PROPOSED MOGARA SOLAR DEVELOPMENT
NEAR KATHU, NORTHERN CAPE

SPECIALIST STUDY:
AQUATIC ASSESSMENT

Prepared for:

CapeEAPrac
George

On behalf of:
K2018091776 (SOUTH AFRICA) (Pty) Ltd

Prepared by:

Scherman Colloty & Associates
1 Rossini Rd
Pari Park
PORT ELIZABETH
6070

Scherman Colloty and Associates cc
Environmental and Aquatic Management Consulting
(CK 2009/112403/23)

October 2018

ACRONYMS

CEMP	Construction Environmental Management Plan
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation, previously DWA & DWAF.
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
GIS	Geographical Information Systems
NFEPA	National Freshwater Ecosystems Priority Areas according to Nel *et al*., 2012
NWA	National Water Act
PES	Present Ecological State
PV	Photovoltaic
RDM	Resource Directed Measures
REC	Recommended Ecological Category
SANBI	South African National Biodiversity Institute
SC&A	Scherman Colloty & Associates
SWMP	Storm Water Management Plan
VEGRAI	Riparian Vegetation Response Assessment Index (Kleynhans *et al*., 2007)
WUA	Water Use Authorisation
WULA	Water Use License Application

TABLE OF CONTENTS

1. INTRODUCTION 5
2. PROJECT DESCRIPTION 5
3 RELEVANT LEGISLATION AND POLICY 6
4. SPECIALIST DETAILS 8
5. APPROACH / METHODS... 9
5.1 Assumptions and limitations 11
6. DESCRIPTION OF THE AFFECTED ENVIRONMENT: REGIONAL, LOCAL AND SITE-SPECIFIC CONTEXT 12
6.1. The Regional Study Area 12
6.2. On-site data 16
6.2.1. Endorheic Pans 16
7. PRESENT ECOLOGICAL STATE, ECOLOGICAL IMPORTANCE AND SENSITIVITY 17
7. IMPACT ASSESSMENT 22
7.1 Impact 1: Impact on pans through the possible increase in surface water runoff on form and function 22
7.2 Impact 2: Increase in sedimentation and erosion 24
7.3 Impact 3: Physical disturbance by the supporting infrastructure (e.g. roads) on hydrological environment 25
8. CUMULATIVE IMPACTS 27
9. ENVIRONMENTAL MANAGEMENT PLAN MEASURES 29
10. CONCLUDING COMMENTS/IMPACT STATEMENT 31
11. REFERENCES 32
12. Appendix 1: Specialist CV 34
13. Appendix 2: Specialist Declaration..36
14. Appendix 3: Assessment methodology 38
15. Appendix 4: Results of the wetland buffer model 50
16. Appendix 5: DWS Risk Assessment Matrix for Section 21 c & i Water Uses 51

1. INTRODUCTION

K2018091776 (SOUTH AFRICA) (Pty) Ltd, an Independent Power Producer (IPP) is proposing to establish the Mogara Solar PV energy facility with associated infrastructure located on the Portion 1 and 2 of Farm Legoko 460. This is located within the Kuruman Regional District in the Gamagara Local Municipality in the John Taolo Mogara District Municipality, Northern Cape Province (Figure 1).

The facility will produce 75 MW, requiring ca. 220ha (The Preferred Site) of the 1921ha farms. An Environmental Impact Assessment (EIA) is thus being conducted for the facility, and the proponent has been advised that they may require a Water Use Authorisation (WUA).

2. PROJECT DESCRIPTION

<u>Extracted from the Project Technical Layout Report</u>

The **Mogara Solar** PV energy facility is to consist of solar photovoltaic (PV) technology with fixed, single or double axis tracking mounting structures, with a net generation (contracted) capacity of 75MWAC (MegaWatts - Alternating Current), as well as associated infrastructure, which will include:

- On-site switching-station / substation;
- Auxiliary buildings (gate-house and security, control centre, office, warehouse, canteen & visitors centre, staff lockers etc.);
- Inverter-stations, transformers and internal electrical reticulation (underground cabling);
- Access and internal road network;
- Laydown area;
- Overhead 132kV electrical transmission line / grid connection connecting to the authorised Sekgame switching station;
- Rainwater tanks; and
- Perimeter fencing and security infrastructure.

It is assumed for the purposes of this report that all the transmission line towers/pylons will be placed outside of any water courses (1:100-year floodline or outside of any defined pans or water courses, whichever is greater), where possible as this will be limited by the allowed transmission line servitudes within the region.

Water supplied for the construction phase will be obtained from the Gamagara Municipality via a Service Level Agreement (SLA) between them and the proponent. The estimated water consumption for the 18-month construction period is 8750m^3, which will then reduce to 4353m^3 per annum for the operational phase.

The project will not employ any on-site treatment or disposal for the sewage wastewater generated during the project's development phase. The generated quantities will differ significantly between the construction and operational phases of the development. The Gamagara Municipality has agreed to take responsibility for the treatment of sewage that will be generated and stored in on-site conservancy tanks and temporary chemical toilets. The wastewater will be treated at the Kathu Waste Water Treatment Works (WWTW).

According to the Gamagara Municipality this facility has sufficient capacity to deal with all the expected Waste Water quantities generated by the project based on the assumption that a maximum of $6750m^3$ will be required.

3 RELEVANT 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 the destruction or pollution by the following:

- Section 24 of The Constitution of the Republic of South Africa;
- 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 (No. 19 of 1974)
- National Forest Act (No. 84 of 1998)
- National Heritage Resources Act (No. 25 of 1999)

The following possible Section 21 Water Uses are anticipated, and would thus require a License or General Authorisation as deemed by the Department of Water and Sanitation:

- Section 21 a – Abstraction of water from boreholes and rivers or dams
- Section 21 b – Storage of water (dams or reservoirs)
- Section 21 c – Impeding or diverting flows when construction occurs within a water course or within 500 m of a wetland
- Section 21 g – Temporary storage of domestic waste in conservancy tanks
- Section 21 i – Alteration of the bed or banks of water course of any activities within 500m of a wetland

Figure 1: The study area and alternative site

4. SPECIALIST DETAILS

Dr. Brian Colloty has a PhD in wetland ecology and importance rating and has conducted wetland and riverine / estuarine assessments for projects throughout Africa. Brian has produced more than 200 wetland studies related to the renewable energy industry in the last 10 years, part of which includes the production of GIS related sensitivity maps and site-specific Environmental Management Plan (EMP) recommendations with regard construction and operational phases of developments. Brian has also been involved in the auditing / monitoring of 10 Wind Farms and 4 PV facilities in the past 5 years, which included management of the Water Use License conditions and / or Plant Search and Rescue operations.

A detailed CV and Specialist Declaration Form are contained in Appendix 1 and 2 respectively.

5. APPROACH / METHODS

The study area is known as an arid rainfall area consisting of dry river beds with little or no flows, while clusters of endorheic pans also occur. Thus, the following approach was followed for the aquatic assessment based on a two day site visit conducted in November 2015 (Summer):

- An assessment of the study area, that covers a 500m development buffer in relation to available information on the aquatic systems within the study area. This includes the site boundary and the associated transmission line.
- A map, demarcating the relevant local drainage areas and catchments of the respective streams and wetlands and other wetland areas within a 500m radius of the study area. This will demonstrate, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the zone of influence.
- Mapping data that demarcates aquatic and wetland vegetation units delineated to a scale of 1:10 000, following the methodology described by the DWS, together with a classification of delineated wetland areas, according to the methods contained in the Level 1 WET-Health methodology and the latest Wetland Classification System (Ollis *et al.*, 2013) after a site visit has been conducted.
- The site visit information presented in the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of any waterbodies, estimating their biodiversity, conservation and ecosystem function importance with regard ecosystem services.
- Recommend buffer zones and No-go areas around any delineated aquatic vegetation areas based on the buffer model as described in Macfarlane *et al*., 2017 for rivers and wetlands respectively.
- Provide mitigations regarding project related impacts, including engineering services that could negatively affect demarcated aquatic vegetation units.
- Recommend specific actions that could enhance the aquatic functioning in the areas, allowing the potential for a positive contribution by the project.
- Supply the client with geo-referenced GIS shape files of the waterbodies as per the required specifications supplied.

A detailed assessment methodology is contained in Appendix 3

Where relevant, recommendations and instructions regarding any additional authorisation, permitting or licensing procedures, or any other requirements pertaining to legislation and policies relevant to the Specialist's field of interest have also been included.

Furthermore, the following checklist as per the NEMA specialist assessment requirements was also adhered to:

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Aquatic Report**
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	**Page 8 and Appendix 1 & 2of this report**
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Appendix 2 of this report**
(c) an indication of the scope of, and the purpose for which, the report was prepared;	**Section 5 of this report**
(A) an indication of the quality and age of base data used for the specialist report;	**Yes – data included ranged from 2015 to present which is also been incorporated into the National SANBI database as report author is the Provincial liaison for this project, which forms part of the National Biodiversity Assessment due 2018**
(B) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	**Yes Section 6**
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**Yes Section 6**
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	**Yes – See Appendix 3**
(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 alternative;	**Yes – See Section 6**
(g) an identification of any areas to be avoided, including buffers;	**Yes – See Section 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;	**Yes – See Section 6**
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**Yes – Section 5 of this report**
(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;	**Yes – Section 6-10 of this report**
(k) any mitigation measures for inclusion in the EMPr;	**Yes – Section 7-9**
(l) any conditions for inclusion in the environmental authorisation;	**Yes – 7-10**
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**Yes – 9**
(n) a reasoned opinion— i. as to whether the proposed activity, activities or portions thereof should be authorised; ii. Regarding the acceptability of the proposed activity or activities; and	**Yes – Section 10 of this report**

iii. 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 or Environmental Authorization, and where applicable, the closure plan;	
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**N/A**
(p) any other information requested by the competent authority	**N/A**
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**

5.1 Assumptions and limitations

To obtain a comprehensive understanding of the dynamics of both the flora and fauna of both 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. However, due to time constraints these long-term studies are not feasible and are mostly based on instantaneous sampling. However, due to the nature of the wetlands observed that have catchments that are easily identified, this was not required, i.e. the inundation zone is clearly visible.

