



GEOHYDROLOGY

GEOTECHNICAL

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## Wetland / Riparian Impact Assessment Report

A WETLAND / RIPARIAN IMPACT ASSESSMENT FOR THE PROPOSED POWER LINE FOR THE GROOTPOORT PHOTOVOLTAIC SOLAR POWER PLANT NEAR LUCKHOFF, FREE STATE PROVINCE

August 2021

Prepared for: ENVIRONAMICS CC  
Compiled by Dr BJ Henning  
Document version 1.0 – Draft



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August 2021



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**Compiled by:**  
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## DOCUMENT HISTORY

| Report no  | Date        | Version | Status |
|------------|-------------|---------|--------|
| L21 068 EC | August 2021 | 2.0     | Final  |

## Wetland & Riparian Impact Assessment Grootpoort Powerline

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## **Wetland & Riparian Impact Assessment Grootpoort Powerline**

### **Declaration**

I, Dr BJ Henning, declare that -

- I act as the independent specialist.
- I will perform the work relating to the project in an objective manner, even if this results in views and findings that are not favourable to the project proponent.
- 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 project, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998; the Act), regulations and any guidelines that have relevance to the activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I will consider, to the extent possible, the matters listed in Regulation 18 of the NEMA EIA Regulations.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the project proponent 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 project; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority or project proponent.
- All the particulars furnished by me in this document are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the Act.



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**SIGNATURE OF SPECIALIST**

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### 1 ASSIGNMENT

AGES Limpopo (Pty) Ltd was appointed by ENVIRONAMICS CC to conduct a riparian / wetland delineation specialist study and risk matrix as part of the objective to obtain the necessary Environmental Authorisation and Water Use License (if necessary) for the proposed development of 132kV single-circuit power line to enable the connection of the authorised Grootpoort Photovoltaic Solar Power Plant (DFFE ref.: 14/12/16/3/3/2/835) to the national grid network. This will enable the evacuation of the generated solar electricity. A 200m wide and 8km long grid connection corridor is being assessed for the placement of the power line route and associated infrastructure. The power line is proposed to connect into the existing Canal Substation. A service road and substation associated with the power line are also proposed to be developed.

A water use license is now applied for, in terms of section 21 of the National Water Act, 1998 (Act No. 36 of 1998) with specific reference to the following water uses:

- Section 21(c) "Impeding or diverting the flow of water in a water course".
- Section 21(i) "Altering the bed, banks or characteristics of a water course".

The study includes a wetland and riparian delineation and functionality assessment, with descriptions of the anticipated impacts (risks) associated with the proposed development activities and mitigation to reduce impacts. This assessment is essential as it will contribute to meeting the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in conjunction with Regulation 982 of 4 December 2014 (as amended), promulgated in terms of Section 24 (5) of NEMA and Chapter 4 of the National Water Act, Act 36 of 1998 Section 21 (c) and (i).

The assignment is interpreted as follows: Compile a study on the riparian zones / wetlands of the site according to guidelines and criteria set by the Department of Water and Sanitation (DWS).

#### 1.1. INFORMATION SOURCES

The following information sources were obtained for the study:

1. All relevant topographical maps, aerial photographs and information (previous studies and environmental databases) related to wetlands in the study area.
2. Requirements regarding the wetland survey as stipulated in the following guidelines:
  - a. National Water Act (1998).
  - b. A practical field procedure for identification and delineation of wetlands and riparian areas (DWAF, 2006).
  - c. National Wetland Classification System for South Africa (SANBI, 2009).
  - d. A Risk Assessment, as required in terms of the General Authorisation Notice

509 of 2016 (Gazette No.40229).

3. Guidelines regarding development in and around wetlands and riparian zones as stipulated by DWS.

### **1.2. REGULATIONS GOVERNING THIS REPORT**

#### **1.2.1. National Environmental Management Act, 1998 (Act No. 107 of 1998) - Gazette No. 43310 Government Notice R. 320**

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 43310 Government Notice R. 320. Specialist reports includes a list of requirements to be included in a specialist report for a wetland and aquatic biodiversity assessment:

1. A specialist report or a report prepared in terms of these regulations must contain:
  - a. Details of
    - i. The specialist who prepared the report; and
    - ii. The expertise of that specialist to compile a specialist report, including a curriculum vitae.
  - b. A declaration that the specialist is independent in a form as may be specified by the competent authority.
  - c. An indication of the scope of, and purpose for which, the report was prepared.
  - d. The date and season of the site investigation and the relevance of the season to the outcome of the assessment.
  - e. A description of the methodology adopted in preparing the report or carrying out the specialized process.
  - f. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.
  - g. An identification of any areas to be avoided, including buffers.
  - h. A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.
  - i. A description of any assumptions made and any uncertainties or gaps in knowledge.

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- j. A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment.
- k. any mitigation measures for inclusion in the EMPr.
- l. any conditions for inclusion in the environmental authorisation.
- m. any monitoring requirements for inclusion in the EMPr or environmental authorisation
- n. a reasoned opinion –
  - i. As to whether the proposed activity or portions thereof should be authorised and
  - ii. If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr and where applicable, the closure plan.
- o. A description of any consultation process that was undertaken during preparing the specialist report.
- p. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and
- q. Any other information requested by the competent authority.

### **1.2.2. The National Water Act (Act No. 36 of 1998)**

Chapter 4 of the National Water Act, Act 36 of 1998 specifies that:

“In general, a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a licence. The Minister may limit the amount of water which a responsible authority may allocate. In making regulations the Minister may differentiate between different water resources, classes of water resources and geographical areas.”

In section 21 of the NWA, water uses which are applicable to the proposed project, are listed as follows:

- c. Impeding or diverting the flow of water in a watercourse.
- i. Altering the bed, banks, course or characteristics of a watercourse.

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General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998) states the following:

In accordance with GN 509 of 2016, a regulated area of a watercourse for Section 21(c) and 21(i) of the NWA, 1998 is defined as:

- The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam.
- In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench: or
- A 500 m radius from the delineated boundary (extent) of any wetland or pan.

This notice should be read together with the Risk Assessment provisions in the General Authorisation Notice in Relation to Section 21.

### **1.2.3. Conservation of Agricultural Resources Act (Act No. 43 of 1983)**

This Act controls the utilization and protection of wetlands, soil conservation and all matters relating thereto including prevention of veld fires, control of weeds and invader plants, prevention of water pollution resulting from farming practices and losses in biodiversity.

### **1.2.4. The National Environmental Management Act (NEMA) (Act No. 107 of 1998)**

This Act embraces all three fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use planning and development. The environmental management principles include the duty of care for wetlands and special attention is given to management and planning procedures.

## **1.3. TERMS OF REFERENCE**

### **1.3.1. Objectives**

The project was done according to the following objectives:

- Conduct a desktop and field investigation to confirm the presence or absence of wetlands / riparian zones within the study area.
- Delineate and map the identified wetland / riverine area on site within the grid corridor.
- Classify riparian zones / wetlands according to their hydro-geomorphic characteristics.

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- Determine the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of all wetlands and riparian areas on site.
- Determine the impacts and risks associated with the proposed development on the wetlands and / or riparian zones (risk assessment matrices).
- Compile a report with the findings and maps.

### **1.3.2. Limitations and assumptions**

The large study area did not allow for the finer level of assessment that can be obtained in smaller study areas. Therefore, data collection in this study relied heavily on data from representative sections, as well as general observations and a desktop analysis.

## 2 METHODS

### 2.1 WETLAND DELINEATION AND CLASSIFICATION

The National Water Act, Act 36 of 1998, defines wetlands as follows:

“Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

Wetlands were delineated according to the delineation procedure given in “A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas” (DWAF, 2003).

Wetland indicators are divided into different unit indicators which need to be given consideration in the delineation of wetlands (Figure 1). The outer edge of the temporary zone requires the delineator to take the following specific indicators into account:

- 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 Macvicar (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile because of prolonged and frequent saturation.
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

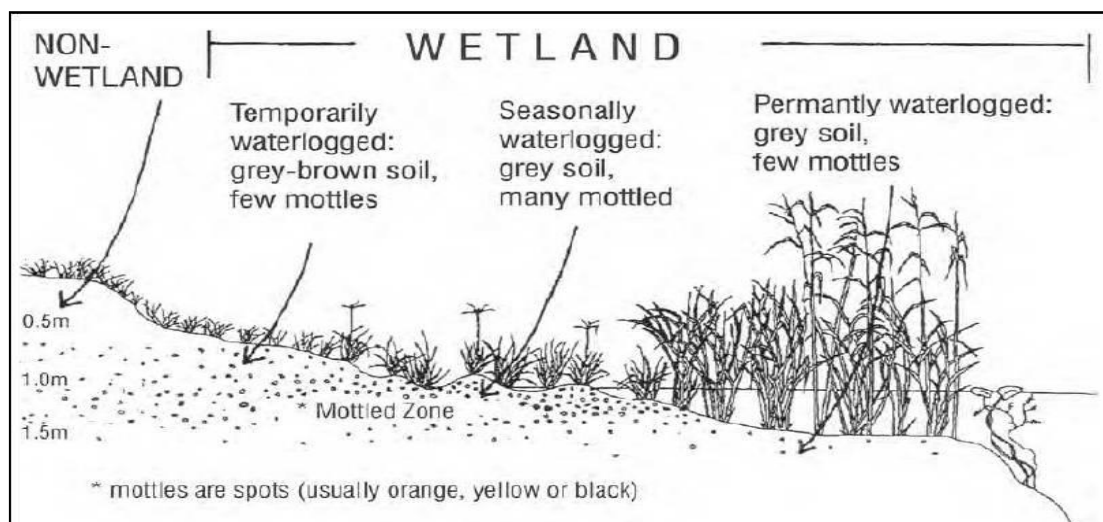


Figure 1. A cross section through a wetland showing how the soil form indicators and vegetation changes from the centre to the edge of the wetland (adapted from Kotze, 1996)

### **2.2 WETLAND CLASSIFICATION**

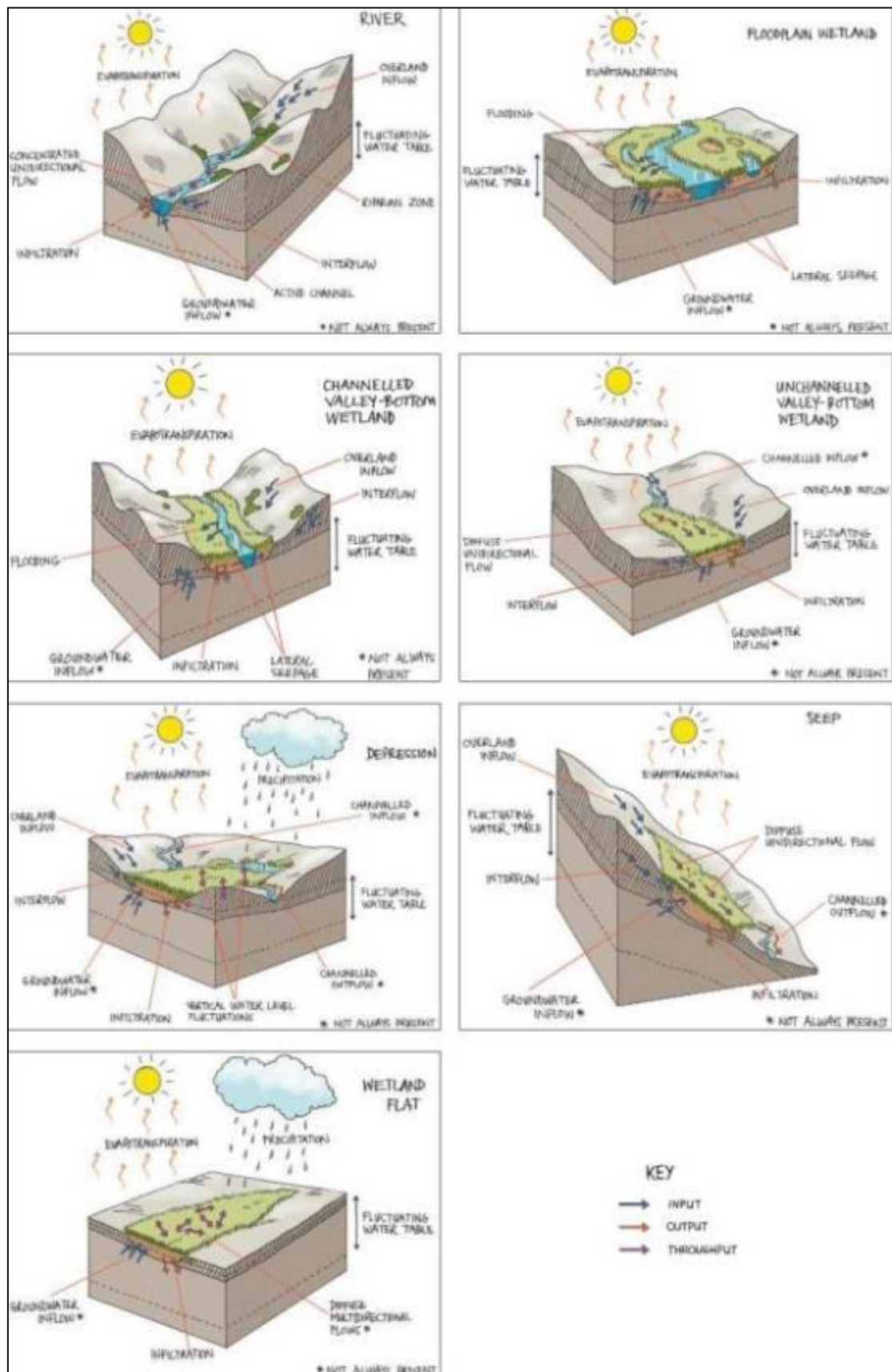
The study area was sub-divided into transects and the soil profile was examined for signs of wetness within 50 cm of the surface using a hand auger along transects. The wetland boundaries were then determined by the positions of augured holes that showed signs of wetness as well as by the presence or absence of hydrophilic vegetation. The wetlands were subsequently classified according to their hydro-geomorphic setting based on the system proposed in the National Wetland Classification System (Table 1) (SANBI, 2009).

