DETERMINATION OF RESOURCE QUALITY OBJECTIVES IN THE OLIFANTS WATER MANAGEMENT AREA (WMA4)

WP10536

RESOURCE UNIT PRIORITISATION REPORT

REPORT NUMBER: RDM/WMA04/00/CON/RQO/0213

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Resource Unit Prioritisation Report

Executive Summary

The Resource Quality Objectives (RQOs) determination procedures for the Olifants Water Management Area (WMA) involved the application of the seven step framework established by the Department of Water Affairs in 2011 (DWA, 2011). Although the procedures involve defining the resource, setting a vision, determination of RQOs and Numerical Limits (NLs), gazetting this and then moving to implementation, monitoring and review before starting the process all over again, some of these steps were achieved in the Water Resource Classification (WRC) Study and not repeated in this study. The procedural steps established for this case study to determine RQOs for rivers, groundwater, dams and wetland resources in the WMA include:

- Step 1. Delineate the Integrated Units of Analyses (IUAs) and Resource Units (RUs).
- Step 2. Establish a vision for the catchment and key elements for the IUAs.
- Step 3. Prioritise and select RUs and ecosystems for RQO determination.
- Step 4. Prioritise sub-components for RQO determination, select indicators for monitoring and propose the direction of change.
- Step 5. Develop draft RQOs and NLs.
- Step 6. Agree Resource Units, RQOs and Numerical Limits with stakeholders.
- Step 7. Finalise and Gazette RQOs.

Components of steps 1 and 2 were available from the WRC study to which this RQO determination process was aligned. This report documents the prioritisation and selection of RUs and ecosystems for RQO determination in the Olifants WMA (Step 3).

The prioritisation process resulted in the selection of the number of resources as indicated in Table 1, for each IUA, for which sub-components and indicators would be selected in Step 4:

Table 1: Summary of results of the prioritisation process for the Olifants WMA

IUA	Rivers	Wetlands	Dams	Groundwater
Total	29	30	23	30
IUA1	4	11	3	
IUA2	2	7	2	
IUA3	1	1	2	
IUA4	1	1	2	
IUA5	4	0	2	
IUA6	5	7	5	
IUA7	1	0	0	
IUA8	1	0	2	
IUA9	2	2	1	
IUA10	4	0	1	
IUA11	2	0	1	
IUA12	2	0	2	
IUA13	1	1	0	

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ABBREVIATIONS

Acronym	Meaning
Al	Aluminium
As	Arsenic
$CaCO_3$	Calcium Carbonate
Cd	Cadmium
Chl-a	Chlorophyll a
Cl	Chlorine
Cr(VI)	Hexavalent chromium
Cu	Copper
DOC	Dissolved organic carbon
DRM	Desktop Reserve Model
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EIS	Ecological Importance and Sensitivity
EWR	Ecological Water Requirements
F	Fluorine
FEPA	Freshwater Ecosystem Priority Areas
FRAI	Fish Response Assessment Index
GIS	Geographical Information Science
Hg	Mercury
□g/l	Micrograms per litre
IBA	Important Bird Areas
IRHI	Index of Reservoir Habitat Impairment
IUA	Integrated Unit of Analysis
IWRM	Integrated Water Resource Management
IWRMP	Integrated Water Resources Management Plan
KNP	Kruger National Park
m^3/s	Cubic meters per meter (cumecs)
MAR	Mean Annual Runoff
MC	Management Class
mg/l	Milligrams per litre
MIRAI	Macroinvertebrate Response Assessment Index
Mn	Manganese
NFEPA	National Freshwater Ecosystem Priority Areas
NL	Numerical Limit
NO_2	Nitrite
NO_3	Nitrate
NTU	Turbidity
NWA	National Water Act
NWRS	National Water Resource Strategy
O_2	Oxygen
Pb	Lead

PES	Present Ecological State
pH	power of hydrogen
PO_4	Phosphate
RDM	Resource Directed Measures
REC	Recommended Ecological Category
REC	Recommended ecological category
RHAM	Rapid Habitat Assessment Method
RHP	River Health Programme
RO	Regional Office
RQOs	Resource Quality Objectives
RR	Reporting rates
RU / RUs	Resource Unit/s
RUET	Resource Unit Evaluation Tool
RUPT	Resource Unit Prioritisation Tool
SASS5	South African Scoring System version 5
Se	Selenium
SPI	Specific Pollution sensitivity Index
TDS	Total Dissolved Solids
TIN	Total Inorganic Nitrogen
TPC	Threshold of Probable Concern
VEGRAI	Vegetation Response Assessment Index
VMAR	Virgin Mean Annual Runoff
WE	Water Ecosystems
WMA	Water Management Area
WRC	Water Resource Classification
WWTW	Waste Water Treatment Works
Zn	Zinc

DEFINITION OF PROJECT SPECIFIC ACRONYMS:

EWR – Ecological Water Requirements is synonymous with the ecological component of the Reserve as defined in the Water Act (1998).

IUA – Integrated Unit of Analysis or spatial units that will be defined as significant resources (as prescribed by the NWA).They are finer-scale units aligned to watershed boundaries, in which socio-economic activities are likely to be similar.

MC – The Management Class is set by the WRC and describes the degree of alteration that resources may be subjected to.

REC – Recommended Ecological Category – this is a recommendation purely from the ecological perspective designed to meet a possible future state.

RU – Resource Unit is a stretch of river that is sufficiently ecologically distinct to warrant its own specification of Ecological Water Requirements

WRC – Water Resources Classification is a procedure required by the Water Act 1998 that produces a MC per IUA for all water resources.

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Resource Unit Prioritisation Report

1 INTRODUCTION

The rationale for requiring RQOs, their components, their applicability and implementation procedures emanate from the National Water Act of South Africa (NWA, 1998). The Water Act (1998) requires that all water resources are protected in order to secure their future and sustainable use. It lays out a plan where each significant water resources (surface water, wetlands, groundwater and estuaries) are classified according to a WRC System. In the process, the Reserve is also determined for the water resource, i.e. the amount of water, and the quality of water, that is required to sustain both the ecosystem and provide for basic human needs. This Reserve then contributes to the Classification of the resource. This classification results in a Management Class and associated RQOs for water resources, which then gives direction for future management activities in the WMA. According to the Water Act (NWA, 1998), the purpose of RQOs are to establish clear goals relating to the quality of the relevant water resources and stipulates that in determining RQOs a balance must be sought between the need to protect and sustain water resources and the need to use them (sensu DWA, 2011). Thus the "working part" of the Classification of water resources, is the RQOs that are produced. These are numerical and narrative descriptors of conditions that need to be met in order to achieve the required management scenario as provided during the resource classification. Such descriptors relate to the:

(a) quantity, pattern, timing, water level and assurance of instream flow
(b) water quality including the physical, chemical, and biological characteristics of the water
(c) character and condition of the instream and riparian habitat; and
(d) characteristics, condition and distribution of the aquatic biota (DWA, 2011).

This section of the RQO determination procedure includes the prioritisation and selection of RUs and ecosystems RQO determination in the Olifants WMA (Step 3; DWA, 2011). The Water Resource Classification System proposes that RQOs are set for each RU. In reality however, this may not be practical as there may be a large number of RUs within a selected catchment. A rationalisation process is necessary to prioritise and select the most useful RUs for RQO determination. The objective of Step 3 is therefore to prioritise and select preliminary RUs which will then be discussed and agreed with stakeholders during Step 6.

2 SCOPE OF THE STUDY

The study entails the determination of Resource Quality Objectives (RQOs) for all significant water resources (rivers, wetlands, dams (or lakes) and groundwater ecosystems) in the Olifants Water Management Area (WMA). The RQO determination procedure established by DWA (2011) has been implemented to determine RQOs in this case study. The RQO determination procedure is based on a seven step framework including (DWA, 2011; Figure 1):

- Step 1. Delineate the Integrated Units of Analysis (IUAs) and define the Resource Units.
- Step 2. Establish a vision for the catchment and key elements for the IUAs.
- Step 3. Prioritise and select preliminary Resource Units for RQO determination.
- Step 4. Prioritise sub-components for RQO determination, select indicators for monitoring and propose the direction of change.
- Step 5. Develop draft RQOs and Numerical Limits (NLs).
- Step 6. Agree RUs, RQOs and NLs with stakeholders.
- Step 7. Finalise and Gazette RQOs.