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

A last assumption is that water required for the various phases of the project will be sourced from a licensed resource and not illegally abstracted from any surrounding water courses, particularly if dust suppression is required.

6. DESCRIPTION OF THE AFFECTED ENVIRONMENT: REGIONAL, LOCAL AND SITE-SPECIFIC CONTEXT

6.1. The Regional Study Area

The study area is located within the D41J Subquaternary Catchment of the Ga-Mogara River (Figure 2) a tributary of the Kuruman River, located within the Molopo River Catchment. The study area however showed no evidence of any water courses or drainage lines that occurred within the site (Figure 2). However, the National Wetland Inventory (ver 5.2) (SANBI) does indicate several endorheic pans within the study area and close to the preferred alternatives (Figure 3).

The landscape is characterised by large plains covered by bushveld. The surrounding land use and consequent state of the surrounding vegetation is largely determined by the agricultural practices within the study area, which is dominated by cattle production.

The pans are typical of this flat landscape where runoff accumulates in these depressions (Plate 1). The depressions have formed through the dissolution of the underlying limestone creating these endorheic systems (i.e. inflow but no visible surface outflow) and are thus karst (lime) related systems (Plate 2). This was confirmed by the soil specialist that indicated that large areas within the study area were covered by hard pan carbonates.

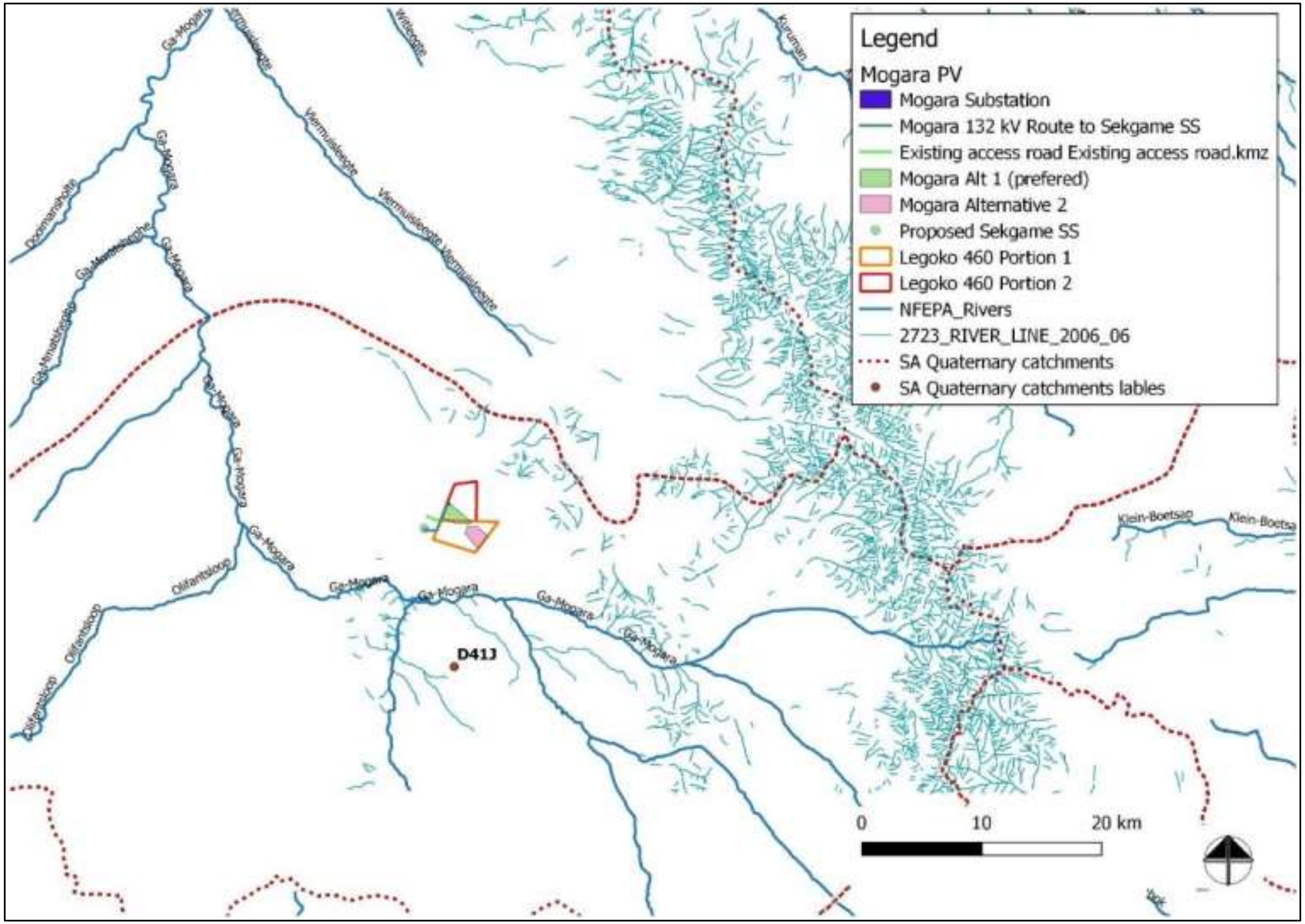

Figure 2: The study area in relation with the Quaternary Catchments and the main stem rivers (Source: DWS & NFEPA)

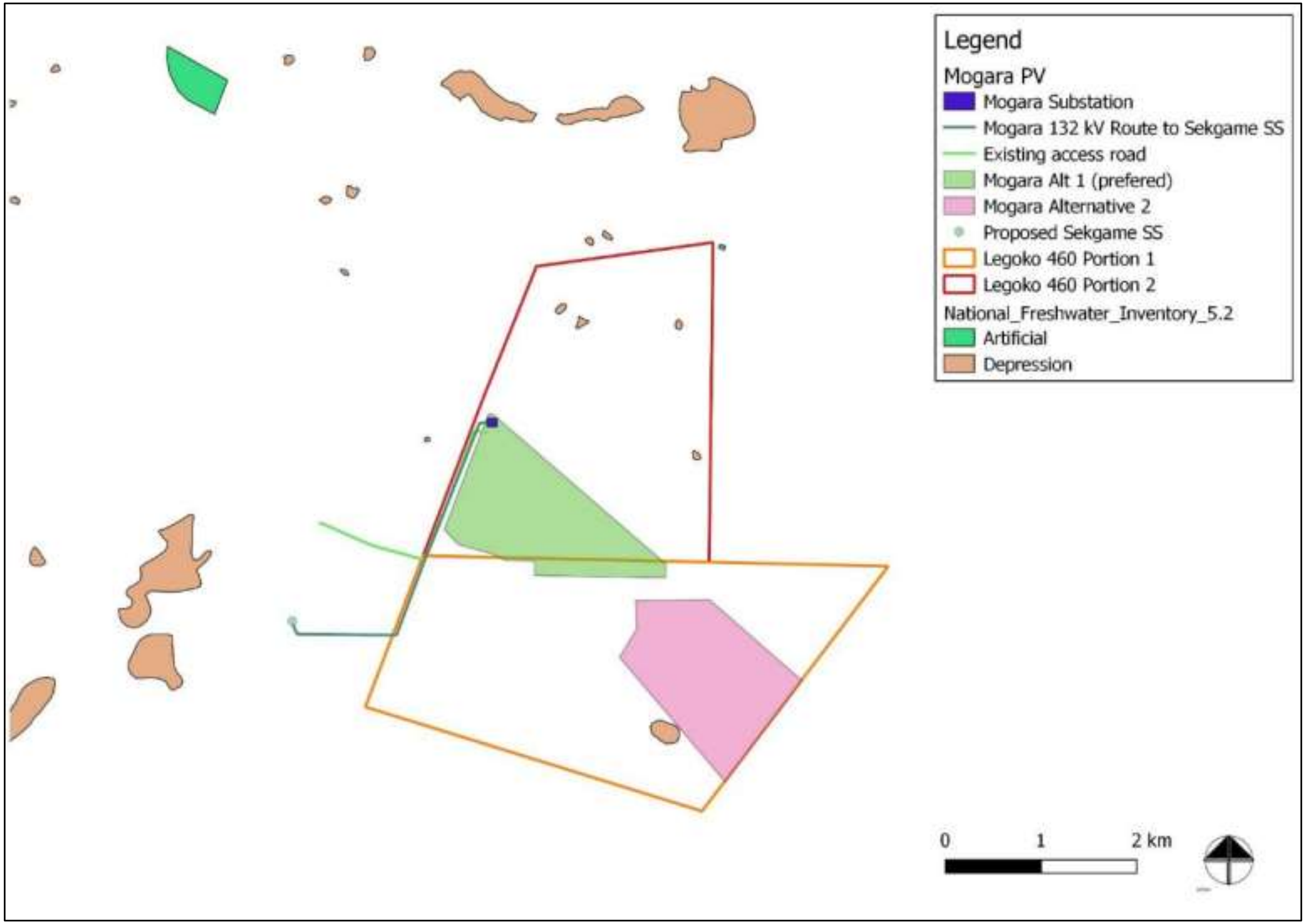

Figure 3: The study area and project components in relation to wetlands and water courses described in National Wetland Inventory v5.2 2018 (SANBI/CSIR)

