ENVIRONMENTAL IMPACT ASSESSMENT (BAR) FOR THE PROPOSED MCTAGGART'S PV3 PHOTOVOLTAIC FACILITY NEAR UPINGTON IN THE NORTHERN CAPE PROVINCE

AQUATIC IMPACT ASSESSMENT

FOR

MCTAGGART'S PV 3 (PTY) LTD

BY

EnviroSci (Pty) Ltd

Dr Brian Colloty

1 Rossini Rd
Pari Park
Port Elizabeth
6070

DATE

3 November 2019

REVISION 1

Executive Summary

McTAGGART'S PV3 (Pty) Ltd appointed EnviroSci (Pty) Ltd to conduct a review of the proposed facility and its potential impact on the aquatic environment while considering the findings of the terrestrial ecological assessment.

The study area (the respective farm portions affected by the development inclusive of a 500m buffer) is located 18 - 20 km south west 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 April 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. It should be noted that the aquatic sensitivity spatial data was provided to the applicant in order for them to develop an optimal layout to minimise the potential aquatic impacts before the compilation of this final impact assessment and should be read in conjunction with the Terrestrial Ecological Assessment.

The proposed development occurs within the D73F catchment associated with the Helbrandleegte and Helbrandkloofspruit systems located in the Nama Karoo ecoregion. These mainstem catchment systems are short tributaries of the Orange (Gariep) River (ca. 10 km from the development area), which were largely ephemeral alluvial systems. Overall, these watercourses are largely in a natural state, when compared to the associated Orange River reach which has modified floodplains and flows. Current impacts occur in localised areas within the development area and included the following:

- Erosion due small road crossings and tracks
- Sand wining / borrow pit operations; and
- Grazing.

Several impacts are also located downstream of the project area, particularly where the Helbrandleegte and Helbrandkloofspruit system join the Orange River. These impacts have resulted in fragmentation, i.e. lack of habitat continuity due to small dams / weirs at the confluence.

Several small depression / pan wetlands were located within the general area, and one pan (High Sensitivity) will affected by the development The National Wetland Inventory v5.2 spatial data, also indicated two other wetlands 2 km upstream of the study area but these were confirmed to be alluvial channels thus misidentified in that database.

In terms of the National Freshwater Ecosystems Priority Areas (NFEPA) assessment, all the systems within the catchment associated within the development have been assigned a condition score of AB (Nel *et al*. 2011), indicating that they are largely intact and perform an ecological function. However, the study area systems are ephemeral and only carried water for a short week long period in 2014, thus the observed development area systems don't support any wide riparian zones. The vegetation associated with these watercourses was thus between 0.5 m and 12 m wide were mostly terrestrial. The depression wetlands, including their catchments were 0.07 ha and 0.11 ha in size respectively and one of these would be affected by the layout or associated infrastructure.

Eighteen woody plant species were found associated with the riparian and pan systems within the study site. Although none of these were obligate or facultative river/wetland species, they do show a preference for areas exposed to runoff. Species within the development area were dominated by

Vachellia erioloba (Camel Thorn, Kameeldoring), *Vachellia haematoxylon* (Grey Camel Thorn), *Boscia foetida* (Stink Shepard's Tree) and *Euclea pseudebenus* (Ebony Tree), all protected under the National Forest Act.

Few grass or forbs species were successfully identified due to the prevailing dry conditions and the intensity of grazing observed.

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

During the ORASECOM (2011) assessment, the following additional species were also observed within the study area between sites OSAEH 26 17 and EFR 03 associated with the Orange River:

"Marginal Zone: Cobble and bedrock areas have a vibrant population of *Gomphostigma virgatum*. Other dominants however are *Salix mucronata, Phragmites australis, Cyperus marg inatus, Persecaria decipiens, P. lapathifolia and Cynodon dactylon*.

Lower Zone: Well wooded in places with *G. virgatum*, and *S. mucronata* mainly, but also with *Vachellia karroo* recruits. Areas which are open (mainly cobble/boulder) or dominated by non-woody vegetation (*P. australis, Crinum bulbispermum, C. marginatus, Persecaria* and *C. dactylon* mainly) make up the mosaic.

Upper Zone: The right bank (RB) has extensive open areas (cobble or boulder) with *Tamarix usneoides* mainly. Otherwise the zone is predominantly woody with common species on both banks but the left bank (LB) mainly being *T. usneoides*, Vachellia karoo, *Searsia pendulina, Ziziphus mucronata*. *Diospyros lycioides, Lycium hirsutum V. erioloba, Prosopis glandulosa* and *Prosopis velutina*). A single specimen of *Combretum erythrophyllum* was found."

The National Freshwater Ecosystems Priority Areas (NFEPA) (Nel *et al*., 2011), also 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 Upstream Fish FEPA, associated with the Orange River, although no permanent fish habitat occurs within the proposed development area based on site observations and the fragmentation mentioned above (dams).

The Present Ecological State scores (PES) for the main watercourses in the study area were rated B – largely natural within the study area, while the associated reach along the Orange River, located at the confluence of these main watercourse, but not in close proximity to the site was rated as follows (DWS, 2014 – where E = Critically Modified):

Subquaternary Catchment Number	Present Ecological State	Catchment Ecological Importance	Catchment Ecological Sensitivity
3151	E	Moderate	High

Although the Orange River reach associated with the study area systems was rated as having a poor ecological state, the surrounding catchments 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 2 as shown in the Northern Cape CBA map.

The pan / depressions received a PES score of B, and EIS score of Moderate, due to the high level of grazing / trampling impact on these systems by animals searching for shade or water.

The following direct impacts were thus assessed and include:

Impact 1: Loss of major riparian systems associated with the mainstem rivers Helbrandleegte and Helbrandkloofspruit through physical disturbance within the proposed road crossings

Impact 2: Loss of wetlands (pan)

Impact 3: Impact on minor drainage lines through physical disturbance

Impact 4: Impact on all riparian and wetland systems through the possible increase in surface water runoff on riparian form and function through hydrological changes

Impact 5: Increase in sedimentation and erosion

Impact 6: Risks on the aquatic environment due to water quality impacts

The proposed layout for the facility would seem to have no direct impact on the main stem (larger scale rivers e.g. Helbrandleegte River) and the aquatic environment, for the most part the McTaggarts PV3 layout has avoided the other significant watercourses, with a High sensitivity as indicated in Figure 7. The only exception being the central southern and north eastern corner sections, where PV panels will span these alluvial areas. Further, it has been assumed that only the panel footings will be placed within these areas, inclusive of 3-4 new internal road crossings. The only concern is the position of the proposed substation locality (within the alluvial water course buffer only), It is therefore recommended that these areas be avoided, which would also reduce the risk of not only habitat loss, but also water quality related issues, should any flows occur (substations units contain oils, that assist in air cooling). There is also a small pan identified as high sensitivity located in the western portion of the proposed McTaggarts PV3 site, however due to the size and the functionality of the pan, the pan is not considered to be significant.