In 2013 the Department of Water Affairs completed the Water Resource Classification (WRC) study for the Olifants WMA which included the delineation IUAs and established a vision for the catchment and key elements for the IUAs (DWA, 2013). This resulted in the determination of Management Classes for each IUA and Recommended Ecological Categories for biophysical nodes selected to represent the riverine ecosystem in the WMA. These outcomes met the IUA delineation requirements for the study and provided the vision information, including Management Classes for the study. As such this study did not duplicate these components but rather adopted the outcomes from the WRC study (DWA, 2013). Apart from these components that were obtained from the WRC study, some developments/adaptations were made to the DWA (2011) RQO determination procedure to the groundwater, wetland and dam components of the study in particular. This report documents the approach adopted and the outcomes of the implementation of Step 3 of the RQO determination procedure (DWA, 2011).

3 METHODOLOGY

3.1 RESOURCE QUALITY OBJECTIVES METHODOLOGY OVERVIEW

The Resource Quality Objectives determination procedures established by DWA (2011) were implemented in this study. This included the implementation of the seven-step procedural framework which is repeatable and as such allows for an adaptive management cycle with additional steps (Figure 1). Overall the procedure involved defining the resource, setting a vision, determining RQOs and Numerical Limits (NLs), gazetting the RQOs and NLs and then moving to implementation, monitoring and review of these RQOs and NLs before starting the process all over again. A summary of the procedural steps established for this case study, with some adaptations that were required to include groundwater, dams and wetland resources include:

- **Step 1. Delineate the IUAs and RUs:** In this case study IUAs were obtained from the Water Resource Classification (WRC) study (DWA, 2012) and applied to all water resources considered in the study (rivers, wetlands, dams and groundwater ecosystems). Three spatial levels for resources were considered for RQO determination in this case study:
    - Regional (IUA) scale assessments were considered for rivers, wetlands and groundwater resources in the study.
    - Resource Unit scale assessments that were aligned to biophysical nodes obtained from the WRC study (DWA, 2012) were considered for river and groundwater resources alone.
    - Ecosystem scale assessments were considered for wetland and dam ecosystems/resources in the study.

  The RU delineation procedure initially involved the identification of sub-quaternary reaches of rivers in the WMA for each biophysical node obtained from the WRC study. The RU delineation process then involved amalgamating the upstream associated sub-quaternary reaches of riverine ecosystems, and their associated catchment areas. As a result, the number of RUs selected for the study was identical to and could later be aligned to the information associated with the biophysical nodes from the WRC study. The delineation procedure for ecosystem scale resource assessment involved the use of Geographical Information System (GIS) spatial ecosystem data.
- **Step 2. Establish a vision for the catchment and key elements for the IUAs:** The stakeholder requirements and their associated outcomes, which include the Management Classes for IUAs and RECs for RUs from the WRC study, were adopted as the vision for this study (DWA, 2012). No further visioning process was appropriate as this could have conflicted with the WRC process. The WRC outcomes were skewed towards river resources in the WMA which necessitated obtaining additional information for the other resources considered in the study (i.e. wetlands, dams and groundwater ecosystems). This additional information is highlighted in the applicable reports.
- **Step 3. Prioritise and select RUs and ecosystems for RQO determination:** This step involved the use of existing ecological specifications (EcoSpecs) and user specifications (UserSpecs) information from the Olifants Reserve and WRC studies. This information was used to implement the RU Prioritisation Tool for rivers (DWA, 2011) and the new RU Prioritisation Tools developed for groundwater RUs as part of this study. Wetland ecosystem prioritisation involved the implementation of a new GIS based prioritisation approach developed for the study and dam ecosystem prioritisation was based on a desktop assessment of available user- and eco-spec information. During this step, RU and ecosystem prioritisation stakeholder participation workshops were carried out during which available information was discussed and amended according to available local information regarding the protection and use requirements for the WMA. During these RU and ecosystem prioritisation stakeholder workshops, consensus was reached to select the final lists of prioritised RUs and ecosystems for the RQO determination process.
- **Step 4. Prioritise sub-components for RQO determination, select indicators for monitoring and propose the direction of change:** This step included the hosting of a range of specialist workshops for rivers, dams, wetlands and groundwater resources where RU Evaluation Tools were used to select sub-components for RQO determination, select indicators and propose the direction of change. The RU Evaluation Tools used for wetlands, dams and groundwater were developed for the study. This information was then used to develop draft RQOs and Numerical Limits in the next step. The relevant activities of this step were:

4.1 Identify and assess the impact of current and anticipated future use on water resource components
4.2 Identify requirements of important user groups
4.3 Selection of sub-components for RQO determination
4.4 Establish the desired direction of change for selected sub-components
4.5 Complete the information sheet for the Resource Unit Evaluation Tool

- **Step 5. Develop draft RQOs and Numerical Limits**: This step was based on the outcomes of the RU and ecosystem prioritisation step (Step 4). From the outcomes of the RU and ecosystem prioritisation step, draft RQOs were established and provided to recognised specialists to establish NLs that were generally quantitative descriptors of the different components of the resource (such as the water quantity, quality, habitat and biota). These descriptors were designed to give a quantitative measures of the RQOs (DWA, 2011). Although the NLs may have had some uncertainty associated with them and were not originally intended for gazetting (DWA, 2011), they were considered for gazetting in the study at the request of the Department of Water and Sanitation (DWS) Chief Directorate: Legal Services. Refer to the RQO and NL reports for more information. The relevant activities of this step were:
    5.1 Carry over sub-component and indicator information from the Resource Unit Evaluation Tool
    5.2 Extract available data to determine the present state for selected sub-components and indicators
    5.3 Assess the suitability of the data
    5.4 Where necessary, collect data to determine the Present State for selected indicators
    5.5 Determine the level at which to set RQOs
    5.6 Set appropriate draft RQOs
    5.7 Set appropriate draft Numerical Limits in line with the draft RQO
    5.8 Determine confidence in the RQOs and process
- **Step 6. Agree on Resource Units, RQOs and Numerical Limits with stakeholders:** This component included the consideration of RQO and NL outcomes with stakeholders prior to the initiation of the gazetting process. The relevant activities of this step were:
    6.1 Notify stakeholders and plan the workshop
    6.2 Present and refine the Resource Unit selection with stakeholders
    6.3 Present the sub-components and indicators selected for the RQO determination
    6.4 Present the proposed direction of change and associated rationale
    6.5 Present and revise RQOs and Numerical Limits
- **Step 7. Finalise and Gazette RQOs:** This component of the RQO determination process is still to be carried out. A Legal Notice was developed as a part of this study for submission to Chief Directorate: Legal Services of the DWS for gazetting.