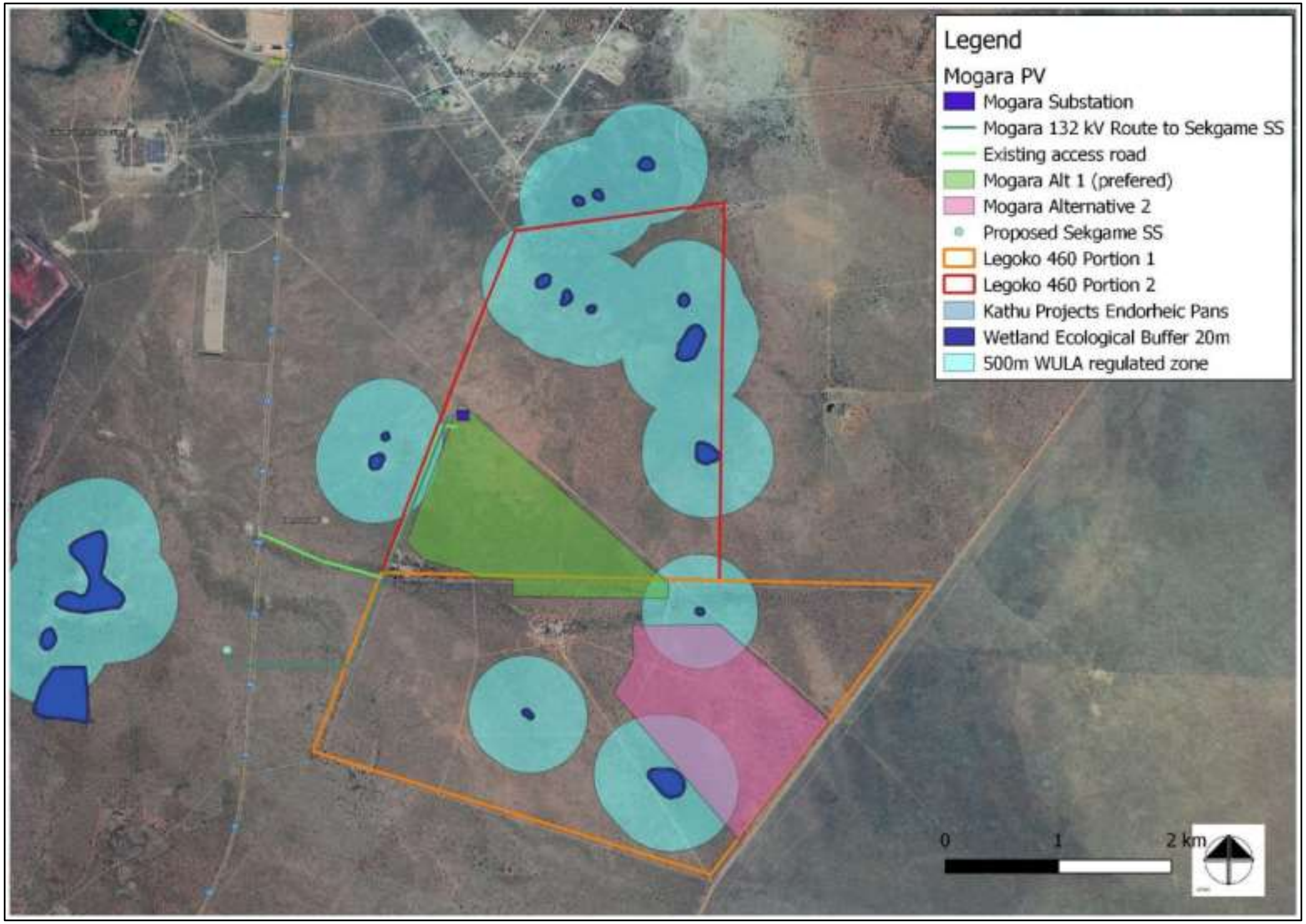

Figure 4: The observed and delineated wetlands observed within the study area with calculated buffers

6.2. On-site data

6.2.1. Endorheic Pans

No flow or surface water was observed during the surveys, particularly within any water courses or drainage lines as none of these features were found present. This assessment is therefore based on a broad evaluation of the natural vegetation found within the region and at the site in relation to the wetlands observed and delineated (Figure 4). The pans, a form of wetland, are ephemeral for long periods, even years, at a time. Surface runoff will thus accumulate for short periods after heavy rainfalls, and then either evaporate or percolate into the surrounding ground water systems. No instream or aquatic vegetation was observed in these systems and species were similar to those observed in the surrounding systems.

Using the buffer model as described by Macfarlane *et al*., 2017 for wetlands, based on the condition of the waterbodies, the state of the study area, coupled to the type of development, as well as the proposed mitigations, the buffer model provided the following (See Figure 4 and 5 and Appendix 4 for details on calculations):

Construction period buffer:	20m
Operation period:	20m
Final:	**20m**

Notably none of the proposed development (PV panels, planned access roads or the transmission line alignments) falls within the wetlands or is located within the 20m no-go ecological buffer (Figure 4 & 5).

Some of the layout areas occur within the 500m regulated zone however, as this does not preclude any development, the project only requires a Water Use License (potentially a General Authorisation – See Appendix 5).

7. PRESENT ECOLOGICAL STATE, ECOLOGICAL IMPORTANCE AND SENSITIVITY

In the compilation of this report, several sensitive areas within and adjacent to the study area were identified. From an aquatic systems point of view most of these were associated with the endorheic pans (Figure 4), noting that three of these have been transformed when converted into farm dams or borrow pits.

However, two sites representative of these systems within the study area were identified and rated to assess the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the affected systems. Although the PES / EIS was assessed using the VEGRAI 3 models, this was only based on the riparian vegetation component as no instream biota, flows or water quality could be used in the Index for Habitat Integrity due to the extreme ephemeral nature of these systems. The description and scores for each of the sites is presented below, while the overall sensitivity of the systems based on the representative sites assessed below is shown in Figure 5. The only systems that received a Low sensitivity assessment were the three pans that had been transformed (Figure 5):

PES Site 1– 27.78194S; 23.23.09297E (DD.dddd WGS84)

Plate 1: A small pan located in the northern portion of the study area. Note the encroaching vegetation in the foreground

The PES assessment was conducted although no instream vegetation was observed, with the pan colonised by typical grass and shrub species from the region. In the Level 3 Riparian Vegetation Response Assessment Index (VEGRAI, Kleynhans *et al*. 2007), PES scoring system (see table below), the non-marginal woody vegetation thus dominated the overall PES score (B/C = Near Natural / Moderately Modified). The score was lowered due to the presence of grazing, trampling and encroachment by the surrounding shrubs.

The EIS of this system, which is representative of all the pans found throughout the site, was rated as Moderate (importance), however due to type and uniqueness within these systems the **Sensitivity would be rated as High** (= Red areas in Figure 5). The likelihood and significance of this impact is assessed in detail in the impact assessment of this report. The EIS score could have been higher but due to the lack of aquatic habitat, grazing and the presence encroaching vegetation the score was reduced.

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	100,0	66,7	3,0	2,0	2,0
NON MARGINAL	73,3	24,4	3,0	1,0	1,0
	2,0				3,0
LEVEL 3 VEGRAI (%)				76.5	
VEGRAI EC				**B/C**	
AVERAGE CONFIDENCE				3,0	

PES Site 2 – 27.787757S 23.104954 (DD.dddd WGS84)

Plate 2: One of the larger pans showing located in to the east of the study area

PES Site 2 was situated south of PES Site 1 within a larger pan. No marginal or instream vegetation or other associated aquatic biota have been observed in this system due to its ephemeral nature. The PES score (See Level 3 VEGRAI assessment results below) was B = Near Natural, but this was due to additional impacts such as existing tracks, livestock tracks and grazing that have affected this system.

The EIS of this system, which is representative of all the pans found throughout the site was rated as Moderate (importance), however due to type and uniqueness within these systems the **Sensitivity would be rated as High** (= Red areas in Figure 5). The likelihood and significance of this impact is assessed in detail in the impact assessment of this report. The EIS score could have been higher but due to the lack of aquatic habitat, grazing, and the presence encroaching vegetation, the score was reduced.

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	100,0	66,7	3.5	1,0	1,0
NON MARGINAL	60,0	20,0	3.5	2,0	2,0
	2,0				3,0
LEVEL 3 VEGRAI (%)				85.8	
VEGRAI EC				**B**	
AVERAGE CONFIDENCE				2,8	

The respective EIS ratings of HIGH were further substantiated by the rating of theses same systems as Ecological Support Areas, which also relate to wetlands by the recent Northern Cape Critical Biodiversity Areas map (Holness & Oosthuysen, 2016), shown in Figure 6.

NOTE NC CBA wetlands were based on Wetland Inventory v5.1 delineations, which have been accurately delineated in this assessment based on field work

