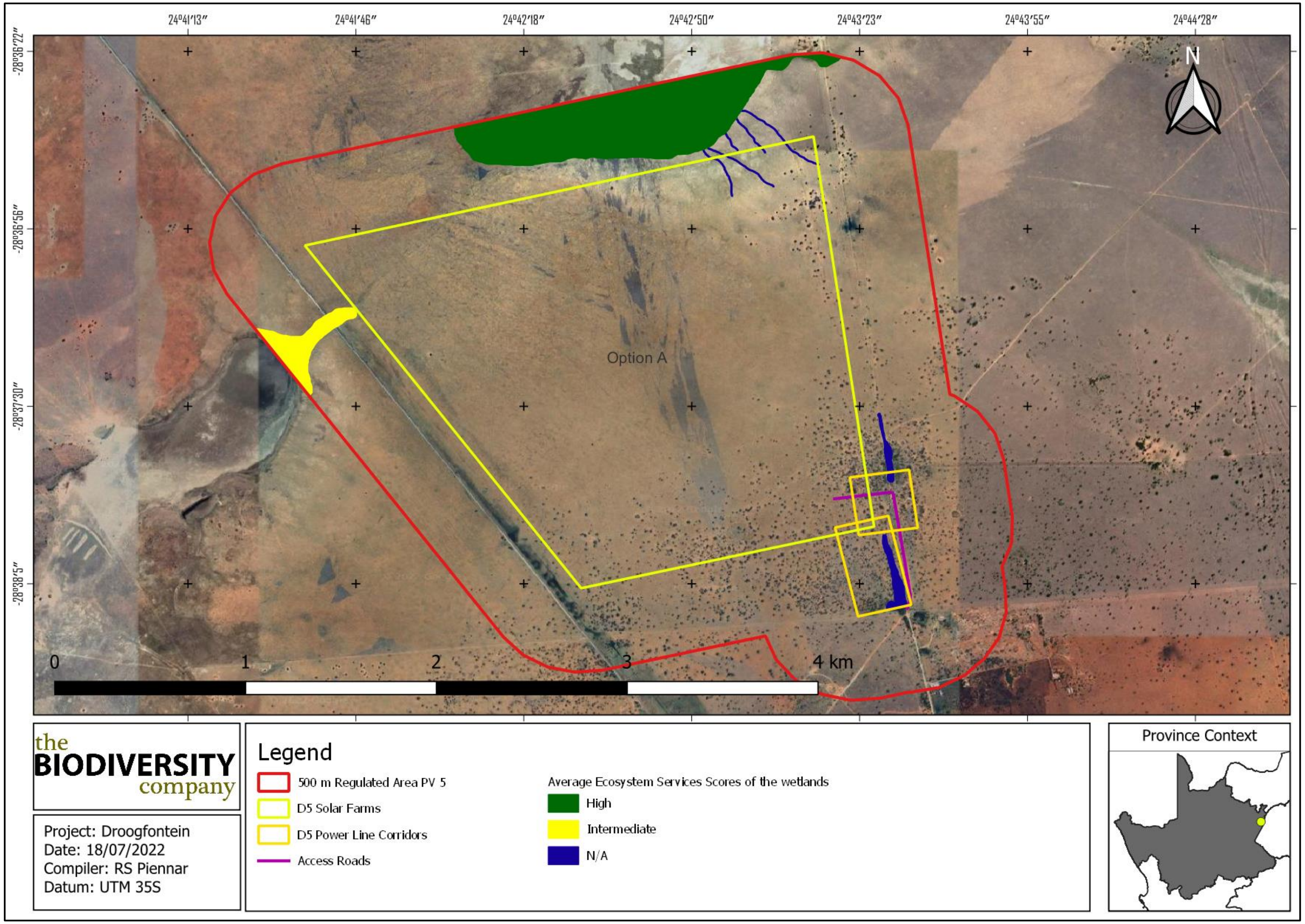

Figure 4-6 Average ecosystem service scores for the delineated wetland systems

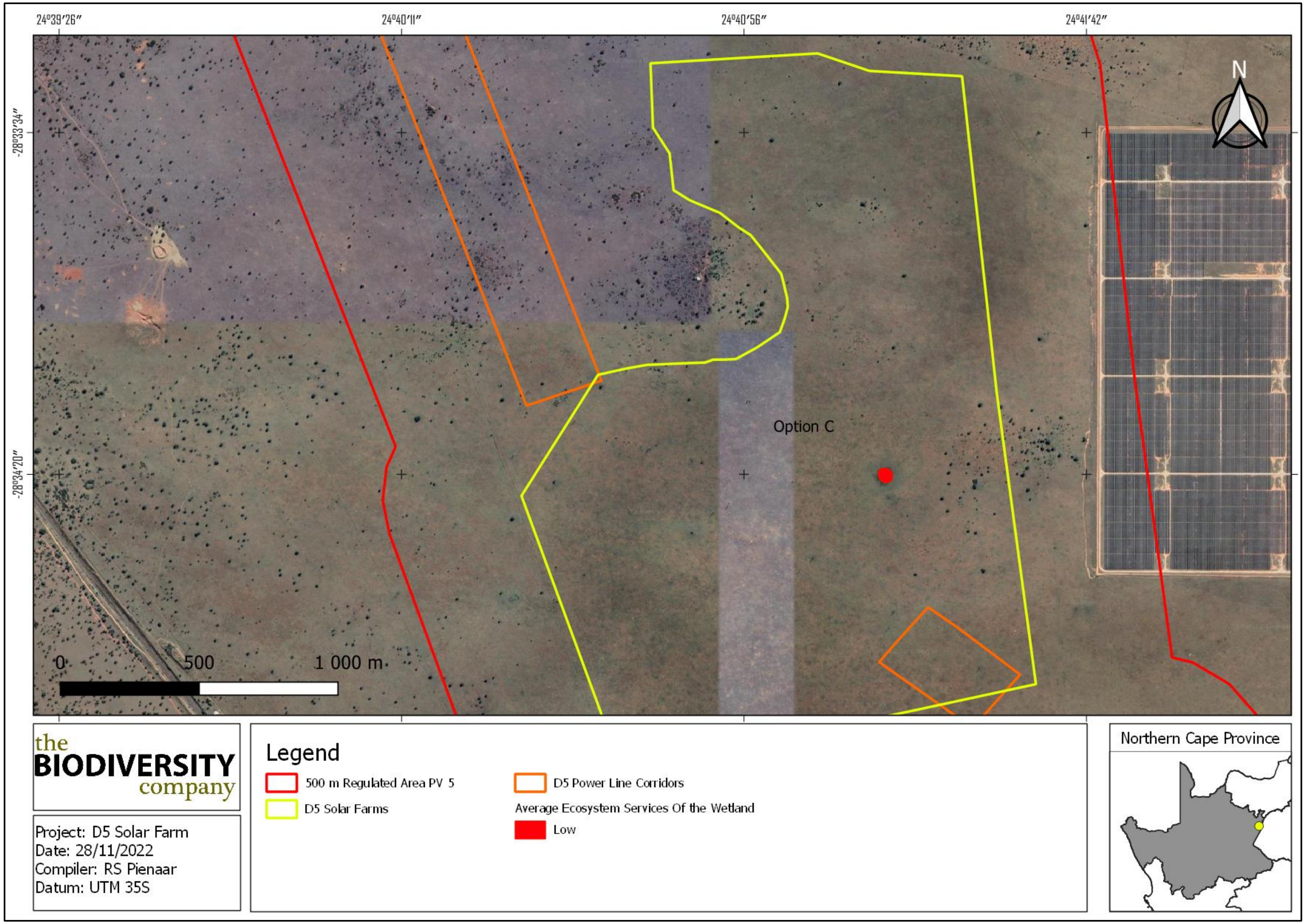

Figure 4-7 Figure 4-8 Average ecosystem service scores for the delineated wetland systems