Other impacts (road crossings) are located in the smaller drainage areas (moderate sensitivity), and with suitable mitigation (proper stormwater management and post construction rehabilitation), the impacts would be Low. Again this is also based on the consideration that in some areas, the PV panels will span these areas, however the footings will be located outside of the delineated 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 assuming the above recommendations be adhered to and these are dealt with during a detailed walkdown, conducted by any aquatic specialist, preconstruction. This, to ensure that the required footings within any sensitive areas are located in suitable areas (minimise damage of vegetation or are micro-sited to areas with impacts already existing) and that the substation is repositioned, while the PV panels avoid the pan.

Therefore, based on the site visit the significance of the remaining impacts assessed for the aquatic systems after mitigation and the recommendation above, the rating would be LOW. This includes the internal roads proposed that would need to cross some of these systems.

Any activities within the delineated watercourses and the associated buffer will require a Water Use license under Section 21 c and i of the National Water Act (Act 36 of 1998). Should any of the present road crossings need to be upgraded then the opportunity exists to improve the current state (lack of habitat continuity) for example by replacing pipe culverts with box culverts.

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. 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 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.
- 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.
- No transmission line towers, substations and construction camps must be placed within the delineated watercourses as well as their respective buffers without obtaining the required approvals from the relevant competent authority.

- 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 from part of the suggested walk down as part of the final EMP preparation.

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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, *et al*. 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 APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Section where this is addressed in the Aquatic Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page 9, 10 and Appendix 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 10
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1 & 2
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5, 6
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 5
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 4, 5, 6 and 9
g) an identification of any areas to be avoided, including buffers;	Section 5 and 6
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 9
k) any mitigation measures for inclusion in the EMPr;	Section 9
l) any conditions for inclusion in the environmental authorisation;	Section 8 and 9
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 9

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Section where this is addressed in the Aquatic Specialist Report
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Yes – This report also meets the DWS requirements in terms of GN 267 (40713) of March 2017

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:	DEA/EIA/
Date Received:	

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

Klip Punt PV 1 – Photovoltaic Solar Energy Facility and associated infrastructure near Upington, 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			
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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:

3 November 2019

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:…3 November 2019…………

Appendix 1 of this report contains a detailed CV

1. Introduction

McTaggarts PV3 (Pty) Ltd appointed EnviroSci (Pty) Ltd to conduct a review of the proposed facility and its potential impact on the aquatic environment while considering the findings of the terrestrial ecological assessment.

The development area is located 18km south west of Upington in the Northern Cape Province and this assessment included delineating any natural waterbodies within the study area 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 April 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. It should be noted that the aquatic sensitivity spatial data was provided to the applicant in order for them to develop an optimal layout to minimise the potential aquatic impacts before the compilation of this final impact assessment and should be read in conjunction with the Terrestrial Ecological Assessment.

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 2010 and 2018 in the area, this was not foreseen as a huge limiting factor. The level of investigation undertaken is sufficient to inform this 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.

For the purposes of this report it is assumed that any existing roads and tracks within the development area will be upgraded, while the new roads can avoid or span (Figure 1) the observed watercourses as far as possible. A further assumption is that water will be sourced from a licensed resource and not illegally abstracted from any surrounding watercourses, particularly if dust suppression is required.

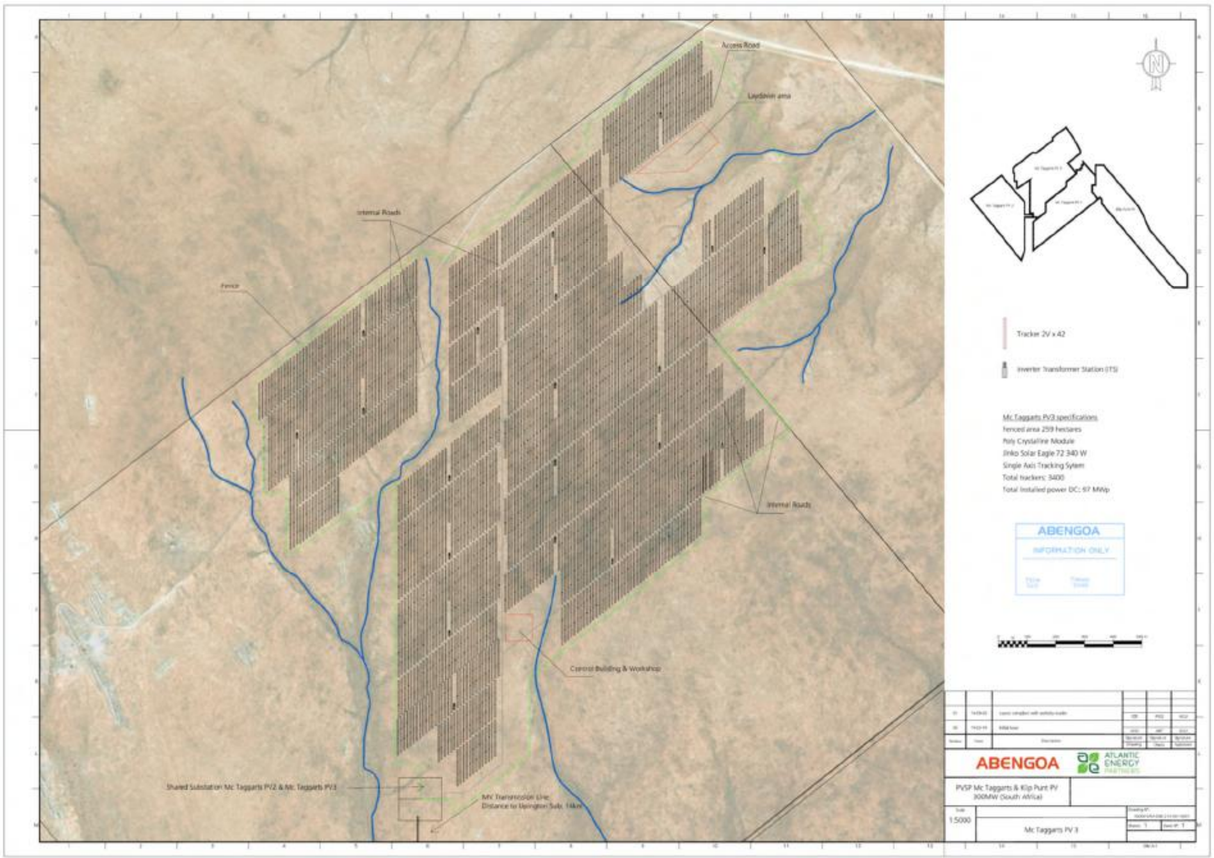

Figure 1: The proposed facility layout in relation to major water courses in the region.

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 the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- 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:
    - o 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:

McTaggarts PV3 (Pty) Ltd is proposing the development of a commercial solar PV facility and associated infrastructure within a study area located approximately 21km south-west of Upington within the Ka! Garib Local Municipality and the ZF Mgcawu District Municipality in the Northern Cape Province. The site borders the Dawid Kruiper Local Municipality.