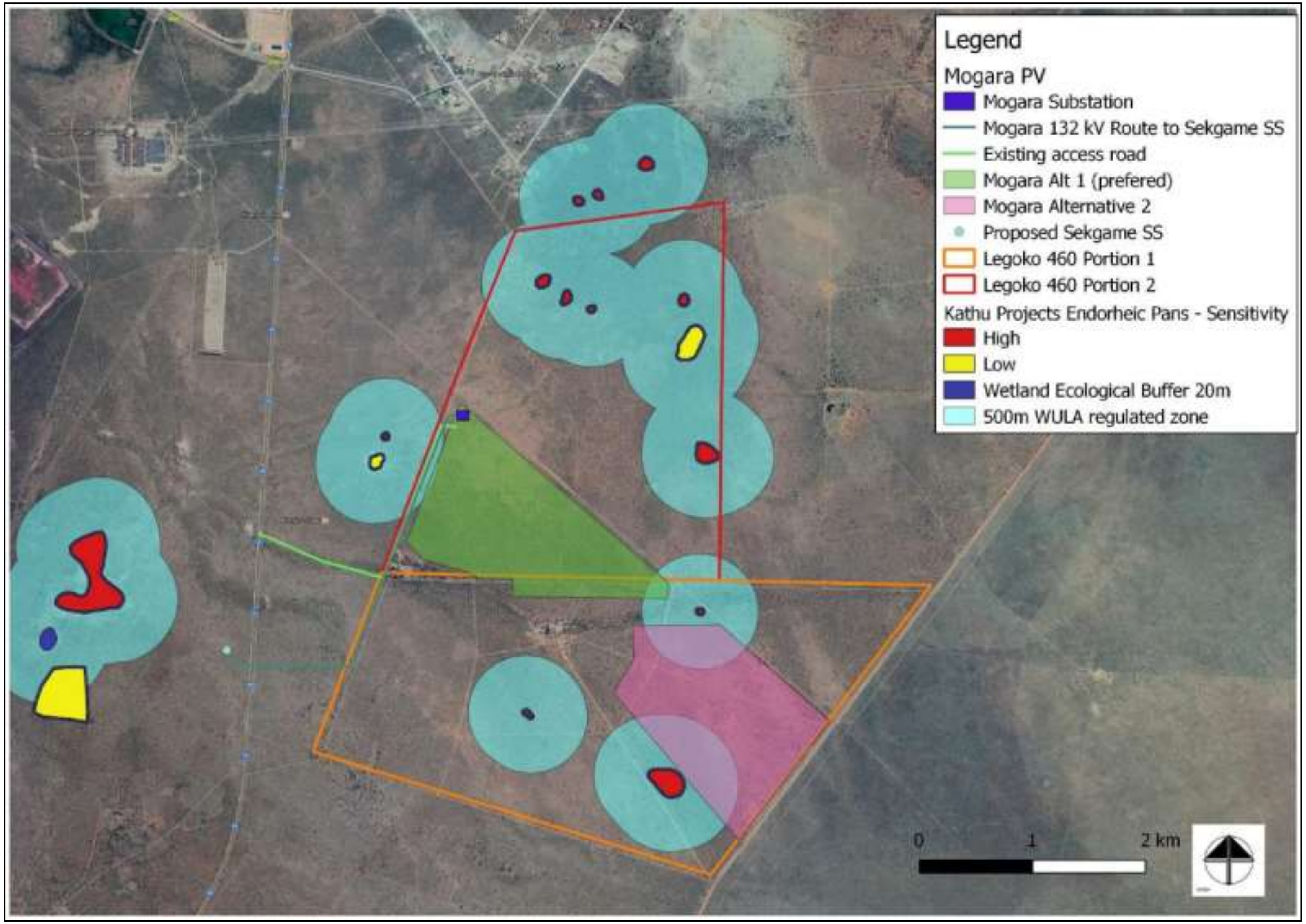

Figure 5: Overall sensitivity rating for the various aquatic systems. Note the 20m no-go buffer is also indicated.

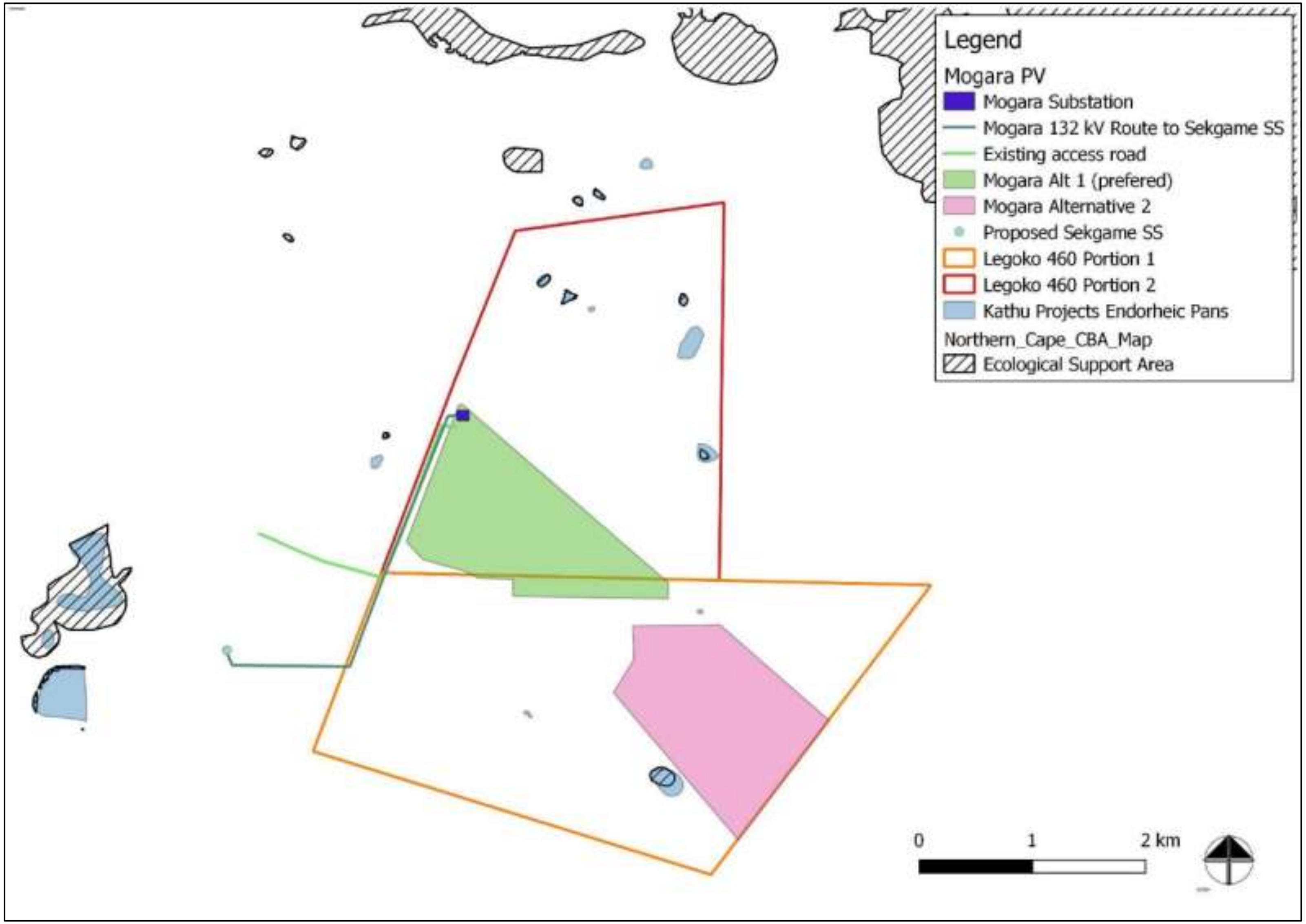

Figure 6: Critical Biodiversity Area ESA map for the Northern Cape (Holness & Oosthuysen, 2016)

7. IMPACT ASSESSMENT

During the impact assessment study, a number of potential key issues / impacts were identified. Note the loss of wetlands (pans) was not assessed as the proposed sites (preferred) would seem to have no direct impact on these systems or their catchments. Also, no structures would be placed within the 20m buffer proposed for the pans (Figure 4 & 5).

However, the proposed project could affect these systems through changes in the hydrological environment by the introduction of hard surfaces. Therefore, the following impacts were assessed:

7.1 Impact 1: Impact on pans through the possible increase in surface water runoff on form and function

The physical removal or the clearing of natural vegetation could 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 (panel arrays), as a large portion of the remaining farm and the catchment would remain intact.

Mitigation:
Any stormwater within the site 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

Cumulative impacts:
The increase in surface run-off velocities and the reduction in the potential for groundwater infiltration is likely to occur, however considering that the site is not near any drainage channels and the annual rainfall is low, this impact is not anticipated. It is however assumed, together with the low mean annual run-off that with suitable stormwater management the impacts could however be mitigated, coupled to the fact that a low percentage of projects actually move into the construction phase.

Residual impacts:
Diversion of run-off away from downstream systems is unlikely to occur as the annual rainfall figures are low and no natural drainage features or water courses are located within the study area.

Impact Significance = Slight Negative

Rapid Impact Assessment Matrix (RIAM)

Group A (Condition criteria)

Extent (A1)		
A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect.		
National / International interests	4	1
Regional / National interests	3	
Areas immediately outside the local condition	2	
Important only to the local condition	1	
No importance	0	
Magnitude of change / effect (A2)		
Magnitude is defined as a measure of the scale of benefit/dis-benefit of an impact or a condition.		
Major positive benefit	3	-1
Significant improvement in status quo	2	
Improvement in status quo	1	
No change / Status quo	0	
Negative change to status quo	-1	
Significant negative dis-benefit or change	-2	
Major dis-benefit or change	-3	
Group A Score:		-1

Group B (Situation criteria)

Duration / Permanence (B1)		
This defines whether a condition is temporary or permanent, and should be seen only as a measure of the temporal status of the condition.(e.g.: an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).		
No change / Not Applicable	1	3
Temporary	2	
Permanent	3	
Reversibility (B2)		
This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence. (e.g.: an accidental toxic spillage into a river is a temporary condition (B1) but its effect (death of fish) is irreversible (B2); a town's sewage treatment works is a permanent condition (B1), the effect of its effluent can be changed (reversible condition) (B2))		
No change / Not Applicable	1	2
Reversible	2	
Irriversible	3	
Cumulative (B3)		
This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a permanent /irreversible situation.		
No change / Not Applicable	1	2
Non-cumulative / single	2	

Cumulative / synergistic	3	
Group B Score:		7
Final Assessment score		**-7**

7.2 Impact 2: Increase in sedimentation and erosion

Increase in sedimentation and erosion within the development footprint

Mitigation:
Any stormwater within the site must be handled in a suitable manner and install stilling basins to capture large volumes of run-off, trap sediments and reduce flow velocities (e.g. water used when washing the mirrors).

Cumulative impacts:
Additional downstream erosion and sedimentation of systems lower in the catchment although unlikely due to lack of any water courses.

Residual impacts:
Additional downstream erosion and sedimentation of systems lower in the catchment although unlikely due to lack of any water courses.

Impact Significance = Slight Negative

Rapid Impact Assessment Matrix (RIAM)
Group A (Condition criteria)

Extent (A1)		
A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect.		
National / International interests	4	1
Regional / National interests	3	
Areas immediately outside the local condition	2	
Important only to the local condition	1	
No importance	0	
Magnitude of change / effect (A2)		
Magnitude is defined as a measure of the scale of benefit/dis-benefit of an impact or a condition.		
Major positive benefit	3	-1
Significant improvement in status quo	2	
Improvement in status quo	1	
No change / Status quo	0	
Negative change to status quo	-1	
Significant negative dis-benefit or change	-2	
Major dis-benefit or change	-3	
Group A Score:		-1

Group B (Situation criteria)

Duration / Permanence (B1)		

This defines whether a condition is temporary or permanent, and should be seen only as a measure of the temporal status of the condition.(e.g.: an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).		
No change / Not Applicable	1	3
Temporary	2	
Permanent	3	
Reversibility (B2)		
This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence. (e.g.: an accidental toxic spillage into a river is a temporary condition (B1) but its effect (death of fish) is irreversible (B2); a town's sewage treatment works is a permanent condition (B1), the effect of its effluent can be changed (reversible condition) (B2))		
No change / Not Applicable	1	2
Reversible	2	
Irreversible	3	
Cumulative (B3)		
This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a permanent /irreversible situation.		
No change / Not Applicable	1	2
Non-cumulative / single	2	
Cumulative / synergistic	3	
Group B Score:		7
Final Assessment score		**-7**

7.3 Impact 3: Physical disturbance by the supporting infrastructure (e.g. roads) on hydrological environment

Physical disturbance by the supporting infrastructure (roads & transmission lines) on the aquatic environment although none occur or could be avoided / spanned

Mitigation:
The proposed layout has been developed to avoid any wetlands. Care should however be taken when any clearing is done, that this area is monitored for plant re-growth, firstly to prevent alien plant infestations and to ensure no erosion or scour takes place.