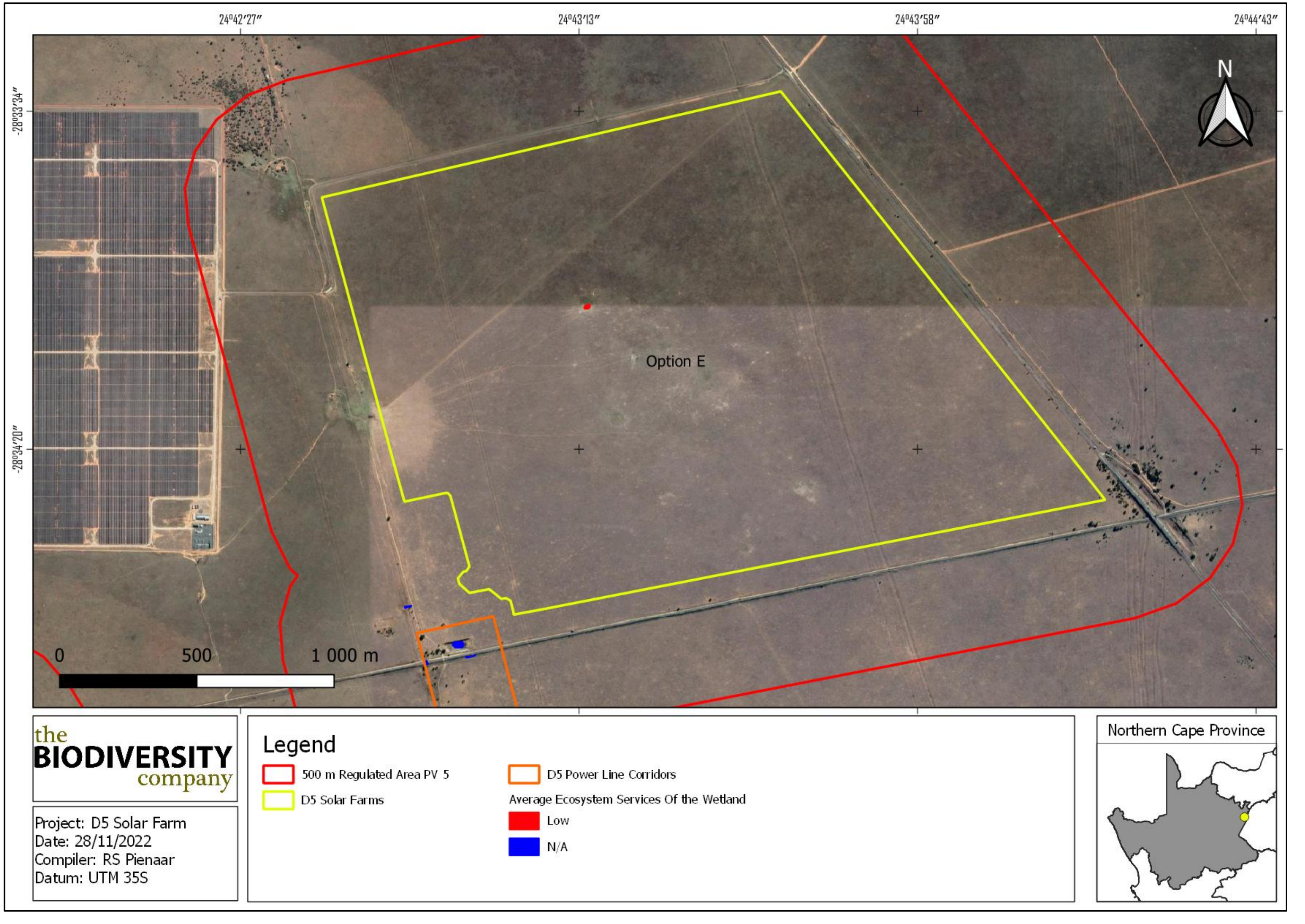

Figure 4-9 Figure 4-10 Average ecosystem service scores for the delineated wetland systems

4.5 The Ecological Health Assessment

The PES for the assessed HGM units is presented in Figure 4-11. The delineated wetland systems have been scored overall PES ratings ranging from “Moderately Modified” (class C) to “Seriously Modified” (class E). The wetlands that scored “Largely Modified” (HGM 3) was due to multiple anthropogenic impacts on the systems. These systems are characterised by overgrazing by cattle and some development within their delineated buffers, they are subject to anthropogenic increases in water inputs and have been affected by the removal of vegetation.

HGM 2 scored “Seriously Modified” for the ecological state due to the presence of a leaking sewerage pipe discharging into the system. The discharge will have an impact on the (water and soil) quality of the system, which will negatively influence the associated vegetation and biota. The wetland is also subject to grazing from cattle and other wildlife.

HGM 3 and 4 also scored “Seriously Modified” for the present ecological state due to loss of hydrophyte vegetation within the wetland. The wetlands undergo overgrazing and trampling through livestock and there are dirt roads running through the wetland’s buffers. The current solar farms also changed the surface hardness of the wetland’s catchments.

HGM 1 was determined to have the highest present ecological score of “Moderately Modified” (C). The wetlands seem to be ‘mostly’ intact with no visible anthropogenic impacts observed during the site visit. When reviewing historical imagery however, there was evidence of dirt roads traversing the wetland which would alter the hydrology of the system, and also likely contribute to sedimentation and the impaired water quality of the system.

