

**ENVIRONMENTAL IMPACT ASSESSMENT (BAR) FOR THE PROPOSED
UPINGTON UPILANGA SOLAR PARK PV1 FACILITY IN THE NORTHERN CAPE
PROVINCE**

AQUATIC IMPACT ASSESSMENT

FOR

Emvelo Capital Projects (Pty) Ltd

BY



EnviroSci (Pty) Ltd

Dr Brian Colloty

1 Rossini Rd
Pari Park
Port Elizabeth
6070

DATE

10 June 2020

REVISION 1

Executive Summary

Savannah Environmental on behalf of **Emvelo Capital Projects (Pty) Ltd** appointed EnviroSci (Pty) Ltd to conduct an assessment of the proposed 100 MW Upilanga PV1 solar voltaic facility and its potential impact on the aquatic environment. The development area in this report refers to the area that will contain the development footprint, which is defined as any area that will require disturbance when establishing the project should it proceed.

The study area (the development area inclusive of a 500m buffer) is located 28km south east of Upington in the Northern Cape Province and this assessment included delineating any natural waterbodies within the properties in question, as well as assessing the potential consequences of the proposed layout on the surrounding watercourses and wetlands. This was based on information collected during various site visits conducted within the same study area for various other projects in May 2010, July 2014, December 2016, October 2018 and January 2020 spanning various seasons. The surveys adhered to the assessment criteria contained in the DWAF 2005 / 2008 delineation manuals and the National Wetland Classification System.

The regulatory requirements are also discussed with regard the National Water Act and NEMA in Section 4 of this report. The PROTOCOL FOR SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR THE ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY (Government Gazette 43110, 20 March 2020), superseding the Appendix 6 NEMA requirements, was also adhered to. This report thus meets the criteria to fulfil a Specialist Assessment Report as portions of the proposed development are located near areas rated as **Very High** sensitivity as per the DEA Screening Tool.

The study area site is situated within quaternary catchment D73E, which was dominated by a large number of highly ephemeral river systems associated with the Orange River (DWAF, 2004). Potential runoff from the site would flow in a northerly direction towards the Orange River via drainage systems such as the Klein-leerkransspruit and Majties (Matjes) River or directly into the canal systems and siphons that run along the Orange River (Figure 4). These are all located within the located in the Nama Karoo ecoregion.

Overall, these watercourses within the study area are largely in a natural state, when compared the associated Orange River reach, which has modified floodplains and flows. Current impacts occur in a localised area within the development area and included the following:

- Erosion due small road crossings and tracks;
- Ruderal alien plants from previous construction projects and
- Grazing.

The National Wetland Inventory v5.2 (2018) spatial data (NWI), indicated a variety of wetland types are located near the study area and included depressions / pans and riverine floodplains, the latter being considered alluvial watercourses in this landscape setting.

However, the study area systems are ephemeral and only carried water for a short week long period in 2014 and in 2019, thus the observed development area systems don't support any wide riparian zones and the vegetation associated with these watercourses was between 0.25 m and 5 m wide were mostly terrestrial. This coupled to the fact that the footprints will largely avoid the mainstem rivers it is anticipated that a detailed hydrological assessment is not required.

Fifteen woody plant species were found associated with the riparian and pan systems within the development area. Although none of these were obligate or facultative river/wetland species, they do show a preference for areas exposed to runoff, but none of these would be considered listed or protected under any National or Provincial legislation.

The only obligate wetland plants observed were those found in association with the man-made dams found at the confluence of the Majties (Matjes) River and the Orange River and along the Orange River itself. Species observed included *Typha capensis*, *Phragmites australis*, *Prosopis glandulosa* and *Cyperus marginatus*. Notably the prevalence of *Prosopis* and alien invasive tree species had increased between 2010 and this survey within the study area that had been visited previously by this report author.

Based then on the information collected in the field, assessment of the previous reports and current aerial photographs, the various aquatic features within the site were then delineated to a fine scale and are shown in Figure 6. These were then categorised based on the hydrogeomorphic approach, catchment position, which could then be linked to sensitivity of these to the proposed development, and compared to the ratings of the DEA Screening Tool results:

1. Alluvial water courses – major with riparian zones
2. Alluvial water courses – minor with no distinct riparian vegetation
3. Secondary water course and drainage lines
4. Pans / Depressions

The following direct impacts were then assessed, which are aligned with those contained in the Biodiversity Assessment Protocol and include in the table below and assessed against the layout:

Biodiversity Assessment Protocol Impacts found applicable to this project	Impacts assessed in this report below
Fragmentation (physical loss of ecological connectivity and or CBA corridors)	Impact 1 & 2
Changes in numbers and density of species	Impact 1 & 2
Faunal and vegetation communities inhabiting the site	Impact 1 & 2
Hydrological regime or Hydroperiod changes (Quantity changes such as abstraction or diversion)	Impact 3
Streamflow regulation	Impact 3
Erosion control	Impact 4
Water quality changes (increase in sediment, organic loads, chemicals or eutrophication)	Impact 5
Cumulative Impacts	Impact 6

- Impact 1: Loss of High Sensitivity systems, namely the major alluvial water courses and or pans through physical disturbance.
- Impact 2: Impact on secondary water courses (Moderate Sensitivity), through physical disturbance
- Impact 3: Impact on all riparian and wetland systems through the possible increase in surface water runoff on riparian form and function through hydrological changes
- Impact 4: Increase in sedimentation and erosion
- Impact 5: Risks on the aquatic environment due to water quality impacts

Impact 6: Cumulative impacts

In summary, the proposed layout for the facility would have no detrimental impact on the following:

- Any Very High sensitivity areas identified by the DEA Screening Tool
- Mainstem rivers and Pans that do contain functioning aquatic environments that received a Very High sensitivity rating as indicated in Figure 9.

Some impacts (panel areas & road crossings) are located in secondary alluvial water courses and minor drainage lines that were either fragmented or contained no riparian zones, with a Moderate sensitivity.

With the proposed mitigation (proper stormwater management and post construction rehabilitation), the impacts would be Low and acceptable for development, as these areas contained no aquatic habitat, and only functioned as a means to sustain / convey baseflows within the greater catchment. The proposed development would in essence not impact on this as surface runoff, although managed to prevent erosion, would still emanate from the site (when significant rainfall occurs), thus maintain this aspect of the hydrological system observed

Therefore, based on the results of this report, the significance of the remaining impacts assessed for the aquatic systems after mitigation would be LOW. This includes the internal roads proposed that would need to cross some of these systems. Thus, based on the findings of this study no objection to the authorisation of any of the proposed activities is made at this point based on the current layout as provided by the developer.

This report also indicates the watercourses and pans within 500m of the development area. Any activities within these areas, the buffers or 500m from the wetland boundary will require a Water Use license under Section 21 c and i of the National Water Act (Act 36 of 1998).

As the proposed activities have the potential to create erosion, the following recommendations are reiterated:

- Vegetation clearing should occur in a phased manner in accordance with the construction programme 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, and suitable dust and erosion control mitigation measures should be included in the EMP to mitigate.
- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination / leaks outside of any delineated waterbodies and their buffers. Washing and cleaning of equipment should also be done in berms or bunds, to trap any cement / hazardous substances and prevent excessive soil erosion. Mechanical plant and bowsers must not be refuelled or serviced within or directly adjacent to any channel.
- It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas along aquatic features, using selected species detailed in this report.
- All alien plant re-growth must be monitored and should these alien plants reoccur these plants should be re-eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.

- It is further recommended that a comprehensive rehabilitation plan be implemented from the project onset within watercourse areas (including buffers) to ensure a net benefit to the aquatic environment. This should form part of the suggested walk down as part of the final EMP preparation preconstruction.

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ACRONYMS

CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DWS	Department of Water and Sanitation formerly the Department of Water Affairs
EIA	Ecological Importance and Sensitivity
EIS	Ecological Importance and Sensitivity
ESA	Ecological Support Area
GIS	Geographic Information System
NFEPA	National Freshwater Ecosystem Priority Atlas (Nel, <i>et al.</i> 2011).
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SQ	Subquaternary catchment
WUL	Water Use License
WULA	Water Use License Application

**COMPLIANCE WITH THE PROTOCOL FOR THE SPECIALIST ASSESSMENT AND MINIMUM REPORT
CONTENT REQUIREMENTS FOR ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY ISSUED 20
MARCH 2020, REPLACING REQUIREMENTS OF APPENDIX 6 – GN R326 EIA REGULATIONS OF 7 APRIL
2017**

DEA Screening Tool Summary			
Requirement	Completed / Assessed	Date	Comments
Desktop and satellite imagery analysis	Yes	15 March 2020	
Preliminary On-site inspection	No	15 January 2020	Several summer / winter, as well low and high rainfall periods have been observed within the region over the years
Additional information			Results
1:50 000 topocadastral maps	Yes	15 March 2020	Cadastre and indicated features unchanged
Google Earth	Yes	15 March 2020	Used as the basis of GIS mapping and layout verification
National Wetland Inventory Spatial Data	Yes	15 March 2020	Natural and artificial systems present
National Vegetation Spatial Data	Yes	15 March 2020	Bushmanland Arid Grassland
Threatened Ecosystems Spatial Data	Yes	15 March 2020	None
Conservation Plans (WCBSP, ECBCP, NCBSP etc)	Yes	15 March 2020	Northern Cape Biodiversity Spatial Plan - CBA 1 (Panel area) while associated infrastructure is within CBA2
National Freshwater Ecosystem Priority AREA (NFEPA)	Yes	15 March 2020	Fish Support Area (FSA)
Strategic Water Resource Area	Yes	15 March 2020	None
Free flowing Rivers	Yes	15 March 2020	None
Wetland Clusters	No	15 March 2020	Yes
Critical Biodiversity Area (CBA)	Yes	15 March 2020	Yes
Ecological Support Area (ESA)	Yes	15 March 2020	Yes
Ecological Importance and Sensitivity of Site (EIS)	Yes	15 March 2020	Moderate
Description of ecosystem processes (movement of surface water, recharge/discharge & sediment transport etc)	Yes	15 March 2020	Ephemeral alluvial systems with little to no riparian zone as well as pans/depressions

Historic Reference Condition and Present Ecological State (PES) of rivers (instream, riparian, floodplain), wetlands or estuaries and possible changes to channel and flow regime (surface & groundwater)	Yes	15 March 2020	PES = B Reference Condition B	
Review of Screening Tool results	Present	Confirmed / Disputed (if disputed photographic evidence must be included into assessment)	Aquatic Biodiversity Specialist Assessment Protocol Required (Y/N or N/A)	Aquatic Biodiversity Compliance Statement Protocol required (Y / N or N/A)
Very High Aquatic Habitat	YES	Confirmed, but avoided by the proposed layout	YES	N/A
Low Aquatic Habitat	No	Confirmed	N/A	N/A
Very High Terrestrial Habitat			NONE PROMULGATED AT THIS POINT	
Low Terrestrial Habitat				
ASSESSMENT AND REPORTING OF IMPACTS ON AQUATIC BIODIVERSITY PROTOCOL REQUIREMENTS				
Aquatic Biodiversity Specialist Assessment Protocol	YES	Aquatic Biodiversity Compliance Statement Protocol		NO
<i>Reason</i>	VERY HIGH aquatic habitats	<i>Reason</i>		
Proposed Site (Site Sensitivity)	Moderate only within the footprint	Proposed Site (Site Sensitivity)		
Preferred Site (Site Sensitivity)	Not Assessed as site specific sensitive no-go areas were provided at the onset of the design process in order to avoid the systems that were rated a No-Go where feasible	Preferred Site (Site Sensitivity)		
ANTICIPATED IMPACT AND IF REQUIRING ASSESSMENT IN THE SPECIALIST ASSESSMENT	(Y/N)	AQUATIC BIODIVERSITY COMPLIANCE STATEMENT REQUIREMENTS		(Y/N)
Aquatic features		Aquatic features		
Alteration in baseflow (increase or Reduction of overall flows)	No	Preferred site and proposed development footprint assessed		Yes

Hydrological regime or Hydroperiod changes (Quantity changes such as abstraction or diversion)	Yes	LOW site sensitivity confirmed	Yes with additional No-Go areas provided by the aquatic specialist including buffers
Change in hydrogeomorphic typing (Unchannelled valley bottom wetland to Channelled Valley Bottom Wetland)	No	Confirm whether or not the proposed development will have an impact on the aquatic features	Impacts will still occur
Water quality changes (increase in sediment, organic loads, chemicals or eutrophication)	Yes		
Fragmentation (physical loss of ecological connectivity and or CBA corridors)	Yes		
Loss or degradation of unique characters or features (waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, pans/ depressions)	No		
Ecosystem regulating and supporting services			
Flood attenuation	No		
Streamflow regulation	Yes		
Sediment trapping	No		
Phosphate assimilation	No		
Nitrate assimilation	No		
Toxicant assimilation	No		
Erosion control	Yes		
Carbon storage	No		
Ecosystem Community Composition			
Changes in numbers and density of species	Yes		
Integrity (condition, viability, predator prey ratios, dispersal rates)	Yes		
Faunal and vegetation communities inhabiting the site	Yes		
Estuary function (where applicable)			
Size of estuary	N/A		