Cumulative impacts:
Additional downstream erosion and sedimentation of systems lower in the catchment although unlikely due to lack of any water courses.

Residual impacts:
Additional downstream erosion and sedimentation of systems lower in the catchment although unlikely due to lack of any water courses.

Impact Significance = Slight Negative

Rapid Impact Assessment Matrix (RIAM)

Group A (Condition criteria)

Extent (A1)		
A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect.		
National / International interests	4	1
Regional / National interests	3	
Areas immediately outside the local condition	2	
Important only to the local condition	1	
No importance	0	
Magnitude of change / effect (A2)		
Magnitude is defined as a measure of the scale of benefit/dis-benefit of an impact or a condition.		
Major positive benefit	3	-1
Significant improvement in status quo	2	
Improvement in status quo	1	
No change / Status quo	0	
Negative change to status quo	-1	
Significant negative dis-benefit or change	-2	
Major dis-benefit or change	-3	
Group A Score:		-1

Group B (Situation criteria)

Duration / Permanence (B1)		
This defines whether a condition is temporary or permanent, and should be seen only as a measure of the temporal status of the condition.(e.g.: an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).		
No change / Not Applicable	1	3
Temporary	2	
Permanent	3	
Reversibility (B2)		
This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence. (e.g.: an accidental toxic spillage into a river is a temporary condition (B1) but its effect (death of fish) is irreversible (B2); a town's sewage treatment works is a permanent condition (B1), the effect of its effluent can be changed (reversible condition) (B2))		
No change / Not Applicable	1	2
Reversible	2	
Irreversible	3	
Cumulative (B3)		
This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a permanent /irreversible situation.		
No change / Not Applicable	1	2

Non-cumulative / single	2	
Cumulative / synergistic	3	
Group B Score:		7
Final Assessment score		**-7**

8. CUMULATIVE IMPACTS

In the assessment of this project, the surrounding projects within a 35km radius of the site were assessed. From an aquatic environment standpoint, these projects don't share any of the same direct subquaternary catchment and thus the other projects are too far removed.

Presently, no significant cumulative impacts with regard to the Preferred Alternative were identified as these are also located outside of the delineated aquatic systems and their buffers for the proposed site.

Impact Significance = Slight to None

Rapid Impact Assessment Matrix (RIAM)

Group A (Condition criteria)

Extent (A1)		
A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect.		
National / International interests	4	1
Regional / National interests	3	
Areas immediately outside the local condition	2	
Important only to the local condition	1	
No importance	0	
Magnitude of change / effect (A2)		
Magnitude is defined as a measure of the scale of benefit/dis-benefit of an impact or a condition.		
Major positive benefit	3	-1
Significant improvement in status quo	2	
Improvement in status quo	1	
No change / Status quo	0	
Negative change to status quo	-1	
Significant negative dis-benefit or change	-2	
Major dis-benefit or change	-3	
Group A Score:		-1

Group B (Situation criteria)

Duration / Permanence (B1)		
This defines whether a condition is temporary or permanent, and should be seen only as a measure of the temporal status of the condition.(e.g.: an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).		
No change / Not Applicable	1	3
Temporary	2	

Permanent	3	
Reversibility (B2)		
This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence. (e.g.: an accidental toxic spillage into a river is a temporary condition (B1) but its effect (death of fish) is irreversible (B2); a town's sewage treatment works is a permanent condition (B1), the effect of its effluent can be changed (reversible condition) (B2))		
No change / Not Applicable	1	2
Reversible	2	
Irreversible	3	
Cumulative (B3)		
This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a permanent /irreversible situation.		
No change / Not Applicable	1	2
Non-cumulative / single	2	
Cumulative / synergistic	3	
Group B Score:		7
Final Assessment score		**-7**

9. ENVIRONMENTAL MANAGEMENT PLAN MEASURES

Project component/s	Site selection with regard minimising the overall impact on the functioning of the aquatic environment
Potential impact	Loss of important habitat
Activity risk source	Placement of hard engineered surfaces (PV plants)
Mitigation: Target / Objective	Select a favourable site, having the least impact or within an area that is least sensitive, i.e. not within wetlands and their buffers.
Mitigation: Action/control	Minimise the loss of aquatic habitat – physical removal and replacement by hard surfaces by avoiding as many of the sensitive (High) pans as possible as is shown in Figure 5
Responsibility	Developer
Timeframe	Planning and design phase
Performance indicator	N/A
Monitoring	N/A

Project component/s	Alteration of sandy substrata into hard surfaces impacting on the local hydrological regime
Potential impact	Poor stormwater management and the alteration hydrological regime
Activity risk source	Placement of hard engineered surfaces
Mitigation: Target / Objective	Any stormwater within the site will be handled in a suitable manner, i.e. clean and dirty water streams around the plant and install stilling basins to capture large volumes of run-off, trapping sediments and reduce flow velocities.
Mitigation: Action/control	Reduce the potential increase in surface flow velocities and the impact on aquatic systems
Responsibility	Developer / Operator
Timeframe	Planning, design and operation phase
Performance indicator	Water quality and quantity management - "Water Use Licence Conditions"
Monitoring	Surface water monitoring plan that ensures no erosion takes place

Project component/s	The use of chemicals and hazardous substances during construction and operation
Potential impact	These pollutants could be harmful to aquatic biota, particularly during low flows when dilution is reduced. Lime-containing (high pH) construction materials such as concrete, cement, grouts, etc., deserve a special mention, as they are highly toxic to fish and other aquatic biota. If dry cement powder or wet uncured concrete comes into contact with surface run-off or river water, these compounds can elevate the pH to lethal levels. Thus extreme care should be taken when these hazardous compounds are used near water. For fish, pH levels of over 10 are considered toxic.
Activity risk source	Accidental spillage of harmful materials and/ or hydrocarbons used during the construction process.
Mitigation: Target / Objective	Management actions that are applicable to all the construction sites include: • Strict use and management of all hazardous materials used on site. Considering the extremely low likelihood of surface flows, it is advised that construction activities are suspended until such contaminants are removed from the site if surface flows are observed at or adjacent to the selected site area. • Strict management of potential sources of pollution (hydrocarbons from vehicles and machinery, cement during construction, etc.). • Strict control over the behaviour of construction workers. • All areas adjacent to the hard-engineered erosion-control structures provided for this project, which are (accidently) disturbed during the construction activities, should to be rehabilitated using appropriate indigenous vegetation.
Mitigation: Action/control	Minimise the potential impact of pollutants entering the pans
Responsibility	Developer / Operator
Timeframe	Planning, design and operation phase
Performance indicator	Water quality and quantity management - "Water Use Licence Conditions"
Monitoring	Surface water monitoring plan

10. CONCLUDING COMMENTS/IMPACT STATEMENT

With suitable mitigation and avoidance of the pans (incl of the 20m no-go buffer), the development should have no direct impact on the overall status of the aquatic systems and within the study area.

No protected or species of special concern (aquatic flora) were observed within the aquatic areas during the site visit thus the development poses no risk to any such species. Therefore, based on the site visits the significance of the impacts on the aquatic environment within the study area would be **SLIGHT**.

When considering any other potential projects within the adjacent / nearby farms the potential for changes to the surrounding aquatic habitat would not be significant especially during the operational phases (hard surfaces and stormwater management). It is however assumed that any such changes would be detrimental to the various projects owners, i.e. erode areas around mirrors. This coupled with the low mean annual run-off and with suitable stormwater management, the impacts could however be mitigated. The likelihood of any cumulative impacts listed in this report is especially low when considering that only a low percentage of projects will actually move into the construction phase.

Figure 4 indicates the various water use regulated zones within the study area as required by legislation. A WULA in terms of Section 21 c and i of the National Water Act will be required should any construction take place within any these areas i.e., any development within 500m of a wetland boundary. The attached Risk Assessment Matrix indicated based on the assumptions in this report that all the impacts would be **LOW** (Appendix 5), thus a General Authorisation could apply.

11. REFERENCES

Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998.

Agricultural Resources Act, 1983 (Act No. 43 of 1983).

Batchelor, A. (2009). Wetland Riparian delineation and sensitivity analysis for the proposed Eskom powerline Honingklip 88kV, Muldersdrift Wetland Consulting Services (Pty) Ltd for KV 3 Engineers

Davies, B. and Day J., (1998). Vanishing Waters. University of Cape Town Press.

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

Department of Water Affairs and Forestry - DWAF (2007). Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types by M. Rountree (ed); C.P. Todd, C. J. Kleynhans, A. L. Batchelor, M. D. Louw, D. Kotze, D. Walters, S. Schroeder, P. Illgner, M. Uys. and G.C. Marneweck. Report no. N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

Duthie, A. (1999) Section E: Procedure for the Intermediate Determination of RDM for Wetland Ecosystesm, Oryx Environmental on behalf of the Department of Water Affairs and Forestry 10 September 1999

Ewart-Smith J.L., Ollis D.J., Day J.A. and Malan H.L. (2006). National Wetland Inventory: Development of a Wetland Classification System for South Africa. WRC Report No. KV 174/06. Water Research Commission, Pretoria.