A development area (located within the study area) with an extent of ~260ha has been identified by McTaggart's PV 3 (Pty) Ltd as a technically suitable site for the development of a solar PV facility with a contracted capacity of up to 75MW. The entire development area is located within Portion 3 of McTaggart's Camp No. 453 and Portion 12 of Klip Punt 452. The entire study area and development area are located within Focus Area 7 of the Renewable Energy Development Zones (REDZ), which is known as the Upington REDZ. Due to the location of the study area and development area within a REDZ, a Basic Assessment (BA) process will be undertaken in accordance with GN R114 as formally gazetted on 16 February 2018.

McTaggart's PV 3 is proposed to accommodate the following infrastructure, which will enable the solar PV facility to supply a contracted capacity of up to 75MW:

» Fixed-tilt or tracking solar PV panels with a maximum height of 3.5m;
» Centralised inverter stations or string inverters;
» A temporary laydown area;
» Cabling between the panels, to be laid underground where practical;
» A 22kV or 33kV/132kV on-site substation (within a larger substation complex) of up to 5 666m2 in extent to facilitate the connection between the solar PV facility and the electricity grid;
» An access road to the development area with a maximum width of 6m;
» Internal access roads within the PV panel array area with a maximum width of 5m; and
» Operation and Maintenance buildings including a gate house and security building, control centre, offices, warehouses, a workshop and visitors centre.

The power generated from the project will be sold to Eskom and will feed into the national electricity grid. Ultimately, the project is intended to be a part of the renewable energy projects portfolio for South Africa, as contemplated in the Integrated Resource Plan.

A separate basic assessment process will be undertaken for the grid connection infrastructure to connect McTaggart's PV 3 to the Upington Main Transmission Substation.

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-hierarchal 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.

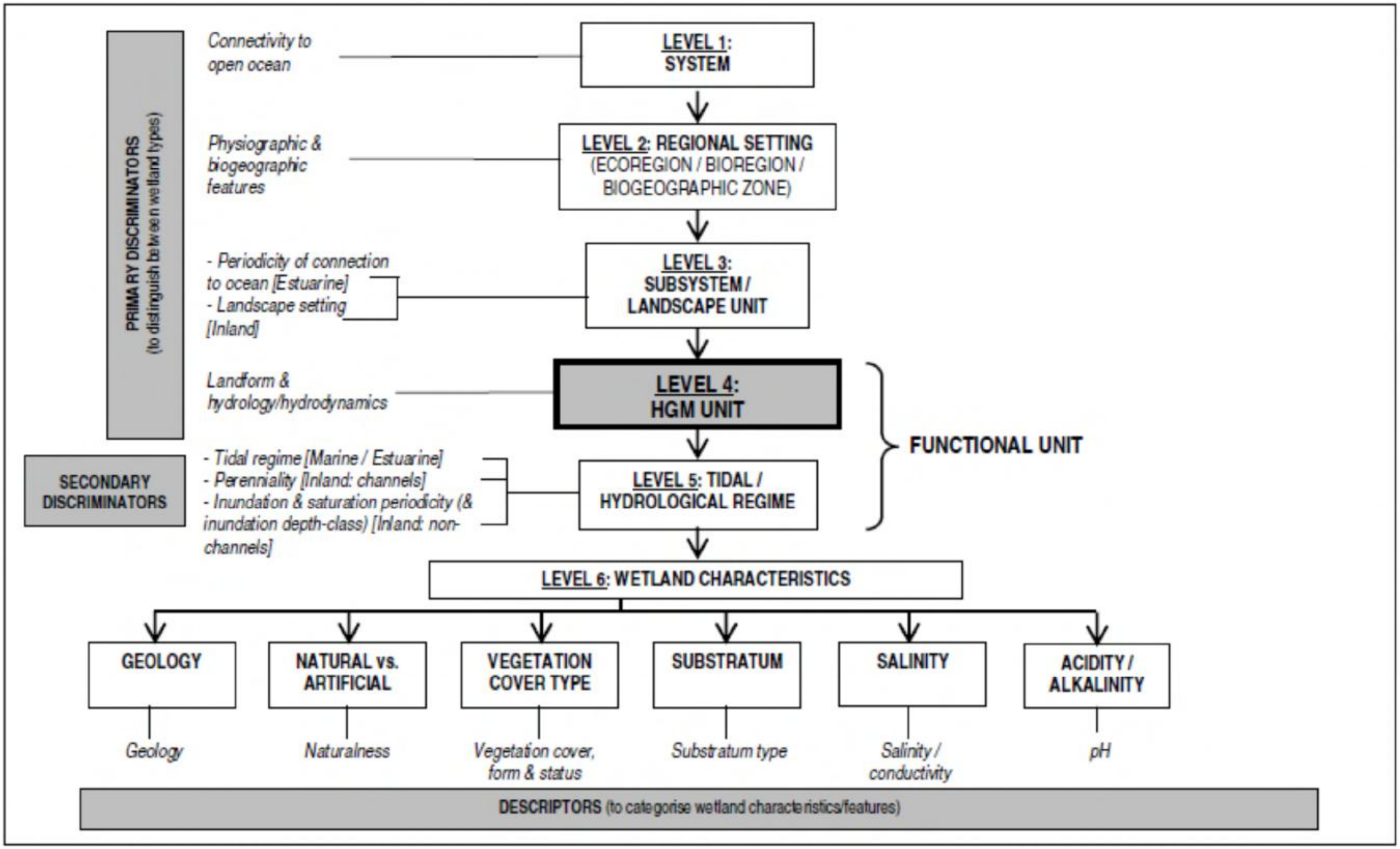

Figure 2: Basic structure of the NWCS, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics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