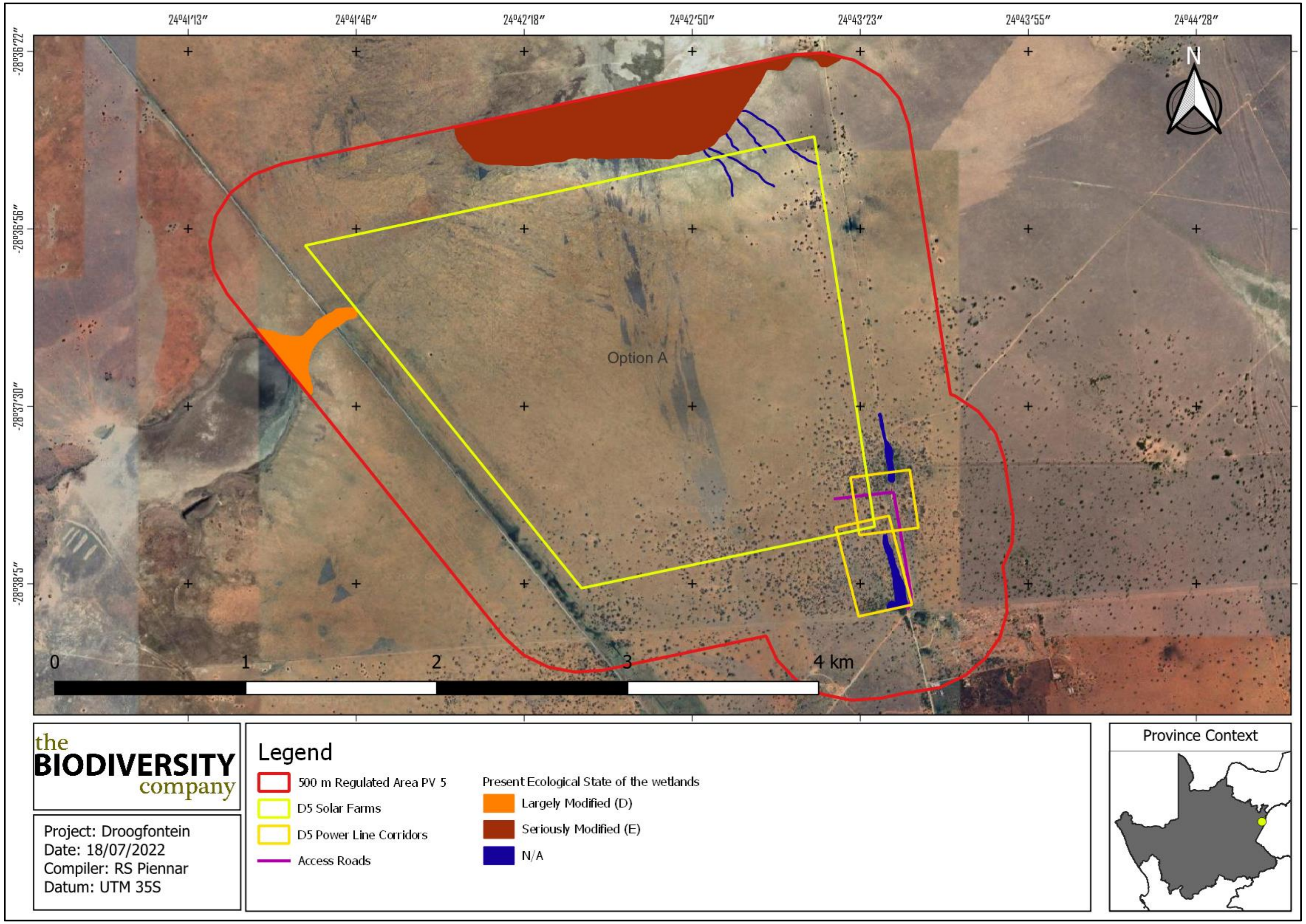

Figure 4-11 Overall present ecological state of delineated wetlands

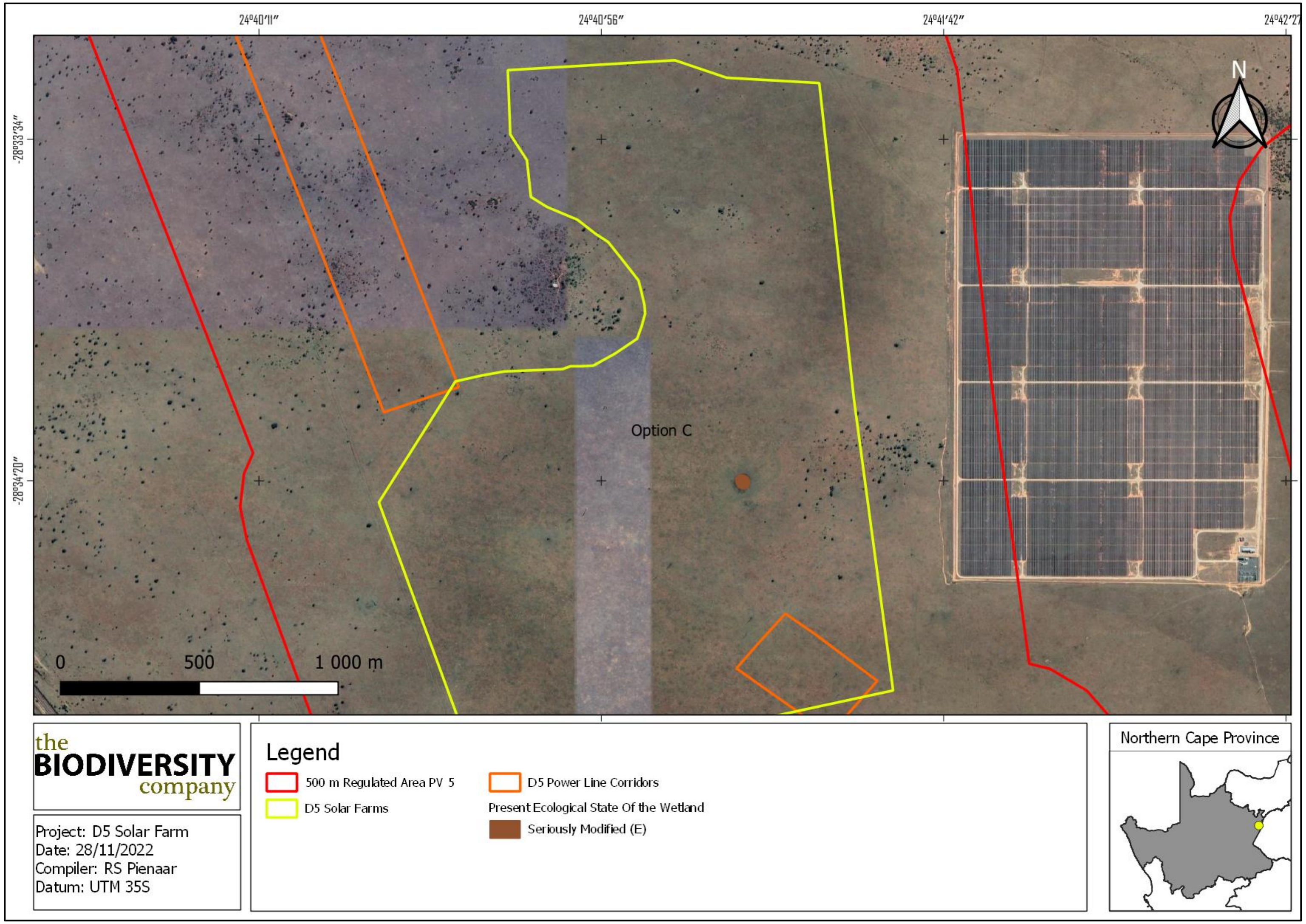

Figure 4-12 Overall present ecological state of delineated wetlands

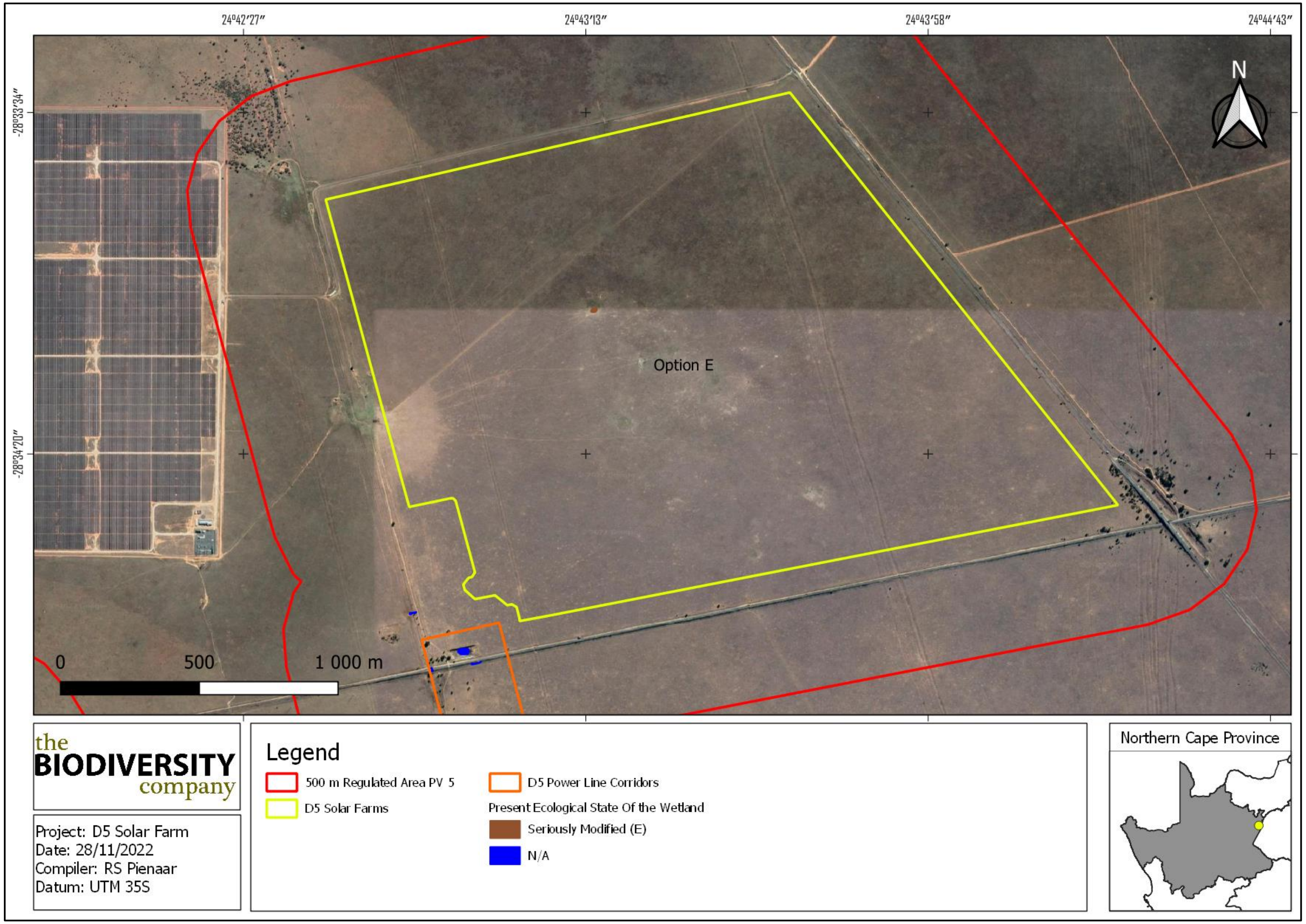

Figure 4-13 Overall present ecological state of delineated wetlands

4.6 The Importance & Sensitivity Assessment

The results of the ecological IS assessment are shown in Table 4-2. Various components pertaining to the protection status of a wetland are considered for the IS, including Strategic Water Source Areas (SWSA), the NFEPA wetland vegetation (wet veg) threat status and the protection status of the wetland. The IS for all the HGM units have been calculated to be “Moderate”, which combines the relatively high protection status and the low protection status of the wetland.

Table 4-2 The IS results for the delineated HGM unit

HGM Type	NFEPA Wet Veg			NBA Wetlands			SWSA (Y/N)	Calculated IS
	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018	Ecosystem Protection Level		
Depressions	Eastern Kalahari Bushveld Group 3	Least Threatened	Not Protected	Best: Class C, Moderately Modified	Least Concerned	Poorly Protected	N	**Moderate**

4.7 Buffer Requirements

It is worth noting that the scientific buffer calculation (Macfarlane et al., 2014) was used to determine the size of the buffer zones relevant to the proposed project. A pre-mitigation buffer zone of 33 m is recommended for the identified wetlands, which can be decreased to 15 m with the addition of all prescribed mitigation measures (see Table 4-3 and Figure 4-14).

Table 4-3 Pre- and post-mitigation buffer requirements

Aspect	Pre-Mitigation Buffer Size (m)	Post Mitigation Buffer Size (m)
Solar project	33	15