Furthermore, because of alluvial deposits being visible from the air, aerial photography was also used to assist in determining the extent of deposits, as well as the vegetation line indicating a difference in species composition or more vigorous growth. The aerial photographs were used to guide on-screen delineation of wetlands in ArcView GIS 3.3.



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Table 1. Wetland Unit types based on hydrogeomorphic characteristics (Adapted from Kotze *et al.* 2005).



### 2.3 RIPARIAN DELINEATION AND CLASSIFICATION

Riparian areas often associated with streams or drainage lines are also important to protect due to the followings ecological and hydrological functions that it performs.

(DWAF, 2003):

- Stabilize stream banks.
- Store water and aid in flood attenuation.
- Improve water quality by trapping nutrients and sediment.
- Maintain natural water temperature for aquatic species.
- Provide shelter and food for avifauna and other animals.
- Provide corridors for movement and migration of different species; and
- Act as a buffer between aquatic ecosystems and adjacent land uses.

The riparian areas have their own unique set of indicators. DWAF (2003) states that to classify an area as a riparian area it must have one or more of the following attributes:

- Are associated with a watercourse.
- Contain distinctively different plant species than adjacent areas; and contain species like adjacent areas but exhibiting more vigorous or robust growth forms; and
- May have alluvial soils.

The delineation process requires that the following be considered:

- Topography associated with the watercourse (figure 2).
- Vegetation (figure 3); and
- Alluvial soils and deposited material.

Many riparian areas display wetland indicators and should be classified as wetlands. However, other riparian areas are not saturated long enough or often enough to develop wetland characteristics, but also perform a few important functions, which need to be safeguarded. In these areas alluvial deposits can predominate and/or the water table is too deep for most of the year to produce hydromorphic features in the top 50cm of the soil profile. These conditions do not support vegetation typically adapted to life in saturated soil and it is therefore important to delineate these riparian areas in addition to wetlands. Riparian areas commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands generally display more diffuse flow and are

lower energy environments.

The general approach for delineating riparian areas in the field is to identify the active channel or the lowest part of the river course. Most likely cues like water with associated emergent vegetation, sedges and reeds or alluvial soil and bedrock will be visible. From this point some topographic units like sandbars, active channel bank, flood benches and macro-channel bank with associated riparian vegetation will be identifiable. The next step would be to proceed upwards towards the macro-channel bank, taking note of alluvial soil, topographic units and vegetation indicators. The outer boundary will be the point on the edge of the macro channel bank where there is a distinct difference between the riparian and terrestrial vegetation. In some cases where riparian vegetation is unrecognisable, because of land-use activities, indicators like alluvial material and topographical units can still be used to visualize the edge of a riparian area. If you are adjacent to a watercourse, it is also important to check for the presence of riparian indicators. The riparian areas were identified using the following information:

- Topographical maps: Riparian areas normally occur within the flood area of a river or stream.
- Aerial photographs: As a result of alluvial deposits being visible from the air, aerial photography can assist in determining the extent of deposits, as well as the vegetation line indicating a difference in species composition or more vigorous growth.

A combination of the abovementioned indicators was used during the field survey that was conducted during July 2021 to identify the indicator plant species, soil types and specific topography related to the wetland areas. The outer boundaries were then recorded using a Global Positioning System (GPS). Riparian areas were mapped by means of the computer programme Arcview 3.3.

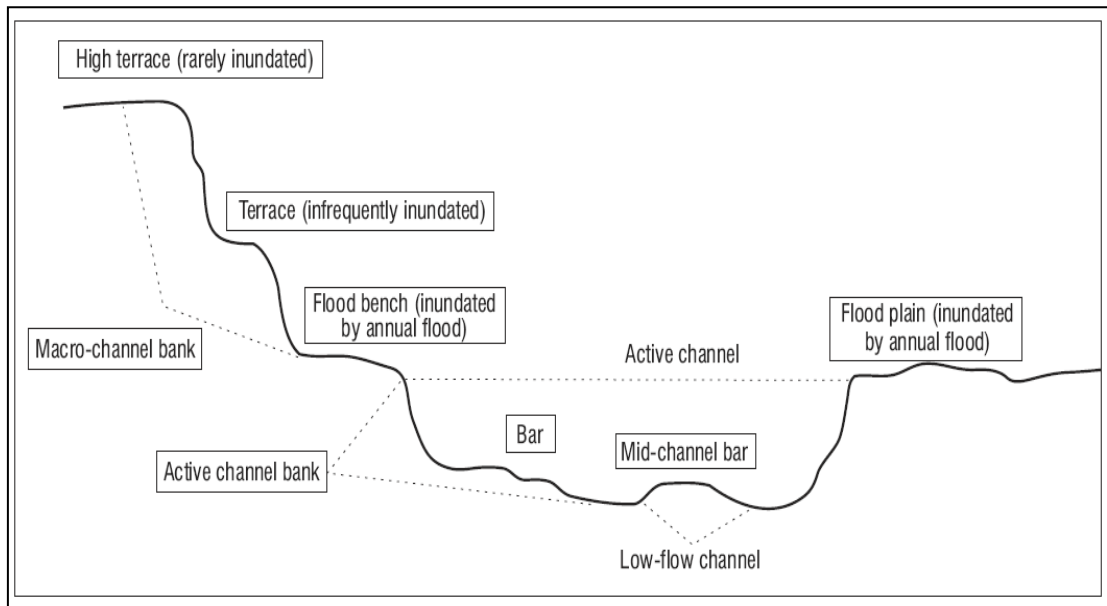


Figure 2. Cross section of topography associated with a channel and floodplains.

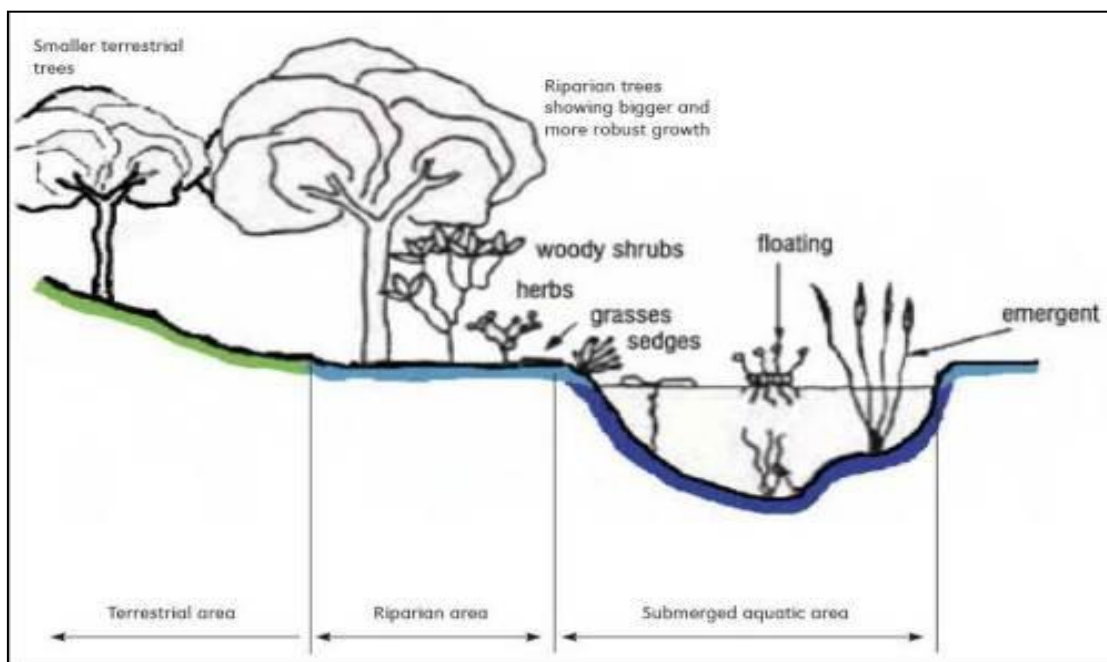


Figure 3. Typical cross section of a river channel displaying riparian habitat (DWA, 2003)

## 2.4 WETLAND INTEGRITY ASSESSMENTS

### 2.4.1 Present Ecological Status (PES) of wetlands

The Present Ecological State (PES) assessment of the wetlands within the study area was undertaken to determine the extent of departure of the wetlands from a natural state or reference condition. This method is based on the modified Habitat Integrity approach (Table 2) developed by Kleynhans (1999). Anthropogenic modification of the criteria and its attributes can have an impact on the ecological integrity of a wetland.

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**Table 2. Habitat integrity assessment criteria for wetlands (Adapted from DWAF, 2003)**

| Criteria and Attributes  | Relevance   |
|--|---|
| <b>Hydrologic</b>  |   |
| <b>Flow Modification</b>   | Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland. |
| <b>Permanent Inundation</b>  | Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.  |
| <b>Water Quality</b>   |   |
| <b>Water Quality Modification</b>  | From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.   |
| <b>Sediment Load Modification</b>  | Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.   |
| <b>Hydraulic / Geomorphic</b>  |   |
| <b>Canalisation</b>  | Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.   |
| <b>Topographic Alteration</b>  | Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities which reduce or changes wetland habitat directly in inundation patterns.   |
| <b>BIOTA</b>   |   |
| <b>Terrestrial Encroachment</b>  | Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.   |
| <b>Indigenous Vegetation Removal</b>   | Transformation of habitat for farming, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and in increases potential for erosion.  |
| <b>Invasive Plant Encroachment</b>   | Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).  |
| <b>Alien Fauna</b>   | Presence of alien fauna affecting faunal community structure  |
| <b>Over utilisation of Biota</b>   | Overgrazing, overfishing, etc.  |
| <b>Attributes are rated and scored as follows:</b><br>Natural / Unmodified – 5 Largely Natural 4 Moderately Modified – 3. Largely Modified - 2. Seriously Modified – 1 Critically Modified - 0 |   |

For this study, the scoring system as described in the document “Resource Directed Measures for Protection of Water Resources, Volume 4. Wetland Ecosystems” (DWAF, 1999) was applied for the determination of the PES (Table 2).

Two tools have recently been developed to facilitate the derivation of scores to reflect the present ecological state, namely the Index of Habitat Integrity (IHI) DWA, 2007, and Wet-Health, developed by Macfarlane et al., 2008. Both these tools have limitations in that they were developed primarily to assess conditions of floodplain and valley bottom wetlands and Hill slope seepage wetlands linked to drainage lines. The former tool was developed to provide a rapid assessment of the PES specifically for application in reserve studies, while the latter tool was developed to support the Working for Wetlands program. The objective of the latter tool was to provide a semi quantitative assessment of the state of wetland prior

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to rehabilitation, and one post rehabilitation to demonstrate “improvement”. The intention in defining the health category (PES) of a wetland is to provide an indication of the current “condition” of a wetland to inform a management class. The latter provides the guidelines against that inform water quality and quantity required to maintain or improve the quality of the water resource.