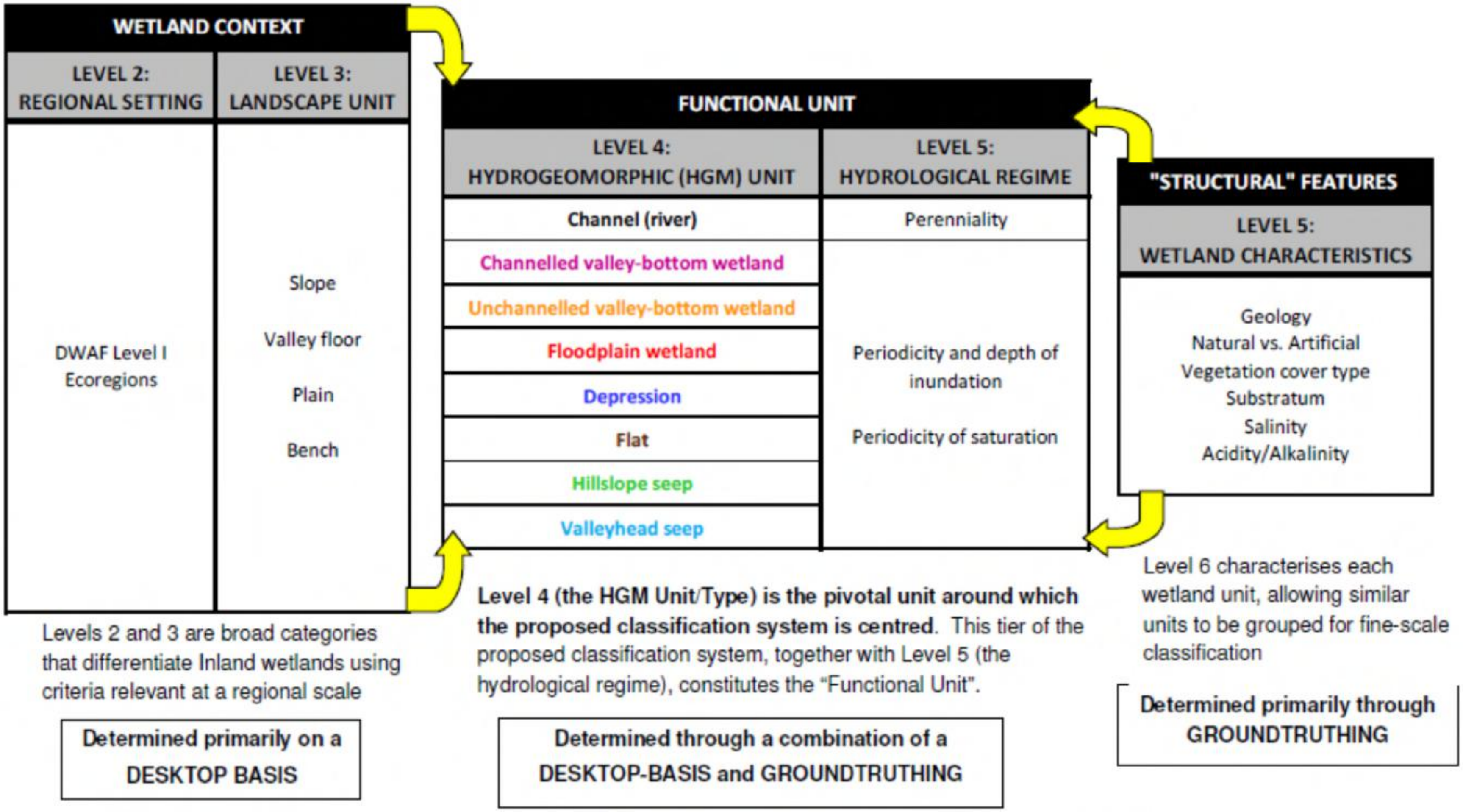

Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al.*, 2013).

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			*Provision of water for human use*
				Provision of harvestable resources[2]
				Provision of cultivated foods
				Cultural significance
				Tourism and recreation
				Education and research

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 buffers distances provided by the provincial authorities and as such the buffer model as described Macfarlane *et al*., 2017 wetlands, rivers and estuaries however the buffers provided by the terrestrial ecologist were utilised, which ranged between 20-30m and where thus greater than those provided by the above mentioned models which provide buffer distances of only 18m.

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 was assessed over a period of several years for various other proposals since 2010 onwards.

The study area (the respective farm portions affected by the development inclusive of a 500m buffer) is located 18 - 20 km south west 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 April 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. It should be noted that the aquatic sensitivity spatial data was provided to the applicant in order for them to develop an optimal layout to minimise the potential aquatic impacts before the compilation of this final impact assessment and should be read in conjunction with the Terrestrial Ecological Assessment.

The proposed development occurs within the D73F catchment associated with the Helbrandleegte and Helbrandkloofspruit systems located in the Nama Karoo ecoregion (Figure 4). These mainstem catchment systems are short tributaries of the Orange (Gariep) River (ca. 10 km from the development area), which were largely ephemeral alluvial systems. Overall, these watercourses are largely in a natural state, when compared to the associated Orange River reach which has modified floodplains and flows. Current impacts occur in localised areas within the development area and included the following:

- Erosion due small road crossings and tracks
- Sand wining / borrow pit operations; and
- Grazing.

Several impacts are also located downstream of the project area, particularly where the Helbrandleegte and Helbrandkloofspruit system join the Orange river. These impacts have resulted in fragmentation, i.e. lack of habitat continuity due to small dams / weirs at the confluence.

Several small depression / pan wetlands were located within the general area, and one pan (High Sensitivity) will affected by the development.v The National Wetland Inventory v5.2 spatial data, also indicated two other wetlands 2 km upstream of the study area but these were confirmed to be alluvial channels thus misidentified in that database (Figure 5).

In terms of the National Freshwater Ecosystems Priority Areas (NFEPA) assessment, all the systems within the catchment associated within the development have been assigned a condition score of AB (Nel *et al*. 2011), indicating that they are largely intact and perform an ecological function. However, the study area systems are ephemeral and only carried water for a short week long period in 2014, thus the observed development area systems don't support any wide riparian zones. The vegetation associated with these watercourses was thus between 0.5 m and 12 m wide were mostly terrestrial. The depression wetlands, including their catchments were 0.07 ha and 0.11 ha in size respectively and one of these would be affected by the layout or associated infrastructure.

Eighteen 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. Species within the study area were dominated by *Vachellia erioloba* (Camel Thorn, Kameeldoring), *Vachellia haematoxylon* (Grey Camel Thorn), *Boscia foetida* (Stink Shepard's Tree) and *Euclea pseudebenus* (Ebony Tree), all protected under the National Forest Act.

Few grass or forbs species were successfully identified due to the prevailing dry conditions and the intensity of grazing observed.

The only obligate wetland plants observed were those found in association with the man-made dams found at the confluence of the Helbrandkloofspruit and the Gariep River and along the Gariep 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.

During the ORASECOM (2011) assessment, the following additional species were also observed within the study area between sites OSAEH 26 17 and EFR 03 along the Orange River:

"Marginal Zone: Cobble and bedrock areas have a vibrant population of *Gomphostigma virgatum*. Other dominants however are *Salix mucronata, Phragmites australis, Cyperus marg inatus, Persecaria decipiens, P. lapathifolia and Cynodon dactylon*.

Lower Zone: Well wooded in places with *G. virgatum*, and *S. mucronata* mainly, but also with *Vachellia karroo* recruits. Areas which are open (mainly cobble/boulder) or dominated by non-woody vegetation (*P. australis, Crinum bulbispermum, C. marginatus, Persecaria* and *C. dactylon* mainly) make up the mosaic.

Upper Zone: The right bank (RB) has extensive open areas (cobble or boulder) with *Tamarix usneoides* mainly. Otherwise the zone is predominantly woody with common species on both banks but the left bank (LB) mainly being *T. usneoides*, Vachellia karoo, *Searsia pendulina, Ziziphus mucronata*. *Diospyros lycioides, Lycium hirsutum V. erioloba, Prosopis glandulosa* and *Prosopis velutina*). A single specimen of *Combretum erythrophyllum* was found."

The National Freshwater Ecosystems Priority Areas (NFEPA) (Nel *et al*., 2011), also 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 Upstream Fish FEPA (Figure 6), associated with the Orange River, although no permanent fish habitat occurs within the proposed development area based on site observations and the fragmentation mentioned above (dams).