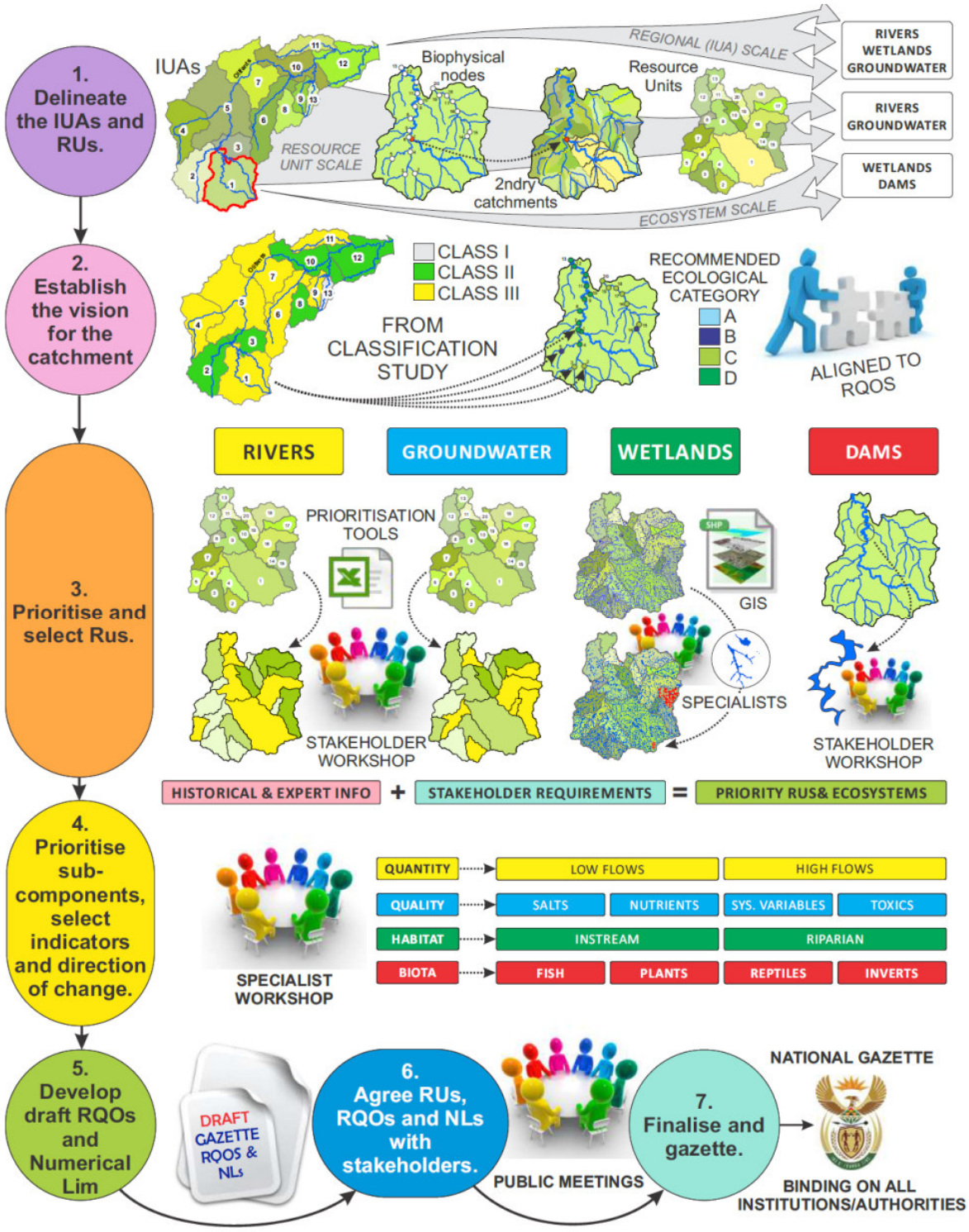

Figure 1: Schematic summary of the RQO determination procedure (adapted from DWA, 2011) which was implemented in this study.

3.2 RESOURCE UNIT PRIORITISATION OVERVIEW AND GAPS

The Water Resource Classification System proposes that RQOs are set for each RU. In reality however, this is not practical as there are a large number of RUs within the WMA and it would be excessively expensive to set

RQOs and to monitor all of them. A rationalisation process is therefore necessary to prioritise and select the most useful RUs for RQO determination. The objective of Step 3 was therefore to prioritise and select preliminary RUs which were discussed and agreed with stakeholders. Different approaches were used to prioritise the river, wetland, groundwater and dam resources within the Olifants WMA. Each of these respective approaches is discussed below.

3.3 STAKEHOLDER WORKSHOPS

For this component of the study a resource unit prioritisation workshop for the Olifants Water Management Area was carried out at the Loskop Dam Nature Reserve from 29-31 July 2013. The workshop was well attended by local community representatives and representatives from the agriculture, industry, mining sectors, regional and national conservation authorities, local and regional water resource managers and scientists. The following tasks were assessed with stakeholders at the workshop:

- Evaluation of the study area, resource units (RU), desktop RU prioritisation results.
- Evaluation of the data used for the desktop RIVER RU prioritisation.
- Evaluation of the data used for the desktop GROUND WATER RU prioritisation.
- Evaluation of the data used for the desktop Lakes and Wetlands RU prioritisation.
- Evaluation of amended RU prioritisation results.
- Selection of RUs for RQO determination of the Olifants WMA RQO study.

3.4 STEP 3: RIVER RESOURCE UNIT PRIORITISATION FOR THE OLIFANTS WMA

3.4.1 APPLICATION OF THE RESOURCE UNIT PRIORITISATION TOOL

The RQO methodology provides a decision support tool, the Resource Unit Prioritisation Tool (RUPT), to guide the selection process (DWA, 2011). This tool was used to determining the relative importance of monitoring each RU in the Olifants WMA as part of management operations. All of the RUs are ranked in order, from highly important to not important.

3.4.2 SCORING OF CRITERIA AND SUB-CRITERIA IN THE RUPT

The RUPT assesses a range of criteria and sub-criteria including the following:

- Position of the Resource Unit within the IUA
- Importance of each Resource Unit to users and level of threat posed to water resource quality for users
- Importance of each RU to ecological components and level of threat posed to water resource quality for the environment
- Resource Units for which management action should be prioritised
- Practical considerations associated with RQO determination for each RU

The information used to evaluate each of these criteria was gathered from a range of sources including the Water Resource Classification, StatsSA Census 2011, the Reconciliation Study for the Olifants, and the PES-EIS study. The method of data processing and scoring of each of criterion and sub-criterion is detailed in Appendix A1. The actual scores assigned to each RU for each sub-criterion are detailed in Appendix A2.

3.4.3 EVALUATION OF THE RELATIVE RANKING AND WEIGHTING OF EACH CRITERION AND SUB-CRITERION

The RUPT assigns standard ranks and relative weights to each criterion and sub-criterion. These ranks and relative weights remained unchanged for all criteria and sub-criteria with the exception of the Ecological Importance sub-criteria. The ranks and weights of these sub-criteria were adjusted as the data included in the provincial biodiversity aquatic plans incorporated the NFEPA data which had already been assessed as a separate sub-criterion. The initial and adjusted ranks and weights for each of these sub-criteria are detailed in Table 2.

Table 2: Initial and adjusted ranks and weights for the Ecological Importance sub-criteria in the RUPT

Criterion	Sub-criteria	Initial rank	Initial weight	Altered rank	Altered weight
Ecological importance	Resource units with a high or very high EIS category	3	80	3	80
	Resource units which have an A/B NEC and / or PES	2	90	2	90
	Resource units identified as National Freshwater Ecosystem Priority Areas	1	100	1	100
	Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans	1	100	4	70

3.4.4 SELECTION OF PRELIMINARY RESOURCE UNITS FOR RQO DETERMINATION

The RUPT provides summary prioritisation scores for each RU. These integrated scores are calculated on the weighted individual scores applied to each RU. The prioritisation scores for each RU based on the desktop application of the RUPT are provided in Table 3. These scores provide an indication of which RUs should be selected for RQO determination.

3.4.5 PRESENTATION AND REVISION OF RUPT AND PRIORITISED RESOURCE UNITS WITH STAKEHOLDERS

The populated RUPT and associated prioritised RUs were presented to stakeholders at a workshop on 29-31 July 2013. This provided an opportunity for stakeholders to interrogate the scores, ranks and weights for each of the criteria and sub-criteria.

Table 3: Resource Units and associated prioritisation scores generated through desktop application of the RUPT and evaluated with stakeholders. A high score represent the most important RU. Three scenarios were considered including maintaining original weighting scores (Scenario 1), reducing management and position variables weights by 50% (Scenario 2) and removing weight of management and position variables (Scenario 3). Top 30 Resource Units highlighted.