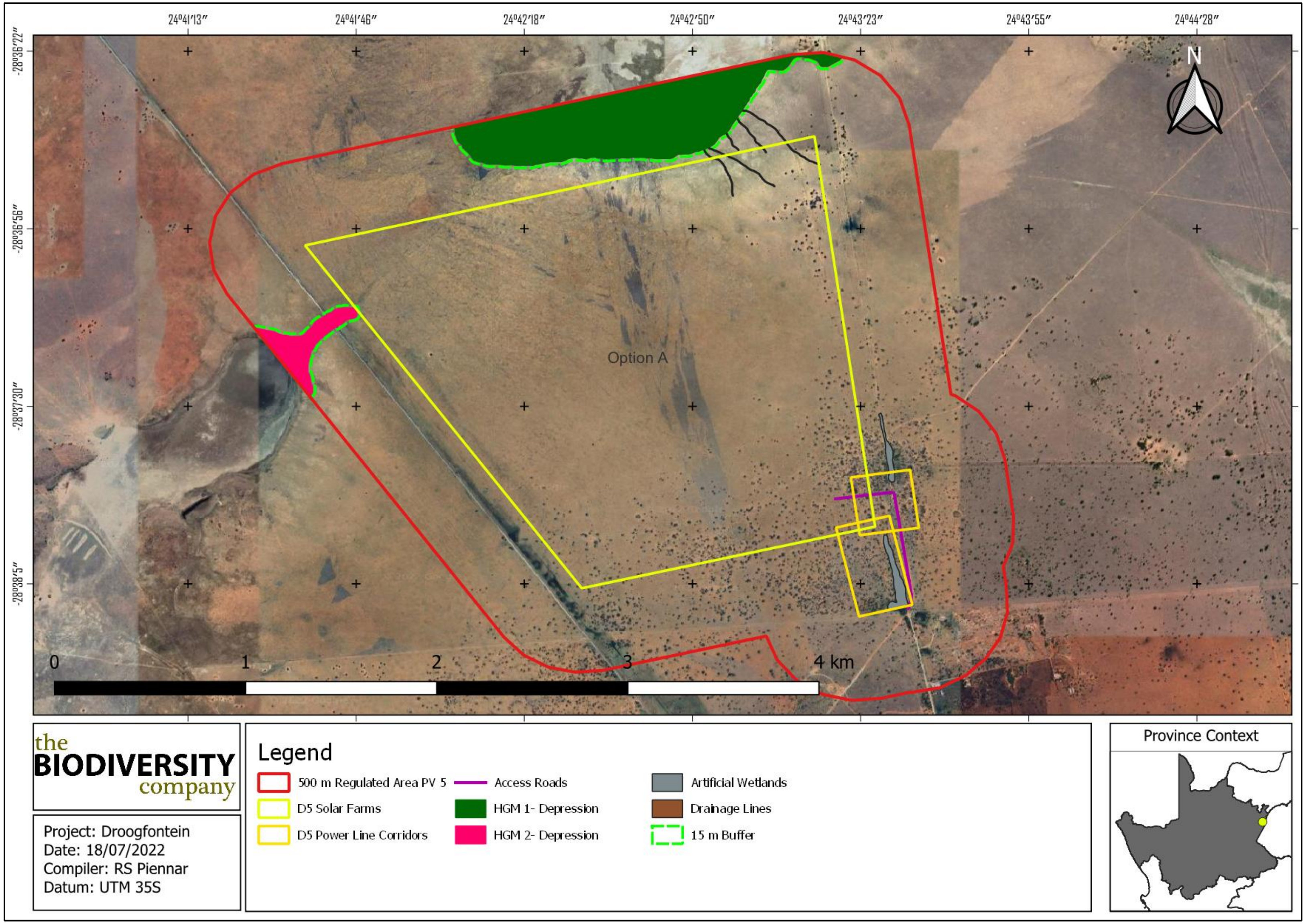

Figure 4-14 Proposed Buffers for both the road upgrade as well as the development

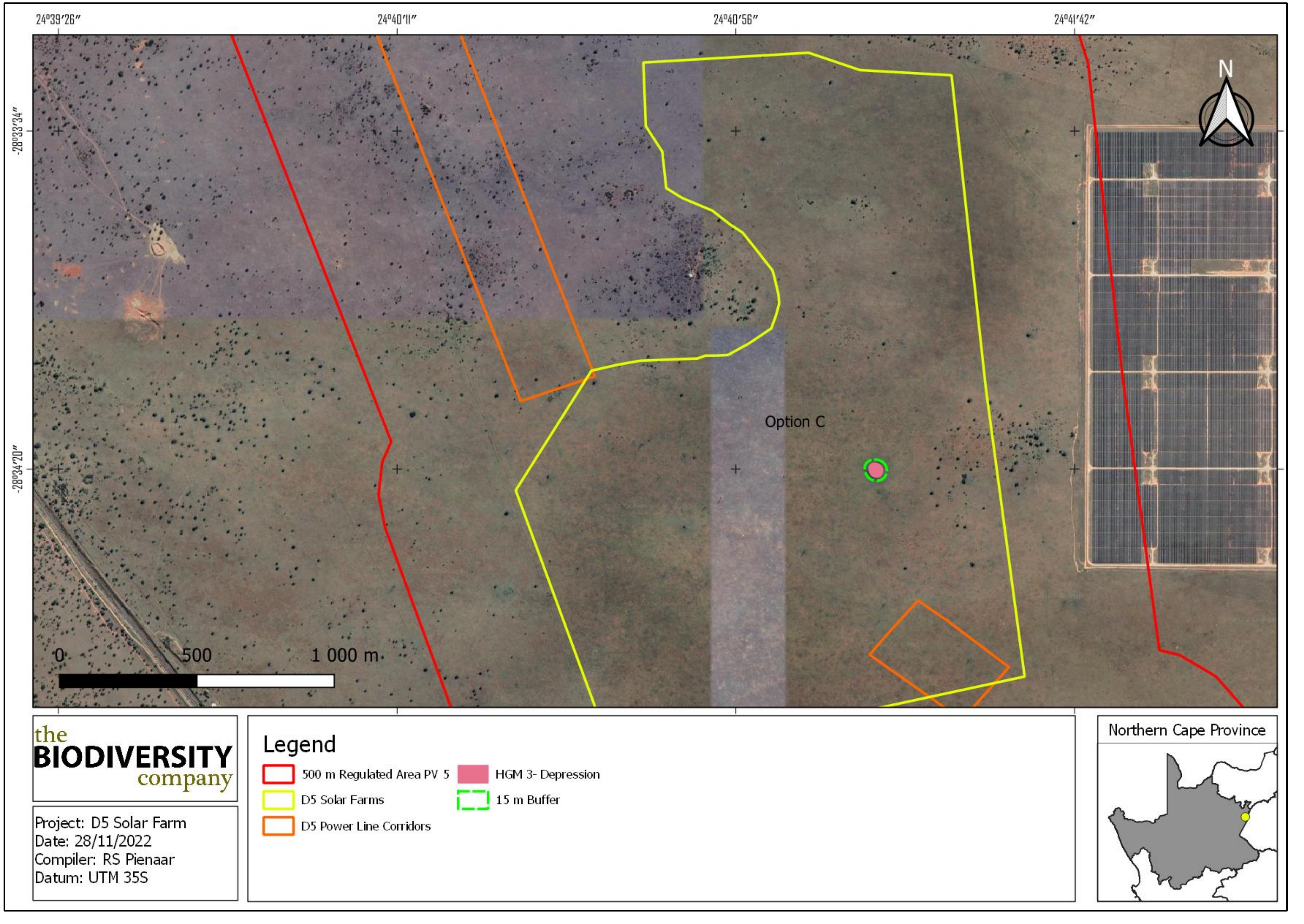

Figure 4-15 Proposed Buffers for both the road upgrade as well as the development