This report also indicates the significant watercourses and wetlands within the study area. Any activities within these areas, and the buffers, will require a Water Use license under Section 21 c and i of the National Water Act (Act 36 of 1998) (Figure 7). No activities will occur within 500m of a wetland as the closest systems (pans) are 700m away.

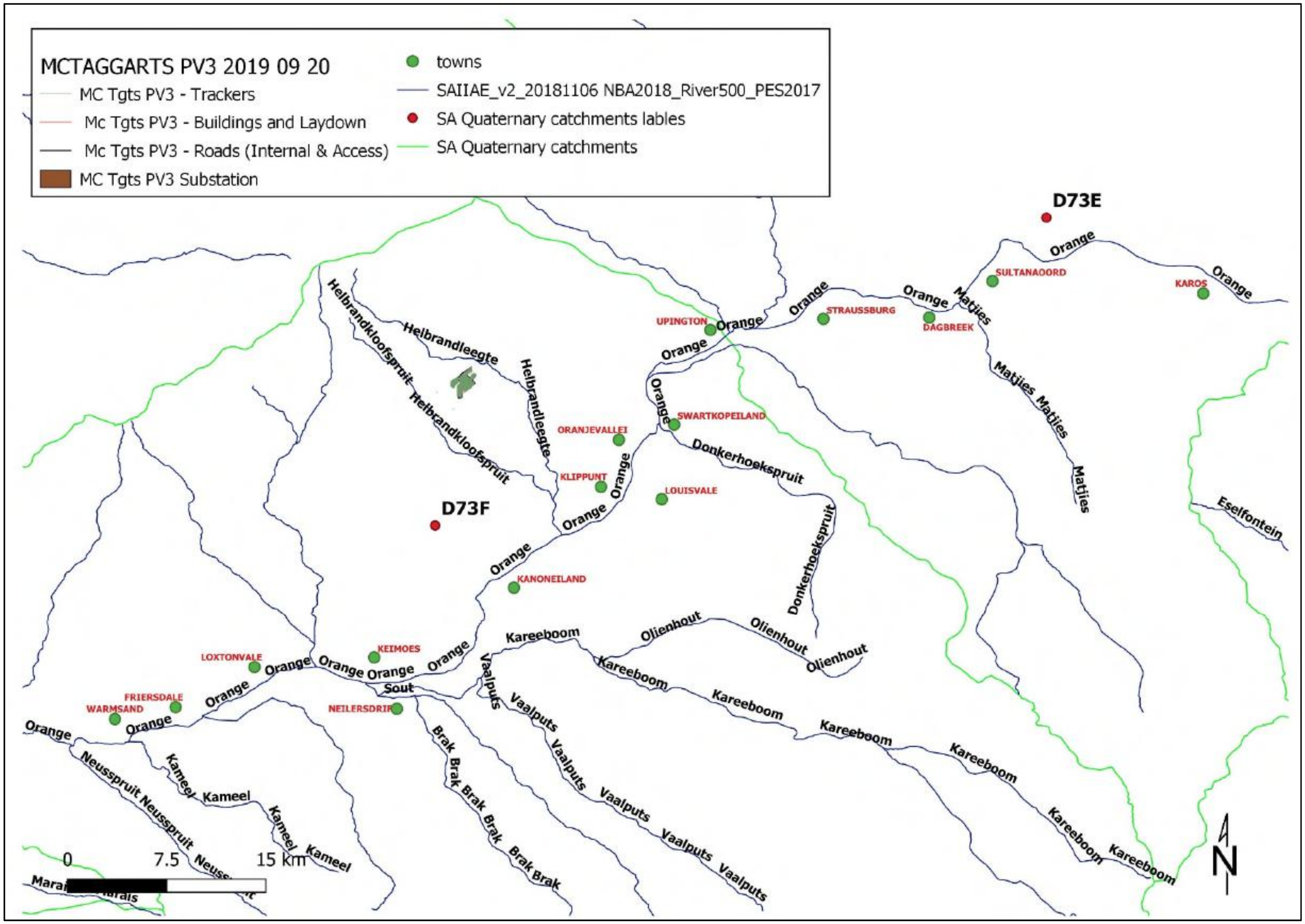

Figure 4: Project locality map indicating the various quaternary catchment boundaries (green line) in relation to the study area (Source DWS and NGI).