RU	Scenario 1	Rank	Scenario 2	Rank	Scenario 3	Rank	RU	Scenario 1	Rank	Scenario 2	Rank	Scenario 3	Rank	RU	Scenario 1	Rank	Scenario 2	Rank	Scenario 3	Rank
1	0.47	**19**	0.59	**25**	0.61	35	42	0.12	116	0.21	112	0.24	112	83	0.44	**26**	0.70	**6**	0.79	**5**
2	0.33	52	0.54	39	0.61	32	43	0.21	83	0.37	64	0.43	62	84	0.35	46	0.56	32	0.63	**29**
3	0.46	**20**	0.58	**27**	0.61	36	44	0.19	90	0.34	75	0.39	71	85	0.36	42	0.57	**30**	0.64	**25**
4	0.34	50	0.56	34	0.63	**27**	45	0.22	76	0.33	81	0.36	79	86	0.49	**17**	0.41	60	0.40	67
5	0.33	51	0.54	38	0.61	31	46	0.55	**10**	0.36	71	0.30	95	87	0.19	89	0.30	92	0.34	87
6	0.45	**22**	0.58	**28**	0.61	37	47	0.37	41	0.44	55	0.44	58	88	0.27	64	0.42	57	0.46	53
7	0.44	**24**	0.56	33	0.58	41	48	0.27	65	0.47	50	0.54	47	89	0.27	63	0.48	48	0.56	45
8	0.36	43	0.56	31	0.63	**28**	49	0.45	**21**	0.72	**5**	0.81	**3**	90	0.13	113	0.17	120	0.18	120
9	0.42	**30**	0.68	**8**	0.77	**8**	50	0.34	49	0.54	40	0.60	40	91	0.20	88	0.35	74	0.40	68
10	0.32	57	0.51	45	0.58	43	51	0.12	115	0.21	113	0.24	113	92	0.23	74	0.35	73	0.39	75
11	0.52	**12**	0.68	**10**	0.71	**11**	52	0.42	**29**	0.68	**7**	0.77	**7**	93	0.30	60	0.44	54	0.49	51
12	0.50	**15**	0.63	**15**	0.66	**20**	53	0.63	**7**	0.47	51	0.42	65	94	0.11	118	0.18	117	0.21	117
13	0.69	**3**	0.76	**3**	0.81	**2**	54	0.40	34	0.63	**17**	0.71	**15**	95	0.56	**9**	0.75	**4**	0.80	**4**
14	0.25	66	0.40	61	0.46	56	55	0.33	54	0.49	47	0.55	46	96	0.39	35	0.43	56	0.43	59
15	0.28	62	0.41	59	0.46	55	56	0.41	32	0.64	**14**	0.73	**10**	97	0.53	**11**	0.47	49	0.48	52
16	0.47	**18**	0.59	**24**	0.61	34	57	0.43	**28**	0.67	**13**	0.76	**9**	98	0.64	**6**	0.68	**11**	0.71	**12**
17	0.35	48	0.54	37	0.61	38	58	0.19	91	0.34	76	0.39	72	99	0.21	81	0.32	86	0.35	84
18	0.23	75	0.33	80	0.36	78	59	0.21	82	0.30	93	0.33	90	100	0.23	73	0.35	72	0.39	74
19	0.28	61	0.41	58	0.46	54	60	0.19	94	0.32	87	0.36	81	101	0.17	103	0.24	106	0.26	107
20	0.44	**25**	0.34	78	0.33	88	61	0.15	106	0.26	101	0.30	98	102	0.18	96	0.34	79	0.39	76
21	0.32	56	0.51	44	0.58	42	62	0.40	33	0.63	**16**	0.71	**14**	103	0.51	**13**	0.67	**12**	0.71	**13**
22	0.33	53	0.53	41	0.61	39	63	0.35	45	0.55	36	0.61	**30**	104	0.70	**2**	0.68	**9**	0.68	**17**
23	0.36	44	0.59	**23**	0.67	**19**	64	0.38	37	0.59	**21**	0.66	**21**	105	0.37	39	0.61	**20**	0.68	**18**
24	0.38	36	0.62	**18**	0.69	**16**	65	0.49	**16**	0.61	**19**	0.63	**26**	106	0.22	78	0.32	84	0.36	83
25	0.22	79	0.30	91	0.33	89	66	0.80	**1**	0.77	**2**	0.77	**6**	107	0.18	98	0.34	77	0.39	73
26	0.35	47	0.58	**26**	0.66	**23**	67	0.32	55	0.36	68	0.37	77	108	0.10	121	0.16	121	0.18	121
27	0.38	38	0.59	**22**	0.66	**22**	68	0.30	59	0.28	97	0.25	110	109	0.20	86	0.37	66	0.43	64
28	0.16	104	0.24	108	0.26	108	69	0.14	110	0.24	105	0.28	103	110	0.20	85	0.37	65	0.43	63
29	0.13	112	0.23	109	0.27	105	70	0.14	109	0.24	104	0.28	102	111	0.12	114	0.23	110	0.27	106
30	0.20	84	0.30	94	0.33	91	71	0.24	70	0.38	63	0.43	60	112	0.15	107	0.28	96	0.33	92
31	0.43	**27**	0.31	88	0.29	99	72	0.65	**5**	0.53	43	0.49	50	113	0.25	69	0.45	52	0.51	48
32	0.16	105	0.27	99	0.31	94	73	0.19	93	0.26	102	0.28	101	114	0.41	31	0.50	46	0.51	49
33	0.31	58	0.53	42	0.61	33	74	0.18	97	0.26	100	0.29	100	115	0.17	102	0.30	90	0.35	85
34	0.22	80	0.32	83	0.36	82	75	0.10	120	0.19	116	0.22	116	116	0.68	**4**	0.78	**1**	0.84	**1**
35	0.23	72	0.36	70	0.39	70	76	0.17	100	0.23	111	0.24	111	117	0.22	77	0.33	82	0.36	80
36	0.11	117	0.21	114	0.24	114	77	0.25	68	0.37	67	0.41	66	118	0.17	99	0.25	103	0.27	104
37	0.18	95	0.29	95	0.32	93	78	0.10	119	0.19	115	0.22	115	119	0.23	71	0.36	69	0.39	69
38	0.37	40	0.57	**29**	0.64	**24**	79	0.14	111	0.18	119	0.19	119	120	0.25	67	0.38	62	0.43	61
39	0.19	92	0.31	89	0.34	86	80	0.14	108	0.18	118	0.19	118	121	0.58	**8**	0.55	35	0.57	44
40	0.51	**14**	0.44	53	0.44	57	81	0.17	101	0.24	107	0.26	109							
41	0.20	87	0.28	98	0.30	97	82	0.45	**23**	0.32	85	0.30	96							

3.4.6 AMENDMENT OF DESKTOP SCORES WITH STAKEHOLDERS

The scores for each criterion were mapped and presented in a graphical format for discussion. Each score was interrogated and where necessary amended. The amended criteria are detailed in Table 4 and the actual change in each score and the associated justification is included in Appendix A3.

Table 4: Overview of amendments by stakeholders to each criterion and sub-criterion

Criterion	Sub-criterion	Proposed amendments by stakeholders
Position of resource unit within IUA		Scores for two RUs were adjusted.
Importance for users (Current & anticipated future use)	Resource units which provide important cultural services to society	A number of scores were adjusted based on local knowledge.
	Resource units which are important in supporting livelihoods of significant vulnerable communities	A number of scores were adjusted based on local knowledge.
	Resource units which are important in meeting strategic requirements and international obligations	Numerous scores were adjusted as stakeholders indicated that strategic water is sourced from the Komati and Vaal which are not located within the WMA.
	Resource units that provide supporting and regulating services	A number of scores were adjusted based on local knowledge.
	Resource units most important in supporting activities contributing to the economy (GDP & job creation) in the catchment (e.g. commercial agriculture, industrial abstractions and bulk abstractions by water authorities)	A number of scores were adjusted based on local knowledge.
Threat posed to users	Level of threat posed to users	A number of scores were adjusted based on local knowledge.
Ecological Importance	Resource units with a high or very high EIS category	Scores for three RUs were adjusted based on local knowledge.
	Resource units which have an A/B NEC and / or PES	Scores for two RUs were increased based on local knowledge.
	Resource units identified as National Freshwater Ecosystem Priority Areas	These scores were not altered during the stakeholder workshop.
	Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans	During the stakeholder engagement workshop, local knowledge facilitated the identification of additional areas that were being protected. This new data was incorporated into the amended RU Prioritisation Tool.
Threat faced by ecological component of the RU	Level of threat posed to ecological components of the resource unit	These scores were not altered during the stakeholder workshop.
Management Considerations	Resource units with PES lower than a D Category or lower than the accepted	The scores for some RUs were increased based on information from the PES-EIS

Criterion	Sub-criterion	Proposed amendments by stakeholders
	gazetted category (NEC)	study.
Practical Considerations	Availability of EWR site data or other monitoring data (RHP, DWAF gauging weirs etc) located within reach?	These scores were not altered during the stakeholder workshop.
	Accessibility of resource unit for monitoring	These scores were not altered during the stakeholder workshop.
	Safety risk associated with monitoring resource units.	These scores were not altered during the stakeholder workshop.