The PES or health of wetlands has only been applied to the “natural” wetlands, i.e., those that have developed naturally because of the presence of water. Wetlands are rated on a scale of A to F, with A being a natural wetland and F being a completely modified and disturbed wetland (Table 3). The Wet-Health assesses the following four factors that influence the “health” or condition of wetlands and in this application floodplains and river channels associated with the site:

- Hydrology.
- Geomorphology.
- Vegetation, and ideally.
- Water quality.

The Present Ecological Status Class (PESC) of the wetlands was based on the available information for each of the criteria listed in Table 2 and the mean score determined for each wetland (Table 3). This approach assumes that extensive degradation of any of the wetland attributes may determine the PESC (DWAF, 2003).

**Table 3. Present Ecological Status Class Descriptions**

| CLASS | CLASS BOUNDARY | CLASS DESCRIPTION   |
|-------|----------------|---|
| A     | >4             | <b>Unmodified, natural.</b> <ul style="list-style-type: none"><li>• The resource base reserve has not been decreased.</li><li>• The resource capability has not been exploited</li></ul>  |
| B     | >3 and <=4     | <b>Largely natural with few modifications.</b> <ul style="list-style-type: none"><li>• The resource base reserve has been decreased to a small extent.</li><li>• A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.</li></ul> |
| C     | >2 and <=3     | <b>Moderately modified.</b> <ul style="list-style-type: none"><li>• The resource base reserve has been decreased to a moderate extent.</li><li>• A change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.</li></ul>                |

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| CLASS | CLASS BOUNDARY | CLASS DESCRIPTION  |
|-------|----------------|--|
| D     | 2              | <b>Largely modified.</b> <ul style="list-style-type: none"> <li>The resource base reserve has been decreased to a large extent.</li> <li>Large changes in natural habitat, biota and basic ecosystem functions have occurred.</li> </ul>   |
| E     | >0 and <2      | <b>Seriously modified.</b> <ul style="list-style-type: none"> <li>The resource base reserve has been seriously decreased and regularly exceeds the resource base.</li> <li>The loss of natural habitat, biota and basic ecosystem functions is extensive.</li> </ul>   |
| F     | 0              | <b>Critically modified.</b> <ul style="list-style-type: none"> <li>The resource base reserve has been critically decreased and permanently exceeds the resource base.</li> <li>Modifications have reached a critical level and the resource has been modified completely with an almost total loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.</li> </ul> |

### 2.4.2 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) assessment was conducted according to the guidelines as discussed by DWAF (1999). Here DWAF defines “ecological importance” of a water resource as an expression of its importance to the maintenance of ecological diversity and function on local and wider scales. “Ecological sensitivity”, according to DWAF (1999), is the system’s ability to resist disturbance and its capability to recover from disturbance once it has occurred.

In the method outlined by DWAF a series of determinants for EIS (Table 4) are assessed for the wetlands on a scale of 0 to 4 (Table 5). The median of the determinants is used to determine the EIS of the wetland unit (Table 5).

**Table 4. Criteria for assessing the Ecological Importance and Sensitivity of Wetlands**

| Determinant  |
|--|
| <b>PRIMARY DETERMINANTS</b>  |
| 1. Rare & Endangered Species                                       |
| 2. Populations of Unique Species                                   |
| 3. Species/taxon Richness  |
| 4. Diversity of Habitat Types or Features                          |
| 5. Migration route/breeding and feeding site for wetland species   |
| 6. Sensitivity to Changes in the Natural Hydrological Regime       |
| 7. Sensitivity to Water Quality Changes                            |
| 8. Flood Storage, Energy Dissipation & Particulate/Element Removal |
| <b>MODIFYING DETERMINANTS</b>                                      |
| 9. Protected Status  |

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|                             |
|-----------------------------|
| <b>Determinant</b>          |
| <b>PRIMARY DETERMINANTS</b> |
| 10. Ecological Integrity    |

Score guideline

Very high = 4; High = 3; Moderate = 2; Marginal/Low = 1; None = 0

Confidence rating

Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1

**Table 5. Ecological Importance and Sensitivity Classes**

| Ecological Importance and Sensitivity Category (EIS)   | Range of Median |
|--|-----------------|
| <u>Very high</u><br>Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers. | >3 and <=4      |
| <u>High</u><br>Wetlands that are ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.  | >2 and <=3      |
| <u>Moderate</u><br>Wetlands that are ecologically important and sensitive on a provincial or local scale. The biodiversity of these Wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.                         | >1 and <=2      |
| <u>Low/marginal</u><br>Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these Wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.                   | >0 and <=1      |

### 2.5 Impact rating assessment matrix

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need.

The significance of the impacts will be determined through a synthesis of the criteria below (Plomp, 2004):

**Probability.** This describes the likelihood of the impact occurring:

- **Improbable:** The possibility of the impact occurring is very low, due to the circumstances, design, or experience.
- **Probable:** There is a probability that the impact will occur to the extent that provision must be made, therefore.
- **Highly Probable:** It is most likely that the impact will occur at some stage of the development.
- **Definite:** The impact will take place regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.

**Duration.** The lifetime of the impact



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- Short term: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
- Medium term: The impact will last up to the end of the phases, where after it will be negated.
- Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
- Permanent: Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

**Scale.** The physical and spatial size of the impact

- Local: The impacted area extends only as far as the activity, e.g., footprint.
- Site: The impact could affect the whole, or a measurable portion of the above-mentioned properties.
- Regional: The impact could affect the area including the neighbouring areas.

**Magnitude/ Severity.** Does the impact destroy the environment or alter its function?

- Low: The impact alters the affected environment in such a way that natural processes are not affected.
- Medium: The affected environment is altered, but functions and processes continue in a modified way.
- High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

**Significance.** This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

- Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
- Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
- Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.

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- High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights will be assigned to each attribute (Table 6):

**Table 6. Impact rating assessment weights**

| Aspect                    | Description   | Weight |
|---------------------------|---|--------|
| <b>Probability</b>        | Improbable  | 1      |
|                           | Probable  | 2      |
|                           | Highly Probable                                       | 4      |
|                           | Definite  | 5      |
| <b>Duration</b>           | Short term  | 1      |
|                           | Medium term   | 3      |
|                           | Long term   | 4      |
|                           | Permanent   | 5      |
| <b>Scale</b>              | Local   | 1      |
|                           | Site  | 2      |
|                           | Regional  | 3      |
| <b>Magnitude/Severity</b> | Low   | 2      |
|                           | Medium  | 6      |
|                           | High  | 8      |
| <b>Significance</b>       | <b>Sum (Duration, Scale, Magnitude) x Probability</b> |        |
|                           | Negligible  | <20    |
|                           | Low   | <40    |
|                           | Moderate  | <60    |
|                           | High  | >60    |

The significance of each activity will be rated without mitigation measures and with mitigation measures for the development.

The mitigation effect of each impact will be indicated without and with mitigation measures as follows:

- Can be reversed.
- Can be avoided, managed or mitigated.
- May cause irreplaceable loss of resources.

### 2.6 Risk assessment matrix

A Risk Assessment, as required in terms of the General Authorisation Notice 509 of 2016 (Gazette No.40229), for any development proposed within the 1:100-year floodline. The risk assessment should be based on the following ratings (Table 7).

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**Table 7. Risk rating tables and methodology for the risk assessment**

### SEVERITY

How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, and habitat)?

|  |   |
|--|---|
| Insignificant / non-harmful  | 1 |
| Small / potentially harmful  | 2 |
| Significant / slightly harmful   | 3 |
| Great / harmful  | 4 |
| Disastrous / extremely harmful and/or wetland(s) involved  | 5 |
| Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating. |   |

### SPATIAL SCALE

How big is the area that the aspect is impacting on?

|  |   |
|--|---|
| Area specific (at impact site)   | 1 |
| Whole site (entire surface right)                                      | 2 |
| Regional / neighbouring areas (downstream within quaternary catchment) | 3 |
| National (impacting beyond secondary catchment or provinces)           | 4 |
| Global (impacting beyond SA boundary)                                  | 5 |

### DURATION

How long does the aspect impact on the resource quality?

|  |   |
|--|---|
| One day to one month, PES, EIS and/or REC not impacted   | 1 |
| One month to one year, PES, EIS and/or REC impacted but no change in status  | 2 |
| One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation | 3 |
| Life of the activity, PES, EIS and/or REC permanently lowered  | 4 |
| More than life of the organisation/facility, PES and EIS scores, a E or F  | 5 |
| PES and EIS (sensitivity) must be considered.  |   |

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### FREQUENCY OF THE ACTIVITY

How often do you do the specific activity?

|                  |   |
|------------------|---|
| Annually or less | 1 |
| 6 monthly        | 2 |
| Monthly          | 3 |
| Weekly           | 4 |
| Daily            | 5 |

### FREQUENCY OF THE INCIDENT/IMPACT

How often does the activity impact on the resource quality?

|  |   |
|--|---|
| Almost never / almost impossible / >20%      | 1 |
| Very seldom / highly unlikely / >40%         | 2 |
| Infrequent / unlikely / seldom / >60%        | 3 |
| Often / regularly / likely / possible / >80% | 4 |
| Daily / highly likely / definitely / >100%   | 5 |

### LEGAL ISSUES

How is the activity governed by legislation?

|  |   |
|--|---|
| No legislation   | 1 |
| Fully covered by legislation (wetlands are legally governed) | 5 |
| Located within the regulated areas                           |   |

### DETECTION

How quickly/easily can the impacts/risks of the activity be observed on the resource quality, people and property?

|                                 |   |
|---------------------------------|---|
| Immediately                     | 1 |
| Without much effort             | 2 |
| Need some effort                | 3 |
| Remote and difficult to observe | 4 |
| Covered                         | 5 |

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### RATING CLASSES

| 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.                                |
| 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. Licence required. |
| 170 – 300 | (H) High Risk     | Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.             |

A low-risk class must be obtained for all activities to be considered for a GA

### CALCULATIONS

Consequence = Severity + Spatial Scale + Duration

Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection

Significance\Risk = Consequence X Likelihood

**RISK ASSESSMENT MUST BE CONDUCTED BY A SACNASP REGISTERED PROFESSIONAL MEMBER AND THE ASSESSOR MUST:**

**1) CONSIDER BOTH CONSTRUCTION AND OPERATIONAL PHASES OF PROPOSED ACTIVITIES;**

**2) CONSIDER RISKS TO RESOURCE QUALITY POST MITIGATION CONSIDERING MITIGATION MEASURES LISTED IN TABLES PROVIDED;**

**3) CONSIDER THE SENSITIVITY (ECOLOGICAL IMPORTANCE AND SENSITIVITY – EIS) AND STATUS (PRESENT ECOLOGICAL STATUS - PES) OF THE WATERCOURSE AS RECEPTOR OF RISKS POSED;**

**4) CONSIDER POSITIVE IMPACTS/RISKS REDUCTION AS A VERY LOW RISK IN THIS ASSESSMENT;**

**5) INDICATE CONFIDENCE LEVEL OF SCORES PROVIDED IN THE LAST COLUMN AS A PERCENTAGE FROM 0 - 100%.**

### **3 STUDY AREA**

#### **3.1 LOCATION AND DESCRIPTION OF ACTIVITY**

The activity entails the development of a 132kV single-circuit power line to enable the connection of the authorised Grootpoort Photovoltaic Solar Power Plant (DFFE ref.: 14/12/16/3/3/2/835) to the national grid network. This will enable the evacuation of the generated solar electricity. A 200m wide and 8km long grid connection corridor is being assessed for the placement of the power line route and associated infrastructure. The power line is proposed to connect into the existing Canal Substation. A service road and substation associated with the power line are also proposed to be developed.