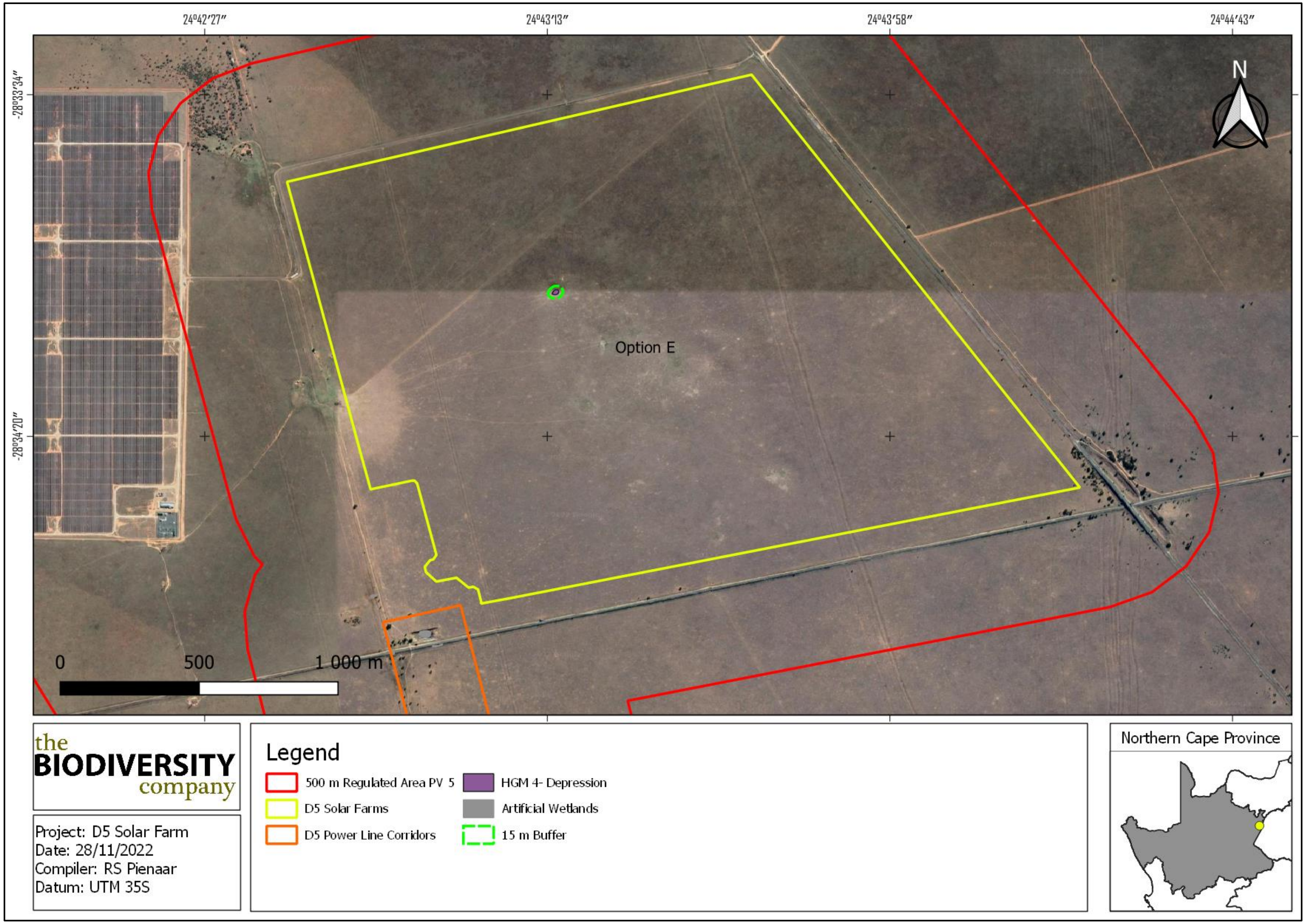

Figure 4-16 Proposed Buffers for both the road upgrade as well as the development

5 Risk Assessment

5.1 Potential Impacts

The impact assessment considered both direct and indirect impacts, if any, to the wetland systems. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 5-1). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts. Figure 5-2 below indicates the different levels of risk associated with the PV areas.

Two separate risk assessments have been completed for the project, the first one being for the PV Options C and E and the second one for the PV Options A, B and D as well as the powerline corridors. The risk assessment for the PV area (Option C & E) where the risks are expected to be medium (pre-mitigation) due to the presence of natural wetlands within the proposed development areas.

For the PV area (Option C & E) avoidance will not be achieved and the risk assessment will thus focus on the second step of the mitigation hierarchy namely minimisation of the impacts. Since direct impacts to the wetlands (and buffers) cannot be avoided, the risk assessment will consider both the direct and indirect risks posed to these systems as a result of the project. Table 5-2 and Table 5-3 illustrates various aspects that are expected to impact upon the delineated wetlands during the respective project phases.

If avoidance cannot be met when designing the PV layout, a wetland compensation plan will need to be compiled in order to replace the ecosystem services provided by the wetland affected by the PV development.

The second risk assessment for the PV areas (Option A, B & D) where the pre-mitigation risk rating will be low due to the fact that no activities pose any risks to the delineated wetlands and their buffer areas. Table 5-4 and Table 5-5 illustrates various aspects that are expected to impact upon the delineated wetlands during the respective project phases.

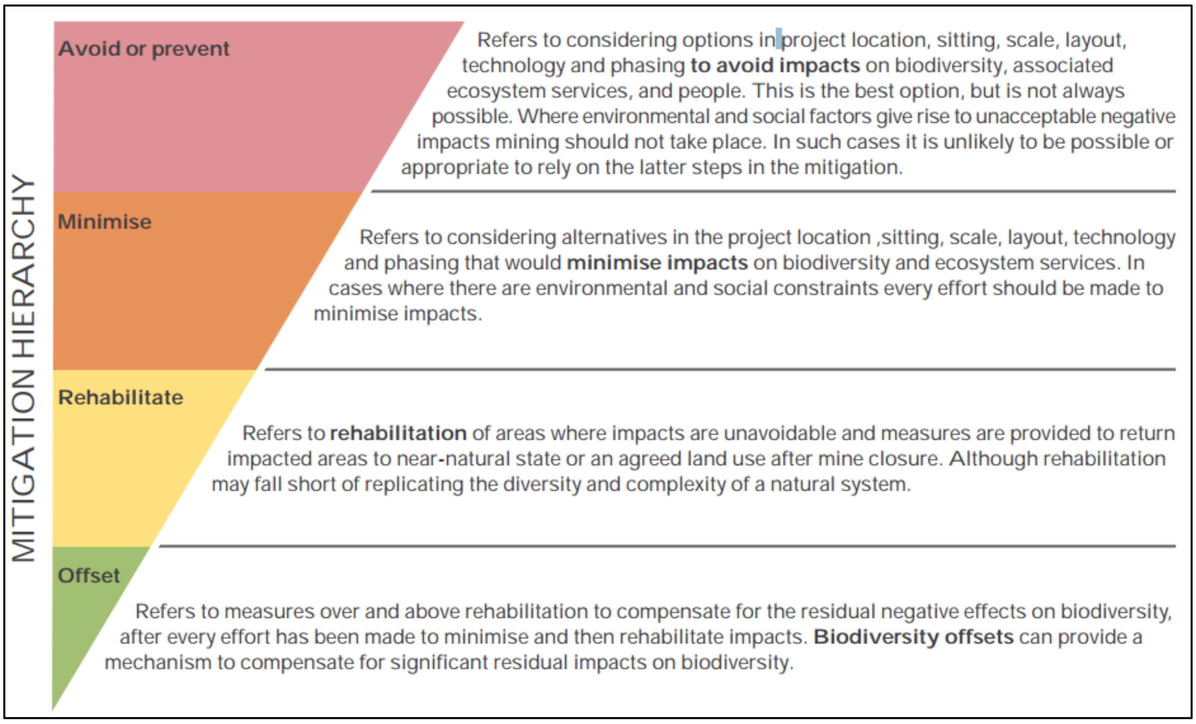

Figure 5-1 The mitigation hierarchy as described by the DEA (2013)