3.4.7 ADJUSTMENT OF RELATIVE RANKINGS AND WEIGHTINGS OF CRITERIA AND SUB-CRITERIA WITH STAKEHOLDERS

Workshop participants also evaluated the relative ranks and weights allocated to each of the criteria and sub-criteria. In order to emphasise the importance of the ecological and user requirements, the weightings and rankings of the other criteria were interrogated. Consequently, stakeholders requested the preparation of the following three scenarios:

- Scenario 1: Use standardised rankings and weightings proposed in the RQO prioritisation process for all criteria and sub-criteria
- Scenario 2: Reduce the relative weighting by 10% for the following criteria:
  - Position of the RU in the IUA
  - Practical considerations
  - Management considerations
- Scenario 3: Reduce the relative weighting to 0 for the following criteria:
  - Position of the RU in the IUA
  - Practical considerations
  - Management considerations

The outputs of these scenarios were discussed at the workshop and informed the selection of final priority RUs.

3.4.8 SELECTION OF FINAL PRIORITY RESOURCE UNITS

After considering all three scenarios, stakeholders felt that Scenario 3 provided the most appropriate RUs for RQO selection. A final priority map was produced where RUs with high scores were initially prioritised on a catchment scale. Thereafter additional RUs for IUAs that did not contain any priority RUs were identified and added to the priority list. Stakeholders then reviewed this list and replaced some of the proposed priority RUs with other RUs which they felt were more important. The rationale for the selection of these RUs by stakeholders is provided in Table 5. A total of 29 RUs were prioritised for the Olifants WMA (Table 20).

Table 5: Additional RUs selected by stakeholders and the associated rationale for their selection

RU	Rationale for selection by stakeholders
31	This RU is located at the base of the Wilge River Catchment in the Olifants River WMA (IUA 2), and was selected by Stakeholders to ensure that all use of the river ecosystems in IUA 2 could be regulated through RQOs selected for this RU.
40	This RU is located downstream of the Loskop Dam and was selected by stakeholders to allow dame releases from the dam to be regulated through RQOs selected for this RU.
46	This RU is located at the base of IUA 4 and represents the only RU selected to allow ecosystem use to be regulated in this IUA. Consensus was reached amongst stakeholders that this RU be selected for the establishment of RQOs.

RU	Rationale for selection by stakeholders
53	This RU is located on the Olifants River mainstem and was selected by stakeholders to establish RQOs at the base of IUA 5. The RQOs established for this RU will ensure that upstream land use in IUA 5 will be regulated. In addition this RU was selected to have RQOs established that would contribute to the regulation of the Flag Boshielo Dam.
72	This RU is also located on the mainstem Olifants River in IUA 7. This RU was selected for RQO determination by stakeholders based on local knowledge of threats to the state of the instream channel and the importance of establishing RQOs for the Olifants River.
82	This RU was selected by stakeholders due its strategic location being positioned at the base of the Spekboom catchment (IUA 8). This RU was selected to ensure that river ecosystem use in this IUA can be regulated and that these RQOs will contribute to achieving RQOs in the highly utilised IUA 6 downstream of this RU.
86	This RU was selected by stakeholders due its strategic location being positioned at the base of the Ohrigstad catchment (IUA 9). This RU was selected to ensure that river ecosystem use in this IUA can be regulated to maintain sensitive Ecospecs in the IUA.
97	This RU was prioritised by stakeholders based on local knowledge of threats to the state of the instream channel and the importance of establishing RQOs for the Makhutswi River, a tributary of the Olifants River so that impacts in this RU are regulated and minimised upstream of the Olifants River.
105	The selection of this RU on the Olifants River, below the confluence of the Makhutswi River (RU97), for prioritisation was based on the importance of regulating the Makhutswi, Moungwane and Malomanye rivers (RU97) in relation to the upper Olifants (RU98) and minimising impacts to the lower Olifants River.
121	This RU was selected by stakeholders due its strategic location being positioned at the base of the Blyde catchment (IUA 13). This RU was selected to ensure that river ecosystem use in this IUA can be regulated to maintain sensitive EcoSpecs in the IUA.

3.5 WETLAND ECOSYSTEM PRIORITISATION FOR THE OLIFANTS WMA

Step 3 of the RQO Process involves the prioritisation and selection of preliminary resource units for RQO determination. This step recognises that a rationalisation process may be necessary to prioritise and select the most useful Resource Units for RQO determination. This is particularly relevant for wetland resources which include thousands of wetlands distributed across the Olifants catchment. The objective of Step 3 was therefore to prioritise and select preliminary Resource Units which will then be discussed and agreed with stakeholders during Step 6.

An excel-based decision support tool was previously developed to guide this selection process of priority wetlands identified during the water resource classification process (DWA, 2011). While this tool provides a useful framework for selecting a sub-set of prioritized wetlands, priority wetland resource units were not identified as part of the classification process undertaken for the Olifants catchment. As such, an alternative approach to wetland prioritisation needed to be developed that considered all wetlands within the Olifants catchment.

Selection of wetland ecosystems is important as monitoring of these wetlands over the long-terms is intended to provide an indication as to how well wetlands in the catchment are being managed and how they are responding to water resource management at both a catchment and IUA level. A two-pronged approach was used to help prioritize wetland ecosystems for RQO determination in the Olifants catchment. This included (i) a desktop based prioritisation process aimed at flagging priorities based on available spatial datasets and (ii)

engagement with key stakeholders to identify potential priority sites based on local knowledge of the study area. The final set of wetlands selected was then reviewed and finalised with stakeholders as part of Step 6 of the RQO process.

A note on selecting individual wetlands for RQO determination

While prioritizing individual wetland ecosystems for RQO determination is regarded as useful, it is important to note that wetlands are highly variable systems and are not linearly connected in the same manner that rivers are. As such monitoring of a sub-set of wetlands is likely to provide very little information on how other wetlands within the catchment are responding to site and catchment-level activities. As such, a decision was taken to also set regional-scale RQOs which are designed to provide general resource quality objectives for all wetlands in the Olifants catchment. This also allows for monitoring to be undertaken at a broader level which can be used to obtain a more holistic picture of wetland management than can be achieved from the information collected for a small sub-set of prioritized wetland ecosystems. The approach and process followed in setting regional-scale RQOs is outlined in the RQO sub-component and subsequent reports.

3.6 METHODOLOGY USED FOR DESKTOP PRIORITIZATION

An alternative approach was developed to prioritize wetlands at a desktop level for RQO determination in the Olifants catchment.

This involved the following broad tasks:

- Developing a consolidated wetland map for the catchment;
- Consolidation and formatting of datasets to inform wetland prioritization;
- Developing a structured hierarchy and assigning weightings to input datasets;
- Undertaking a formal GIS analysis to integrate information into consolidated desktop wetland prioritisation layers.

Further details of the individual tasks associated with this prioritisation exercise are summarised in this section of the report while details of input datasets are provided in Appendix B and C.

3.6.1 DEVELOPMENT OF A CONSOLIDATED WETLAND MAP

The NFEPA wetland coverage was used as the primary basis for delineating wetlands in the catchment. This was however replaced by more accurate information in the Upper Olifants where more detailed wetland coverage had been prepared by Exigent (2006). Further details regarding the delineation of wetland ecosystems are provided in the RU delineation report.

3.6.2 CONSOLIDATION AND FORMATTING OF DATA TO INFORM WETLAND PRIORITIZATION

Prior to undertaking the prioritisation process, it was important to collate available spatial datasets for wetlands in the focus area. The selection of datasets was informed largely by the prioritisation criteria identified in the resource unit prioritisation tool (DWAF, 2011). Scores (ratings) were then applied to each dataset by considering the relative importance of features identified. In order to prevent scoring biases, these scores ranged from 0-1 with scores of 1 indicating features with the highest importance. A summary of the datasets used in the prioritisation process are described below while details of the scores applied for each of the input coverages is captured in Appendix C.

3.6.3 POSITION OF RESOURCE UNIT WITHIN THE IUA

Resource Units on large mainstem rivers at the downstream end of the IUAs are located at the edge of socio-economic zones where user requirements are likely to differ. Such Resource Units also aggregate the upstream impacts from the entire IUA and can therefore be a useful gauge of the success of upstream management activities. In the case of wetlands, large river-linked wetlands (valley bottoms & floodplains) may therefore be useful candidates for selection. A GIS coverage was therefore created by selecting and rating the relative usefulness of wetlands along mainstem rivers within the Olifants catchment.