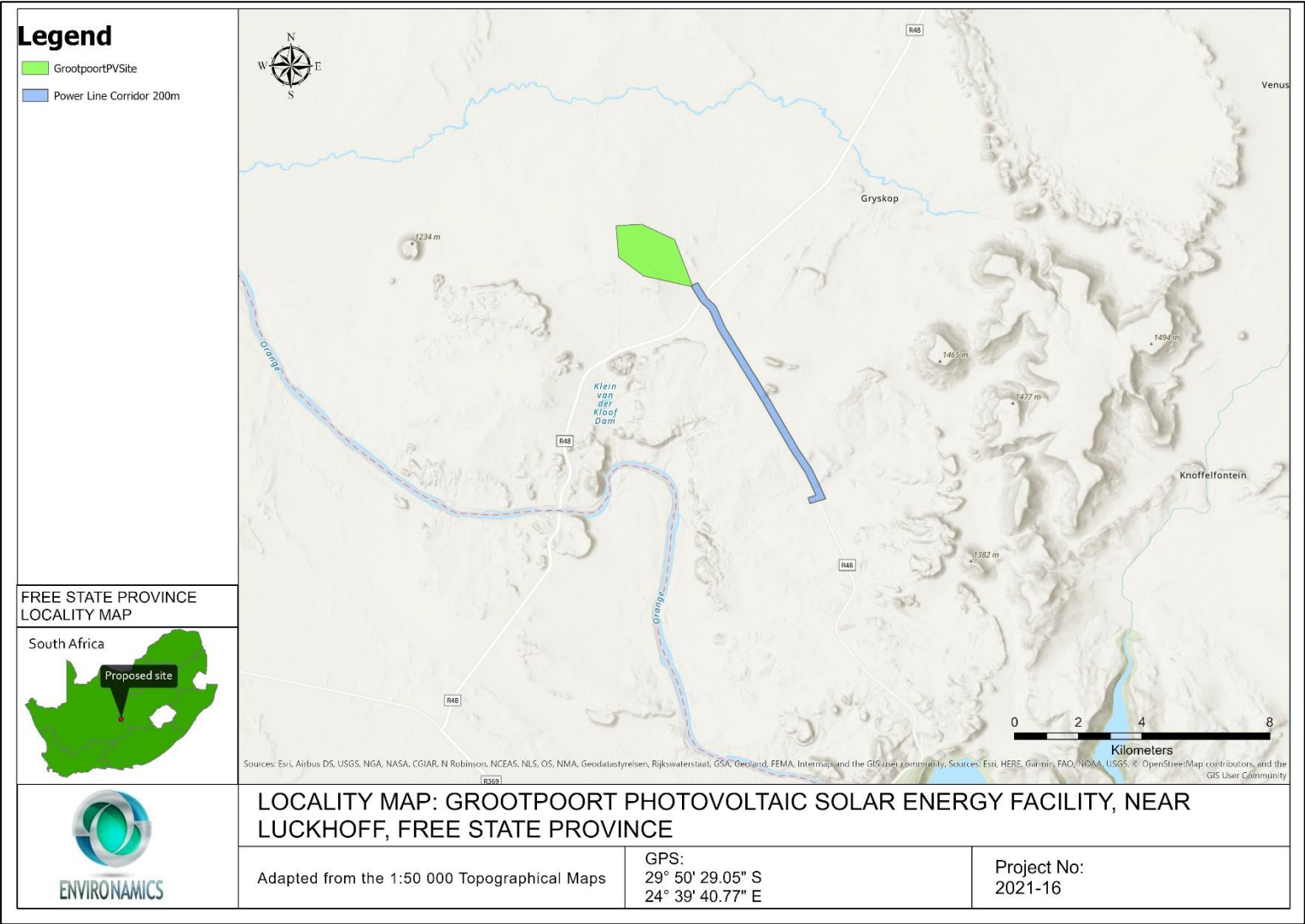
The grid connection corridor is approximately 17km south-west from the town of Luckhof and falls within the Letsemeng Local Municipality of the Xhariep District Municipality, Free State Province (Figure 1).

Various properties are affected by the grid connection corridor, which includes:

- Grootpoort 168 (Portion 1),
- Dundee 416 (RE, Portion 2 and 4),
- Excelsior 676,
- Lombardsdam 81 (RE),
- Naauwpoort 417 (Portion 5),
- Ou Rondefontein 146 (Portion 2 and 4),
- Rondefontein 99 (Portion 1),
- Fauresmith Rd 1251,
- Fauresmith Rd 1252.

The planned development footprint of the powerline was carefully selected after a pre-screening site visit was conducted on the 20th of July 2021. The aerial map of the powerline corridor is presented in Figure 5.

Wetland & Riparian Impact Assessment Grootpoort Powerline





## Wetland & Riparian Impact Assessment Grootpoort Powerline

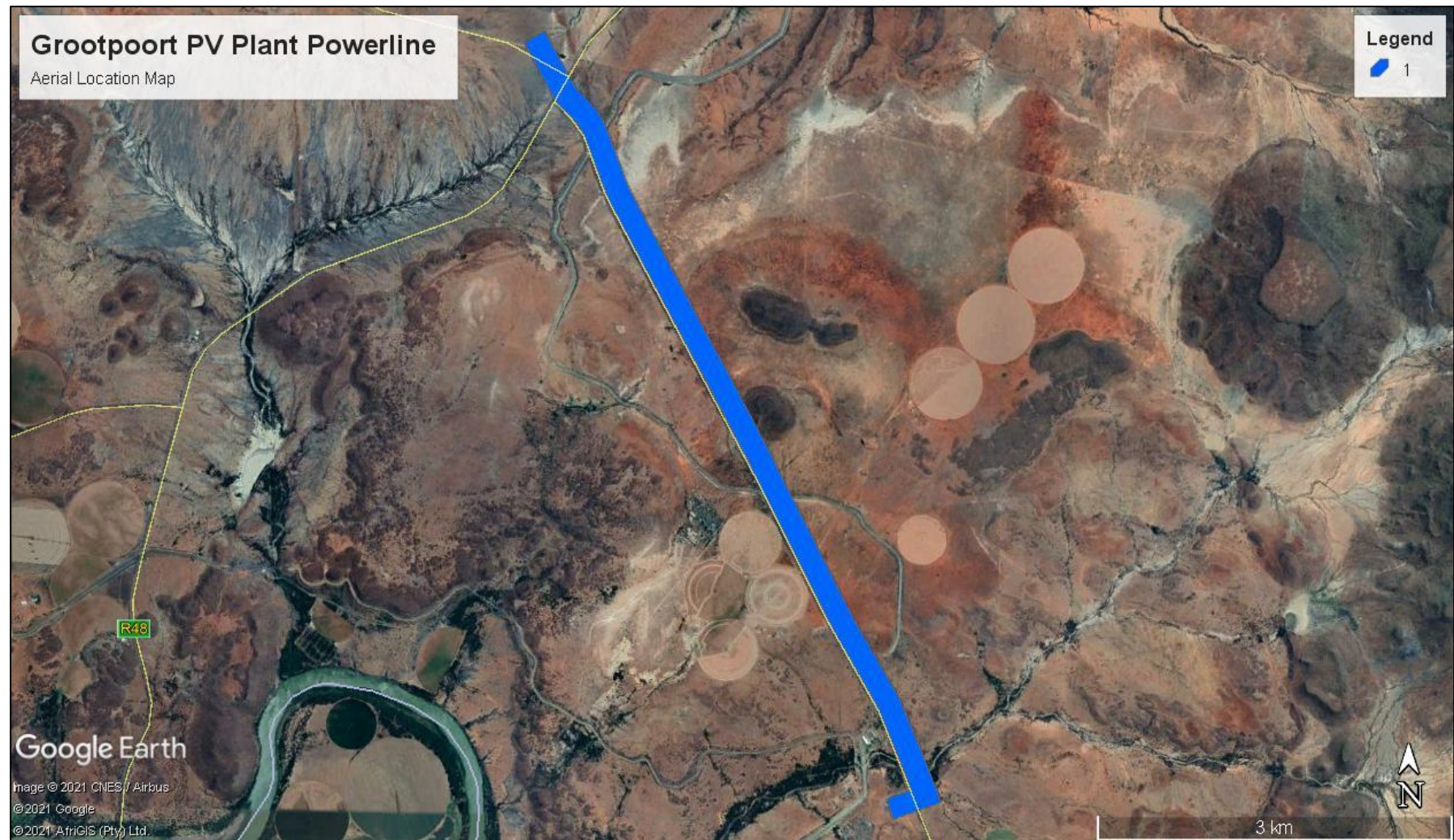


Figure 5. Aerial Map indicating the proposed location of the powerline corridor for the Grootpoort PV Plant



### **3.2 CLIMATE**

Climate in the broad sense is a major determinant of the geographical distribution of species and vegetation types. However, on a smaller scale, the microclimate, which is greatly influenced by local topography, is also important. Within areas, the local conditions of temperature, light, humidity and moisture vary greatly, and it is these factors which play an important role in the production and survival of plants (Tainton, 1981). The climate for the region can be described as warm-temperate. In terrestrial environments, limitations related to water availability are always important to plants and plant communities.

The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). The study area is situated within the summer and autumn rainfall region with very dry winters and frequent frost that occurs during the colder winter months. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987).

The Mean Annual Precipitation ranges from about 150 mm in the northwest to 350 mm along some grassland margins on the Great Escarpment and in the east. Water concentrates between rocks because of rainfall runoff. Incidence of frost is relatively high but ranging widely from <30 days per year at lower altitudes to >80 days at highest altitudes (Mucina & Rutherford, 2006).

The mean annual temperature for the area is 16. °C, and the mean annual frost days is 37 days. Mean Annual Potential Evaporation is 2615mm, with Mean Annual Soil Moisture Stress of 82%.

### **3.3 GEOLOGY AND SOIL TYPES**

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the study area include the Ag151 and Fb85 land types (Land Type Survey Staff, 1987) (ENPAT, 2001). The land type, geology and associated soil types is presented in Table 8 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

**Table 8. Land types, geology, and dominant soil types of the proposed development site**

| Landtype | Soils   | Geology   |
|----------|---|---|
| Ag151    | Red-yellow apedal freely drained soils, red high base <300 deep   | Shale of the Ecca Group, Karoo Sequence with abundant dolerite intrusions.  |
| Fb85     | Glenrosa and/or Mispah forms (other soils may occur) lime rare or absent in upland soils but generally present in low-lying soils | Shale, mudstone, sandstone, limestone and coal of the Beaufort Group, Karoo Sequence. Dolerite intrusions are common. |

The soils in this area are primarily primitive, skeletal soils in rocky areas developing over sedimentary rocks such as mudstones and arenites of the Adelaide Subgroup of the Karoo Supergroup and to a lesser extent also the Ecca Group (Waterford and Volksrust Formations) as well as Jurassic dolerite sills and dykes and subsummit positions of mesas and butts with dolerite boulder slopes. Almost entirely Ib land type (Mucina & Rutherford, 2006). On site it was found that in areas where drainage lines run off the slope, shale and mudstones of the Adelaide Subgroup are exposed leading to the development of vegetation subcommunities. This varies slightly from the general geology of the vegetation type which area shales of the Volksrust Formation and to a lesser extent the Prince Albert Formation (both Ecca Group) as well as Dwyka Group diamictites form the underlying geology. Jurassic Karoo Dolerite sills and sheets support this vegetation complex in places. Wide stretches of land are covered by superficial deposits including calcretes of the Kalahari Group. Soils are variable from shallow to deep, red-yellow, apedal, freely drained soils to very shallow Glenrosa and Mispah forms. Mainly Ae, Ag and Fc land types.

## 3.4 TOPOGRAPHY, LANDUSES AND DRAINAGE

The study area lies completely within the Upper Orange Water Management Area (WMA) and entirely within the Nama Karoo ecoregion (Kleynhans et al., 2005).

The topography is characterised by slightly undulating plains with drainage channels bisecting the area. The topography of the site can be described as generally favourable, when considering that most of the area consists of slopes of less than 1:5. The site is located at an altitude of between 1160 and 1220 meters above mean sea level (AMSL).

Most properties situated within a 500m radius are being used for livestock grazing and crop cultivation. The proposed development land is used for livestock farming. The natural vegetation of the site is mostly intact.

The site is located within the D33A quaternary catchment and is situated in the Upper Orange Water Management Area. Drainage occurs as sheet-wash into the drainage channels on site that eventually drains into the major river namely the Orange River that occurs to the

south of the site.