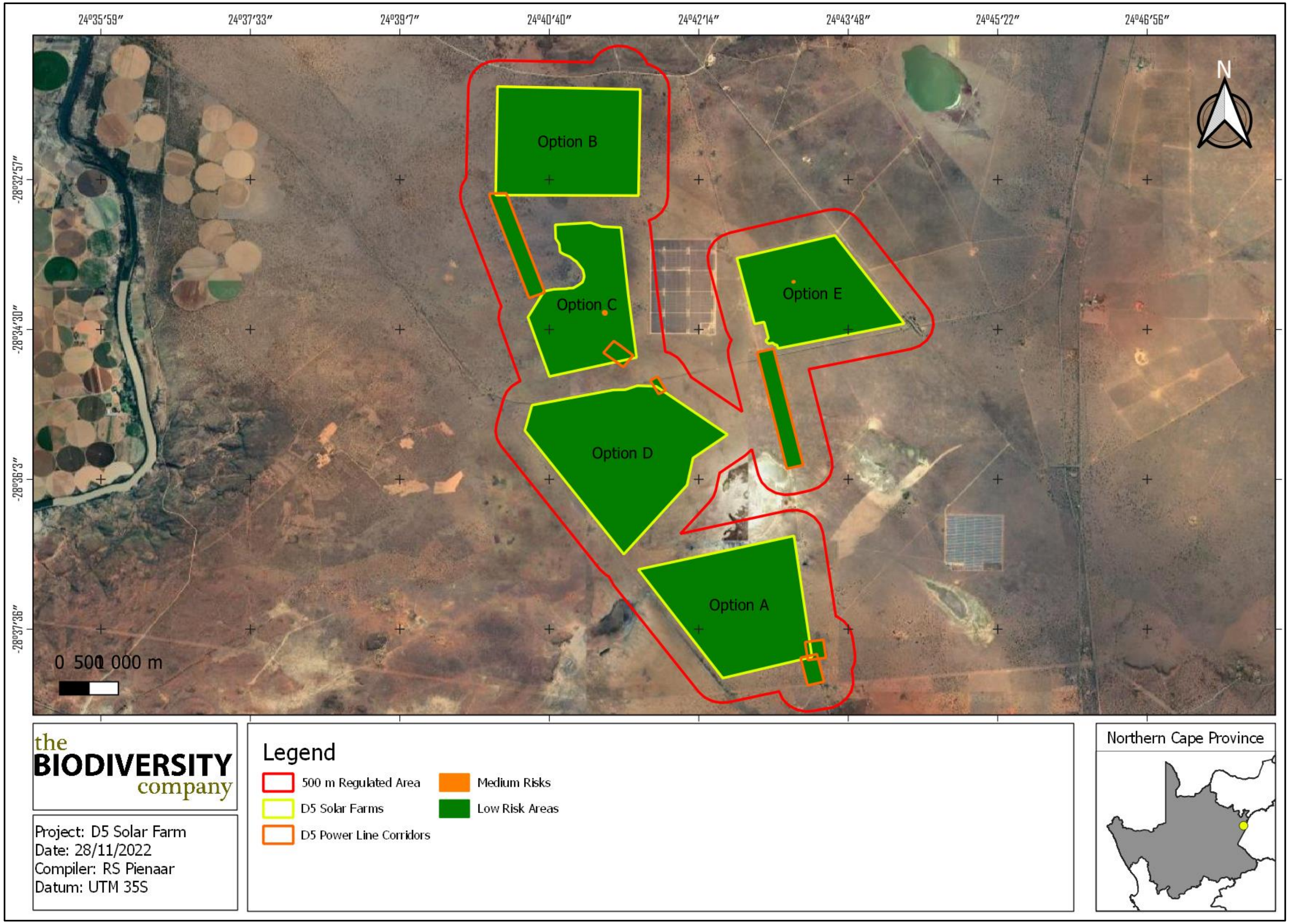

Figure 5-2 The identified risk areas

Table 5-1 Impacts assessed for the proposed project

Activity	Aspect	Impact
Construction Phase	Clearing of vegetation	• Altered surface flow dynamics; • Erosion; • Alteration of sub-surface flow dynamics; • Sedimentation of the water resource; • Direct and indirect loss of wetland areas; • Water quality impairment; • Compaction; • Decrease in vegetation; • Change of drainage patterns; • Altering hydromorphic properties; and • Indirect loss of wetland areas.
	Stripping and stockpiling of topsoil	
	Establish working area	
	Minor Excavations	
	Vehicle access	
	Leaks and spillages from machinery, equipment & vehicles	
	Solid waste disposal	
	Human sanitation& ablutions	
	Re-fuelling of machinery and vehicles	
	Laying of core samples	
	Backfill of material	
Operational Phase	Traffic	
	Waste Disposal	
	Altered Overflow Dynamics	
Decommissioning Phase	Removal of structures, machinery and equipment	
	Rehabilitation of site to agreed land use	

Table 5-2 DWS Risk Impact Matrix for the proposed project

Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase (PV site, Substations and Powerline)								
Clearing of vegetation	3	1	3	3	2,5	1	4	7,5
Stripping and stockpiling of topsoil	3	1	3	3	2,5	1	4	7,5
Establish working area	3	2	2	2	2,25	2	2	6,25
Minor Excavations	3	1	2	2	2	1	2	5
Vehicle access	1	2	2	2	1,75	1	2	4,75
Leaks and spillages from machinery, equipment & vehicles	1	3	2	2	2	1	2	5
Solid waste disposal	1	3	2	2	2	1	2	5
Human sanitation& ablutions	3	2	2	2	2,25	1	2	5,25
Re-fuelling of machinery and vehicles	2	3	2	2	2,25	1	4	7,25
Laying of core samples	1	3	2	2	2	1	2	5
Backfill of material	2	1	2	2	1,75	1	2	4,75
Operational Phase (PV site, Substations and Powerline)								
Traffic	2	3	3	2	2,5	2	5	9,5
Waste Disposal	1	1	2	2	1,5	1	5	7,5
Altered Overflow Dynamics	3	3	3	3	3	1	5	9
Decommissioning Phase (PV site, Substations and Powerline)								
Removal of structures, machinery and equipment	1	2	1	2	1,5	2	1	4,5
Rehabilitation of site to agreed land use	1	2	1	2	1,5	2	1	4,5