3.6.4 CONCERN FOR USERS

The importance of wetlands from a user perspective is based on the joint-consideration of the importance of wetlands in supporting user requirements and the threat posed to such resources. The rationale is therefore that those wetland that are highly important and under threat should be targeted for RQO determination above other wetland units. Details of the criteria used to assess these criteria are detailed below.

3.6.5 IMPORTANCE TO USERS (CURRENT & ANTICIPATED FUTURE)

This assessment was designed to consider both current and anticipated future use. A number of sub-criteria relevant to different user considerations were included in the assessment and are detailed below.

Resource Units which provide cultural services

Cultural services are less tangible than material services but nonetheless may be highly valued by society. Relevant benefits may include recreational use, tourism or scientific benefits, and aesthetic, cultural or spiritual values. Resource Units which provide these benefits should be protected as they contribute to the wellbeing of society. User groups for which this service is likely to be particularly important include subsistence users, recreation and tourism and real estate and property owners/developers. In the case of the Olifants catchment, the following datasets were used to obtain an indication of the potential importance of wetlands in providing cultural services:

- **Important Bird Areas**: The purpose of the IBA Programme is to identify and protect a network of sites, at a biogeographical scale, critical for the long-term viability of naturally-occurring bird populations. Such sites are targeted for research and birding activities.
- **Ramsar sites**: Ramsar sites have been identified based on unique site attributes that emphasise their conservation value at both a National and International level.
- **Formally Protected Areas**: Formal conservation areas are also typically the focus of tourism, research and education activities. Wetlands within these areas are therefore likely to contribute towards these cultural values.

Note that wetlands that are likely to be important from a cultural perspective for subsistence users were not specifically identified. Such wetlands are however likely to be linked with vulnerable communities and would therefore be covered by that criteria.

Resource Units which support the livelihoods of significant vulnerable communities

Many poor communities are directly reliant on wetlands for domestic water use, food, grazing, medicine, and building materials. Poor communities are particularly vulnerable to wetland degradation as these changes affect their livelihoods directly. The level of vulnerability determines the degree of impact caused by changes in the level of service provision. Resource units which support significant vulnerable communities should therefore be prioritised. The following datasets were used to identify and rank regions in terms of the likely reliance of communities on wetland resources:

- **Statistics South Africa Census Data**: Poorer communities are likely to be more reliant on natural resources that more affluent communities. Income levels therefore provide a useful indicator of areas in which reliance on natural resources (including those available from wetlands) is likely to be higher. Population density is also a useful indicator, with higher levels of reliance anticipated in areas with higher population densities. Dwelling type also provides useful information and can be used to differentiate between rural communities (e.g. living in huts) and more formal housing which would suggest more affluent communities.

- **Climatic conditions:** Reliance of communities on water provision from water resources (including wetlands) is likely to be particularly high in situations where rainfall variability is high and where there are prolonged periods of no rainfall. The number of months without rainfall (available at a quaternary catchment level) therefore provides another useful indicator of potential community reliance on wetland resources.

Resource Units used for strategic requirements or international obligations

Resource Units which are used for strategic purposes or are important in meeting international obligations should be prioritised to ensure that obligations are met. International obligations are linked to river flows in this case, with no specific focus on wetlands[1]. As such, this criterion was excluded from the prioritisation process.

Resource Units which provide supporting and regulating services

Regulating and supporting services provided by wetlands include flood attenuation, stream flow regulation, sediment trapping, erosion control, water quality enhancement and carbon storage. Assessing the relative importance of wetlands in providing these services is not easily achieved at a desktop level and is influenced by the ability of the wetland to supply these services (determined by wetland attributes) and the demand for these services (determined by catchment context and surrounding land use). An attempt has been made to rate the potential importance of wetlands in providing a sub-set of these regulating and supporting services using available GIS datasets as outlined below:

Flood attenuation

- Supply of flood attenuation service: Wetland type provides a broad surrogate for the ability of different wetlands to provide a flood attenuation function. Ranking of types was informed by WET-Ecoservices (Kotze *et. al.*, 2009).
- Demand for flood attenuation service: This is influenced by a range of factors including:
    - Catchment slope: The greater the average slope of the catchment, the higher the likelihood of increased runoff, particularly after heavy storm events.
    - Runoff potential: The higher the runoff potential of soils in the catchment, the greater the likelihood of elevated flows after heavy rains.
    - Dams in catchment: Dams typically help to attenuate floods. Wetlands within catchments characterised by high dam densities are therefore likely to be less important in providing this service than wetlands located in catchments with low dam densities.
    - Land use: Land use can also have a significant impact on storm flows by altering infiltration capacities and increasing natural runoff levels. Catchments with high levels of urban infrastructure and transformation are therefore more likely to be characterised by elevated flood peaks.
    - Rainfall intensity: Catchments characterised by intense rainfall events are likely to exhibit more flashy flows with higher incidences of flooding.

This information had been summarised for the Olifants catchment at a quaternary catchment level as part of the Wet-Win Project (IWMI, 2011) and was used to inform this assessment.

Sediment trapping and erosion control

- Supply of sediment trapping & erosion control services: Wetland type provides a broad surrogate for the ability of different wetlands to provide a sediment trapping & erosion control function. Ranking of types was informed by WET-Ecoservices (Kotze *et. al.*, 2009).
- Demand for sediment trapping & erosion control services: This is influenced by a range of factors including:
    - Dams in catchment: Dams typically capture sediment from their receiving catchments this reducing sediment loads in downstream water resources. Wetlands within catchments characterised by high dam densities are therefore likely to be less important in providing this service than wetlands located in catchments with low dam densities.

[1] Note: The importance of Ramsar sites is recognised but is addressed under ecological aspects.

- Sediment sources: The demand for this service is likely to be higher in catchments characterised by high sediment sources in the catchment.
- Land use and erodibility: Catchments characterised by land uses that are typically characterised by high levels of erosion are likely to contribute towards high sediment loads in water resources. Wetlands in these catchments are therefore likely to be more important in providing this service.

This information had been summarised for the Olifants catchment at a quaternary catchment level as part of the Wet-Win Project (IWMI, 2011) and was used to inform this assessment.

Water quality enhancement:

- Supply of water quality enhancement service: Wetland type provides a broad surrogate for the ability of different wetlands to provide a water quality enhancement function. Ranking of types was informed by WET-Ecoservices (Kotze *et. al.*, 2009).
- Demand for water quality enhancement services: This is influenced by the water quality entering wetland resources. A range of surrogates can be used to obtain an indication of water quality impacts including:
  - Non-point source agriculture and irrigation: Water resources within catchments characterised by high levels of agricultural activities are likely to be subject to higher levels of diffuse pollution than wetlands within catchments with low levels of agricultural use.
  - Mining activities: Mining activities are known to have a range of negative impacts on water quality. Catchments characterised by a high proportion of mines are therefore likely to have greater water quality problems than those with low levels of mining activity.
  - Population density: This provides a surrogate for pressure on the environment and potential negative impacts on water quality. Water resources in catchments characterised by high population densities are therefore likely to be more impacted than those located in less populated landscapes.

This information had been summarised for the Olifants catchment at a quaternary catchment level as part of the Wet-Win Project (IWMI, 2011) and was used to inform this assessment.

Levels of Physico-Chemical impacts on water resources have also been subjectively assessed at a sub-quaternary catchment scale as part of the desktop PES/EIS assessment (Kleynhans, 2013). This provides another useful indicator of potential water quality impacts.

Resource Units which support activities which contribute to the economy

This criterion was not regarded as an important variable for wetlands in this case study and was excluded from the prioritisation process.

3.6.6 THREAT POSED TO USERS

This assessment should consider the risk of the water resource to users in each resource unit. Resource units which are threatened or are likely to be threatened by current or planned future activities (e.g. mines, towns, industries, dams, intensive agriculture) should be monitored.

Threats have effectively been determined at a quaternary catchment level through the Wet-Win project (IWMI, 2011) which used available data to assess the potential impact of catchment-related activities on wetland condition. Aspects considered as part of this assessment included:

- Hydrological threats which considered potential impacts associated with dams and withdrawals for irrigation, bulk, rural and urban use;
- Geomorphological threats including potential reductions in sediment input from dams and increased sediment inputs associated with various land uses;
- Modifications to wetland vegetation as a result of land uses in the catchment;
- The PES of rivers in the quaternary catchment; and
- The population density as a surrogate for potential water quality impacts.