Availability of sediment	N/A		
Wave action in mouth	N/A		
Protection of mouth	N/A		
Beach slope	N/A		
volume of Mean Annual Runoff	N/A		
Extent of saline intrusion (especially where relevant to Permanently Open Systems	N/A		
REPORTING REQUIREMENTS ADDRESSED OR INCLUDED IN THE ASSESSMENT / COMPLIANCE STATEMENT (REPLACING SECTION 6 OF NEMA REGULATIONS (REPORTING REQUIREMENTS			
Details of SACNASP author included (Registration number, field of expertise and CV	YES	Details of SACNASP author included (Registration number, field of expertise and CV attached in appendix 1.	
Signed statement of independence	YES	Signed statement of independence	
Statement of duration, date and season of site inspection, methods and models use, as well as equipment	YES	A baseline profile description of biodiversity and ecosystems of the site	
Description of assumptions and limitations (uncertainties & knowledge gaps)	YES	The methodology used to verify the sensitivities of the aquatic biodiversity features on the site including the equipment and modelling used where relevant.	
Local of No-Go areas for construction and operation	YES	In the vase of linear activity, confirmation from the aquatic biodiversity specialist that in their opinion, based on the mitigation and remedial measures proposed the land cane be returned to the current state within two years of completion of the construction phase.	
Additional environmental impacts	YES	Proposed impact management actions and impact management outcomes or any monitoring requirements for inclusion in the EMPr.	
Direct, indirect and cumulative impacts assessed	YES	Description of assumptions and limitations (uncertainties & knowledge gaps).	
Degree to which impacts and risks can be mitigated	YES	Any conditions to which approval is subject	
Degree to which impact or risks can be reversed	YES	Signed copy of assessment must be appended to the BAR or EIA	
Degree to which impact or risks can cause the loss of irreplaceable resources	YES		

Inclusion of a suitable construction and operational buffer using accepted methodologies	YES	
Proposed impact management actions and impact management outcomes for inclusion in the EMPr	YES	
Motivation for using High Sensitive Areas versus available Low Biodiversity Sensitive Areas	YES	
Substantiated statement based on the findings of the specialist assessment, regarding the acceptability or no of the proposed development and if the proposed development should receive approval or not	YES	
Any conditions to which approval is subject	YES	
Signed copy of assessment must be appended to the BAR or EIA	YES	

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SPECIALIST DECLARATION



environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

(For official use only)

File Reference Number:

NEAS Reference Number:

Date Received:

DEA/EIA/

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

UPINGTON ILANGA SOLAR PARK PV1 FACILITY IN THE NORTHERN CAPE PROVINCE

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at <https://www.environment.gov.za/documents/forms>.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:

Department of Environmental Affairs

Attention: Chief Director: Integrated Environmental Authorisations

Private Bag X447

Pretoria

0001

Physical address:

Department of Environmental Affairs

Attention: Chief Director: Integrated Environmental Authorisations

Environment House

473 Steve Biko Road

Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:

Email: EIAAdmin@environment.gov.za

1.

2. SPECIALIST INFORMATION

Specialist Company Name:	EnviroSci (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Dr Brian Colloty			
Specialist Qualifications:	Ph.D			
Professional affiliation/registration:	SACNASP Pr Sci Nat 400268/07 Ecological			
Physical address:	1 Rossini Rd Pari Park Port Elizabeth 6070			
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Postal code:	6070	Cell:	0834983299	
Telephone:	0413662077	Fax:	-	
E-mail:	b.colloty@gmail.com			

3. DECLARATION BY THE SPECIALIST

I, _____ Brian Colloty _____, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;

- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

EnviroSci (Pty) Ltd

Name of Company:

10 June 2020

Date

SPECIALIST REPORT DETAILS

Report prepared by: Dr. Brian Colloty Pr.Sci.Nat. (Ecology) / Member SAEIES.

Expertise / Field of Study: BSc (Hons) Zoology, MSc Botany (Rivers), Ph.D Botany Conservation Importance rating (Estuaries) and interior wetland / riverine assessment consultant from 1996 to present.

I, **Dr. Brian Michael Colloty** declare that this report has been prepared independently of any influence or prejudice as may be specified by the National Department of Environmental Affairs and or Department of Water and Sanitation.



Signed:...

..... Date:....10 June 2020.....

Appendix 1 of this report contains a detailed CV

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1. Introduction

Savannah Environmental on behalf of **Emvelo Capital Projects (Pty) Ltd** appointed EnviroSci (Pty) Ltd to conduct an assessment of the proposed 100 MW Upilanga PV1 solar voltaic facility and its potential impact on the aquatic environment. The development area refers to the study area that will contain the development footprint, which is defined as any area that will require disturbance when establishing the project should it proceed (Figure 1).

The study area (the development area inclusive of a 500m buffer) is located 28km south east of Upington in the Northern Cape Province and this assessment included delineating any natural waterbodies within the properties in question, as well as assessing the potential consequences of the proposed layout on the surrounding watercourses and wetlands. This was based on information collected during various site visits conducted within the same study area for various other projects in May 2010, July 2014, December 2016, and October 2018 spanning various seasons. The surveys adhered to the assessment criteria contained in the DWAF 2005 / 2008 delineation manuals and the National Wetland Classification System.

The regulatory requirements are also discussed with regard the National Water Act and NEMA in Section 4 of this report. The PROTOCOL FOR SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS FOR THE ENVIRONMENTAL IMPACTS ON AQUATIC BIODIVERSITY (Government Gazette 43110, 20 March 2020), superseding the Appendix 6 NEMA requirements, were also adhered to. This report thus meets the criteria to fulfil a Specialist Assessment Report as portions of the proposed development are located near areas rated as **Very High** sensitivity as per the DEA Screening Tool.

Several important national, provincial and municipal scale conservation plans were also reviewed, with the results of those studies being included in this report. Most conservation plans are produced at a high level, so it is therefore important to verify the actual status of the study area during this initial phase, prior to the final development plan being produced.

1.1 Aims and objectives

The aim of this report is to provide the applicant with the requisite delineation of any natural waterbodies that has informed the development of the proposed layout and associated infrastructure, while providing the competent authorities with the relevant information to determine legislative requirements.

Certain aspects of the development may also trigger the need for Section 21, Water Use License Applications (WULAs) (or General Authorisation [GA] applications) such as river or water course crossings or any activities within 500m of a wetland boundary. These applications must be submitted to the Department of Water and Sanitation (DWS) and information contained in this report must be used in the supporting documentation.

Information with regard to the state and function of the observed water bodies, suitable no-go buffers and assessment of the potential impacts are also provided.

1.2 Assumptions and Limitation

To obtain a comprehensive understanding of the dynamics of both the flora and fauna of the aquatic communities within a study site, as well as the status of endemic, rare or threatened species in any area, assessments should always consider investigations at different time scales (across seasons/years) and through replication. No base-line long-term monitoring was undertaken as part of this assessment. However, a concerted effort was made to assess as much of the potential development area, as well as make use of any available literature, species distribution data and aerial photography. Furthermore, based on the previous assessments undertaken between 2020 and 2020 in the area, this was not foreseen as a huge limiting factor. The level of investigation undertaken is sufficient to inform this type of assessment.

It should be emphasised that information, as presented in this document, only has reference to the study area as indicated on the accompanying maps. Therefore, this information cannot be applied to any other area without detailed investigation.

A further assumption is that water will be sourced from the existing licensed pipeline and not illegally abstracted from any other surrounding watercourses, particularly if dust suppression is required.

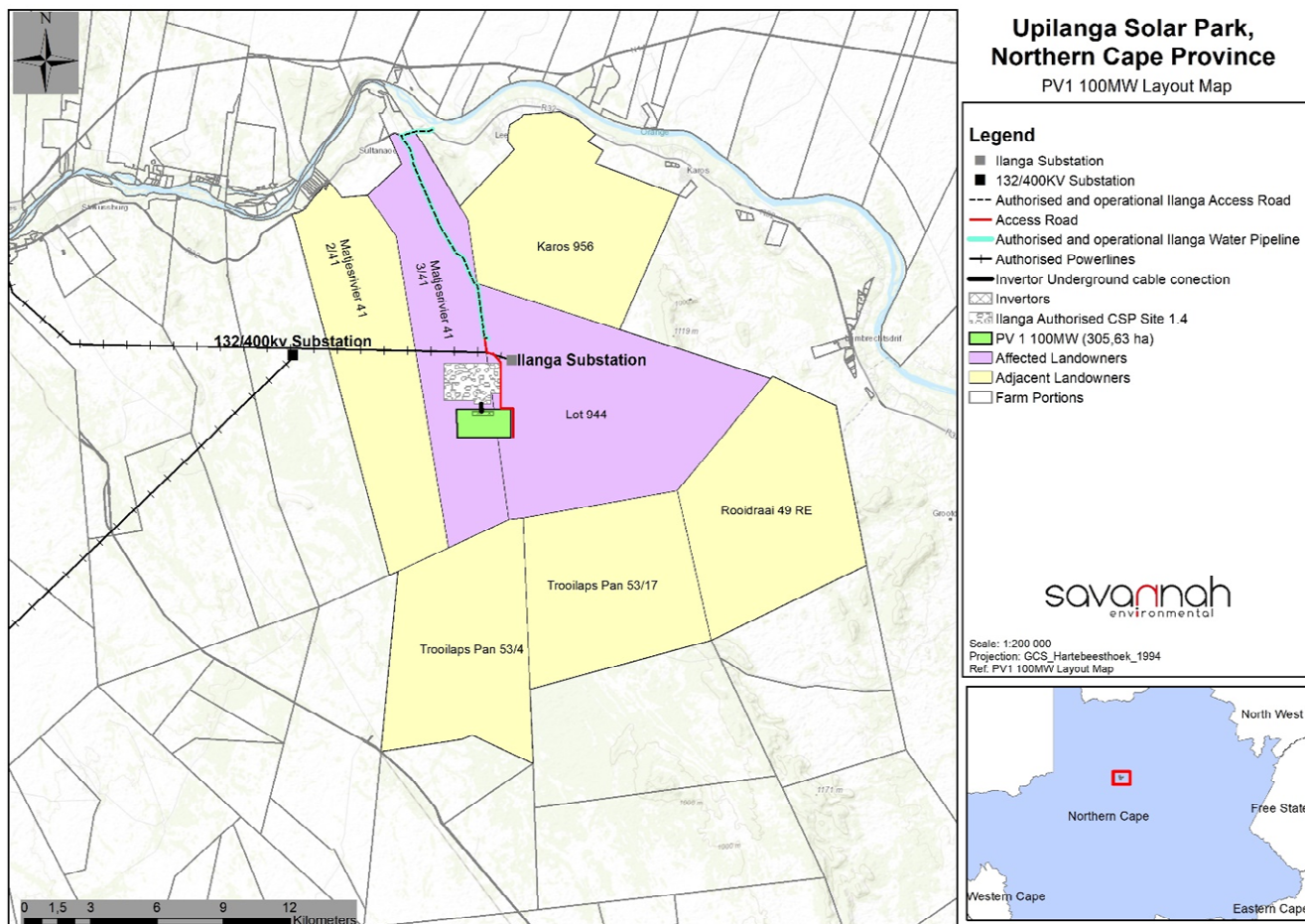


Figure 1: The proposed facility layout in relation to the relevant farm portions and proposed versus authorised project components

2. Terms of Reference

The following scope of work was used as the basis of this study to fulfil the above requirements as provided by the EAP:

General Requirements:

- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements;
- Provide a thorough overview of all applicable legislation, guidelines
- Cumulative impact identification and assessment as a result of other developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered);
- Identification sensitive areas to be avoided (including providing shapefiles/kmls);
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
 - Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

- Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
- Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- Comparative assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures in order to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (e.g. permits, licenses etc) and specialist comment if the proposed development should be authorised.

3. Project Description

The following information was provided by the client:

Emvelo Capital Projects (Pty) Ltd, an independent power developer of solar power plants in South Africa proposes the development of Upillanga PV1, a 100MW photovoltaic (PV) solar energy facility and associated infrastructure on a site located 28km south-east of the town of Upington in the Northern Cape Province. The project and associated infrastructure is proposed within Portion 3 of the farm Matjesrivier 41 and Lot 944 and will form part of the Upilanga Solar Park located approximately 30 km east of Upington. The site falls within the jurisdiction of the Dawid Kruiper and the greater ZF Mgcawu District Municipality.