### **3.5 STRATEGIC WATER SOURCE AREAS (SWSA), NATIONAL FRESHWATER ECOSYSTEM PRIORITY AREAS (NFEPA) STATUS OF RIVERS AND WETLANDS ON SITE**

NFEPA maps provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or 'FEPAs'. NFEPA maps were developed using the principles of systematic biodiversity planning, also known as systematic conservation planning (Margules and Pressey 2000). Systematic biodiversity planning is a well-established field of science in which South Africa is considered a world leader (Balmford 2003). The NFEPA maps and supporting information form part of a comprehensive approach to sustainable and equitable development of South Africa's scarce water resources. For integrated water resources planning, NFEPA provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). NFEPA products are therefore directly applicable to the National Water Act, feeding into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives. NFEPA products are also directly relevant to the National Environmental Management: Biodiversity Act (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act. NFEPA products support the implementation of the National Environmental Management: Protected Areas Act (Act 57 of 2003) by informing the expansion of the protected area network.

The project area is located within proximity of a NFEPA river, namely the Orange River. None of the powerline corridor is bisected by NFEPA Rivers or wetlands, although some NFEPA pans occur near the powerline corridor as indicated in Figure 10.

Strategic Water Source Areas (SWSAs) are now defined as areas of land that either:

- Supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or
- Have high groundwater recharge and where the groundwater forms a nationally important resource; or
- Areas that meet both criteria (a) and (b).

They include transboundary Water Source Areas that extend into Lesotho and Swaziland. All surface water SWSAs are in high rainfall areas where baseflow is at least 11 25 mm/a, which

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is evidence of a strong link between groundwater and surface water in the SWSAs. The aquifers sustain baseflow, contribute to runoff and, especially, contribute to dry season flows. Sustained river flows are important as they support people and communities who depend directly on rivers for their water, especially during the dry season and droughts.

The 2018 national and transboundary surface-water SWSAs cover about 124 075 km<sup>2</sup> (10% of the region) and provide a MAR of 24 954 million m<sup>3</sup> (50% of the total). The greatest volume of MAR is generated by the Southern Drakensberg (9% of national and transboundary MAR), followed by the Eastern Cape, Northern Drakensberg and Maloti Drakensberg, and the Boland. The Boland has the highest MAR per unit area (3588 m<sup>3</sup>/ha/year), followed by Table Mountain, the Northern Drakensberg and the Mpumalanga Drakensberg.

Seven of these SWSAs are transboundary areas because Lesotho and Swaziland include portions of important SWSAs for South Africa. The portions of the SWSAs that fall within Lesotho (Eastern Cape, and the Southern, Northern and Maloti Drakensberg) cover 18 570 km<sup>2</sup> and generate a MAR of about 3522 million m<sup>3</sup>. This MAR sustains the Orange and Caledon Rivers and supplies water to Gauteng via the Lesotho Highlands water supply system. In the case of Swaziland, the portions of the SWSAs falling in this country (Ekangala Drakensberg, Mbabane Hills, Upper Usutu) total 9376 km<sup>2</sup> and produce a MAR of about 2053 million m<sup>3</sup>. In total, the SWSAs in these two countries produce about 11% of the total MAR, which is a substantial contribution that needs to be protected.

The project area is not located within any SWSA as indicated in Figure 6.

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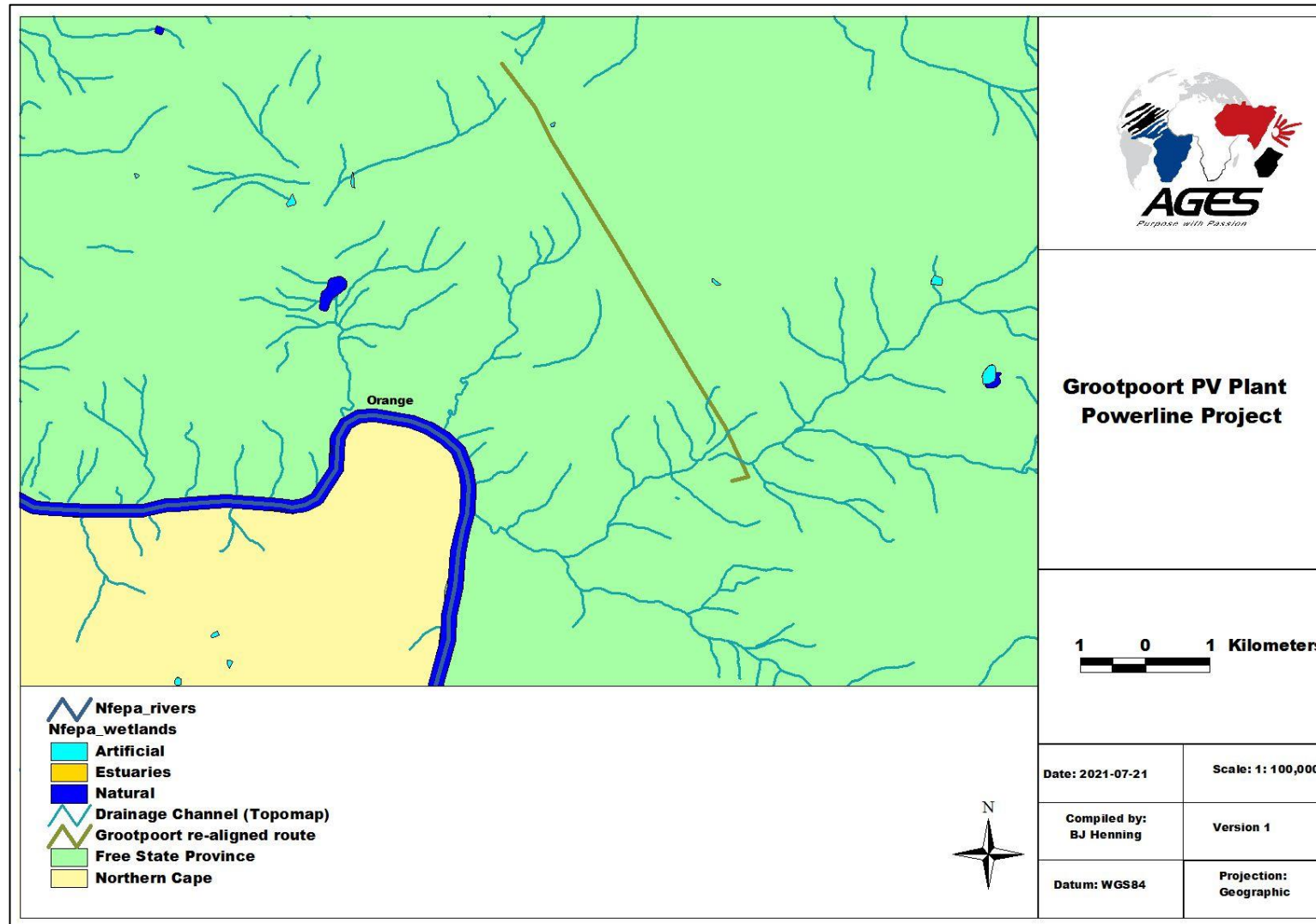


Figure 6. Location of the project area in relation to NFEPA Rivers and SWSA

### **3.6 BIOME AND VEGETATION TYPES**

The Nama-Karoo Biome occurs on the central plateau of the western half of South Africa, at altitudes between 500 and 2000m, with most of the biome falling between 1000 and 1400m. It is the second-largest biome in the region.

The geology underlying the biome is varied, as the distribution of this biome is determined primarily by rainfall. The rain falls in summer and varies between 100 and 520mm per year. This also determines the predominant soil type - over 80% of the area is covered by a lime-rich, weakly developed soil over rock. Although less than 5% of rain reaches the rivers, the high erodibility of soils poses a major problem where overgrazing occurs.

The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clayey soils. Grazing rapidly increases the relative abundance of shrubs. Most of the grasses are of the C4 type and, like the shrubs, are deciduous in response to rainfall events.

The amount and nature of the fuel load is insufficient to carry fires and fires are rare within the biome. The large historical herds of Springbok and other game no longer exist. Like the many bird species in the area - mainly larks - the game was probably nomadic between patches of rainfall events within the biome. The Brown Locust and Karoo Caterpillar exhibit eruptions under similarly favourable, local rainfall events, and attract large numbers of bird and mammal predators.

Less than 1% of the biome is conserved in formal areas. Urbanization and agriculture are minimal, and irrigation is confined to the Orange River valley and some pans. Most of the land is used for grazing, by sheep (for mutton, wool and pelts) and goats, which can be commensurate with conservation.

The most recent classification of the area by Mucina & Rutherford (2006) shows that the site is classified as Northern Upper Karoo and a small section of the vegetation type Besemkaree Koppies Shrubland.

The Northern Upper Karoo vegetation type occurs in patches in the northern Cape and Free State Provinces: Northern regions of the Upper Karoo plateau from Prieska, Vosburg and Carnarvon in the west to Philipstown, Petrusville and Petrusburg in the east. Bordered in the north by Niekerkshoop, Douglas and Petrusburg and in the south by Carnarvon, Pampoenpoort and De Aar. A few patches occur in Griqualand West. Altitude varies mostly from 1 000–1 500 m. (Mucina & Rutherford, 2006). This vegetation type is

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typically characterised by shrubland dominated by dwarf karoo shrubs, grasses and *Senegalia mellifera subsp. detinens* and some other low trees (especially on sandy soils in the northern parts and vicinity of the Orange River). Flat to gently sloping, with isolated hills of Upper Karoo Hardeveld in the south and Vaalbos Rocky Shrubland in the northeast and with many interspersed pans. (Mucina & Rutherford, 2006). The Northern Upper Karoo is classified as Least threatened with a target conservation of 21%. None of this vegetation type is currently conserved in statutory conservation areas and about 4% has been cleared for cultivation (the highest proportion of any type in the Nama-Karoo) or irreversibly transformed by building of dams (Houwater, Kalkfontein and Smart Syndicate Dams). Areas of human settlements are increasing in the northeastern part of this vegetation type (Mucina & Rutherford, 2006). Erosion is moderate (46.2%), very low (32%) and low (20%). *Prosopis glandulosa*, regarded as one of the 12 agriculturally most important invasive alien plants in South Africa, is widely distributed in this vegetation type (Mucina & Rutherford, 2006). *Prosopis* occurs in generally isolated patches, with densities ranging from very scattered to medium (associated with the lower Vaal River drainage system and the confluence with the Orange River) to localised closed woodland on the western border of the unit with Bushmanland Basin Shrubland. (Mucina & Rutherford, 2006).

The Besemkaree Koppies Shrubland occurs in the Northern Cape, Free State and Eastern Cape Provinces: On plains of Eastern Upper Karoo (between Richmond and Middelburg in the south and the Orange River) and within dry grasslands of the southern and central Free State. Extensive dolerite-dominated landscapes along the upper Orange River belong to this unit as well. Extends northwards to around Fauresmith in the northwest and to the Wepener District in the northeast. Altitude 1120– 1680 m. It is characterised by slopes of koppies, butts and tafelbergs covered by two-layered karroid shrubland. The lower closed-canopy layer is dominated by dwarf small-leaved shrubs and, especially in precipitation-rich years, also by abundant grasses, while the upper loose canopy layer is dominated by tall shrubs, namely *Searsia erosa*, *S. burchellii*, *S. ciliata*, *Euclea crispa subsp. ovata*, *Diospyros austro-africana* and *Olea europaea subsp. africana*. The Besemkaree Koppies Shrubland is classified as Least threatened with a target conservation of 28%. Only 5% of this vegetation type is currently conserved in statutory conservation areas and about 3% has been cleared for cultivation (the highest proportion of any type in the Nama-Karoo) or irreversibly transformed by building of dams (Houwater, Kalkfontein and Smart Syndicate Dams).

### 4 RESULTS

#### 4.1 HYDROGEOMORPHIC UNITS

DWAF (2003) states that to classify an area as a wetland it must have one or more of the following attributes:

- Hydromorphic soils that exhibit features characteristic of prolonged saturation.
- The presence of hydrophytes (even if only infrequently).
- A shallow water table that results in saturation at or near the surface, leading to the development of anaerobic conditions in the top 50cm of the soil.

One wetland type was identified on the site for the proposed powerline development corridor namely:

- Depressions:
  - Exorheic depressions (man-made dams).

The other drainage features on the proposed powerline corridor are classified as channels (rivers) with riparian woodland. The rivers are classified as Floodplain Rivers.

The wetland and riparian map for the wetlands and rivers are presented in Figure 8.