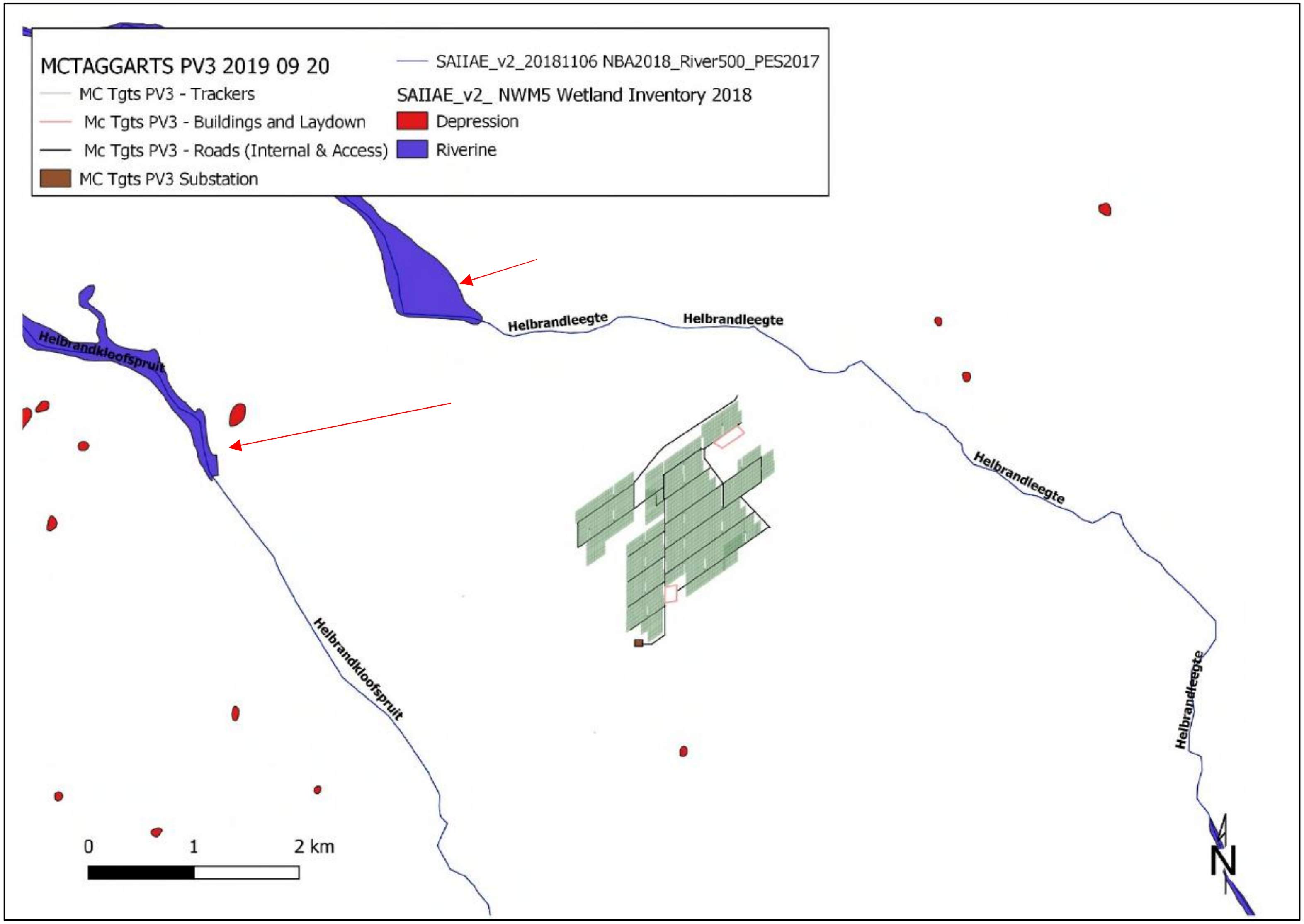

Figure 5: The various waterbodies near the study area identified in the National Wetland Inventory V5.2 (2018), and the two wetlands along the Helbrandleegte are sandbars not wetlands (red arrows)

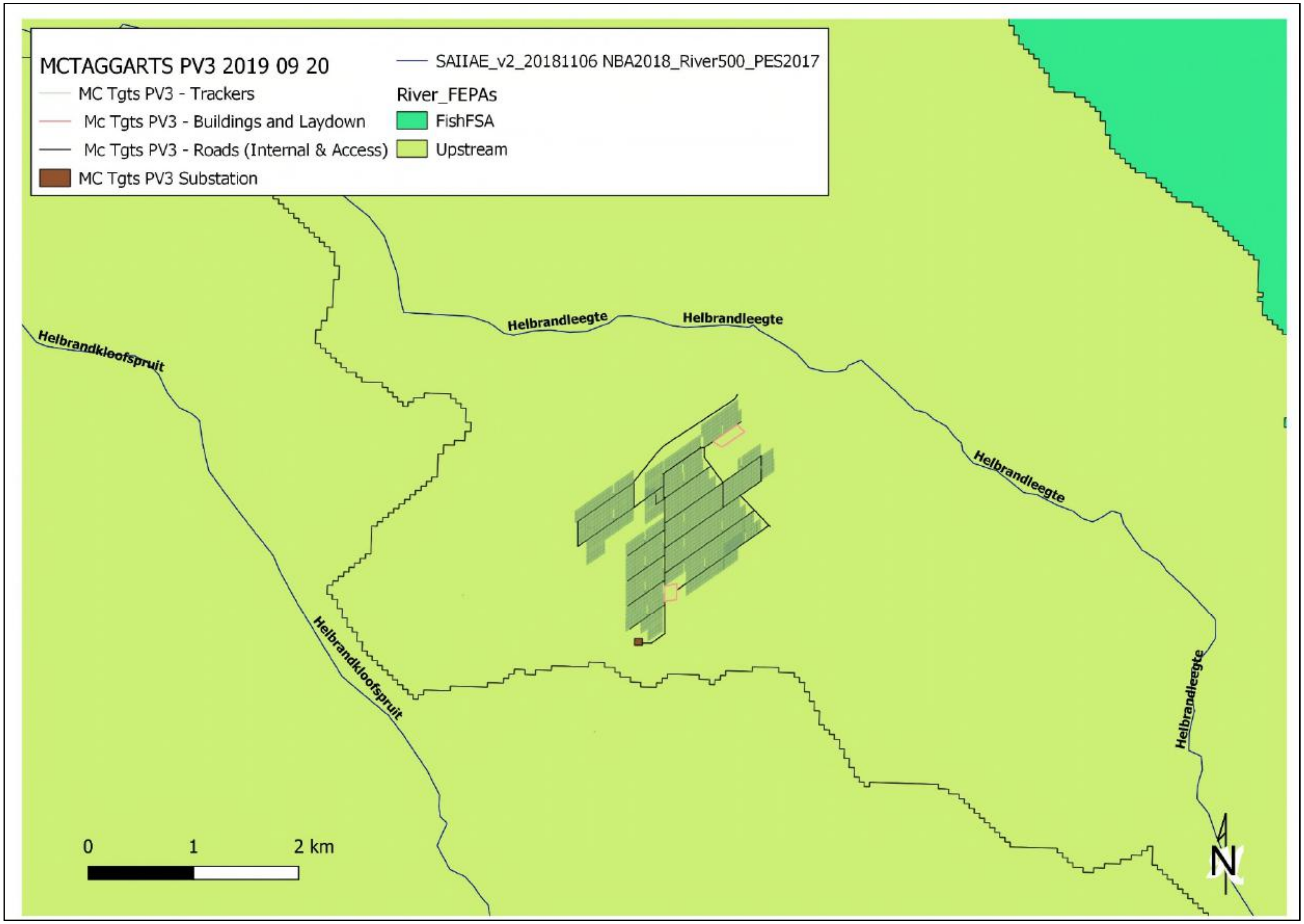

Figure 6: The respective Subquaternary catchments rated in terms of Freshwater Ecosystem Priority Areas (FEPAs) in relation to the study area