The proposed project will have a contracted capacity of up to 100MW, and will make use of PV solar technology for the generation of electricity. The project will comprise the following key infrastructure and components:

- » Solar PV panels with a maximum height of 2.2m utilising Single axis tracking; Fixed axis tracking; Dual axis tracking or Fixed Tilt mounting structures.
- » Grid alternatives using underground cables to connect to the on-site substation at authorised site 1.4 and ultimately to the existing the Ilanga substation
- » A step-up facility (inverter) to step up the electricity current from 33kV to 132kV.
- » A temporary laydown area.
- » Cabling between the panels, to be laid underground where practical.
- » An access road to the development area no more than 6m wide.
- » Internal access roads within the PV panel array area with a maximum width of 4m.
- » Perimeter security fencing around the development area.
- » Operation and Maintenance buildings including a gate house and security building, control centre, offices, warehouses, a workshop and visitors centre.

The electricity current from the Upilanga PV1 PV facility will be converted and evacuated via an inverter and with the aid of underground cables connect to the authorised Ilanga CSP site 1.4 on-site substation (DEA Ref.: 14/12/16/3/3/2/299). The onsite substation at site 1.4 will connect to the existing Ilanga substation which ultimately feeds into the national grid via the following possible alternatives that were assessed in this report

1. On-site inverter (step up facility) to convert power from Direct Current (DC) to an Alternative (AC) and step up the electricity current from 33kV to 132kV that will connect to the on-site substation at authorised site 1.4 via underground cables. The electricity will be evacuated via the authorised grid connection (DEA Ref.: 14/12/16/3/3/2/299) to the existing Ilanga substation.
2. An onsite 11kV/22kV/33kV collector substation to receive, convert and step up electricity from the PV facility directly to the existing 132kV Ilanga Substation via underground cables (The on-site collector substation at authorised site 1.4 connects to the Ilanga substation).
3. Loop in and loop out the 132kV lines connecting the existing Ilanga Substation to Gordonia Substation

Although it is anticipated that any of these will avoid any of the observed watercourses, directly (underground cables) or span these areas via the overhead routes.

4. Methodology

This study followed the approaches of several national guidelines regarded for aquatic assessment. These have been modified by the author, to provide a relevant mechanism of assessing the present state of the study systems applicable to the specific environment and in a clear and objective manner, assess the potential impacts associated with the proposed development site based on information collected within the relevant farm portions of a number of years for this and other proposed projects.

Current water resource classification systems make use of the Hydrogeomorphic (HGM) approach, and for this reason, the National Wetland Classification System (NWCS) approach will be used in this study, a system that also differentiates between riverine and wetland aquatic systems.

4.1 Waterbody classification systems

Since the late 1960's, wetland classification systems have undergone a series of international and national revisions. These revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith *et al.*, 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects. **Coupled to this was the inclusion of other criteria within the classification systems to differentiate between river, riparian and wetland systems, as well as natural versus artificial waterbodies.**

The South African National Biodiversity Institute (SANBI) in collaboration with several specialists and stakeholders developed the newly revised and now accepted National Wetland Classification Systems (NWCS) (Ollis *et al.*, 2013). This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, with including structural features at the finer or lower levels of classification (Ollis *et al.*, 2013).

Wetlands develop in a response to elevated water tables, linked either to rivers, groundwater flows or seepage from aquifers (Parsons, 2004). These water levels or flows then interact with localised geology and soil forms, which then determines the form and function of the respective wetlands. Water is thus the common driving force, in the formation of wetlands (DWAf, 2005). It is significant that the HGM approach has now been included in the wetland classifications as the HGM approach has been adopted throughout the water resources management realm with regards to the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. All these systems are then easily integrated using the HGM approach in line with the Eco-classification process of river and wetland reserve determinations used by the Department of Water and Sanitation (DWS). The Ecological Reserve of a wetland or river is used by DWS to assess the water resource allocations when assessing WULAs.

The NWCS process is provided in more detail in the methods section of the report, but some of the terms and definitions used in this document are present below:

Definition Box

Present Ecological State is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State/Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

EcoStatus is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas or wetland that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology and water quality).

Reserve: The quantity and quality of water needed to sustain basic *human needs* and *ecosystems* (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The *Ecological Reserve* pertains specifically to aquatic ecosystems.

Reserve requirements: The quality, quantity and reliability of water needed to satisfy the requirements of basic human needs and the Ecological Reserve (inclusive of instream requirements).

Ecological Reserve determination study: The study undertaken to determine Ecological Reserve requirements.

Licensing applications: Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment.

Ecological Water Requirements: This is the quality and quantity of water flowing through a natural stream course that is needed to sustain instream functions and ecosystem integrity at an acceptable level as determined during an EWR study. These then form part of the conditions for managing achievable water quantity and quality conditions as stipulated in the **Reserve Template**

Water allocation process (compulsory licensing): This is a process where all existing and new water users are requested to reapply for their licenses, particularly in stressed catchments where there is an over-allocation of water or an inequitable distribution of entitlements.

Ecoregions are geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. • NOTE: For purposes of the classification system, the 'Level I Ecoregions' for South Africa, Lesotho and Swaziland (Kleynhans *et al.* 2005), which have been specifically developed by the Department of Water Affairs & Forestry (DWAF) for rivers but are used for the management of inland aquatic ecosystems more generally, are applied at Level 2A of the classification system. These Ecoregions are based on physiography, climate, geology, soils and potential natural vegetation.

4.2 Wetland definition

Although the National Wetland Classification System (NWCS) (Ollis *et al.*, 2013) is used to classify wetland types it is still necessary to understand the definition of a wetland. Terminology currently strives to characterise a wetland not only on its structure (visible form), but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (Davis 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is recognised as the seaward boundary of the shallow photic zone (Lombard *et al.*, 2005). An additional minor adaptation of the definition is the removal of the term 'fen' as fens are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows (Ollis *et al.*, 2013):

WETLAND: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten metres. The only legislated definition of wetlands in South Africa, however, is contained within the National Water Act (Act No. 36 of 1998) (NWA), where wetlands are defined as “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 adapted to life in saturated soil.” This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the latter as a watercourse (Ollis *et al.*, 2013). Table 1 below provides a comparison of the various wetlands included within the main sources of wetland definitions used in South Africa.

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. “wetlands”, as defined by the NWA, together with open waterbodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands in order to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (Ollis *et al.*, 2013).

Wetlands must therefore have one or more of the following attributes to meet the above definition (DWAF, 2005):

- A high-water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil.
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines and rivers.

Table 1: Comparison of ecosystems considered to be ‘wetlands’ as defined by the proposed NWCS, the NWA and ecosystems included in DWAF’s (2005) delineation manual.

Ecosystem	NWCS “wetland”	National Water Act wetland	DWAF (2005) delineation manual
Marine	YES	NO	NO
Estuarine	YES	NO	NO
Waterbodies deeper than 2 m (i.e. limnetic habitats often described as lakes or dams)	YES	NO	NO
Rivers, channels and canals	YES	NO ¹	NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	YES	YES	YES
Riparian ² areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	YES	YES	YES ³
Riparian ³ areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	NO	NO	YES ³

¹ Although river channels and canals would generally not be regarded as wetlands in terms of the National Water Act, they are included as a ‘watercourse’ in terms of the Act

² According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods and would be considered riparian wetlands, as opposed to non –wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.

³ The delineation of ‘riparian areas’ (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF’s (2005) delineation manual.

4.3 National Wetland Classification System method

During this study, due to the nature of the wetlands and watercourses observed, it was determined that the newly accepted NWCS be adopted. This classification approach has integrated aspects of the HGM approach used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers.

The NWCS (Ollis *et al.*, 2013) as stated previously, uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils & vegetation) stemming from the Cowardin approach (Ollis *et al.*, 2013).

The classification system used in this study is thus based on Ollis *et al.* (2013) and is summarised below:

The NWCS has a six-tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 2). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular system has with the open ocean (greater than 10 m in depth). Level 2 then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale.

This is opposed to specific attributes such as soils and vegetation. **Level 2** has adopted the following systems:

- Inshore bioregions (marine)
- Biogeographic zones (estuaries)
- Ecoregions (Inland)

Level 3 of the NWCS assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the hydrogeomorphic (HGM) units discussed earlier. The HGM units are defined as follows:

- Landform – shape and localised setting of wetland
- Hydrological characteristics – natural of water movement into, through and out of the wetland
- Hydrodynamics – the direction and strength of flow through the wetland

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for inland wetlands. Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the NWCS.

Level 6 uses six descriptors to characterise the wetland types based on biophysical features. As with Level 5, these are non-hierarchical in relation to each other and are applied in any order, dependent on the availability of information. The descriptors include:

- Geology;
- Natural vs. Artificial;
- Vegetation cover type;
- Substratum;
- Salinity; and
- Acidity or Alkalinity.

It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, and these are thus nested in relation to each other.

The HGM unit (Level 4) is the **focal point of the NWCS**, with the upper levels (Figure 3 – Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

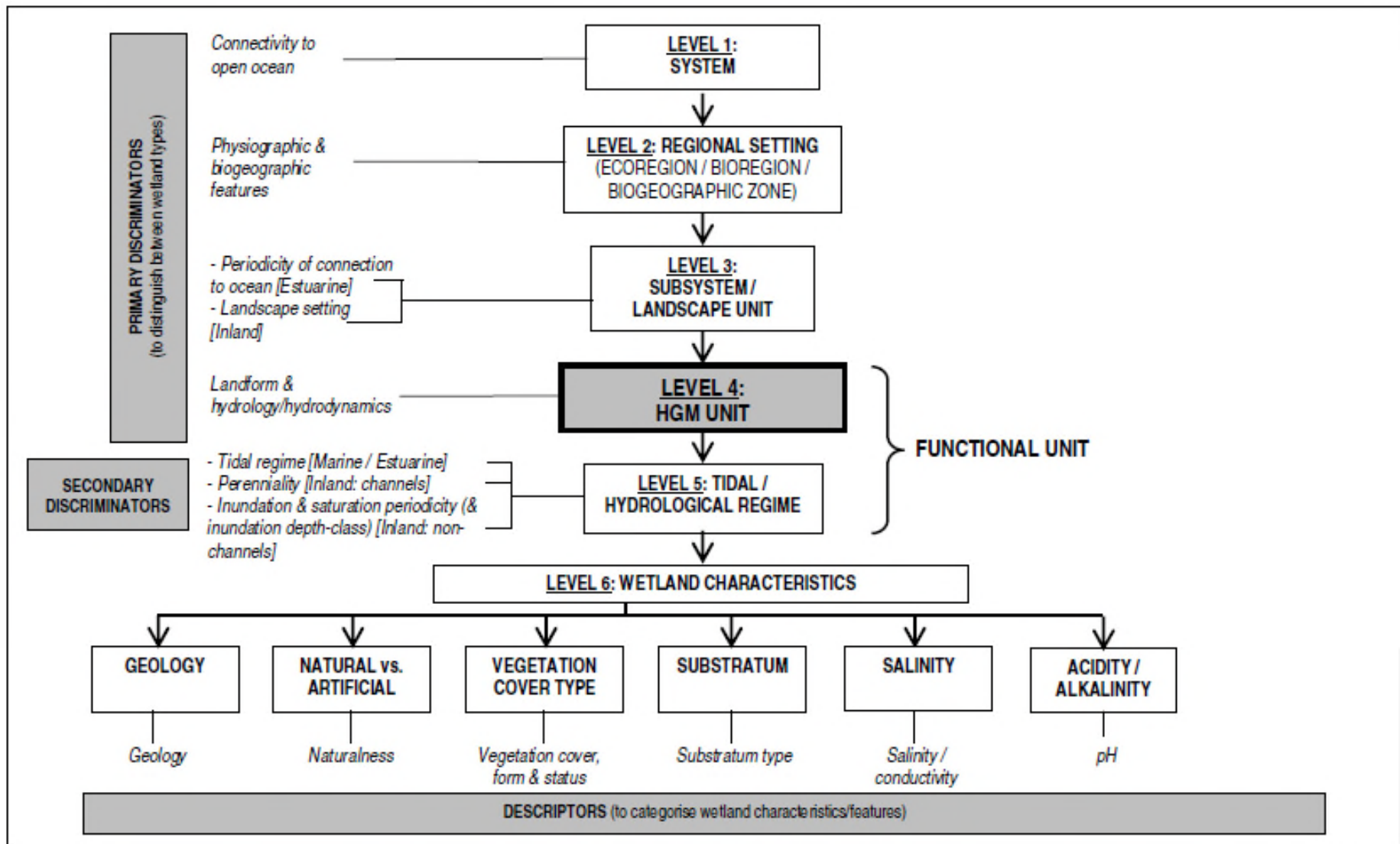


Figure 2: Basic structure of the NWCS, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From Ollis *et al.*, 2013).