##### 4.1.1 Depressions

The depression in the project area represents a man-made dam (Photograph 1) classified as endorheic depressions. A depression is classified as a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates. Dominant water sources are precipitation, ground water discharge, interflow and (diffuse or concentrated) overland flow. For 'depressions with channelled inflow', concentrated overland flow is typically a major source of water for the wetland, whereas this is not the case for 'depressions without channelled inflow'. Dominant hydrodynamics are (primarily seasonal) vertical fluctuations. Depressions may be flat-bottomed (in which case they are often referred to as 'pans') or round-bottomed (in which case they are often referred to as 'basins') and may have any combination of inlets and outlets or lack them completely. Water exits by means of concentrated surface flow in channels for exorheic depressions, although the primary means of water still exits as evaporation.

The vegetation associated with depressions is mostly sedges and bulrushes depending on the depth of the water and the substrate. Species such as *Phragmites australis* and *Typha*



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*capensis* mostly grow along the shallow edges of dam and pans in the project area on a muddy substrate. The riparian woodland is characterised by *Vachellia karroo* and *Ziziphus mucronata*.



**Photograph 1. Man-made dam in the northern section of the project area**

### 4.1.2 River channels and floodplains

All rivers and streams with the associated riparian vegetation in the project area are ecologically sensitive, forming important, limited and specialised habitats for several plant and fauna species. The species composition is unique and relatively limited in distribution and coverage. These habitats also form linear corridors linking different open spaces. The drainage channels of the project area (Photograph 2, 3) eventually flow into the Orange River that occurs to the south of the project area. The riverine woodland would be important dry season refuge areas for many fauna species in their natural state. It is also a centre of floral diversity. Riparian areas have been identified as important dry season refuge areas for a variety of large mammal species. The impacts on the sensitive riparian ecosystems, regardless of the source, need to be restricted. Impacts on this system include erosion, habitat loss and degradation and the associated impacts on faunal and floral diversity, dewatering of marshes and wetlands, water abstraction as well as increased sedimentation (SANParks 2003). Continued impacts on the riverine ecosystems may also ultimately reduce the capacity of this system to absorb dramatic

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flooding events. The band of trees that occurs along the channel can be classified as riparian vegetation. This vegetation is very important for connectivity with adjacent vegetation as well as a migratory route for riparian animals.

Most of the drainage channels on site are non-perennial. Channels are subdivided further within this level of the hierarchy into six geomorphological zones, as defined by Rowntree and Wadeson (2000). These zones are based largely on gradient which influences flow velocity and channel characteristics such as substratum particle size that are important characteristics of riverine habitat types. The following geomorphological zones occur in the project area and described as follows (after Rowntree and Wadeson 2000):

- Lowland River: a low-gradient alluvial fine-bed channel. It may be confined but has a fully developed meandering pattern within a distinct floodplain that develops in unconfined reaches where there is increased silt content in bed or banks. Characteristic gradient: 0.0001- 0.001.
- Lower Foothill River: a lower-gradient mixed-bed alluvial channel with sand and gravel dominating the bed and sometimes locally bedrock-controlled. Reach types typically include pool-riffle or pool-rapid with sand bars common in pools. Pools are of significantly greater extent than rapids or riffles. A floodplain is often present. Characteristic gradient: 0.001-0.005.

The non-perennial drainage channels are characterized by a channel that cuts through a slightly undulating landscape. The non-perennial riverine areas form to narrow channels (Photograph 2). These riverine areas support low riparian woodland dominated by species such as *Vachellia karroo* and various grasses such as *Panicum maximum* and *Eragrostis rotifer*.



**Photograph 2. Non-perennial drainage channel in the project area**

The major river in the southern section of the project area can be described as a floodplain river or a lowland river) (Photograph 3). The floodplain is not classified as a floodplain wetland, but a river with some wetland characteristics in the channel and its banks.

A floodplain is flat or nearly flat land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and experiences flooding during periods of high discharge (Figure 7). It includes the floodway, which consists of the stream channel and adjacent areas (riparian woodland, hydrophilic grassland, Photograph 3) that carry flood flows, and the flood fringe, which are areas covered by the flood, but which do not experience a strong current. In other words, a floodplain is an area near a river or a stream which floods easily. Floodplains are made by a meander eroding sideways as it travels downstream. When a river breaks its banks and floods, it leaves behind layers of rock and mud. These gradually build up to create the floor of the flood plain. Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream. These are accumulations of sand, gravel, loam, silt, and/or clay, and are often important aquifers, the water drawn from them being pre-filtered compared to the water in the river.



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The vegetation associated with the floodplain is mostly microphyllous woodland and hygrophilous grasses in the project area. Species such as *Vachellia karroo*, *Searsia pyroides*, *Ziziphus mucronata* and *Searsia lancea* mostly grow in the floodplain area (Photograph 10), together with grass species such as *Eragrostis rotifer*.

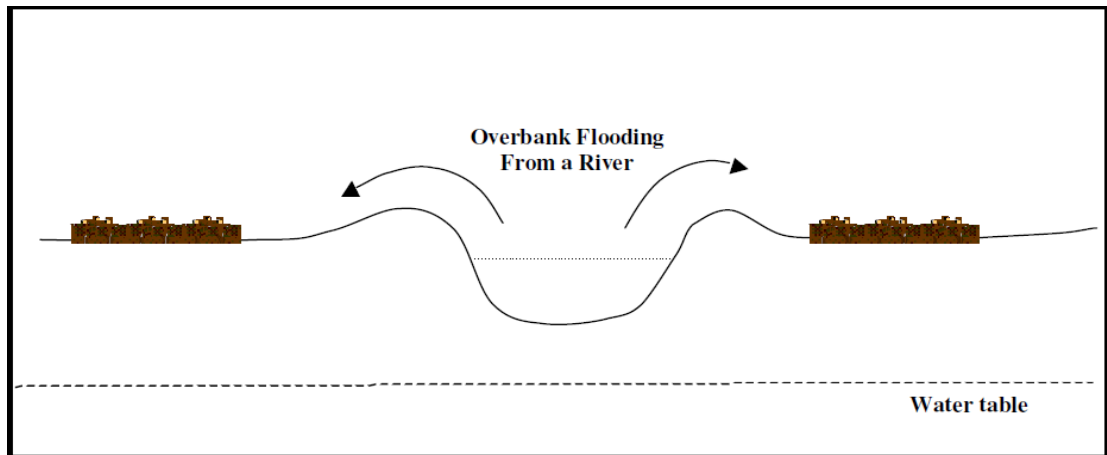


Figure 7. Cross section through a floodplain



Photograph 3 The floodplain river in the project area of the powerline corridor



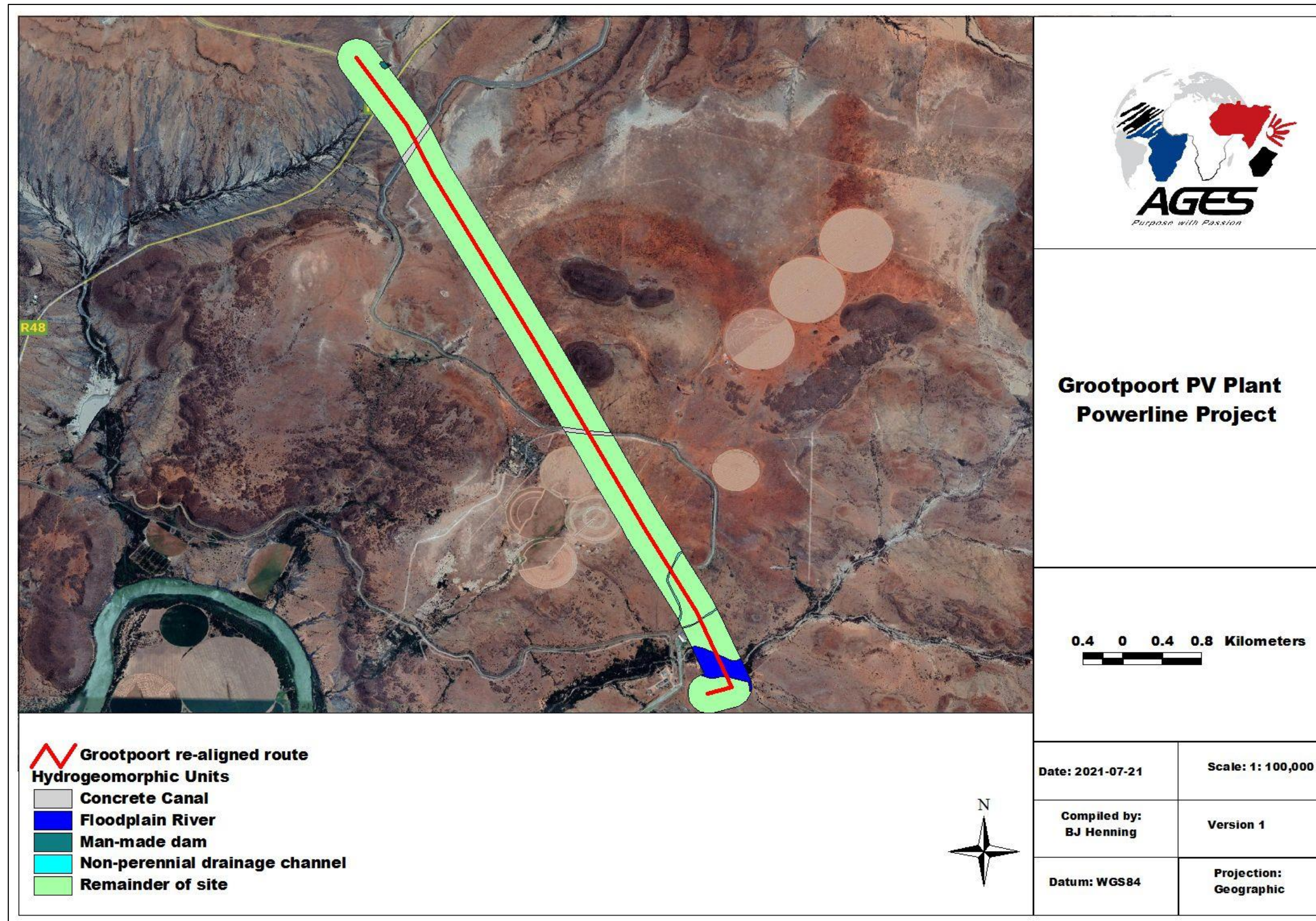


Figure 8. Riparian delineation map of the proposed powerline corridor



## 4.2 WETLAND / RIVERINE INTEGRITY ASSESSMENTS

In determining the integrity of the drainage system, the condition of the site and the indirect and direct disturbances is considered. The impoundments, roads, alien invasive vegetation species, pollution, sedimentation and density roughness elements was taken into account in determining the PES and EIS of the riparian / wetland units on site (Table 9). Appendix A and B indicate the scores for the PES and EIS respectively.

Evidence was observed on site of transformation of the floristic characteristics of the site at least to some extent. Impacting activities which may have altered the expected floristic composition include alien infestation, impoundment and road crossings. The valleybottom wetlands and riverine areas were assessed.

**Table 9. Present Ecological State and Ecological Importance & Sensitivity of the wetland and riparian systems on the proposed development site**

| Hydro-geomorphic Unit                                | PES                          | EIS      |
|--|------------------------------|----------|
| Non-perennial drainage channels<br>Floodplain Rivers | Class C: Moderately modified | Moderate |

Anthropogenic disturbance of soil and primary vegetation have altered the natural hydrological functioning of the drainage systems (wetlands and riverine areas) associated with the proposed powerline corridor. The reference state was probably Class B that changed to a Class C.

However, the biotic and abiotic characteristics clearly indicated that the drainage system is functional in terms of flood attenuation, erosion control, sediment trapping and biodiversity. The limited presence of facultative wetland plant species such as sedges, and the absence of temporary pools limit the ability of this wetland system to contribute to streamflow regulation. All the wetlands' components on site were found to be limiting in their ability to improve water quality by removing nitrates, phosphates, and other toxicants. The drainage system as an entity (dam, non-perennial and valleybottom wetlands) has a Class C PES (Moderately Modified). The riparian woodland plays an important role as a corridor for fauna in the area and has only been impacted by upstream agricultural activities and road crossings. The state of the individual hydrologic component functions is as follows:

- **Hydrologic:** Class D – Largely Modified
- **Water quality:** Class C: Moderately Modified
- **Hydraulic / Geomorphic:** Class C: Moderately Modified
- **Biota:** Class C: Moderately Modified

## **Wetland & Riparian Impact Assessment Grootpoort Solar Parks Powerline**

Considering the importance as a fauna corridor as well as the red data species associated with the riverine woodland and wetlands, the area has a MODERATE EIS. This HGM unit is therefore considered to be ecologically sensitive and important. The biodiversity of this riparian zone may be sensitive to flow and habitat modification, while the channel plays a significant role in moderating the quantity and quality of water entering downstream areas.