These threats were integrated into a single score representing the anticipated levels of impact to wetlands within each quaternary catchment (Scores ranged from 0 (no impact) to 10 (maximum impact)).

The PES/EIS project (Kleynhans, 2013) also provides ratings for a suite of criteria that provides an indication of current pressures on aquatic resources. The most relevant from a wetland perspective which were used to inform the prioritisation process include:

- Riparian – Wetland Zone Modification;
- Potential Flow Modification; and
- Potential Physico-Chemical modifying activities.

These threat scores were integrated to provide another surrogate measure of threats facing wetland ecosystems. Scores from this and the Wet-Win datasets were then integrated to provide an indication of pressures facing wetlands across the study area.

3.6.7 ASSESSMENT OF THE IMPORTANCE OF EACH RESOURCE UNIT TO ECOLOGICAL COMPONENTS

As with anthropogenic users, there are a range of attributes that affect the importance of setting RQOs for different Resource Units. In order to help highlight Resource Units that are important from an ecological perspective, four sub-criteria were proposed in the RQO manual:

- Ecological Importance and Sensitivity (EIS) Categories
- Present Ecological State (PES) and Recommended Ecological Category (REC)
- National Freshwater Ecosystem Priority Areas; and
- Priority habitats / species identified in provincial conservation plans.

Available datasets were reviewed and used to develop a suite of GIS coverages indicating the importance of wetlands from an ecological perspective. The approach and rationale followed is briefly described here.

3.6.8 ENVIRONMENTAL CONCERN

The importance of wetlands from a conservation perspective is based on the joint-consideration of the ecological importance and sensitivity of wetlands and the threat posed to such resources. The rationale is therefore that those wetland that are highly important and under threat should be targeted for RQO determination above other wetland units. Details of the criteria used to assess these criteria are detailed below,

Ecological importance and sensitivity

Resource Units with high or very high Ecological Importance and Sensitivity Category require special attention to prevent deterioration of these resource units. These areas are considered vital for protecting important or sensitive species and maintaining aquatic biodiversity.

An assessment of the ecological importance and sensitivity of wetlands within the Olifants catchment was informed by a range of available datasets. This included:

- **Protection status of the wetland**: Wetlands falling within protected areas (including Ramsar sites) contribute towards the long-term protection of ecosystems and species.
- **Threat status of the wetland vegetation group**: Threat status of wetland vegetation groups have been determined as part of the National Freshwater Ecosystem Priority Areas (NFEPA) project. The threat status of the wetland vegetation group is based on levels of transformation and protection of wetland ecosystems with similar characteristics. Wetlands occurring within a threatened wetland group are regarded as having a greater ecological importance than those occurring within wetland vegetation groups of lower threat status.
- **Importance associated with wetlands in the catchment**: The importance of threatened taxa was assessed by experts for river reaches at a desktop level as part of the desktop PES/EIS assessment (DWA, 2013). This provides another level of information on ecological importance that was integrated into this assessment.

- **Sensitivity to changes in floods**: Floodplains are regarded as most sensitive, followed by valley bottoms, seeps and pans. This was therefore evaluating by linking sensitivity to wetland type information.
- **Sensitivity to changes in low flows / dry season**: Unchannelled valley bottom wetlands are regarded as most sensitive, followed by seeps and other wetland types. This was therefore evaluating by linking sensitivity to wetland type information.

Intolerance to water level / flow changes: Vertebrate tax**o**n (excluding fish) and vegetation that are sensitive / intolerant to water level changes were assessed at a desktop level as part of the desktop PES/EIS process (DWA, 2012). Relevant attributes were therefore extracted from this dataset to inform this assessment.

Resource Units which have an A/B NEC and /or PES

Resource Units with an A/B PES or an agreed A/B NEC (in the case where Water Resource Classification has been undertaken) need to be carefully managed to prevent deterioration of these reaches. This is particularly relevant given the poor state of South Africa's rivers and the need to protect aquatic biodiversity. PES was based on information available in the Wetland FEPA coverage and that provided in the Exigent dataset.

Resource Units which have been identified as a National Freshwater Ecosystem Priority Area

Resource Units identified as National Freshwater Ecosystem Priority Areas have been identified using spatial modelling and expert review. Such areas are regarded as priorities for protection and monitoring from an ecological perspective. A range of datasets were used and include:

- **Wetland FEPA datasets:** A range of important data is available in this coverage which was used to select priority wetlands for protection. This includes data on important wetlands in Mpumalanga; wetlands prioritised by experts for their biodiversity importance and wetlands occurring in proximity to a range of recorded threatened species. For the purposes of this assessment, two attributes are regarded as most important:
  - **Rank:** Wetlands were ranked (1=most important to 6=least important) in terms of their importance. This provides a useful basis for comparing the relative importance of wetlands in contributing towards biodiversity objectives.
  - **WETFEPA**: Here, priority wetlands have been selected to meet national wetland conservation targets.
- **Wetland clusters:** Wetland clusters are groups of wetlands within 1 km of each other and embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands.
- **FEPA Catchments:** FEPAs support the biodiversity sector's input into the development of Catchment Management Strategies and into the Water Resource Classification process[2]. This database including FEPAs, RehabFEPAs, Fish Support Areas and Upstream management areas therefore highlights catchments where water resource management (including wetland management) is important to meet biodiversity targets.

Resource Units which have been identified as a priority in provincial aquatic systematic conservation plans

NFEPA datasets are regarded as providing an adequate representation of priority areas identified through a systematic conservation planning approach. Provincial-level aquatic conservation plans were therefore not used as part of this prioritisation exercise.

3.6.9 LEVEL OF THREAT POSED TO WATER RESOURCE QUALITY FOR THE ENVIRONMENT

Resource units which are threatened or are likely to be threatened by current or planned future upstream activities (e.g. mines, towns, industries, dams, intensive agriculture) should be monitored due to the potential risk posed to ecological elements of the water resource. Threats to wetland resources have already been assessed (See Section 2.2.2) and were used again here.

[2] Note that the FEPA datasets have effectively replaced the previous Aquatic Conservation Plan previously used to identify conservation priorities in Mpumulanga (Mervyn Lotter, *Pers. comm.*.)

3.6.10 IDENTIFYING RESOURCE UNITS FOR WHICH MANAGEMENT ACTION SHOULD BE PRIORITISED

In the case of rivers, priority is given to river reaches where the PES is lower than a D category which needs to be improved. This is not regarded as a critical requirement for prioritizing wetland resources. By contrast, monitoring should probably rather focus on remaining intact systems.

3.6.11 ASSESSING PRACTICAL CONSIDERATIONS ASSOCIATED WITH RQO DETERMINATION FOR EACH RESOURCE UNIT

Apart from the criteria already considered, there are additional practical considerations which are worth considering during the Resource Unit prioritisation process. These include the availability of data to inform RQO determination and practical constraints associated with accessibility and security risks. In the case of wetlands, the availability of data is a key consideration. Unfortunately much wetland information resides with mining companies and consultants and there was not sufficient time to try and consolidate such information. Sites that have been prioritised and worked on by Working for Wetlands do typically have baseline wetland data and therefore could act as useful sites. Wetlands associated with WFWetlands activities were therefore highlighted together with those associated with DWA monitoring and EWR sites.

3.6.12 EVALUATING THE RELATIVE RANKING AND WEIGHTING OF EACH CRITERION

Once available datasets were collated, the ranking and relative weighting of various criteria and sub-criteria were re-evaluated. Decision Analyst (Queensland Government Department of Natural Resources and Mines, 2005) was used to assist in ranking the various input criteria. This was done by first developing a simple structured hierarchy reflecting the relationships between various variables (Figure 1). AHP Pairwise analysis was then used to make pair-wise comparisons of the all elements in the same level of the hierarchy which allowed input criteria to be objectively rated against one another based on the perceived accuracy and relevance of the various input datasets. The resultant scores were used to assign weightings to the various input layers as detailed in Appendix E of this report.