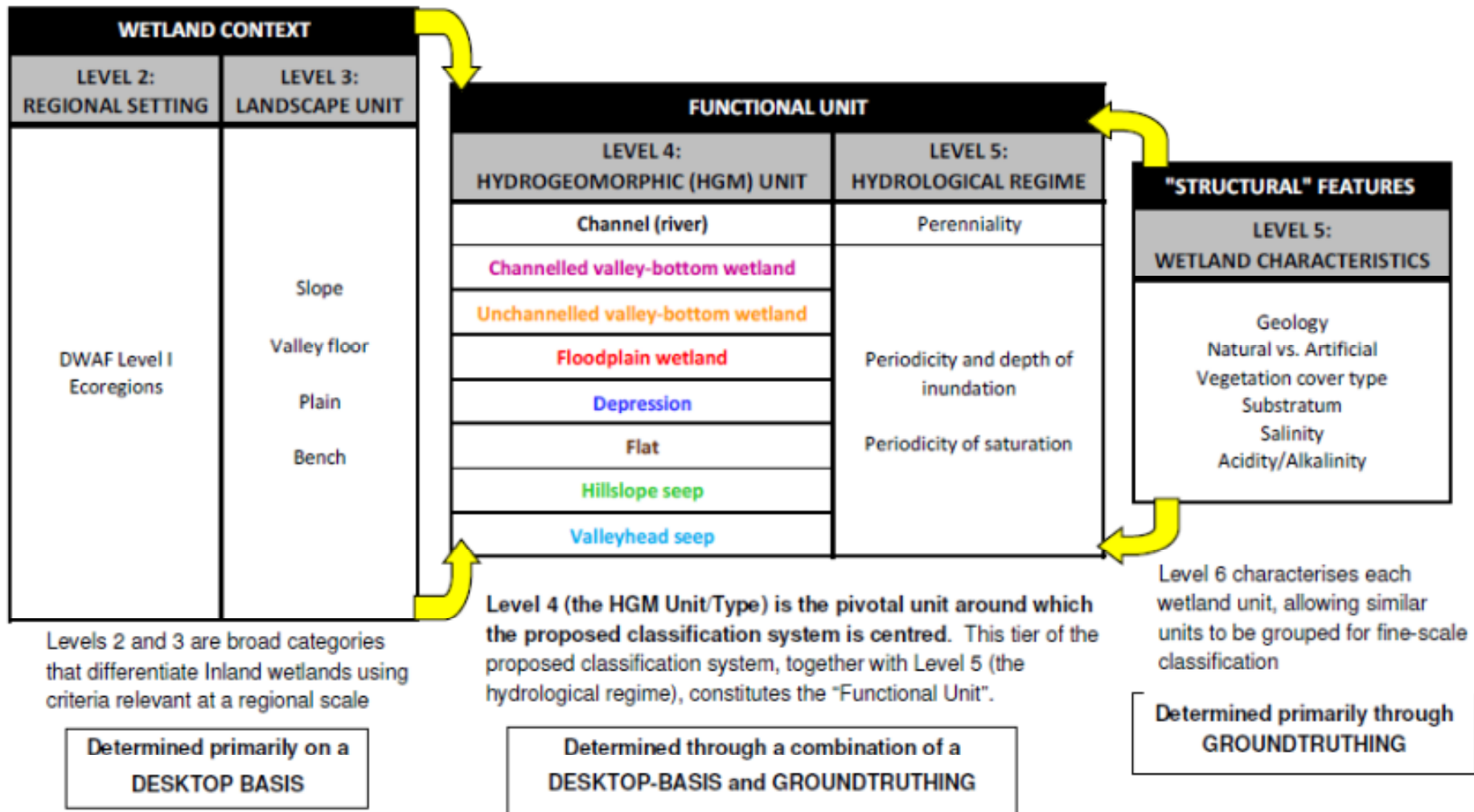


Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al.*, 2013).

4.4 Waterbody Condition

To assess the PES or condition of the observed wetlands, a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories (Table 2) and provide a score of the PES of the habitat integrity of the wetland system being examined. The author has included additional criteria into the model-based system to include additional wetland types. This system is preferred when compared to systems such as WET-Health – wetland management series (WRC 2009), as WET-Health (Level 1) was developed with wetland rehabilitation in mind and is not always suitable for impact assessments. This coupled with the degraded state of the wetlands in the study area, indicated that a complex study approach was not warranted, i.e. conduct a Wet-Health Level 2 and WET-Ecosystems Services study required for an impact assessment.

Table 2: Description of A – F ecological categories based on Kleynhans *et al.*, (2005)

ECOLOGICAL CATEGORY	ECOLOGICAL DESCRIPTION	MANAGEMENT PERSPECTIVE
A	Unmodified, natural.	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Some human-related disturbance, but mostly of low impact potential
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	

The WETLAND-IHI model is composed of four modules. The “Hydrology”, “Geomorphology” and “Water Quality” modules all assess the contemporary driving processes behind wetland formation and maintenance. The last module, “Vegetation Alteration”, provides an indication of the intensity of human land use activities on the wetland surface itself and how these may have modified the condition of the wetland. The integration of the scores from these 4 modules provides an overall PES score for the wetland system being examined. The WETLAND-IHI model is an MS Excel-based model, and the data required for the assessment are generated during a site visit.

Additional data may be obtained from remotely sensed imagery (aerial photos; maps and/or satellite imagery) to assist with the assessment. The interface of the WETLAND-IHI has been developed in a format which is similar to DWA’s River EcoStatus models which are currently used for the assessment of PES in riverine environments.

4.5 Aquatic ecosystem importance and function

South Africa is a Contracting Party to the Ramsar Convention on Wetlands, signed in Ramsar, Iran, in 1971, and has thus committed itself to this intergovernmental treaty, which provides the framework for the national protection of wetlands and the resources they could provide. Wetland conservation is now driven by the South African National Biodiversity Institute, a requirement under the National Environmental Management: Biodiversity Act (No 10 of 2004).

Wetlands are among the most valuable and productive ecosystems on earth, providing important opportunities for sustainable development (Davies and Day, 1998). However, wetlands in South Africa are still rapidly being lost or degraded through direct human induced pressures (Nel *et al.*, 2004).

The most common attributes or goods and services provided by wetlands include:

- Improve water quality;
- Impede flow and reduce the occurrence of floods;
- Reeds and sedges used in construction and traditional crafts;
- Bulbs and tubers, a source of food and natural medicine;
- Store water and maintain base flow of rivers;
- Trap sediments; and
- Reduce the number of water-borne diseases.

In terms of this study, the wetlands provide ecological (environmental) value to the area acting as refugia for various wetland associated plants, butterflies and birds.

In the past, wetland conservation has focused on biodiversity as a means of substantiating the protection of wetland habitat. However not all wetlands provide such motivation for their protection, thus wetland managers and conservationists began assessing the importance of wetland function within an ecosystem.

Table 3 below summarises the importance of wetland function when related to ecosystem services or ecoservices (Kotze *et al.*, 2008). One such example is emergent reed bed wetlands that function as transformers converting inorganic nutrients into organic compounds (Mitsch and Gosselink, 2000).

Table 3: Summary of direct and indirect ecoservices provided by wetlands from Kotze *et al.*, 2008

Ecosystem services supplied by wetlands	Indirect benefits	Hydro-geochemical benefits	Flood attenuation	
			Stream flow regulation	
			Water quality enhancement benefits	Sediment trapping
				Phosphate assimilation
				Nitrate assimilation
		Toxicant assimilation		
		Erosion control		
		Carbon storage		
		Biodiversity maintenance		
		Direct benefits	<i>Provision of water for human use</i>	
	<i>Provision of harvestable resources²</i>			
	<i>Provision of cultivated foods</i>			
	<i>Cultural significance</i>			
	<i>Tourism and recreation</i>			
	<i>Education and research</i>			

Conservation importance of the individual wetlands was based on the following criteria:

- Habitat uniqueness;
- Species of conservation concern;
- Habitat fragmentation or rather, continuity or intactness with regards to ecological corridors; and
- Ecosystem service (social and ecological).

The presence of any or a combination of the above criteria would result in a HIGH conservation rating if the wetland was found in a near natural state (high PES). Should any of the habitats be found modified the conservation importance would rate as MEDIUM, unless a Species of Conservation Concern (SCC) was observed, in which case it would receive a HIGH rating. Any system that was highly modified (low PES) or had none of the above criteria, received a LOW conservation importance rating. Wetlands with HIGH and MEDIUM ratings should thus be excluded from development with incorporation into a suitable open space system, with the maximum possible buffer being applied. Natural wetlands or wetlands that resemble some form of the past landscape but receive a LOW conservation importance rating could be included into stormwater management features, and should not be developed to retain the function of any ecological corridors.

4.6 Relevant wetland legislation and policy

Locally the South African Constitution, seven (7) Acts and two (2) international treaties allow for the protection of wetlands and rivers. These systems are protected from destruction or pollution by the following:

- Section 24 of The Constitution of the Republic of South Africa, 1996;
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- The Ramsar Convention, 1971 including the Wetland Conservation Programme (DEAT) and the National Wetland Rehabilitation Initiative (DEAT, 2000);
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments, as well as the NEM: Biodiversity Act;
- National Water Act, 1998 (Act No. 36 of 1998);
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983); and
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).
- Nature and Environmental Conservation Ordinance, 1974 (No. 19 of 1974)
- National Forest Act, 1998 (No. 84 of 1998)
- National Heritage Resources Act, 1999 (No. 25 of 1999)

NEMA and the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983) would also apply to this project. These Acts have categorised many invasive plants together with associated obligations on the land owner.

4.7 Provincial legislation and policy

Currently there are no formalised riverine or wetland buffer distances provided by the provincial authorities and as such the buffer model as described Macfarlane & Bredin (2017) for wetlands, rivers and estuaries was used.

These buffer models are based on the condition of the waterbody, the state of the remainder of the site, coupled to the type of development, as well as the proposed alteration of hydrological flows. Based then on the information known for the site the buffer model provided the following:

Rivers (i.e. all watercourses)

- Construction period: 36 m
- Operation period: 32 m
- Final: 36 m

Wetlands (Pans)

- Construction period: 47 m
- Operation period: 43 m
- Final: 47 m

Therefore the final buffer for all systems rated as Very High was 36m and 47m respectively, noting that development would have to take place within the secondary systems, so no buffer was proposed for these areas as the suitability of each area affected was assessed to determine if infrastructure could be placed within that particular area.

Other policies that are relevant include:

- Provincial Nature Conservation Ordinance (PNCO) – Protected Flora. Any plants found within the development area are described in the ecological assessment.
- National Freshwater Ecosystems Priority Areas (NFEPA) – (Nel *et al.*, 2011). This mapping product highlights potential rivers and wetlands that should be earmarked for conservation on a national basis.

5. Description of the affected environment

As previously mentioned, the study area has been assessed over a period of several dry years for various other proposals since 2010 onwards, followed by heavy rainfall in December 2019 and January 2020. This presented an opportunity to see the effect of the typical sporadic ephemeral flows within these systems.

The study area site is situated within quaternary catchment D73E (Figure 4), which was dominated by a large number of highly ephemeral river systems associated with the Orange River (DWAF, 2004). Potential runoff from the site would flow in a northerly direction towards the Orange River via drainage systems such as the Klein-leerkransspruit and Majties (Matjes) River or directly into the canal systems and siphons that run along the Orange River (Figure 4). These are all located within the located in the Nama Karoo ecoregion.

Overall, these watercourses within the study area are largely in a natural state, when compared the associated Orange River reach, which has modified floodplains and flows. Current impacts occur in a localised area within the development area and included the following:

- Erosion due small road crossings and tracks;
- Ruderal alien plants from previous construction projects and
- Grazing.

The National Wetland Inventory v5.2 (2018) spatial data (NWI), indicated a variety of wetland types are located near the study area and included depressions / pans and riverine floodplain, the latter being considered alluvial watercourses in this landscape setting (Figure 5).

However, the study area systems are ephemeral and only carried water for a short week long period in 2014 and in 2019, thus the observed development area systems don't support any wide riparian zones and the vegetation associated with these watercourses was between 0.5 m and 12 m wide were mostly terrestrial.

Fifteen woody plant species were found associated with the riparian and pan systems within the development area. Although none of these were obligate or facultative river/wetland species, they do show a preference for areas exposed to runoff, but none of these would be considered listed or protected under any National or Provincial legislation.