Table 5-3 DWS Risk Impact Matrix for the proposed project continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Clearing of vegetation	1	3	5	2	11	82,5	Moderate	Low
Stripping and stockpiling of topsoil	1	3	5	2	11	82,5	Moderate	Low
Establish working area	2	3	5	2	12	75	Moderate	Low
Minor Excavations	1	3	5	2	11	55	Low	Low
Vehicle access	3	3	1	3	10	47,5	Low	Low
Leaks and spillages from machinery, equipment & vehicles	1	3	1	2	7	35	Low	Low
Solid waste disposal	1	3	1	3	8	40	Low	Low
Human sanitation& ablutions	1	3	1	2	7	36,75	Low	Low
Re-fuelling of machinery and vehicles	3	3	5	2	13	94,25	Moderate	Low
Laying of core samples	3	3	5	2	13	65	Moderate	Low
Backfill of material	1	3	1	3	8	38	Low	Low
Operational Phase								
Traffic	5	2	1	1	9	85,5	Moderate	Low
Waste Disposal	2	2	1	2	7	52,5	Low	Low
Altered Overflow Dynamics	2	2	1	2	7	63	Moderate	Low
Decommissioning Phase								
Removal of structures, machinery and equipment	2	2	1	3	8	36	Low	Low
Rehabilitation of site to agreed land use	2	2	1	3	8	36	Low	Low

Table 5-4 DWS Risk Impact Matrix for the proposed project

Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase (PV site, Substations and Powerline)								
Clearing of vegetation	2	1	2	2	1.75	2	1	4.75
Stripping and stockpiling of topsoil	1	1	1	1	1	2	2	5
Establish working area	1	1	1	1	1	1	1	3
Minor Excavations	1	1	1	1	1	2	2	5
Vehicle access	1	2	1	1	1.25	2	1	4.25
Leaks and spillages from machinery, equipment & vehicles	1	3	1	1	1.5	2	1	4.5
Solid waste disposal	1	2	1	1	1.25	2	1	4.25
Human sanitation& ablutions	1	3	1	1	1.5	2	1	4.5
Re-fuelling of machinery and vehicles	1	3	1	1	1.5	2	1	4.5
Laying of core samples	1	1	1	1	1	2	2	5
Backfill of material	1	1	1	1	1	2	2	5
Operational Phase (PV site, Substations and Powerline)								
Traffic	1	2	1	3	1,75	2	5	8,75
Waste Disposal	1	2	2	2	1,75	1	4	6,75
Altered Overflow Dynamics	1	2	2	2	1,75	1	4	6,75
Decommissioning Phase (PV site, Substations and Powerline)								
Removal of structures, machinery and equipment	1	2	1	2	1,5	2	1	4,5
Rehabilitation of site to agreed land use	1	2	1	2	1,5	2	1	4,5

Table 5-5 DWS Risk Impact Matrix for the proposed project continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Clearing of vegetation	1	2	1	1	5	23.75	Low	Low
Stripping and stockpiling of topsoil	3	3	1	3	10	50	Low	Low
Establish working area	1	2	1	2	6	18	Low	Low
Minor Excavations	3	2	1	4	10	50	Low	Low
Vehicle access	2	2	1	2	7	29.75	Low	Low
Leaks and spillages from machinery, equipment & vehicles	2	2	1	3	8	36	Low	Low
Solid waste disposal	2	2	1	2	8	34	Low	Low
Human sanitation& ablutions	2	2	1	2	7	31.5	Low	Low
Re-fuelling of machinery and vehicles	2	2	1	2	7	31.5	Low	Low
Laying of core samples	2	2	1	2	7	35	Low	Low
Backfill of material	1	2	1	2	6	30	Low	Low
Operational Phase								
Traffic	2	1	1	1	5	43,75	Low	Low
Waste Disposal	5	1	1	1	8	54	Low	Low
Altered Overflow Dynamics	3	1	1	1	6	40,5	Low	Low
Decommissioning Phase								
Removal of structures, machinery and equipment	2	2	1	3	8	36	Low	Low
Rehabilitation of site to agreed land use	2	2	1	3	8	36	Low	Low

5.1.1 Mitigation Measures

The following general mitigation measures are provided in view of the expected Low levels of risk posed to the wetland areas:

- The wetland and buffer areas must be avoided;
- A stormwater management plan must be compiled and implemented for the project, facilitating the diversion of clean water to the delineated resources;
- The construction vehicles and machinery must make use of existing access routes as much as possible, before adjacent areas are considered for access;
- Laydown yards, camps and storage areas must be within project area;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces;
- All chemicals and toxicants to be used for the construction must be stored within the drilling site and in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;
- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No dumping of material on-site may take place; and
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported.

6 Conclusion and Recommendation

6.1 Baseline Ecology

During the site assessment, four HGM units were identified and assessed within the 500 m regulated area. These comprise of four depression wetlands which were considered for the functional assessment. The wetlands scored an overall PES ranging from of D – “Largely Modified” to E – “Seriously Modified” due to the modification to both the hydrology and vegetation of the wetlands through anthropogenic activities. The wetlands scored “Moderate” importance and sensitivity due to the low threat status, protection level and integrity of systems. The average ecosystem service score was determined to range from “Low” to “High” due to the vegetation cover and amount of pollution running into the wetlands. A 15 m post mitigation buffer was assigned to the wetland systems.

6.2 Risk Assessment

Two risk assessments have been completed for this project. The first risk assessment completed for the PV area (Option C & E) showed that both direct and indirect impacts will occur on the wetlands. Thus, avoidance cannot be met and the focus was moved to minimising the impacts on the wetlands. The residual risk for these options is expected to be low.

The second risk assessment completed was for the PV areas (Option A, B & D), the assessment showed that both direct and indirect impacts will not occur. All pre-mitigation risks were determined to be "Low", with the residual impacts being further mitigated to an acceptable level of risk.

6.3 Specialist Recommendation

Based on the results and conclusions presented in this report, it is expected that the proposed activities will pose low residual risks on the wetlands and thus no fatal flaws were identified for the project. Although Option C and E will influence two small depression wetlands. It is the specialist opinion that the loss of those wetlands will have a negligible impact, and can be compensate by means of onsite rehabilitation of other water resources. A General Authorisation (GN 509 of 2016) is required for the water use authorisation for these options.

Option B is preferred for PV 5 since there are no wetlands within 500 m of the development. No water use authorisation (Section 21 c and i) is required for this option.

In accordance with the General Authorisation (GA) in terms of section 39 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) for water uses as defined in section 21 (c) or section 21 (i) a GA does not apply "*to any water use in terms of section 21 (c) or (i) of the Act associated with the construction, installation or maintenance of any sewer pipelines, pipelines carrying hazardous materials and to raw water and waste water treatment works*". It is uncertain if this is applicable for the development, but a General Authorisation may not be permissible for the project.

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