### **5 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE WETLAND AND RIPARIAN ZONES**

The proposed development will have a potential direct or indirect impact on the wetlands and riparian habitat. Mitigation (including rehabilitation) of the impacts and should rather focus on the management of stormwater, erosion prevention and connection with the larger system. Indirect impacts could occur because of construction activities (dust, spillages etc.). The following section deals with the anticipated impacts of the proposed development on the wetland of the site.

#### **5.1 IMPACT ON THE CHARACTERISTICS OF THE WATERCOURSE I.E. FLOW REGIME, HABITAT, BIOTA, WATER QUALITY AND GEOMORPHOLOGY DUE TO CONSTRUCTION WITHIN FLOODLINE ZONE**

##### **5.1.1 Description of impact:**

The construction activities associated with the proposed powerline development will potentially have an impact on the wetland areas and water levels, whether it is through direct or indirect impacts at the crossings. The clearance of vegetation for the powerline development will either have a direct or indirect impact on the wetlands and smaller drainage channels. Loss of the riparian and instream habitat will also result in permanent loss or displacement of the invertebrates, birds and small mammals' dependant on the wetland vegetation for feeding, shelter and breeding purposes. All functions associated with the riverine zones and the surrounding landscape will be compromised if mitigation measures are not applied correctly. Other indirect impacts of the construction of the powerline development on the characteristics of the water course include impacts on water quality and changes to the geomorphology should the development cause impacts on downstream areas.

##### **5.1.2 Mitigation measures:**

- Clearing of vegetation at the crossings for the powerline corridors should be scheduled for the drier winter months and limited to areas immediately needed for construction. Vegetation stripping should occur in parallel with the progress of construction to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment. Only selected plant species must be used in the re-vegetation process.
- Minimize soil exposure around the powerline development. Re-vegetate exposed areas surrounding the powerline development and allow a sufficient buffer between



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the cropland development to prevent sedimentation into the wetlands / rivers.

- Manage water effectively on, to, within, and from this site.
- The location where the powerline crosses the drainage channels should be the least sensitive area. The site should be indicated by an ecologist after consultation by the engineers. The following mitigation measures and management actions should be taken to minimize potential impacts of the line crossing drainage channels:
  - Identify areas of historic or potential vulnerability, such as geologically unstable materials or areas subject to flooding.
  - Avoid problematic areas and avoid power line locations in areas of high natural hazard risk, such as landslides, rock-fall areas, steep slopes (over 60-70%), wet areas, saturated soils, etc.
  - Avoid or minimize construction in narrow canyon bottoms or on flood plains of rivers that will inevitably be inundated during major storm events.
  - Minimize changes to natural drainage patterns and crossings to drainages. Drainage crossings are potentially problematic, so they must be well designed. Changes to natural drainage patterns or channels often result in either environmental damage or failures.
  - Perform scheduled maintenance to be prepared for storms. Ensure that culverts have their maximum capacity, ditches are cleaned, and that channels are free of debris and brush than can plug structures.
  - Typically keep cut and fill slopes as flat as possible and well covered (stabilized) with vegetation to minimize slumping as well as minimize surface erosion. Well-cemented but highly erosive soils may best to resist surface erosion with near-vertical slopes that minimize the surface area exposed to erosion.
  - Use deep-rooted vegetation for biotechnical stabilization on slopes. Use a mixture of good ground cover plus deep-rooted vegetative species, preferably native species, to minimize deep-seated mass instability as well as offer surface erosion control protection.
  - Locate the power line on narrow sections of rivers and in areas of bedrock where possible. Avoid fine, deep alluvial deposits (of fine sand and silt) that are scour susceptible and problematic, or which otherwise require costly

foundations.

- Ensure that structural designs for the power line crossing the drainage channels include appropriate design criteria and have good foundations to prevent failures during floods.
  - Place retaining structures, foundations, and slope stabilization measures into bedrock or firm, in-place material with good bearing capacity to minimize undermining, rather than placing these structures on shallow colluvial soil or on loose fill material.
- The power line should not negatively impact on the actual riparian area itself, and the pylons should be placed outside any riparian zones.
- All development activities should be restricted to the footprint areas of the proposed powerline development. The Environment Site Officer (ESO) should demarcate and control these areas. Storage of building equipment, fuel and other materials should be limited to demarcated areas. Layouts should be adapted to fit natural patterns rather than imposing rigid geometries.
- The Environment Control Officer (ECO) should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment and specifically wetlands. The ECO should enforce any measures that he/she deem necessary. Regular environmental training should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation.
- Rehabilitation of the development area after construction have been completed should be considered a high priority and all areas rehabilitated should be audited after construction has ceased by a suitably qualified environmentalist.
- Should the development be approved by authorities, environmental monitoring of environmental aspects should be implemented during and after the construction phase of the development to ensure that minimal impact is caused to the floodline or wetlands of the area.
- Demarcate all riparian boundaries with pegs and danger tape.
- Edge effects of pre-construction and construction activities, including erosion, sedimentation and alien/weed control, need to be strictly managed in wetland areas.

## **Wetland & Riparian Impact Assessment Grootpoort Solar Parks Powerline**

- The following general rehabilitation measures should be implemented in the disturbed riparian zone:
  - All disturbed surface areas will be re-shaped to resemble the surrounding natural topography. Surfaces will be ripped / scarified, and re-vegetated with indigenous grass species.
  - As far, as is practical, implement concurrent rehabilitation processes to limit degradation of soil biota.
  - Terrestrial invasive removal programs must be maintained throughout the proposed development as well as in the aftercare and maintenance phases.

### **5.2 SOIL COMPACTION AND INCREASED RISK OF SEDIMENT TRANSPORT AND EROSION**

#### **5.2.1 Description of impact:**

The use of heavy machinery during the construction process of the powerline development will result in the compaction of soil, resulting in decreased infiltration of rainwater and increased surface run-off volumes and velocities leading to a greater erosion risk. The hardened surfaces of the road and compacted soils of the proposed development area will also lead to an increase in surface run-off during storm events which will likely be discharged via stormwater outlet points, concentrating flows leaving the exposed areas. This can lead to erosion and channel incision in the wetland / riparian zones and change the downstream habitat. This could result in higher velocity flows with greater erosive energy which can result in channel incision and gully erosion downstream within the channel riparian zones.

Soil erosion also promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous fauna and flora.

The development will cause insignificant changes to the sediment regime of the area considering that no major rivers or drainage channels occur on site.

#### **5.2.2 Mitigation measures**

- Stringent controls must be put in place to prevent any unnecessary disturbance or compaction of alluvial soils. Compaction of soils should be limited and / or avoided as far as possible. Compaction will reduce water infiltration and will result in increased runoff and erosion. Where any disturbance of the soil takes place (have taken place in the past), these areas must be stabilized and any alien plants which establish should be cleared and follow up undertaken for at least 2 years thereafter

and preferably longer. Where compaction becomes apparent, remedial measures must be taken (e.g., “ripping” the affected area). Topsoil should preferably be separated from the subsoil, and topsoil sections should be kept intact as deep as possible.

- Reprofilling of the banks of disturbed drainage areas to a maximum gradient of 1:3 to ensure bank stability.
- Reinforce banks and drainage features where necessary with gabions, reno mattresses and geotextiles. This is especially relevant for the stormwater outlet area.
- Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion.
- Erosion control mechanisms must be established as soon as possible. Further financial provision should be continued over the subsequent years to allow for maintenance of the gabions, reno mattresses, and associated structures.
- A stormwater plan must be developed with the aid of an engineer to ensure that water runoff is diverted off the site without pooling and stagnation or erosion. Financial provision for closure will include the estimated costs for erosion control post-construction.
- If compaction occurs, rectification can be done by application and mixing of manure, vegetation mulch or any other organic material into the area. Use of well cured manure is preferable as it will not be associated with the nitrogen negative period associated with organic material that is not composted.
- Vehicle traffic should not be allowed on the rehabilitated areas, except on allocated roads. It will have a negative impact due to the dispersive/compaction characteristics of soils and its implications on the long term.
- Appropriate design and mitigation measures must be developed and implemented to minimise impacts on the natural flow regime of the watercourse i.e., through placement of structures/supports and to minimise turbulent flow in the watercourse.
- The indiscriminate use of machinery within the in-stream and riparian habitat will lead to compaction of soils and vegetation and must therefore be strictly controlled.
- Perform scheduled maintenance to be prepared for storms. Ensure that culverts

have their maximum capacity, ditches are cleaned, and that channels are free of debris and brush than can plug structures.

### **5.3 SOIL AND WATER POLLUTION**

#### **5.3.1 Description of impact:**

Construction work will also carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or ground water, leading to potential medium/long-term impacts on fauna and flora.

#### **5.3.2 Mitigation measures**

- Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.
- No dumping of waste should take place within the wetland / riparian zone. If any spills occur, they should be immediately cleaned up.
- Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility.
- Excess waste or chemicals should be removed from site and discarded in an environmentally friendly way. The ECO should enforce this rule rigorously.
- All vehicles should be inspected for oil and fuel leaks on a regular basis. Vehicle maintenance yards on site should make provision for drip trays to capture spills. Drip trays should be emptied into a holding tank and returned to the supplier.
- Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) and chemical dust suppressants of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.
- A speed limit (preferably 40 km/hour) should be enforced on dirt roads.
- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with the label and application permit directions and stipulations for terrestrial and aquatic applications.

### **5.4 SPREAD AND ESTABLISHMENT OF ALIEN INVASIVE SPECIES**

#### **5.4.1 Description of impact:**

The construction almost certainly carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project.

Furthermore, the spread of the alien invasive species through the area will be accelerated when seeds are carried by storm water into the drainage features and riparian zones on the site that will cause environmental degradation and indigenous species to be displaced.

#### **5.4.2 Mitigation measures**

- Alien and invader vegetation must not be allowed to colonise in the area. Control involves killing alien invasive plants present, seedlings and establishing an alternative plant cover to limit re-growth. The use of indigenous plants must be encouraged in the rehabilitated areas (stormwater canals), and stockpiles containing mostly exotic or weedy species should receive specialised handling and should be invasion. Control should begin prior to construction phase considering small populations of AIS occur around the sites.
- Institute strict control over materials brought onto site, which should be inspected for seeds and steps taken to eradicate these before transport to the site. The contractor is responsible for the control of weeds and invader plants.
- Rehabilitate disturbed areas as quickly as possible.
- Institute a monitoring programme to detect alien invasive species early.
- Institute an eradication/control programme for early intervention if invasive species are detected. The use of indigenous plants must be encouraged in the rehabilitated areas (stormwater canals), and stockpiles containing mostly exotic or weedy species should receive specialised handling and should be covered for extended periods to inhibit seedling germination of these species. Active management and eradication of