The only obligate wetland plants observed were those found in association with the man-made dams found at the confluence of the Majties (Matjes) River and the Orange River and along the Orange River itself. Species observed included *Typha capensis*, *Phragmites australis*, *Prosopis glandulosa* and *Cyperus marginatus*. Notably the prevalence of *Prosopis* and alien invasive tree species had increased between 2010 and this survey within the study area that had been visited previously by this report author.

Based then on the information collected in the field, assessment of the previous reports and current aerial photographs, the various aquatic features within the site were then delineated to a fine scale and are shown in Figure 7. These were then categorised based on the hydrogeomorphic approach, catchment position, which could then be linked to sensitivity of these to the proposed development, and compared to the ratings of the DEA Screening Tool results (See Section 6 below for additional sensitivity / importance details and Figure 6):

5. Alluvial water courses – major with riparian zones
6. Alluvial water courses – minor with no distinct riparian vegetation
7. Secondary water course and drainage lines
8. Pans / Depressions

Any activities within these areas, the buffers, or 500m from the wetland boundary will require a Water Use license under Section 21 c and i of the National Water Act (Act 36 of 1998) (Figure 6).

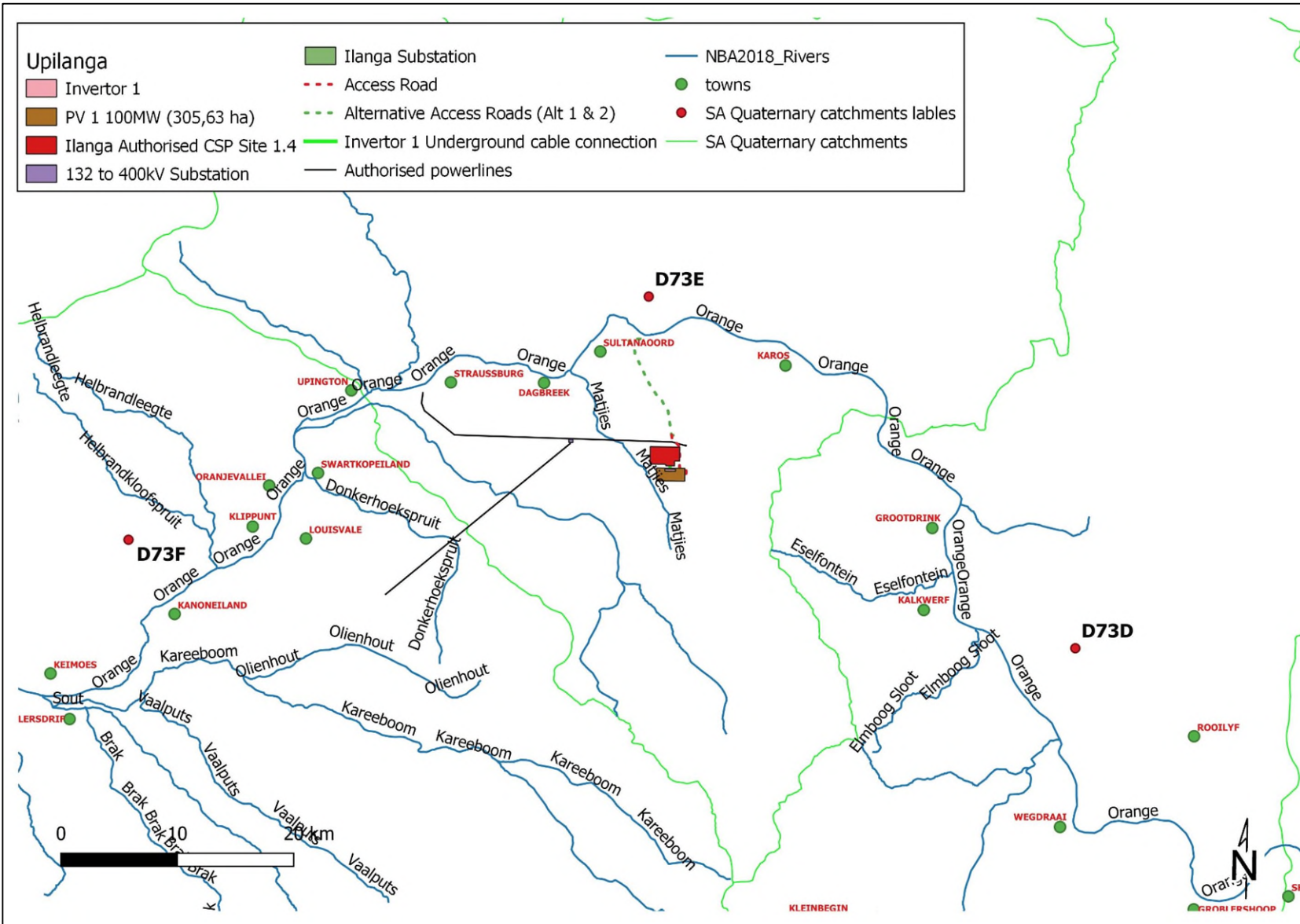


Figure 4: Project locality map indicating the various quaternary catchment boundaries (green line) in relation to the study area (Source DWS and NGI).

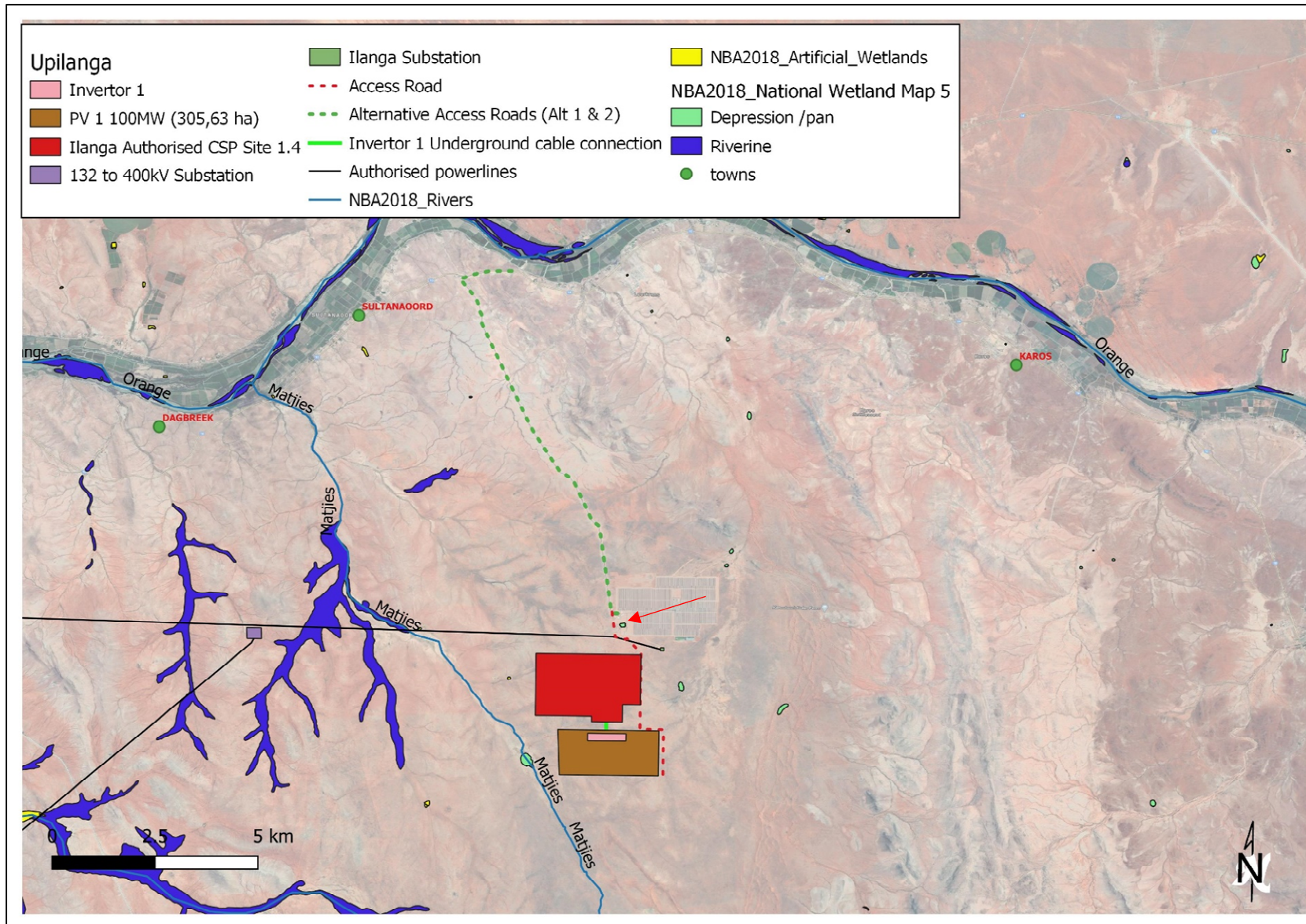


Figure 5: The various waterbodies near the study area identified in the National Wetland Inventory V5.2 (2018), and the waterbody that was confirmed as artificial and not a natural wetland system (red arrow)

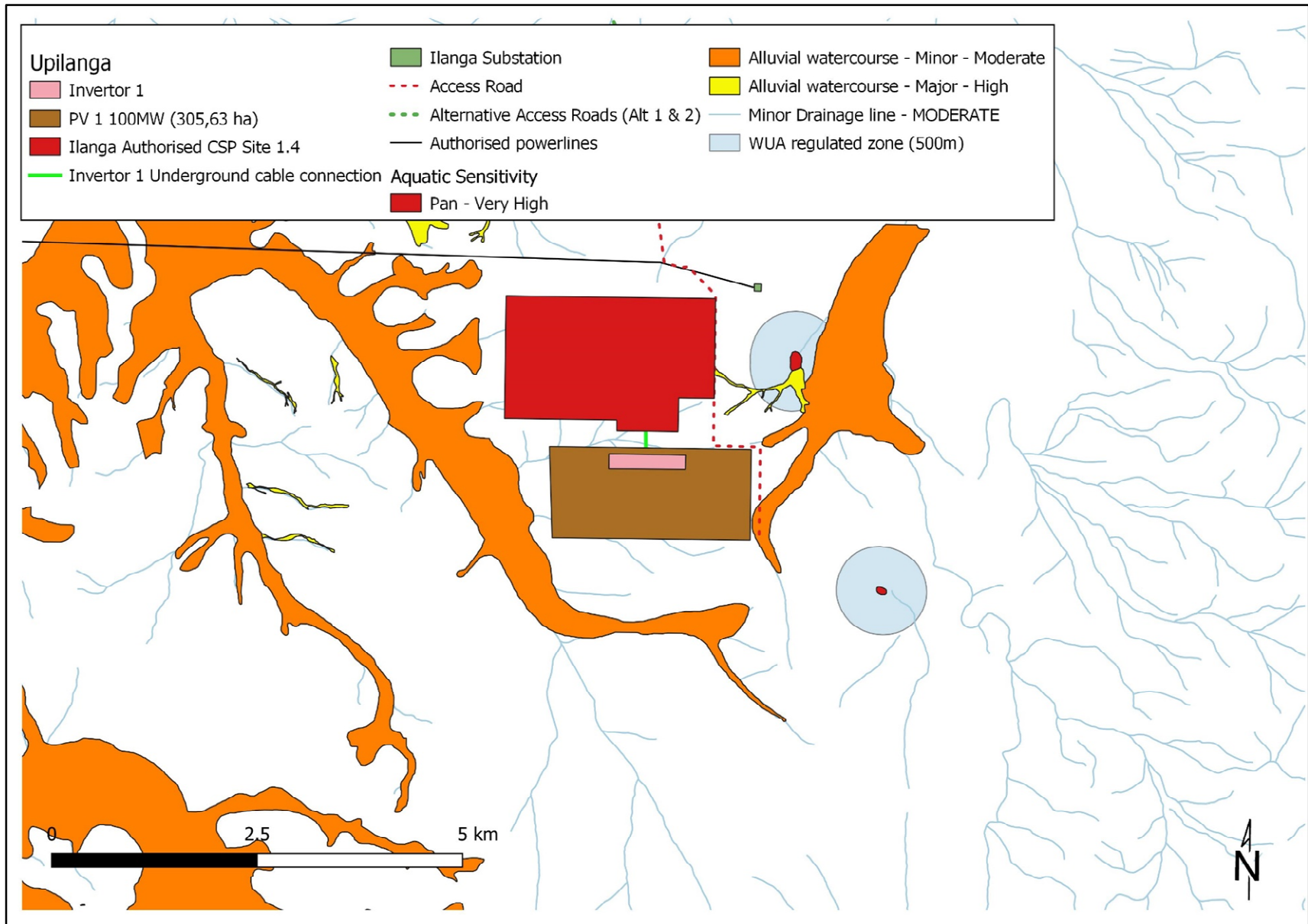


Figure 6: Wetlands and watercourses within the study area in relation to the activities, with buffers, sensitivity ratings and the 500m regulated WULA zone.