Germishuizen, G. and Meyer, N.L. (eds) (2003). Plants of southern Africa: an annotated checklist. Strelitzia 14, South African National Biodiversity Institute, Pretoria.

Holness, S & Oosthuysen, E. 2016. Northern Cape Critical Biodiversity Area map, SANBI BGIS.

Jacobson, P.J., Jacobson, K.M. & Seely, M.K. (1995). Ephemeral Rivers and their catchments. Desert Research Foundation of Namibia, Windhoek.

Kleynhans C.J., Thirion C. and Moolman J. (2005). A Level 1 Ecoregion Classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

Kleynhans CJ, Mackenzie J, Louw MD. 2007. Module F: Riparian Vegetation Response Assessment Index in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N. (2008). WET-EcoServices A technique for rapidly assessing ecosystem services supplied by wetlands. WRC Report No: TT 339/08.

Louw, M D. (2010). Work package 5: Assessment of Environmental Flow Requirements. Deliverable 10: Resource Unit delineation. Draft Report prepared for ORASECOM, July 2010.

Macfarlane, D.M. & Bredin, I.P. 2017. Buffer Zone Guidelines for Rivers, Wetlands and Estuaries Buffer Zone Guidelines for Rivers, Wetlands and Estuaries. WRC Report No TT 715/1/17 Water Research Commission, Pretoria.

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

Mitsch, J.G. and Gosselink, G. (2000). Wetlands 3rd End, Wiley, New York, 2000, 920 pg.

Mucina, L. & Rutherford, M.C. (2006). South African vegetation map. South African National Biodiversity Institute – Accessed: http:// bgis.sanbi.org/vegmap/map.asp, 15 September 2010.

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

National Water Act, 1998 (Act No. 36 of 1998), as amended

Nel, J., Maree, G., Roux, D., Moolman, J., Kleynhans, N., Silberbauer, M. and Driver, A. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 2: River Component. CSIR Report Number ENV-S-I-2004-063. Council for Scientific and Industrial Research, Stellenbosch.

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

Parsons R. (2004). Surface Water – Groundwater Interaction in a Southern African Context. WRC Report TT 218/03, Pretoria.

Ramsar Convention, (1971) including the Wetland Conservation Programme (DEAT) and the National Wetland Rehabilitation Initiative (DEAT, 2000).

SANBI (2009). Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report. Prepared by the Freshwater Consulting Group (FCG) for the South African National Biodiversity Institute (SANBI).

SANBI (2012). National Wetland Inventory of the South African National Biodiversity Institute (SANBI). www.bgis.sanbi.org/wetmap/map.asp, 12 March 2012.

Thomas, D.S.G. (1997). Arid zone geomorphology: Section 1 Arid environments, their nature and extent, 2nd edition. Ed. D.S.G. Thomas, Wiley England.

12. Appendix 1: Specialist CV

CURRICULUM VITAE
Dr Brian Michael Colloty
7212215031083

1 Rossini Rd
Pari Park
Port Elizabeth, 6070
brian@itsnet.co.za
083 498 3299

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.

Dr Brian Colloty 1

- 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).

Dr Brian Colloty 2

13. Appendix 2: Specialist Declaration

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Mogara Solar

Specialist:	Scherman Colloty and Associates		
Contact person:	Dr Brian Colloty		
Postal address:	1 Rossini Rd Pari Park PE		
Postal code:	6070	Cell:	0834983299
Telephone:	0413662077	Fax:	-
E-mail:	Brian@itsnet.co.za		
Professional affiliation(s) (if any)	SACNASP Ecology 4000268/07 Member of the SA Wetland Society		

Project Consultant:	CapeEA Prac		
Contact person:	Dale Holder		
Postal address:	PO Box 2070, George		
Postal code:	6530	Cell:	-
Telephone:	044 874 0365	Fax:	-
E-mail:	dale@cape-eaprac.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Brian Colloty, declare that --

General declaration:

- 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]

Signature of the specialist:

Scherman Colloty and Associates

Name of company (if applicable):

29/06/2018

Date:

14. Appendix 3: Assessment methodology

The assessment was initiated with a survey of the pertinent literature, past reports and the various conservation plans that exist for the study region. Maps and Geographical Information Systems (GIS) were then employed to ascertain, which portions of the proposed development, could have the greatest impact on the wetlands and associated habitats.

Site visits were conducted to ground-truth the above findings, thus allowing critical comment of the development when assessing the possible impacts and delineating the wetland areas.

Sampling equipment used included:

- Camera
- GPS
- Soil auger
- Sample bags
- Munsell colour chart
- Field data capture sheets (PES/EIS/IHI)
- Electronic maps on Ipad

Wetland and riparian areas were then assessed on the following basis:

- Vegetation type – verification of type and its state or condition based, supported by species identification using Germishuizen and Meyer (2003), Vegmap (Mucina and Rutherford, 2006 as amended) and the South African Biodiversity Information Facility (SABIF) database.
- Plant species were further categorised as follows:
    - Terrestrial: species are not directly related to any surface or groundwater base-flows and persist solely on rainfall
    - Facultative: species usually found in wetlands (inclusive of riparian systems) (67 – 99% of occurrences), but occasionally found in terrestrial systems (non-wetland) (DWAF, 2005/2007)
    - Obligate: species that are only found within wetlands (>99% of occurrences) (DWAF, 2005/2007)
- Assessment of the wetland type based on the National Wetland Classification System (NWCS) method discussed below and the required buffers
- Mitigation or recommendations required

National Wetland Classification System (Ollis *et al*., 2013)

Since the late 1960s, 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.

The South African National Biodiversity Institute (SANBI) in collaboration with a number of specialists and stakeholders developed the newly revised and now accepted National

Wetland Classification Systems (NWCS, 2014). This system comprises a hierarchical classification process of defining a wetland based on the principles of the Hydrogeomorphic (HGM) approach at higher levels, including structural features at the finer or lower levels of classification.

Wetlands developed 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, 2005/2007). It is significant that the HGM approach has now been included in wetland classification as the HGM approach has been adopted throughout the water resources management realm with regard the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. All of 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 water use license applications (WULA).

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).

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.

Wetland definition

Although the National Wetland Classification System (2014) is used to classify wetland types it is still necessary to understand the definition of a wetland. Wetland definitions as with classification systems have changed over the years. 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 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:

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 water course (NWCS, 2014). The DWS is however reconsidering this position with regard the management of estuaries due to the ecological needs of these systems with regard to water allocation. Table 1 provides a comparison of the various wetlands included within the main sources of wetland definition 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 (NWCS, 2014).

Wetlands must therefore have one or more of the following attributes to meet the above definition (DWAF, 2005/2007):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm 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.

Table 1: Comparison of ecosystems considered to be 'wetlands' as defined by the proposed NWCS, the National Water Act (Act No. 36 of 1998), and ecosystems are 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[2] areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	▪ NO	▪ NO	▪ YES[3]

Wetland 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.

[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 would be considered riparian wetlands, 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.

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 2 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 2: Summary of direct and indirect ecoservices provided by wetlands from Kotze *et al.*, 2008.

<table>
<tr><td rowspan="15">Ecosystem services supplied by wetlands</td><td rowspan="9">Indirect benefits</td><td rowspan="8">Hydro-geochemical benefits</td><td colspan="2">Flood attenuation</td></tr>
<tr><td colspan="2">▪ Stream flow regulation</td></tr>
<tr><td rowspan="5">Water quality enhancement benefits</td><td>▪ Sediment trapping</td></tr>
<tr><td>▪ Phosphate assimilation</td></tr>
<tr><td>▪ Nitrate assimilation</td></tr>
<tr><td>▪ Toxicant assimilation</td></tr>
<tr><td>▪ Erosion control</td></tr>
<tr><td colspan="2">▪ Carbon storage</td></tr>
<tr><td colspan="3">▪ Biodiversity maintenance</td></tr>
<tr><td rowspan="6">Direct benefits</td><td colspan="3">▪ Provision of water for human use</td></tr>
<tr><td colspan="3">▪ Provision of harvestable resources[2]</td></tr>
<tr><td colspan="3">▪ Provision of cultivated foods</td></tr>
<tr><td colspan="3">▪ Cultural significance</td></tr>
<tr><td colspan="3">▪ Tourism and recreation</td></tr>
<tr><td colspan="3">▪ Education and research</td></tr>
</table>

National Wetland Classification System method

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

The NWCS (SANBI, 2009) 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 (SANBI, 2009).

The classification system used in this study is thus based on SANBI (2009) and is summarised below:

The NWCS has a six tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 1). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular systems 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:

(i) Landform – shape and localised setting of wetland
(ii) Hydrological characteristics – nature of water movement into, through and out of the wetland
(iii) 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 the 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 of six descriptors to characterise the wetland types on the basis of 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:

(i) Geology;
(ii) Natural vs. Artificial;
(iii) Vegetation cover type;
(iv) Substratum;
(v) Salinity; and
(vi) Acidity or Alkalinity.

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

The HGM unit (Level 4) is the **focal point of the NWCS**, with the upper levels (Figure 2 – 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.