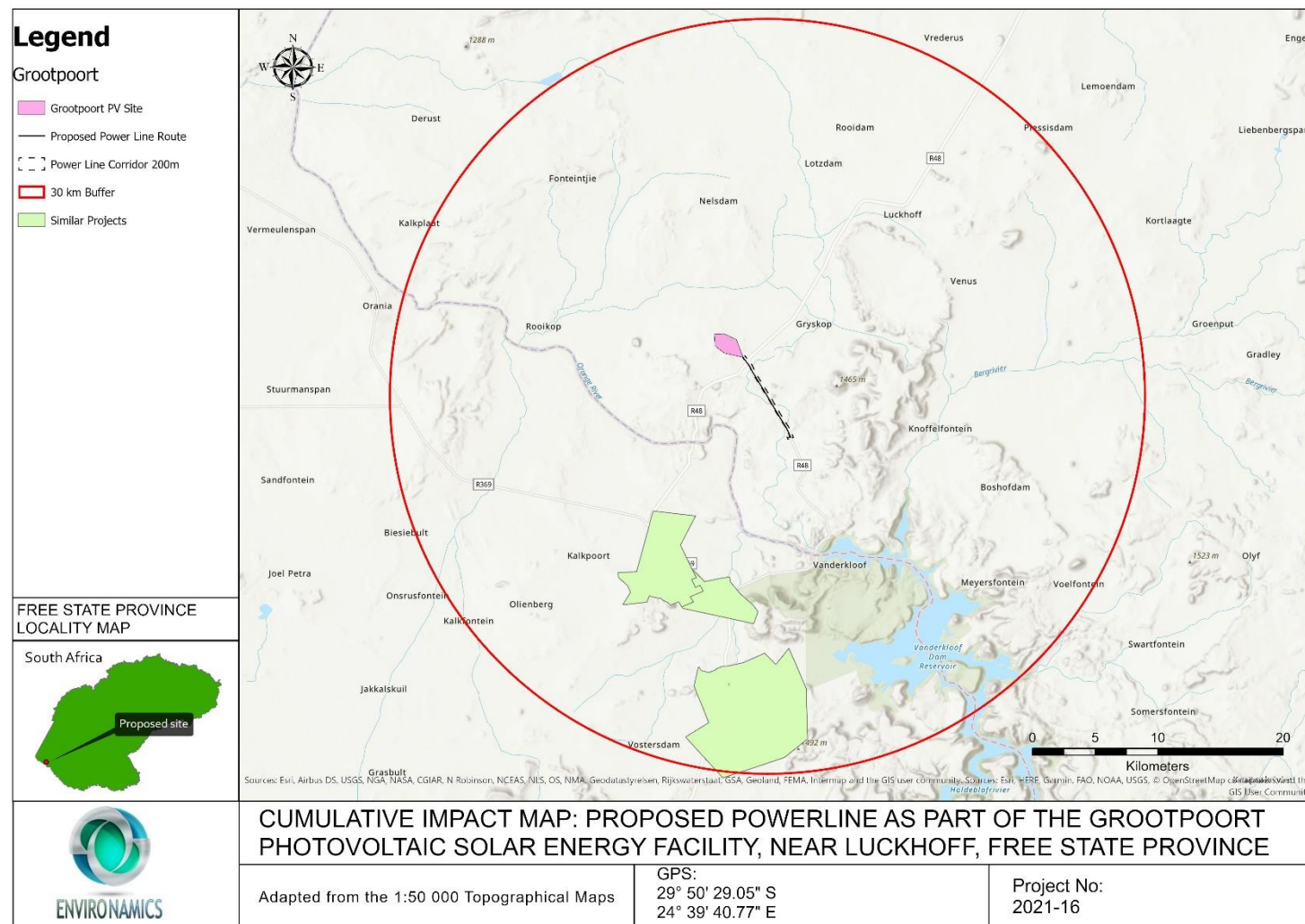
exotic / alien plant species should also occur when seedlings are found.

### **5.5 CUMULATIVE IMPACTS**

The cumulative impacts associated with the Grootpoort PV Plant powerline development in combination with other similar renewable energy development in a 30 kilometer radius indicated in Figure 9 on the riparian and wetland systems of the larger area is considered as LOW because of the following:

- The impact of powerline crossing drainage systems and wetlands are considered as LOW in general. The most important would be to place pylons outside drainage systems and apply mitigation that would prevent indirect impacts.
- The state of the drainage ecosystem of the larger area is considered as degraded in general due to farming activities such as crop cultivation and mining causing sedimentation of the drainage ecosystems. The other solar developments are located mostly on degraded land with low conservation value.
- The development of linear developments such as powerlines long roads will limit impacts to roadside servitudes and small sections of the drainage ecosystems and therefore the impacts will be lower compared to when bisecting areas with pristine drainage ecosystems.

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**Figure 9. Cumulative impact map of the proposed powerline development in combination with other renewable energy developments in a 30 kilometer radius**



### **5.6 IMPACT ASSESSMENT MATRIX**

Table 10 indicate the impacts described above and specific ratings of significance the development impact will potentially have on the aquatic biodiversity components of the study area. The impacts are indicated pre- and post-mitigation in Table 10 that clearly indicates the importance of mitigation needed for each of the potential impacts.

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Table 10. Impact assessment Matrix for the proposed powerline development

| Nr                                     | Activity   | Impact   | Without or With Mitigation | Nature (Negative or Positive Impact) | Probability     |       | Duration    |       | Scale     |       | Magnitude/ Severity |       | Significance |            | Mitigation Measures     | Mitigation Effect                         |
|--|--|--|----------------------------|--------------------------------------|-----------------|-------|-------------|-------|-----------|-------|---------------------|-------|--------------|------------|-------------------------|---|
|  |  |  |                            |                                      | Magnitude       | Score | Magnitude   | Score | Magnitude | Score | Magnitude           | Score | Score        | Magnitude  |                         |   |
| Aquatic Biodiversity Impact Assessment |  |  |                            |                                      |                 |       |             |       |           |       |                     |       |              |            |                         |   |
| Construction & Operational Phases      |  |  |                            |                                      |                 |       |             |       |           |       |                     |       |              |            |                         |   |
| 1                                      | Powerline crossings at wetlands and / or rivers. Clearing of vegetation for construction of infrastructure, access roads etc.  | Impact on the characteristics of the watercourse i.e. flow regime, habitat, biota, water quality and geomorphology due to construction within floodline zone | WOM                        | Negative                             | Definite        | 5     | Permanent   | 5     | Local     | 1     | Medium              | 6     | 60           | Moderate   | Refer to Sections 5.1.2 | May cause irreplaceable loss of resources |
|  |  |  | WM                         | Negative                             | Highly Probable | 4     | Medium term | 3     | Local     | 1     | Low                 | 2     | 32           | Low        |                         |   |
| 2                                      | Topsoil & subsoil stripping, exposure of soils to wind and rain during construction causing erosion and sedimentation in wetlands                                    | Soil erosion and sedimentation   | WOM                        | Negative                             | Definite        | 5     | Permanent   | 5     | Regional  | 3     | Medium              | 6     | 70           | High       | Refer to section 5.2.2  | Can be reversed                           |
|  |  |  | WM                         | Negative                             | Highly Probable | 4     | Medium term | 3     | Site      | 2     | Low                 | 2     | 28           | Low        |                         |   |
| 4                                      | Heavy machinery and vehicle movement on site   | Water Pollution of rivers / wetlands   | WOM                        | Negative                             | Highly Probable | 4     | Long term   | 4     | Regional  | 3     | Medium              | 6     | 52           | Moderate   | Refer to section 5.3.2  | Can be avoided, managed, or mitigated     |
|  |  |  | WM                         | Negative                             | Probable        | 2     | Long term   | 4     | Site      | 2     | Low                 | 2     | 16           | Negligible |                         |   |
| 5                                      | Continued movement of personnel and vehicles on and off the site during the construction phase, as well as occasional delivery of materials required for maintenance | Spreading of alien invasive species in wetlands / rivers   | WOM                        | Negative                             | Highly Probable | 4     | Permanent   | 5     | Site      | 2     | Medium              | 6     | 52           | Moderate   | Refer to section 5.4.2  | Can be reversed                           |
|  |  |  | WM                         | Negative                             | Probable        | 2     | Medium term | 3     | Site      | 2     | Low                 | 2     | 14           | Negligible |                         |   |

## **5.7 RISK ASSESSMENT MATRIX FOR THE CONSTRUCTION AND OPERATIONAL PHASES OF THE DEVELOPMENT**

Appendix C indicates the risk assessment matrices for the proposed powerline development post mitigation. The most significant impacts are habitat destruction, erosion and soil compaction, although impacts such as alien species invasion and spillages are limited during the construction phase or can be successfully mitigated. The impacts will be significantly lower with mitigation compared to when no mitigation measures are implemented during construction and operational phases.

### 6 DISCUSSION & CONCLUSION

The riparian / wetland delineation for the Grootpoort Solar Plant Powerline project was done according to the criteria set by the Aquatic Biodiversity Compliance Protocols (2020), Department of Water Affairs and Forestry (2003) and the National Wetland Classification System for South Africa (SANBI, 2009). The soils, vegetation associated with wetlands and landscape were all used as parameters in identifying the wetlands and riparian zones.

Two wetland types were identified namely a valleybottom wetland and depressions (pans and man-made dams). The non-perennial channels can be classified as 'River channels', although these drainage channels are not wetlands in the 'true' sense of the word but should rather be described as water courses as stipulated in the National Water Act. The channels are floodplain river channels. Baseline soil information, landscape profile and vegetation were used to confirm riparian and terrestrial properties within the study area. The impacts associated with the construction site is reflected in the results of the PES assessment which indicates that the riparian zones, wetlands and water courses are 'Moderately Modified'.

The EIS of the drainage system on site are MODERATE and are ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.

An impact assessment was conducted for the wetlands and riparian zones on site in addition to the mitigation measures recommended to ensure the protection of the riverine ecosystems. Impacts relating to the proposed development on the water courses / riparian zones are as follows:

- Impact on the characteristics of the watercourse i.e., flow regime, habitat, biota, water quality and geomorphology due to construction within floodline zone.
- Soil erosion and sedimentation.
- Water pollution from spillages, vehicle emissions and dust.
- Spread and establishment of alien invasive species in wetlands.
- Specific mitigation measures need to be implemented in the areas surrounding the riparian zones and water courses to prevent any negative impacts other than

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the impacts that will be caused during the clearance of the power line servitude.

- Provided that all the mitigation measures and recommendations surrounding the water courses and riparian zones are strictly adhered to (i.e., impacts managed to a low acceptable level) the development of the solar development can be supported.

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### 8 APPENDIX A PES SCORES OF THE WETLANDS

| Criteria and Attributes            | Relevance   | Channels with riparian woodland     |
|------------------------------------|---|-------------------------------------|
| <b>Hydrologic</b>                  |   | <b>Class D Largely Modified</b>     |
| Flow Modification                  | Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland. | 2                                   |
| Permanent Inundation               | Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.  | 2                                   |
| <b>Water Quality</b>               |   | <b>Class C: Moderately Modified</b> |
| Water Quality Modification         | From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.   | 3                                   |
| Sediment Load Modification         | Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.   | 3                                   |
| <b>Hydraulic / Geomorphic</b>      |   | <b>Class C: Moderately Modified</b> |
| Canalisation                       | Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.   | 3                                   |
| Topographic Alteration             | Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities which reduce or changes wetland habitat directly in inundation patterns.   | 2                                   |
| <b>BIOTA</b>                       |   | <b>Class C: Moderately Modified</b> |
| Terrestrial Encroachment           | Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.   | 3                                   |
| Indigenous Vegetation Removal      | Transformation of habitat for farming, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and in increases potential for erosion.  | 2                                   |
| Invasive Plant Encroachment        | Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).  | 2                                   |
| Alien Fauna                        | Presence of alien fauna affecting faunal community structure  | 2                                   |
| Over utilisation of Biota          | Overgrazing, overfishing, etc.  | 3                                   |
| <b>Total</b>                       |   | <b>27</b>                           |
| <b>Mean</b>                        |   | <b>2.45</b>                         |
| <b>Category</b>                    |   | <b>C</b>                            |
| <b>Ecological Management Class</b> |   | <b>Moderately Modified</b>          |

## 9 APPENDIX B EIS SCORES OF THE WETLANDS IN THE STUDY AREA

| Determinant  | Channels with riparian woodland |
|--|---------------------------------|
| <b>PRIMARY DETERMINANTS</b>  |                                 |
| 1. Rare & Endangered Species                                       | 2                               |
| 2. Populations of Unique Species                                   | 1                               |
| 3. Species/taxon Richness  | 2                               |
| 4. Diversity of Habitat Types or Features                          | 2                               |
| 5. Migration route/breeding and feeding site for wetland species   | 2                               |
| 6. Sensitivity to Changes in the Natural Hydrological Regime       | 2                               |
| 7. Sensitivity to Water Quality Changes                            | 2                               |
| 8. Flood Storage, Energy Dissipation & Particulate/Element Removal | 2                               |
|  |                                 |
| <b>MODIFYING DETERMINANTS</b>                                      |                                 |
| 9. Protected Status  | 0                               |
| 10. Ecological Integrity   | 2                               |
| TOTAL*   | 17                              |
| MEDIAN   | 1.7                             |
| <b>OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE</b>               | <b>Moderate</b>                 |



**10 APPENDIX C RISK ASSESSMENT MATRIX FOR THE POWERLINE  
DEVELOPMENT SITE (ALL DRAINAGE CHANNEL CROSSINGS)**