6. Present Ecological State, conservation importance and sensitivity

The PES of an aquatic system represents the extent to which it has changed from the reference or near pristine condition (Category A) towards a highly impacted system where there has been an extensive loss of natural habit and biota, as well as ecosystem functioning (Category E).

The PES scores have been revised for the country and based on the new models, aspects of functional importance, as well as direct and indirect impacts, have been included (DWS, 2014). The new PES system also incorporates Ecological Importance (EI) and Ecological Sensitivity (ES) separately as opposed to Ecological Importance and Sensitivity (EIS) in the old model, although the new model is still heavily centred on rating rivers using broad fish, invertebrate, riparian vegetation and water quality indicators. The Recommended Ecological Category (REC) is still contained within the new models, with the default REC being B, when little or no information is available to assess the system or when only one of the above-mentioned parameters are assessed or the overall PES is rated between a C or D.

The Present Ecological State scores (PES) for the development area were rated B – largely natural, while the associated reach along the Orange River, located at the confluence of these main watercourse was rated as follows (DWS, 2014 – where D = Largely Modified):

Present Ecological State	Catchment Ecological Importance	Catchment Ecological Sensitivity
D	Moderate	High

Although the Orange River reach associated with the study area systems was rated as having a lower ecological state, the surrounding catchments, inclusive of the development area, these were still considered to have a Moderate and High Ecological Importance and Ecological Sensitivity and for this reason the study area was included as a Critical Biodiversity Area Type 1 as shown in the Northern Cape CBA map (Figure 7).

The pan / depressions received a PES score of B, and EIS score of Medium. The score (PES = B) was due to the effect of grazing / trampling by animals searching for shade or water.

In terms of the National Freshwater Ecosystems Priority Areas (NFEPA) assessment, all the systems within the development area have been assigned a condition score of AB (Nel et al. 2011), indicating that they are largely intact and of biological significance. The NFEPA project (Nel *et al.*, 2011) then earmarked sub-quaternaries, based either on the presence of important biota (e.g. rare or endemic fish species) or conversely the degree of riverine degradation, i.e. the greater the catchment degradation the lower the priority to conserve the catchment. The important catchments areas are then classified as Freshwater Ecosystems Priority Areas (FEPAs). The survey area falls within an FEPA (Figure 8), associated with the Matjes River, although no permanent fish habitat occurs within the proposed development area based on site observations and the fragmentation mentioned above (dams), the overall catchment is still important from a hydrological standpoint.

These ratings and the PES and EIS scores were then translated in the respective sensitivity ratings of the various aquatic systems (Very High to Moderate), and used to prepare a sensitivity map (Figure 9).

The layout was developed to avoid all Mainstem Alluvial water courses and Pans (inclusive of the 47m buffer), which rated as Very High Sensitivity (Figure 9). These corresponded to the Very High Sensitivity systems considered in the DEA Screening Tool spatial data, although this report considers their actual hydrogeomorphic classification, i.e. only the pans are considered a wetland type. Some of the remaining secondary aquatic systems (highly ephemeral, with no aquatic habitat) area located within the development area were considered Moderately Sensitive. No buffer was proposed, as several technical and other environmental constraints (sensitive vegetation for example), needed to be considered, thus several PV panel areas needed to be placed

within these secondary systems. Each of these areas, where panels or associated infrastructure will be placed was considered on an area for area basis, to ensure that the panels will be placed within areas that won't affect the general hydrology of the region and or result in alteration of the form or function of the respective aquatic systems.

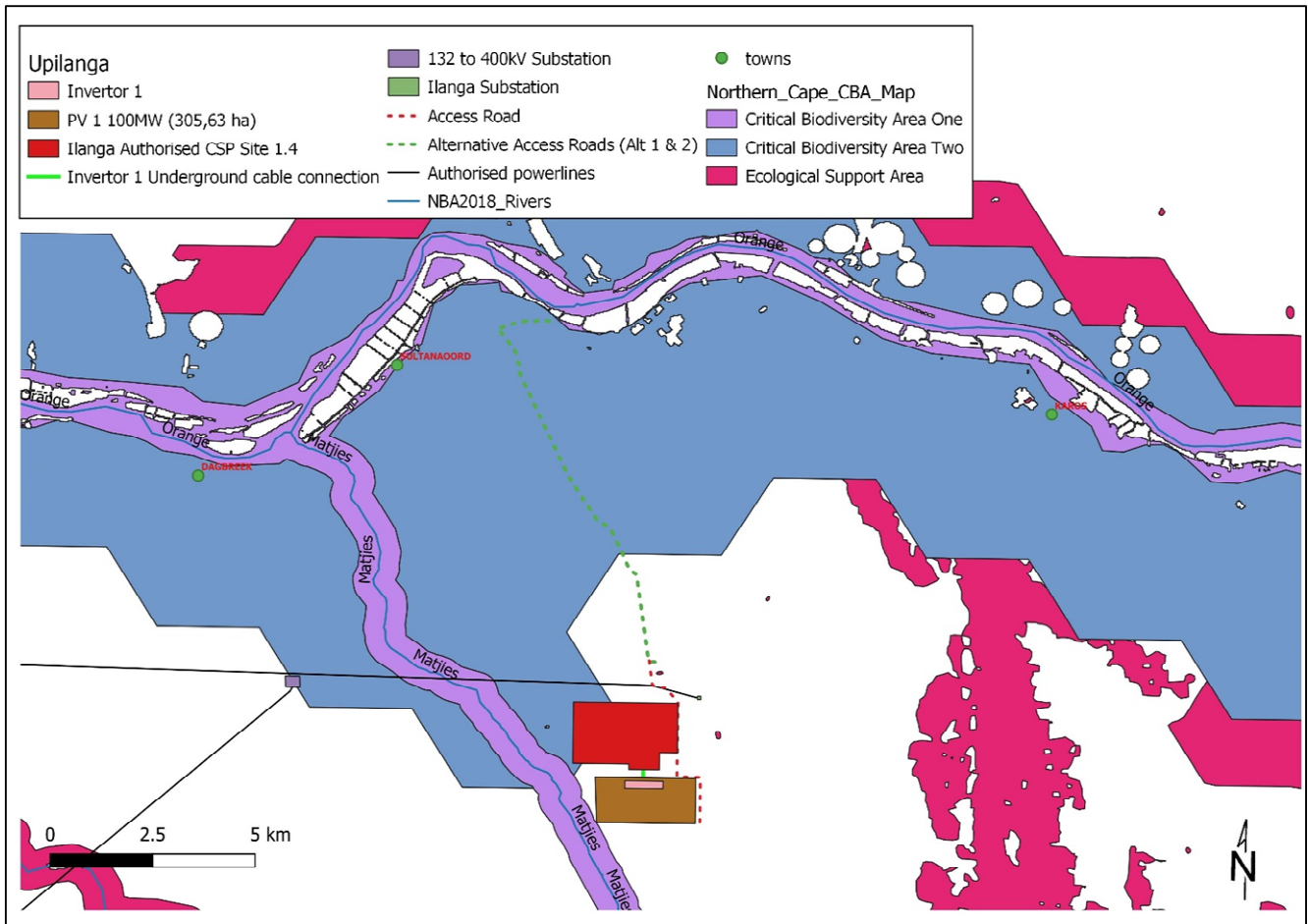


Figure 7: Critical Biodiversity Areas as per the Northern Cape Critical Biodiversity Areas Map.

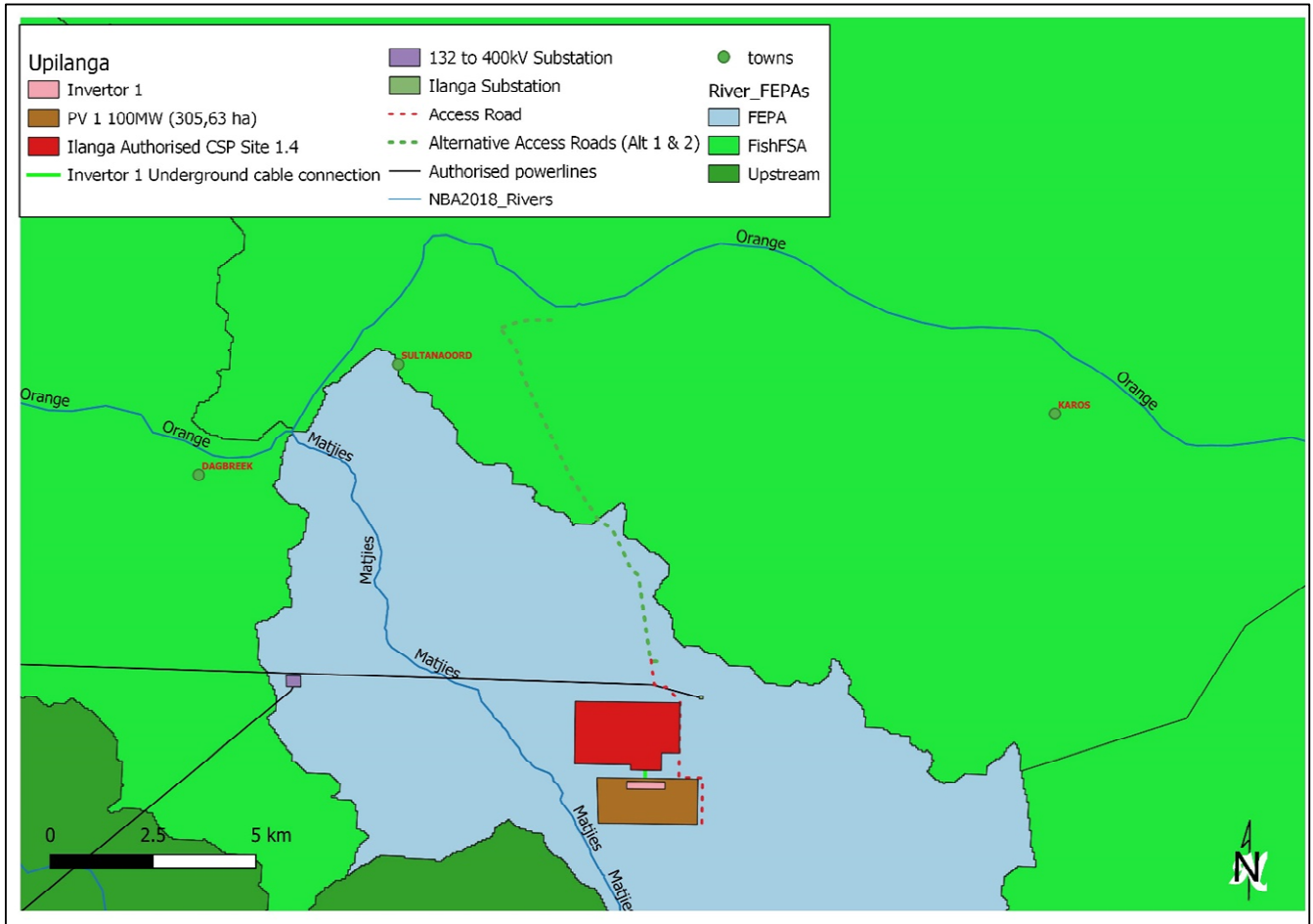


Figure 8: The respective subquaternary catchments rated in terms of Freshwater Ecosystem Priority Areas (FEPAs) in relation to the study area