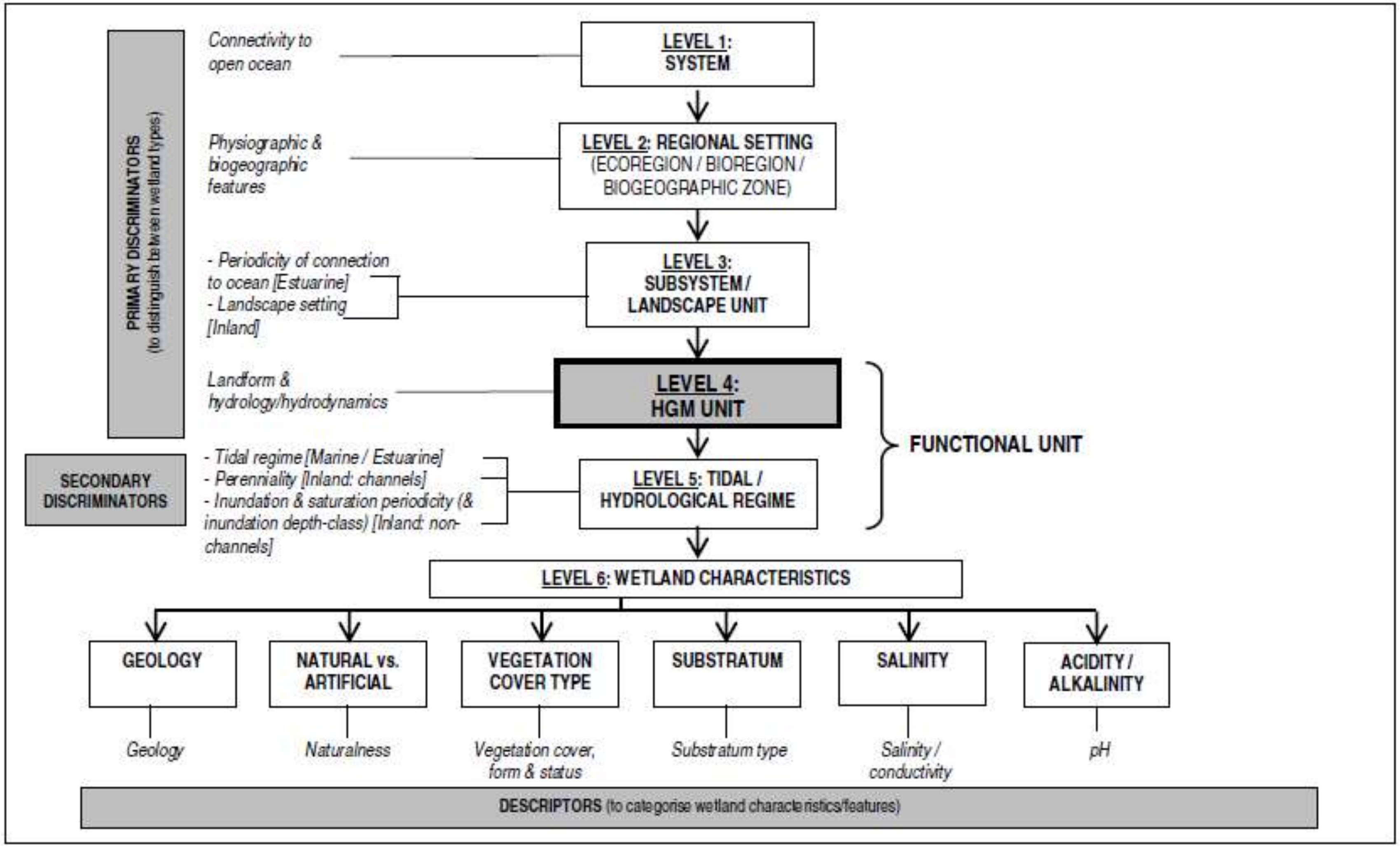

Figure 1: Basic structure of the National Wetland Classification System, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From SANBI, 2009).

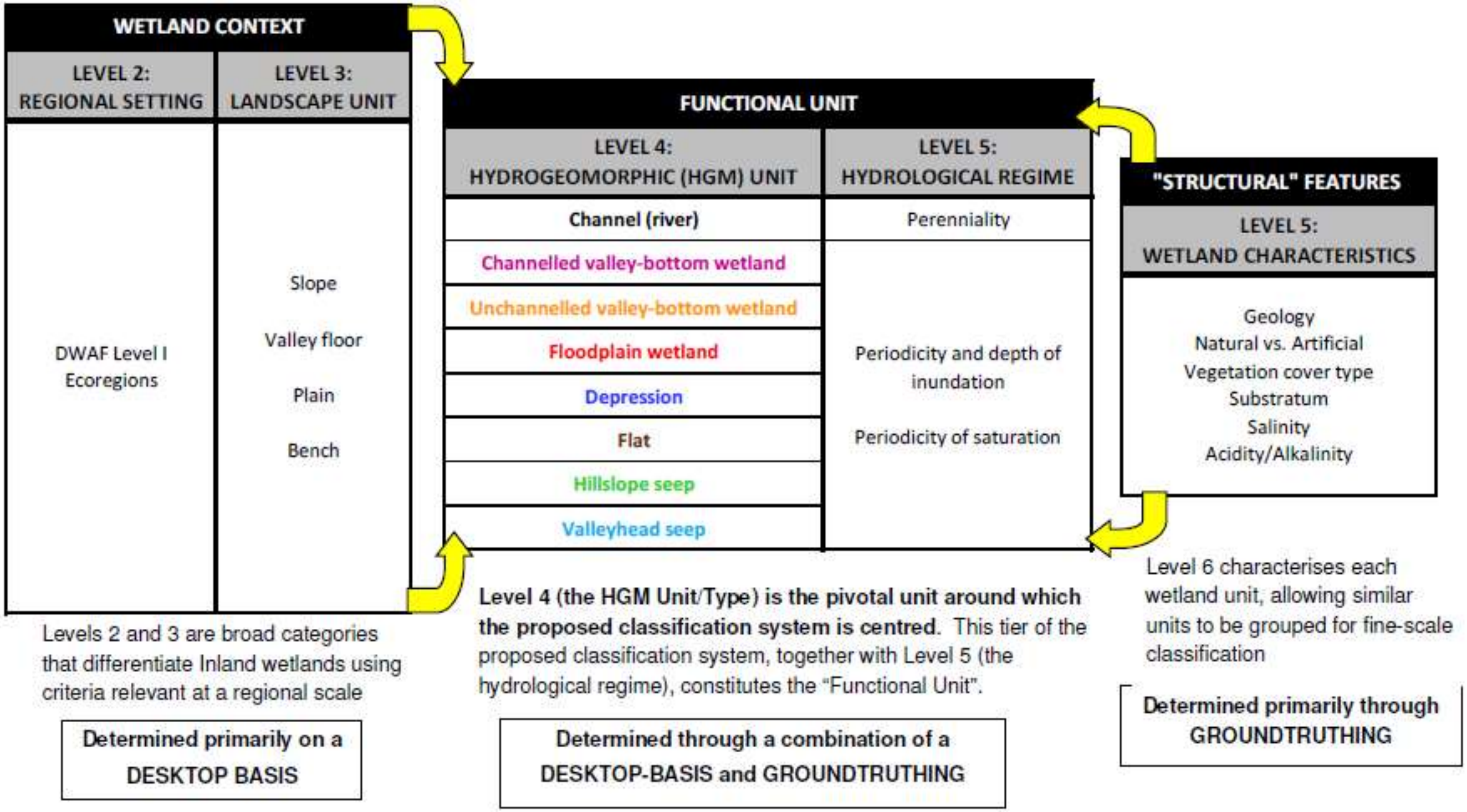

Figure 2 Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from SANBI, 2009).

Wetland condition and conservation importance assessment

To assess the Present Ecological State (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 4), 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 to degraded state of the wetlands in the study area, 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 4: Description of A – F ecological categories based on Kleynhans *et al*., (2005).

<table>
<tr><th>ECOLOGICAL CATEGORY</th><th>ECOLOGICAL DESCRIPTION</th><th>MANAGEMENT PERSPECTIVE</th></tr>
<tr><td>A</td><td>Unmodified, natural.</td><td>Protected systems; relatively untouched by human hands; no discharges or impoundments allowed</td></tr>
<tr><td>B</td><td>Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.</td><td>Some human-related disturbance, but mostly of low impact potential</td></tr>
<tr><td>C</td><td>Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.</td><td rowspan="2">Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation</td></tr>
<tr><td>D</td><td>Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.</td></tr>
<tr><td>E</td><td>Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.</td><td rowspan="2">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</td></tr>
<tr><td>F</td><td>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.</td></tr>
</table>

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 landuse 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 rapid 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 DWAF's River EcoStatus models which are currently used for the assessment of PES in riverine environments.

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

- Habitat uniqueness
- Species of conservation concern
- Habitat fragmentation with regard ecological corridors
- 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 was observed (HIGH). Any systems 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. Wetlands which receive a LOW conservation importance rating could be included into stormwater management features, but should not be developed so as to retain the function of any ecological corridors.

15. Appendix 4: Results of the wetland buffer model

[illegible]

Note: For further guidance on the application of this tool, users should refer to the guideline for the determination of buffer zones. It is also important to note that buffer widths calculated by the model only cater for impacts associated with diffuse-source surface runoff. Additional mitigation measures should therefore be defined to cater for other potential impacts. Finally, please note that this buffer zone tool has been designed to be completed sequentially for a single site - users must therefore use a new template for each assessment rather than "tweaking" previous assessments.

Name of Assessor	Brian Colloty	Project Details	AEP Pans	Date of Assessment	Jun-18

Step 1: Define objectives and scope of assessment and determine the most appropriate level of assessment

Level of assessment	Site-based

Step 2: Map and categorize water resources in the study area

Approach used to delineate the wetland boundary?	Site-based delineation	Wetland type	Depression

Step 3: Refer to the DWA management objectives for mapped water resources or develop surrogate objectives

Present Ecological State	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.
Ecological importance & sensitivity	High	Features that are considered to be ecologically important and sensitive at a regional scale. The functioning and/or biodiversity of these features are typically moderately sensitive to anthropogenic disturbances. They typically play an important role in providing ecological services at the local scale.
Management Objective	Maintain	

Step 4: Assess the risks from proposed developments and define mitigation measures necessary for protecting mapped water resources in the study area

Assess threats of planned activities on water resources and determine desktop buffer requirements

Proposed development / activity	Sector	Industry	Includes a range of industrial activities from light industrial with limited impacts on surrounding land use, to hazardous or noxious industry with high impact on surrounding land use. Includes activities such as the processing of resources and storage of manufactured materials and products.
	Sub-Sector	Industry (worst case)	#N/A