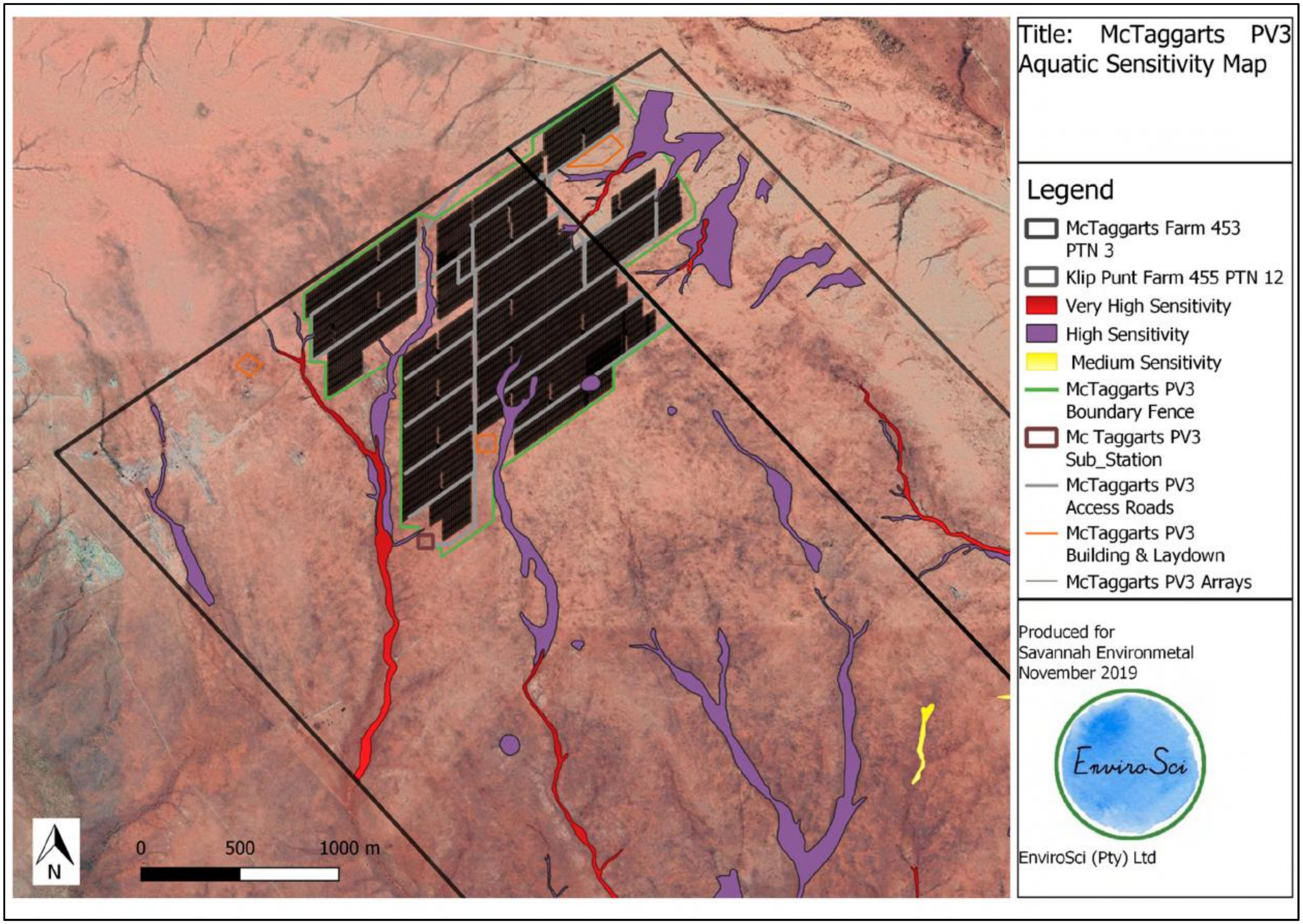

Figure 7: Wetlands and watercourses with buffers, within the study area in relation to the activities, respective sensitivity ratings and the 500m regulated WULA zone.

6. Present Ecological State and conservation importance

The Present Ecological State or 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 main watercourses in the study area were rated B – largely natural within the study area, while the associated reach along the Orange River but well outside of the study area was rated as follows (DWS, 2014 – where E = Critically Modified):

Subquaternary Catchment Number	Present Ecological State	Ecological Importance	Ecological Sensitivity
3151	E	Moderate	High

Although the Orange River reach associated with the study area systems was rated as having a poor ecological state, the surrounding catchments 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 2 as shown in the Northern Cape CBA map. (Figure 8).

The pan / depressions received a PES score of B, and EIS score of Moderate, due to the high level of grazing / trampling impact on these systems by animals searching for shade or water.

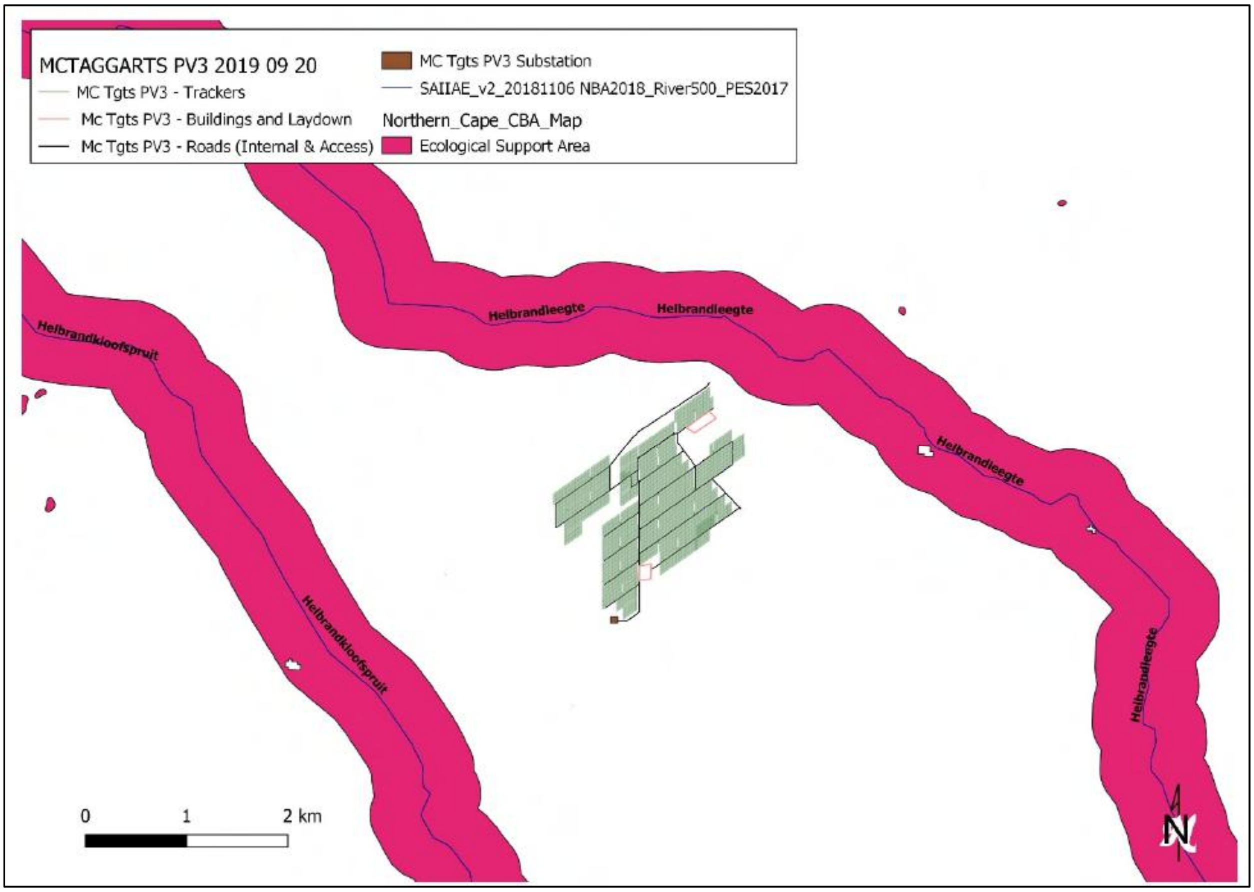

Figure 8: Critical Biodiversity Areas as per the Northern Cape Critical Biodiversity Areas Map.