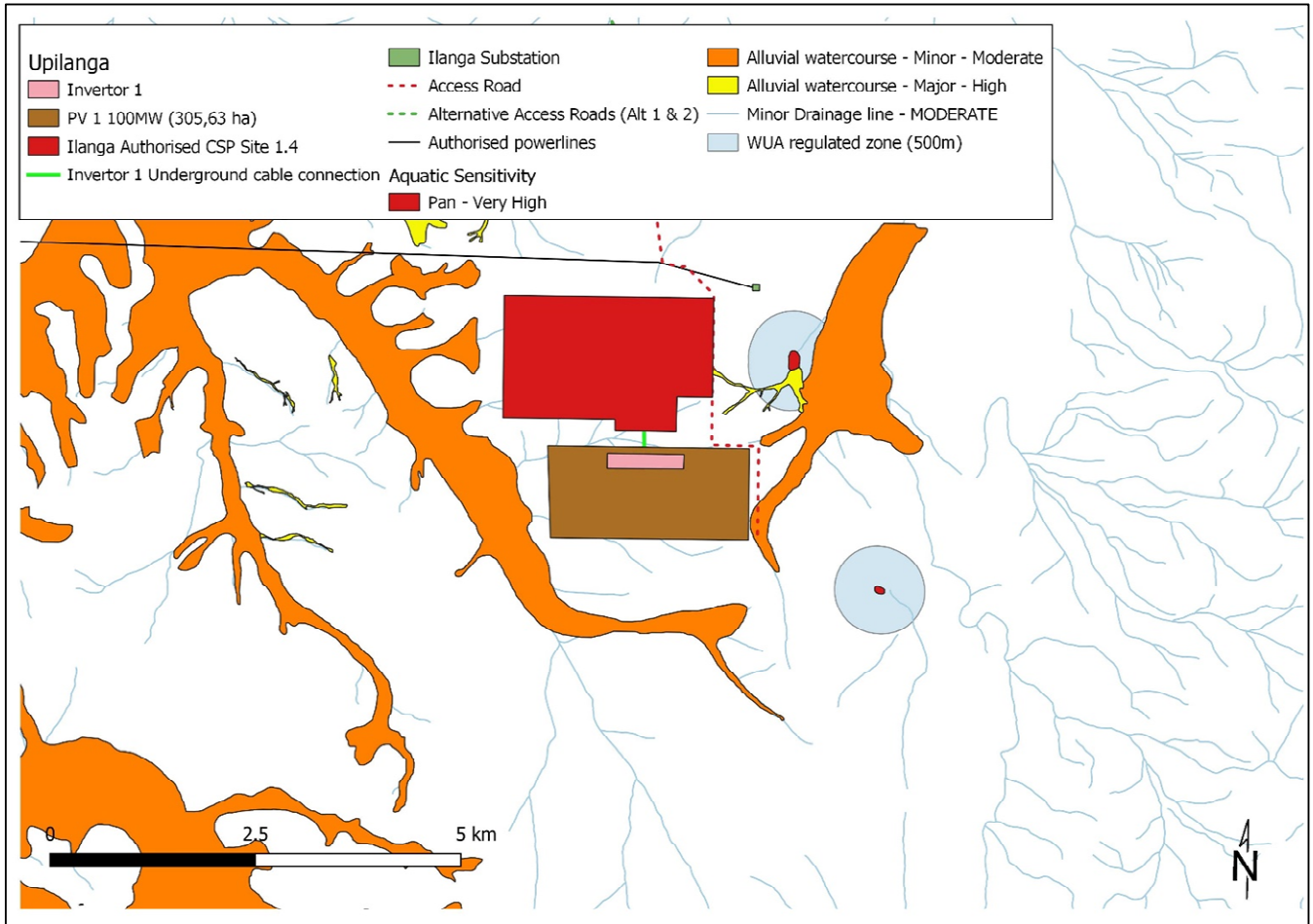


Figure 9: The delineated aquatic systems and final sensitivity ratings for each. The respective wetland Water Use License Regulated Zone of 500m for wetlands is also shown

7. Permit requirements

Based on an assessment of the proposed activities and past engagement with DWS, the following WULs/ GA's could be required based on the following thresholds as listed in the following Government Notices, however ultimately the Department of Water and Sanitation (DWS) will determine if a GA or full WULA will be required during the pre-application process (Phase 1):

- **DWS Notice 538 of 2016, 2 September in GG 40243**– Section 21 a & b, Abstraction and Storage of water.
- **Government Notice 509 in GG 40229 of 26 August 2016** – Section 21 c & i, Impeding or diverting the flow of water in a watercourse and/ or altering the bed, banks, course or characteristics of a watercourse.
- **Government Notice 665, 6 September 2013 in GG 36820** (Has expired as GA is only valid for 5 years thus a full WULA will be required) – Section 21g Disposing of waste in a manner that may detrimentally impact on a water source which includes temporary storage of domestic waste water i.e. conservancy tanks under Section 37 of the notice.

	Water Use Activity	Applicable to this development proposal
S21(a)	Taking water from a water resource	N/A as a licensed source with pipeline is already in place.
S21(b)	Storing water	Only If the total volume stored is greater than 40 000 m ³ then a full Water Use License will be required. This is however unlikely that onsite water storage for the purpose of the facility would ever exceed this threshold or has been included in other aspects of the authorised projects surround this proposal.
S21(c)	Impeding or diverting the flow of water in a watercourse	Yes – several new crossings of watercourses will be required.
S21(d)	Engaging in a stream flow reduction activity	Not applicable
S21(e)	Engaging in a controlled activity	Not applicable
S21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit	Not applicable
S21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource	Typically, the conservancy tanks at construction camps and then O/M buildings require a license (GA if volumes are below 5000 m ³)
S21(h)	Disposing in any manner of water which contains waste from, or which has been	Not applicable

	Water Use Activity	Applicable to this development proposal
	heated in, any industrial or power generation process	
S21(i)	Altering the bed, banks, course or characteristics of a watercourse	Yes – several new crossings of watercourses will be required
S21(j)	Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons	Not applicable
S21(k)	Using water for recreational purposes	Not applicable

DWS WILL DETERMINE IF A GA OR WULA APPLICATION WILL BE REQUIRED DURING THE PREAPPLICATION PHASE AND TYPICALLY IF ONE OF THE ABOVE WATER USES REQUIRES A WULA THEN ALL APPLICATIONS WILL BE TREATED AS A WULA AND NOT GA. THE SUBMISSION PROCESS AND DETAIL REQUIREMENTS DO HOWEVER NOT DIFFER, ONLY THE PROCESSING TIMEFRAMES (60 vs 300 DAYS) DO.

8. Impact assessment

During the impact assessment a number of potential key issues / impacts were identified, and these were assessed based on the methodology supplied by Savannah Environmental. The following impacts that have the potential to arise should the project go-ahead were assessed:

- Impact 1: Impact 1: Loss of High Sensitivity systems, namely the major alluvial water courses and or pans through physical disturbance.
- Impact 2: Impact on secondary water courses (Moderate Sensitivity), through physical disturbance
- Impact 3: Impact on all riparian and wetland systems through the possible increase in surface water runoff on riparian form and function through hydrological changes
- Impact 4: Increase in sedimentation and erosion
- Impact 5: Risks on the aquatic environment due to water quality impacts
- Impact 6: Cumulative impacts

Note no natural wetlands will be directly affected by this project, as all infrastructure is well outside of these systems catchments, as well as the 500m Water Use regulatory zone.

The impacts were assessed as follows:

Nature: Impact 1 - Loss of major riparian systems such as the mainstem rivers Klein-leerkransspruit and Majties (Matjes) rivers through physical disturbance within these High Sensitivity areas.		
The physical removal or disturbance of the narrow woody riparian zones, being replaced by hard engineered surfaces. This biological impact would however be localised, as a large portion of the remaining farm and the Klein-leerkransspruit and Majties (Matjes) catchment would remain intact with no new direct crossings being proposed by this project on these major systems. Furthermore, all of the remaining infrastructure has been located well outside any of these mainstem systems that were considered having a HIGH sensitivity, i.e. only secondary alluvial water courses and drainage lines will be affected by the internal roads (see Impact 2)		
	Without mitigation	With mitigation
Extent	High (3)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (7)	Low (4)
Probability	Definite (5)	Probable (3)
Significance	High (70)	Low (27)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium

Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	
<p>Mitigation:</p> <p>The most significant form of mitigation would be to select development options that contain no aquatic features. The proposed layout has been developed to avoid the important main stem systems, thus requiring only crossings or footprints within alluvial watercourses and drainage lines – See Impact 2) demarcated to be a low/medium sensitivity and is therefore considered to be an acceptable infringement and loss of the features or sections thereof.</p> <p>Additional general mitigations include:</p> <ul style="list-style-type: none"> • Vegetation clearing should occur in a phased manner in accordance with the construction programme 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. Suitable dust and erosion control mitigation measures should be included in the EMP to mitigate these impacts. • All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination / leaks. Washing and cleaning of equipment should also be done in berms or bunds, to trap any cement / hazardous substances and prevent excessive soil erosion. Mechanical plant and bowsers must not be refuelled or serviced within or directly adjacent to any channel. It is therefore suggested that all construction camps, laydown areas, or other temporary areas and stores should be located more than 50 m from any demarcated watercourses, as the only allowable features would be the PV panels mounting structures, that will span any of the observed watercourses, i.e. footings will be outside of these areas and certain access roads. • It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas along aquatic features, using selected species detailed in this report assisted by an appropriate specialist. • All alien plant re-growth must be monitored, and should these alien plants reoccur these plants should be re-eradicated. The scale of the development does however not warrant the use of a Landscape Architect and / or Landscape Contractor. <p>It is further recommended that a comprehensive rehabilitation plan be implemented from the project onset to ensure a net benefit to the environment within all areas that will remain undisturbed but were affected during the construction phase. This should form part of the suggested walk down as part of the final EMP preparation.</p>		
<p>Cumulative impacts:</p> <p>None – no direct connection between this and other systems, such as the Orange River, exist.</p>		
<p>Residual impacts:</p>		

Possible impact on the remaining catchment due to changes in run-off characteristics in the development area.

Nature: Impact 2 - Impact on Secondary alluvial water courses (Moderate Sensitivity) and minor drainage lines (Moderate Sensitivity) through physical disturbance

The physical removal of narrow strips of woody riparian zones being replaced by hard engineered surfaces will alter the hydrological nature of the area, by increasing the surface run-off velocities, while reducing the potential for any run-off to infiltrate the soils. This impact would however be localised, as it is intended that the PV panels and mounting structures traverse the watercourses and will not be placed within the watercourse, i.e. span the watercourses which will reduce the proposed impacts.

	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Low (4)
Probability	Definite (5)	Probable (3)
Significance	Medium (45)	Low (27)
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

The most significant form of mitigation would be to select a development area, which contained no drainage lines. The proposed layout has been developed to avoid the important systems, thus requiring only crossings or footprints within minor watercourse (dry drainage lines) which is considered to be an acceptable infringement and loss of the features or sections thereof.

An additional general mitigation measure is:

- Vegetation clearing should occur in a phased manner in accordance with the construction programme 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. Suitable dust and erosion control mitigation measures should be included in the EMP to mitigate these impacts.

Cumulative impacts:

The increase in surface run-off velocities and the reduction in the potential for groundwater infiltration is likely to occur, considering that the development area is near the main drainage channels, however the annual rainfall figures are low.

Residual impacts:

Diversion of run-off away from downstream systems is unlikely to occur as the annual rainfall figures are low.

Nature: Impact 3 - Impact on riparian systems through the possible increase in surface water runoff on riparian form and function

Increase in hard surface areas, and roads that require stormwater management will increase through the concentration of surface water flows that could result in localised changes to flows (volume) that would result in form and function changes within the riparian systems, which are currently ephemeral, i.e. riparian systems species composition changes, which then results in habitat change / loss.

	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (2)
Probability	Definite (5)	Probable (3)
Significance	Medium (35)	Low (21)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

Any stormwater within the development area must be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments, and reduce flow velocities (e.g. water used when washing the panels).

The project should also try to capture and recycle any form of run-off created by the daily operations. This would minimise the amount of water required by the project, but also serve to limit the downstream impacts on the riparian systems through an increase in run-off, a situation that these systems are currently unaccustomed to.

<p>Cumulative impacts:</p> <p>Downstream alteration of hydrological regimes due to the increased run-off from the area.</p>
<p>Residual impacts:</p> <p>Possible impact on the remaining catchment due to changes in run-off characteristics in the development area.</p>

Nature: Impact 4 - Increase in sedimentation and erosion within the development footprint

Increase in hard surface areas, and roads that require stormwater management will increase through the concentration of surface water flows. These higher volume flows, with increased velocity result in downstream erosion and sedimentation.

	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (1)
Probability	Definite (5)	Probable (3)
Significance	Medium (35)	Low (18)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

Any stormwater within the development area must be handled in a suitable manner, i.e. separate clean and dirty water streams around the plant, and install stilling basins to capture large volumes of run-off, trap sediments and reduce flow velocities (e.g. water used when washing the PV Panels).

Suitable stormwater management features with erosion control measures (gabions) should also be installed in areas where concentrated flows are anticipated.

Cumulative impacts:

Downstream erosion and sedimentation of the downstream systems and farming operations. During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream)

already deposited downstream will be washed into the Orange River, although currently no direct connections with the Orange River, extreme high flows do enter the river from the development area.

Residual impacts:

During flood events, the unstable banks (eroded areas) and sediment bars (sedimentation downstream) already deposited downstream.

Nature: Impact 5 – Impact on localised surface water quality

During both preconstruction, construction and to a limited degree the operational activities, chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement powder, wet cement, shutter-oil, etc.) associated with site-clearing machinery and construction activities could be washed downslope via the ephemeral systems.