Climatic factors	MAP Class	0 - 400mm	Rainfall Intensity	Zone 1

Phase	Threat Posed by the proposed land use / activity	Desktop Threat Rating	Specialist Threat Rating	Justification for changes in threat ratings
Construction Phase	1. Alteration to flow volumes	VL	VL	
	2. Alteration of patterns of flows (increased flood peaks)	L	VL	Activities will avoid the small pans and buffers with Stormwater management in place
	3. Increase in sediment inputs & turbidity	VH	L	Activities will avoid the small pans and buffers with Stormwater management in place
	4. Increased nutrient inputs	VL	VL	
	5. Inputs of toxic organic contaminants	M	VL	No such chemical will be used
	6. Inputs of toxic heavy metal contaminants	M	VL	N/A
	7. Alteration of acidity (pH)	M	M	
	8. Increased inputs of salts (salinization)	N/A	N/A	
	9. Change (elevation) of water temperature	L	L	
	10. Pathogen inputs (i.e. disease-causing organisms)	L	L	
Operational Phase	1. Alteration to flow volumes	H	L	Activities will avoid the small pans and buffers with Stormwater management in place
	2. Alteration of patterns of flows (increased flood peaks)	VH	L	Activities will avoid the small pans and buffers with Stormwater management in place
	3. Increase in sediment inputs & turbidity	VH	L	Activities will avoid the small pans and buffers with Stormwater management in place
	4. Increased nutrient inputs	H	L	Activities will avoid the small pans and buffers with Stormwater management in place
	5. Inputs of toxic organic contaminants	VH	L	Activities will avoid the small pans and buffers with Stormwater management in place
	6. Inputs of toxic heavy metal contaminants	VH	L	Activities will avoid the small pans and buffers with Stormwater management in place
	7. Alteration of acidity (pH)	VH	L	PV plant
	8. Increased inputs of salts (salinization)	H	VL	PV pLant
	9. Change (elevation) of water temperature	VH	VL	PV plant
	10. Pathogen inputs (i.e. disease-causing organisms)	H	VL	PV plant

Assess the sensitivity of water resources to threats posed by lateral land-use impacts

Overall size	Size of the wetland relative to (as a percentage of) its catchment	Average slope of the wetland's catchment	The inherent runoff potential of the soil in the wetland's catchment	The extent to which the wetland (HGM) setting is generally characterized by sub-surface water input
0.5-5 ha	Large (>20%)	<3%	Mod. Low (B)	Low (Floodplain)
Perimeter to area ratio	**Vulnerability of the HGM type to sediment accumulation**	**Vulnerability of the wetland to erosion given the wetland's slope and size**	**Extent of open water in relation to the extent of the HGM unit**	**Sensitivity of the vegetation to burial under sediment**
Moderately low (800- 401 m per ha)	Depression – endorheic, Flat	Low (Vulnerability score 0)	Very low (<0.5%)	Moderately low
Peat / high organic content versus mineral soils	**Inherent level of nutrients in the landscape**	**Sensitivity of the vegetation to increased availability of nutrients**	**Sensitivity of the vegetation to toxic inputs, changes in acidity & salinization**	**Natural wetness regimes**
Mineral	Moderate base status	Moderately low	Moderately low	Dominated by temporarily saturated soils
Natural salinity levels	**Level of domestic, livestock and contact recreational use**	**Mean Annual Temperature**	Note: See the *Technical Manual* for further information on the rationale for indicator selection and how these attributes affect the sensitivity of wetlands to lateral inputs.	
Non Saline (<200 mS/m)	High	Zone 5 (19.5 - 24.2 Deg C)		

Assess the sensitivity of important biodiversity elements to threats posed by lateral land-use impacts

Phase	Threat Posed by the proposed land use / activity	Sensitivity: Water Resource	Sensitivity: Biodiversity	Site-Based Risk Class	Justification for increasing the sensitivity to cater for any important biodiversity elements including special habitats and species of conservation concern.
Construction Phase	1. Alteration to flow volumes	M		VL	
	2. Alteration of patterns of flows (increased flood peaks)	H		VL	
	3. Increase in sediment inputs & turbidity	L		VL	
	4. Increased nutrient inputs	M		VL	
	5. Inputs of toxic organic contaminants	M		VL	
	6. Inputs of toxic heavy metal contaminants	M		VL	
	7. Alteration of acidity (pH)	H		M	
	8. Increased inputs of salts (salinization)	M		N/A	
	9. Change (elevation) of water temperature	L		VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	H		L	
Operational Phase	1. Alteration to flow volumes	M		L	
	2. Alteration of patterns of flows (increased flood peaks)	H		L	
	3. Increase in sediment inputs & turbidity	L		VL	
	4. Increased nutrient inputs	M		VL	
	5. Inputs of toxic organic contaminants	M		L	
	6. Inputs of toxic heavy metal contaminants	M		L	
	7. Alteration of acidity (pH)	H		L	
	8. Increased inputs of salts (salinization)	M		VL	
	9. Change (elevation) of water temperature	L		VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	H		VL	

Refine desktop buffer requirements based on site-based investigations

Buffer attributes	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Slope of the buffer	Very Gentle (0 - 2%)			
Vegetation characteristics (Construction phase)	Fair: Moderately robust vegetation with fair interception (e.g. tufted grass stands but with lowered basal cover) OR less robust vegetation with very good interception (e.g. kikuyu pasture).			
Vegetation characteristics (Operational phase)	Fair: Moderately robust vegetation with fair interception (e.g. tufted grass stands but with lowered basal cover) OR less robust vegetation with very good interception (e.g. kikuyu pasture).			
Soil permeability	Moderately low: Deep moderately fine textured soils (e.g. loam & sandy clay loam) OR shallow (<30cm) moderately drained soils.			
Micro-topography of the buffer zone	Uniform topography: Smooth topography with no concentrated flow paths anticipated.			
Site-based aquatic impact buffer requirements (without additional mitigation measures)				
Construction Phase	20	Not Assessed	Not Assessed	Not Assessed
Operational Phase	20	Not Assessed	Not Assessed	Not Assessed

Where appropriate, identify additional mitigation measures and refine aquatic impact buffer width accordingly

Phase	Threat Posed by the proposed land use / activity	Specialist Threat Rating	Description of any additional mitigation measures	Refined Threat Class	Specialist justification for refined threat ratings with clear reference to supporting documentation.
Construction Phase	1. Alteration to flow volumes	VL			
	2. Alteration of patterns of flows (increased flood peaks)	VL			
	3. Increase in sediment inputs & turbidity	L			
	4. Increased nutrient inputs	VL			
	5. Inputs of toxic organic contaminants	VL			
	6. Inputs of toxic heavy metal contaminants	VL			
	7. Alteration of acidity (pH)	M			
	8. Increased inputs of salts (salinization)	N/A			
	9. Change (elevation) of water temperature	L			
	10. Pathogen inputs (i.e. disease-causing organisms)	L			
Operational Phase	1. Alteration to flow volumes	L			
	2. Alteration of patterns of flows (increased flood peaks)	L			
	3. Increase in sediment inputs & turbidity	L			
	4. Increased nutrient inputs	L			
	5. Inputs of toxic organic contaminants	L			
	6. Inputs of toxic heavy metal contaminants	L			
	7. Alteration of acidity (pH)	L			
	8. Increased inputs of salts (salinization)	VL			
	9. Change (elevation) of water temperature	VL			
	10. Pathogen inputs (i.e. disease-causing organisms)	VL			

	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Revised aquatic impact buffer requirements (including additional mitigation measures)				
Construction Phase	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Operational Phase	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Additional mitigation measures to consider	Y/N	Comments
Have additional mitigation measures been identified to cater for any point-source discharges?	Y	
Have additional mitigation measures been identified to cater for potential groundwater impacts?	Y	

Where necessary review and refine aquatic impact buffer requirements to cater for practical management considerations

	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Final aquatic impact buffer requirements (including practical management considerations)				
Construction Phase	20	Not Assessed	Not Assessed	Not Assessed
Operational Phase	20	Not Assessed	Not Assessed	Not Assessed
Final aquatic impact buffer requirement	20	Not Assessed	Not Assessed	Not Assessed

16. Appendix 5: DWS Risk Assessment Matrix for Section 21 c & i Water Uses

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: ......Dr Brian Colloty.............................. Reg no. ......Ecologist 400268/07..................................

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity														
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
1	Construction phase	Clearing of vegetation	Clearing of remaining vegetation in close proximity to wetland vegetation within the channel for washing facility and road / culvert upgrade	Clearing of vegetation, with provision of erosion control systems and stormwater management. Proposed designs must allow for maintenance of flows without impedance or diversion within the delineated wetlands areas	1	1	1	1	1	1	3	5	3	2	5	1	11	55	LOW
2	Construction phase	Clearing of vegetation	Clearing of remaining vegetation in close proximity to wetland vegetation within the channel for washing facility and road / culvert upgrade	Unstable soils will erode and create sedimentation downstream	1	2	2	1	1,5	1	1	3,5	2	2	5	1	10	35	LOW
3	Construction phase	Loss of Species of Special Concern	Several plant species within the region are conservation worthy or are protected by the Provincial Nature Conservation Ordinance	Loss of threatened or protected plant species, although aquatic related species were observed within the site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LOW
4	Construction phase	Creation of hard surfaces	Hard surface areas requiring stormwater management	Increase in hard surfaces result in increased volumes and velocities of surface water flows, which are mitigated by Stormwater and erosion control measures	2	1	1	1	1,25	2	2	5,25	2	2	5	1	10	52,5	LOW
5	Construction phase	Spills and leaks from construction vehicles / machinery	Impact on localised surface water quality	Leaks from plant / machinery during the construction phase	3	1	1	3	2	1	1	4	2	2	5	1	10	40	LOW
6	Construction phase	Loss of wetland areas	Loss of any wetland areas	Clearing of wetland vegetation to create access road, with provision of erosion control systems and stormwater management. Proposed designs allow for maintenance of flows without impedance or diversion i.e. low level bridges	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LOW
7	Operational Phase	Creation of hard surfaces	Additional roads, and hard surface areas requiring stormwater management	Unstable soils will erode and create sedimentation downstream	3	1	1	1	1,5	1	3	5,5	2	2	5	1	10	55	LOW
8	Operational Phase	Water quality impacts	Any spills or leaks from the washing facility	All designs should include bunds or other suitable mechanisms to prevent any additional water quality impacts from reaching the wetland channel	1	3	2	3	2,25	1	2	5,25	1	1	5	1	8	42	LOW