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	Yes if not sourced from the local Water Board or a municipal supply.
S21(b)	Storing water	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.
S21(c)	Impeding or diverting the flow of water in a watercourse	Yes – several new crossings of watercourses will be required, as well as activities within 500m of a wetland boundary.
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 heated in, any industrial or power generation process	Not applicable

	Water Use Activity	Applicable to this development proposal
S21(i)	Altering the bed, banks, course or characteristics of a watercourse	Yes – several new crossings of watercourses will be required, as well as activities within 500m of a wetland boundary.
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 DETEMINE 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: Loss of major riparian systems associated with the mainstem rivers Helbrandleegte and Helbrandkloofspruit through physical disturbance within the proposed road crossings

Impact 2: Loss of wetlands (pan)

Impact 3: Impact on minor drainage lines through physical disturbance

Impact 4: Impact on all riparian and wetland systems through the possible increase in surface water runoff on riparian form and function through hydrological changes

Impact 5: Increase in sedimentation and erosion

Impact 6: Risks on the aquatic environment due to water quality impacts

Impact 7: Cumulative impacts

The impacts were assessed as follows:

Nature: Impact 1 - Loss of major riparian systems such as the mainstem rivers Helbrandleegte and Helbrandkloofspruit 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 Helbrandleegte and Helbrandkloofspruit 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 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

Mitigation:

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.

Additional general mitigations include:

- 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 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.

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 from part of the suggested walk down as part of the final EMP preparation.

Cumulative impacts:

None – no direct connection between this and other systems, such as the Orange River, exist.

Residual impacts:

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

Nature: Impact 2 - Loss of wetlands within the proposed development area

Physical removal or disturbance will be required for one of the observed pans. This very small pan has a localised catchment thus significant changes to its hydrology are anticipated. However, several larger and more intact systems are located within the region and these will be avoided thus this impact is considered acceptable.

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	High (8)
Probability	Definite (5)	Definite (5)
Significance	**High (65)**	**High (65)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated	Yes	

Mitigation:

The most significant form of mitigation would be avoid this system completely, however due to the spatial constraints of the development area, the size and functionality of the pan, as well as the avoidance of the larger more intact systems, this impact is considered acceptable provided the following mitigation measures are adhered to:

- Vegetation clearing should occur in 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, batching plants or areas and any stores should be located more than 50 m from any demarcated watercourses.
- 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.

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 from part of the suggested walk down as part of the final EMP preparation

Cumulative impacts:

None – no direct connection between this and other systems, such as the Orange River, exist.

Residual impacts:

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

Nature: Impact 3 - Impact on alluvial water courses (High 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. It is however recommended that the substation be reposition to avoid these area, to minimise any loss of these areas. 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 4 - 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 too.

Cumulative impacts:

Downstream alteration of hydrological regimes due to the increased run-off from the area.

Residual impacts:

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

Nature: Impact 5 - 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 Gariep River, although currently no direct connections with the Gariep 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 6 – 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. It is however recommended that the substation be reposition to avoid these area, to minimise any loss of these areas.

	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:

- Reposition the substation locality
- 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.
- 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.

Cumulative impacts:

None as no direct connection between the development area and Orange River remains

Residual impacts:

Residual impacts will be negligible after appropriate mitigation.

Nature: Impact 7 – Cumulative Impacts

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.

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.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
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)	

Mitigation: • 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

The proposed layout for the facility would seem to have no direct impact on the main stem (larger scale rivers e.g. Helbrandleegte River) and the aquatic environment, for the most part the McTaggarts PV3 layout has avoided the other significant watercourses, with a High sensitivity as indicated in Figure 7. The only exception being the central southern and north eastern corner sections, where PV panels will span these alluvial areas. Further, it has been assumed that only the panel footings will be placed within these areas, inclusive of 3-4 new internal road crossings. The only concern is the position of the proposed substation locality (within the alluvial water course buffer only), It is therefore recommended that these areas be avoided, which would also reduce the risk of not only habitat loss, but also water quality related issues, should any flows occur (substations units contain oils, that assist in air cooling). There is also a small pan identified as high sensitivity located in the western portion of the proposed McTaggarts PV3 site, however due to the size and the functionality of the pan, the pan is not considered to be significant.

Other impacts (road crossings) are located in the smaller drainage areas (moderate sensitivity), and with suitable mitigation (proper stormwater management and post construction rehabilitation), the impacts would be Low. Again this is also based on the consideration that in some areas, the PV panels will span these areas, however the footings will be located outside of the delineated 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 assuming the above recommendations be adhered to and these are dealt with during a detailed walkdown, conducted by any aquatic specialist, preconstruction. This, to ensure that the required footings within any sensitive areas are located in suitable areas (minimise damage of vegetation or are micro-sited to areas with impacts already existing) and that the substation is repositioned, while the PV panels avoid the pan.

Therefore, based on the site visit the significance of the remaining impacts assessed for the aquatic systems after mitigation and the recommendation above, the rating would be LOW. This includes the internal roads proposed that would need to cross some of these systems.

Any activities within the delineated watercourses and the associated buffer will require a Water Use license under Section 21 c and i of the National Water Act (Act 36 of 1998). Should any of the present road crossings need to be upgraded then the opportunity exists to improve the current state (lack of habitat continuity) for example by replacing pipe culverts with box culverts.

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

- Vegetation clearing should occur in 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. 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, batching plants or areas and any stores should located more than 50 m from any demarcated watercourses. as the only allowable features would be the PV panels area, that will span any of the observed watercourses, i.e. footings will be outside of these areas
- 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 development 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 of buffers) to ensure a net benefit to the aquatic environment. This should from part of the suggested walk down as part of the final EMP preparation.

10. References

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12. Appendix 1 - Specialist CV

CURRICULUM VITAE
Dr Brian Michael Colloty
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Profession: Ecologist & Environmental Assessment Practitioner (Pr. Sci. Nat. 400268/07 & EAPSA certified). Member of the South African Wetland Society
Specialisation: Ecology and conservation importance rating of inland habitats, wetlands, rivers & estuaries
Years experience: 21 years

SKILLS BASE AND CORE COMPETENCIES

- 21 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.
- 12 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) - NMMU
- 1995: B Sc Hon (Zoology) - NMMU
- 1996: M Sc (Botany - Rivers) - NMMU
- 2000: Ph D (Botany – Estuaries & Mangroves) – NMMU

EMPLOYMENT HISTORY

- 1996 – 2000 Researcher at Nelson Mandela Metropolitan University – SAB institute for Coastal Research & Management. Funded by the WRC.
- 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 – present Owner / Ecologist of Scherman Colloty & Associates cc

SELECTED RELEVANT PROJECT EXPERIENCE

World Bank IFC Standards

- Kenmare Mining Pilivilli, Mozambique - wetland (mangroves, peatlands and estuarine) assessment and biodiversity offset analysis - current
- 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 Biofeuls 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

- 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.

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- 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), 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 behlaf 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 for the Indwe 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 Exarro 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 85 renewable projects in the past four years in the Western, Eastern, Northern Cape, KwaZulu-Natal and Free State provinces. Clients included RES-SA, RedCap, 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 farm), 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 N2, PE to Cape Town, 2012 on behalf of SRK (2013).