	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (2)	Low (1)
Probability	Definite (5)	Probable (3)
Significance	Medium (35)	Low (18)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes (high)	

Mitigation:

- Strict use and management of all hazardous materials used on site.
- Strict management of potential sources of pollution (e.g. litter, hydrocarbons from vehicles & machinery, cement during construction, etc.).
- Containment of all contaminated water by means of careful run-off management on site.
- Appropriate ablution facilities should be provided for construction workers during construction and on-site staff during the operation of the facility.
- Strict control over the behaviour of construction workers.
- Appropriate waste management.

<ul style="list-style-type: none"> Working protocols incorporating pollution control measures (including approved method statements by the contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced.
<p>Cumulative impacts:</p> <p>None as no direct connection between the development area and Orange River remains</p>
<p>Residual impacts:</p> <p>Residual impacts will be negligible after appropriate mitigation.</p>

<p>Nature: Impact 6 – Cumulative Impacts</p> <p>In the assessment of this project, a number of projects have been assessed by the report author within a 35km radius and or other sites were accessed during the course of travelling between the various projects. Of these potential projects, this report author has been involved in the initial EIA aquatic assessments or has managed / assisted with the WUL process for several of these projects.</p> <p>All of the projects have indicated that their intention with regard to mitigation, i.e. selecting the best possible routes /sites to minimise the local and regional impacts, or improving the drainage or hydrological conditions within these rivers the cumulative impact could be seen as a net benefit. However, the worse-case scenario has been assessed below, i.e. only the minimum of mitigation be implemented by the other projects such as stormwater management, and that flows within these systems are sporadic.</p>		
	<p>Overall impact of the proposed project considered in isolation</p>	<p>Cumulative impact of the project and other projects in the area</p>
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (1)	Low (2)
Probability	Probable (3)	Definite (5)
Significance	Low (18)	Medium (35)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes (high)	
<p>Mitigation:</p>		

- Improve the current stormwater and energy dissipation features not currently found along the tracks and roads within the region
- Install properly sized culverts with erosion protection measures at the present road / track crossings are already installed

Residual impacts:

Residual impacts will be negligible after appropriate mitigation.

9. Conclusion and Recommendations

In summary, the proposed layout for the facility would have no detrimental impact on the following:

- Any Very High sensitivity areas identified by the DEA Screening Tool
- Mainstem rivers and Pans that do contain functioning aquatic environments that received a High sensitivity rating as indicated in Figure 9.

Some impacts (panel areas & road crossings) are located in secondary alluvial water courses and minor drainage lines that were either fragmented or contained no riparian zones, with a Moderate sensitivity.

With the proposed mitigation (proper stormwater management and post construction rehabilitation), the impacts would be Low and acceptable for development, as these areas contained no aquatic habitat, and only functioned as a means to sustain / convey baseflows within the greater catchment. The proposed development would in essence not impact on this as surface runoff, although managed to prevent erosion, would still emanate from the site (when significant rainfall occurs), thus maintain this aspect of the hydrological system observed

Therefore, based on the results of this report, the significance of the remaining impacts assessed for the aquatic systems after mitigation would be LOW. This includes the internal roads proposed that would need to cross some of these systems. Thus, based on the findings of this study no objection to the authorisation of any of the proposed activities is made at this point based on the current layout as provided by the developer.

This report also indicates the watercourses and pans within 500m of the development area. Any activities within these areas, the buffers or 500m from the wetland boundary will require a Water Use license under Section 21 c and i of the National Water Act (Act 36 of 1998). As the proposed activities have the potential to create erosion, the following recommendations are reiterated:

- Vegetation clearing should occur in a phased manner in accordance with the construction programme 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, and suitable dust and erosion control mitigation measures should be included in the EMP to mitigate.
- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination / leaks outside of any delineated waterbodies and their buffers. Washing and cleaning of equipment should also be done in berms or bunds, to trap any cement / hazardous substances and prevent excessive soil erosion. Mechanical plant and bowsers must not be refuelled or serviced within or directly adjacent to any channel.
- It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas along aquatic features, using selected species detailed in this report.
- All alien plant re-growth must be monitored and should these alien plants reoccur these plants should be re-eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.
- It is further recommended that a comprehensive rehabilitation plan be implemented from the project onset within watercourse areas (including buffers) to ensure a net benefit to the aquatic environment. This should form part of the suggested walk down as part of the final EMP preparation preconstruction.

10. References

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Berliner D. and Desmet P. 2007. Eastern Cape Biodiversity Conservation Plan: Technical Report. Department of Water Affairs and Forestry Project No 2005-012, Pretoria. 1 August 2007.

Department of Water Affairs and Forestry - DWAF (2005). A practical field procedure for identification and delineation of wetland and riparian areas Edition 1. Department of Water Affairs and Forestry, Pretoria. Updated with amendments in 2007.

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Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), as amended.

National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

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Pool-Stanvliet, R., Duffell-Canham, A., Pence, G. & Smart, R. 2017. The Western Cape Biodiversity Spatial Plan Handbook. Stellenbosch: CapeNature.

12. Appendix 1 - Specialist CV

CURRICULUM VITAE

- **Dr Brian Michael Colloty**

- **7212215031083**

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Profession: Ecologist & Environmental Assessment Practitioner (Pr. Sci. Nat. 400268/07)

Member of the South African Wetland Society

Specialisation: Ecology and conservation importance rating of terrestrial habitats, wetlands, rivers & estuaries

Years experience: 25 years

SKILLS BASE AND CORE COMPETENCIES

- 25 years experience in environmental sensitivity and conservation assessment of aquatic and terrestrial systems inclusive of Index of Habitat Integrity (IHI), WET Tools, Riparian Vegetation Response Assessment Index (VEGRAI) for Reserve Determinations, estuarine and wetland delineation throughout Africa. Experience also includes biodiversity and ecological assessments with regard sensitive fauna and flora, within the marine, coastal and inland environments. Countries include Mozambique, Kenya, Namibia, Central African Republic, Zambia, Eritrea, Mauritius, Madagascar, Angola, Ghana, Guinea-Bissau and Sierra Leone. Current projects also span all nine provinces in South Africa.
- 15 years experience in the coordination and management of multi-disciplinary teams, such as specialist teams for small to large scale EIAs and environmental monitoring programmes, throughout Africa and inclusive of marine, coastal and inland systems. This includes project and budget management, specialist team management, client and stakeholder engagement and project reporting.
- GIS mapping and sensitivity analysis

TERTIARY EDUCATION

- 1994: B Sc Degree (Botany & Zoology) - NMU
- 1995: B Sc Hon (Zoology) - NMU
- 1996: M Sc (Botany - Rivers) - NMU
- 2000: Ph D (Botany – Estuaries & Mangroves) – NMU

EMPLOYMENT HISTORY

- 1996 – 2000 Researcher at Nelson Mandela University – SAB institute for Coastal Research & Management. Funded by the WRC to develop estuarine importance rating methods for South African Estuaries
- 2001 – January 2003 Training development officer AVK SA (reason for leaving – sought work back in the environmental field rather than engineering sector)
- February 2003- June 2005 Project manager & Ecologist for Strategic Environmental Focus (Pretoria) – (reason for leaving – sought work related more to experience in the coastal environment)
- July 2005 – June 2009 Principal Environmental Consultant Coastal & Environmental Services (reason for leaving – company restructuring)
- June 2009 – August 2018 Owner / Ecologist of Scherman Colloty & Associates cc
- August 2018 Owner / Ecologist - EnviroSci (Pty) Ltd

SELECTED RELEVANT PROJECT EXPERIENCE

World Bank IFC Standards

- Botswana South Africa 400kv transmission line (400km) biodiversity assessment on behalf of Aurecon - current
- Farim phosphate mine and port development, Guinea Bissau – biodiversity and estuarine assessment on behalf of Knight Piesold Canada – 2016.
- Tema LNG offshore pipeline EIA – marine and estuarine assessment for Quantum Power (2015).
- Colluli Potash South Boulder, Eritrea, SEIA marine baseline and hydrodynamic surveys co-ordinator and coastal vegetation specialist (coastal lagoon and marine) (on-going).
- Wetland, estuarine and riverine assessment for Addax Biofuels Sierra Leone, Makeni for Coastal & Environmental Services: 2009
- ESHIA Project manager and long-term marine monitoring phase coordinator with regards the dredge works required in Luanda bay, Angola. Monitoring included water quality and biological changes in the bay and at the offshore disposal outfall site, 2005-2011

South African

- Plant and animal search and rescue for the Karusa, Soetwater, Nxuba, Oyster Bay and Garob Wind Farms on behalf of Enel Green Power, 2018 - 2020
- Plant and Animal Search and Rescue for the Port of Ngqura, Transnet Landside infrastructure Project, with development and management of on site nursery (Current).
- Plant and Animal Search and Rescue for the Port of Ngqura, OTGC Tank Farm Project (2019)
- Plant search and rescue, for NMBM (Driftsands sewer, Glen Hurd Drive), Department of Social Development (Military veterans housing, Despatch) and Nxuba Wind Farm, - current
- Wetland specialist appointed to update the Eastern Cape Biodiversity Conservation Plan, for the Province on behalf of EOH CES appointment by SANBI – current. This includes updating the National Wetland Inventory for the province, submitting the new data to CSIR/SANBI.
- CDC IDZ Alien eradication plans for three renewable projects Coega Wind Farm, Sonop Wind Farm and Coega PV, on behalf of JG Afrika (2016 – 2017).
- Nelson Mandela Bay Municipality Baakens River Integrated Wetland Assessment (Inclusive of Rehabilitation and Monitoring Plans) for CEN IEM Unit - Current

- Rangers Biomass Gasification Project (Uitenhage), biodiversity and wetland assessment and wetland rehabilitation / monitoring plans for CEM IEM Unit – current.
- Gibson Bay Wind Farm implementation of the wetland management plan during the construction and operation of the wind farm (includes surface / groundwater as well wetland rehabilitation & monitoring plan) on behalf of Enel Green Power - current
- Gibson Bay Wind Farm 133kV Transmission Line wetland management plan during the construction of the transmission line (includes wetland rehabilitation & monitoring plan) on behalf of Eskom – 2016.
- Tsitsikamma Community Wind Farm implementation of the wetland management plan during the construction of the wind farm (includes surface / biomonitoring, as well wetland rehabilitation & monitoring plan) on behalf of Cennergi – completed May 2016.
- Alicedale bulk sewer pipeline for Cacadu District, wetland and water quality assessment, 2016
- Mogalakwena 33kv transmission line in the Limpopo Province, on behalf of Aurecon, 2016
- Cape St Francis WWTW expansion wetland and passive treatment system for the Kouga Municipality, 2015
- Macindane bulk water and sewer pipelines wetland and wetland rehabilitation plan 2015
- Eskom Prieska to Copperton 132kV transmission line aquatic assessment, Northern Cape on behalf of Savannah Environmental 2015.
- Joe Slovo sewer pipeline upgrade wetland assessment for Nelson Mandela Bay Municipality 2014
- Cape Recife Waste Water Treatment Works expansion and pipeline aquatic assessment for Nelson Mandela Bay Municipality 2013
- Pola park bulk sewer line upgrade aquatic assessment for Nelson Mandela Bay Municipality 2013
- Transnet Freight Rail – Swazi Rail Link (Current) wetland and ecological assessment on behalf of Aurecon for the proposed rail upgrade from Ermelo to Richards Bay
- Eskom Transmission wetland and ecological assessment for the proposed transmission line between Pietermaritzburg and Richards Bay on behalf of Aurecon (2012).
- Port Durnford Exxaro Sands biodiversity assessment for the proposed mineral sands mine on behalf of Exxaro (2009)
- Fairbreeze Mine Exxaro (Mtunzini) wetland assessment on behalf of Strategic Environmental Services (2007).
- Wetland assessment for Richards Bay Minerals (2013) – Zulti North haul road on behalf of RBM.
- Biodiversity and aquatic assessments for 125 renewable projects in the past 9 years in the Western, Eastern, Northern Cape, KwaZulu-Natal and Free State provinces. Clients included RES-SA, Red Cap, ACED Renewables, Mainstream Renewable, GDF Suez, Globeleq, ENEL, Abengoa amongst others. Particular aquatic sensitivity assessment and Water Use License Applications on behalf of Mainstream Renewable Energy (8 wind farms and 3 PV facilities.), Cennergi / Exxaro (2 Wind farms), WKN Wind current (2 wind farms & 2 PV facilities), ACED (6 wind farms) and Windlab (3 Wind farms) were also conducted. Several of these projects also required the assessment of the proposed transmission lines and switching stations, which were conducted on behalf of Eskom.
- Vegetation assessments on the Great Brak rivers for Department of Water and Sanitation, 2006 and the Gouritz Water Management Area (2014)
- Proposed FibreCo fibre optic cable vegetation assessment along the PE to George, George to Graaf Reinet, PE to Colesburg, and East London to Bloemfontein on behalf of SRK (2013-2015).