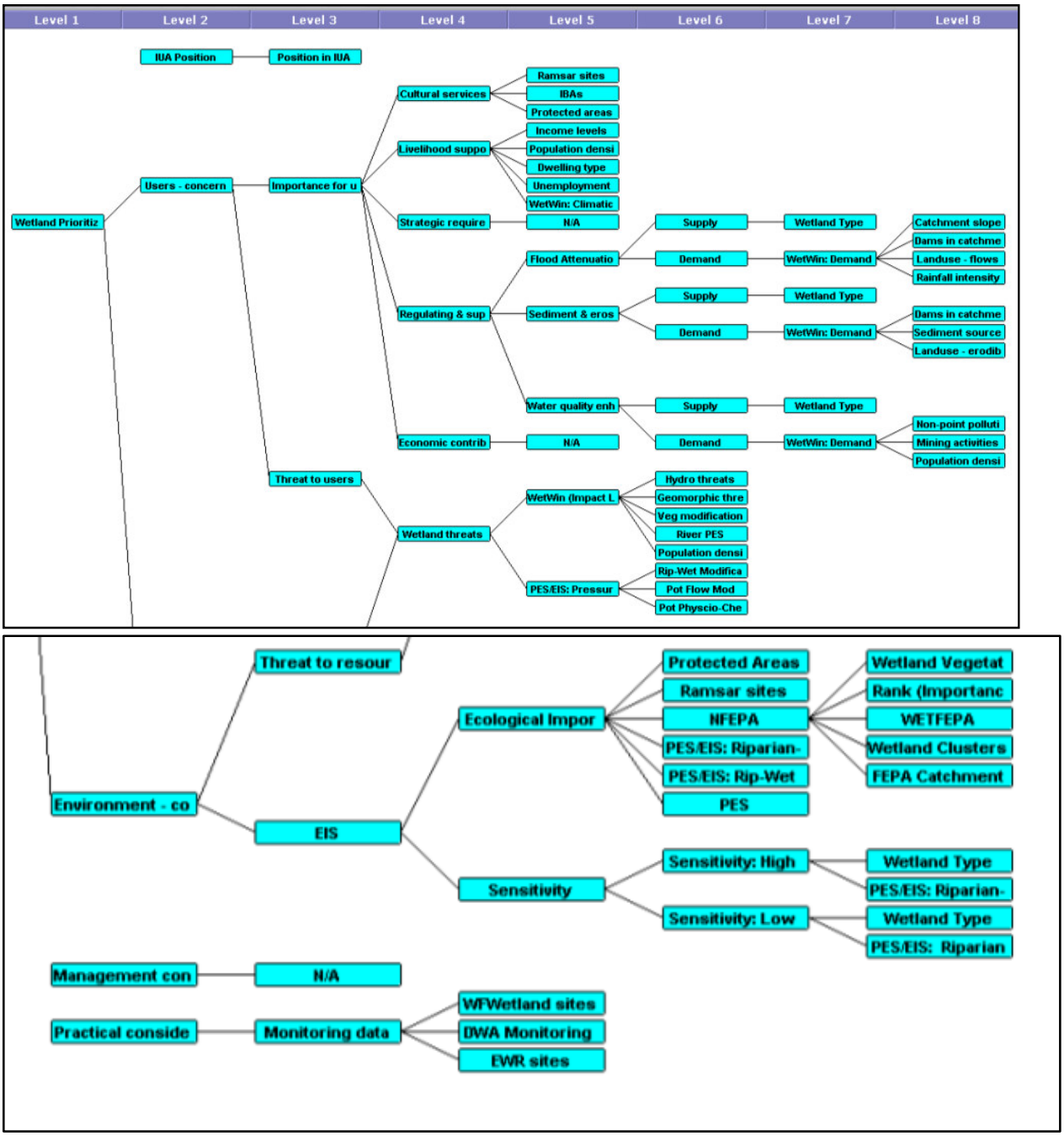

Figure 2: Structured hierarchy used to inform the prioritisation process.

3.6.13 UNDERTAKING A FORMAL GIS ANALYSIS TO DEVELOP PRIORITISATION LAYERS

The purpose of this sub-step was to flag priority wetland ecosystems which should be considered for RQO determination. A Geographic Information System was used to intersect the various datasets and to calculate scores for each level of the hierarchy. The scores for users and the environment integrate both the importance for users/environment and the threats to users/environment in order to calculate an overall 'concern score' for each Resource Unit. These 'concern scores' help to highlight those Resource Units that are important and subject to a high level of threat by anthropogenic activities and which are therefore likely to be a priority for users or the environment. The resultant maps were used to inform the selection of potential wetland systems for RQO determination.

Deviations from the RQO methodology

Whilst undertaking a GIS-based analysis is somewhat different to that advocated in the RQO guidelines, the thinking and process of screening sites using important criteria remains the same. It is important to note however that whilst the initial Resource Unit Prioritisation Tool was developed to integrate the scores for criteria at level 2 of the hierarchy (IUA position; User Concerns; Environmental Concerns; Management Constraints & Practical Considerations), a decision was made to not combine scores from these datasets into a final prioritisation score for this project. The rationale here was that by weighting these layers, the weighted score did not adequately reflect the high priority that should be given to wetlands rated as being of high concern from a user ***or*** environmental perspective. Following discussions from stakeholders, it was also agreed that while management and practical considerations are worth considering, these aspects should not directly affect site selection. The position of wetlands within the IUA was also regarded as being of low importance and as such, these three elements were effectively de-coupled from the prioritisation process.

3.6.14 IUA-LEVEL VERIFICATION AND SELECTION OF CANDIDATE WETLANDS FOR RQO DETERMINATION.

The RQO procedures document (DWA, 2011) strongly recommended that at least one Resource Unit be selected within each IUA to ensure that management requirements within each of these units are adequately considered. A systematic approach was therefore followed to verify the potential usefulness of prioritized wetlands within each IUA. This was done by zooming in to wetlands that had been prioritized from either a user or environmental perspective and displaying these together with available contour data, river features and aerial photography. In many instances, this revealed that wetland features were not present and represented riparian areas while in other instances, the extent of wetlands was poorly indicated. It was also evident that the distribution of wetlands was highly variable across the catchment with the extent of wetlands being extremely limited in some IUAs. As a result, a higher number of candidate wetlands were typically identified in IUAs with higher wetland densities while no suitable candidate sites could be identified in some of the IUAs.

3.7 STAKEHOLDER ENGAGEMENT AND SELECTION OF PRIORITY WETLANDS

3.7.1 IDENTIFICATION OF POTENTIAL CANDIDATE WETLANDS THROUGH STAKEHOLDER ENGAGEMENT

In order to try and supplement the desktop approach to prioritization, a range of key stakeholders within the catchment were contacted to help identify further candidate wetlands for RQO determination based on (i) outstanding biodiversity value and / or (ii) functional importance. A list of these stakeholders, together with brief notes on the inputs obtained is captured in Table 6, below.

Table 6: List of key stakeholders contacted and summary of feedback obtained.

Stakeholder	Organization	Input provided
Ursula Franke	Endangered Wildlife Trust	Highlighted the Lakenvlei wetland and Verloren Valei Nature Reserve wetland as priorities for cranes and White-winged Flufftails.
Lientjie Cohen	MTPA	Did not provide any specific data. Suggested a number of contacts to follow up with further.
Marisa Coetzee	Association for Water and Rural Development (AWARD)): Project Coordinator of the Resilience in the Limpopo River Basin program (RESILIM-Olifants)	Did not provide any specific information.

Stakeholder	Organization	Input provided
Charmaine Uys	Birdlife South Africa	Highlighted the importance of a number of wetlands for bird conservation and provided contact details for other key stakeholders.
Frank Webb	BotSoc (Lowveld)	Did not identify any priority wetlands but flagged the Eastern MP Highveld as an important area from a botanical perspective.
Anton Linström	Wet-earth eco-specs	Identified 12 potential candidate wetlands based on his experience in working in the area.
Craig Whittington-Jones	GDARD	Provided documentation regarding the importance of a number of wetlands for grass-owl conservation.
Peter Ardurne	FOSAF / Steenkampsberg Environmental Initiative	No feedback obtained.
Mattheuns Pretorius	Endangered Wildlife Trust	Highlighted the importance of the Elandsvlei pan systems for Grass-Owls and provide supporting documentation.
Professor Ray Jansen	Tshwane University of Technology	He indicated that he was not familiar with the Olifants catchment and would not be able to contribute substantially to this project.
Ian Little	Endangered Wildlife Trust	No feedback obtained.
Frans Krige	MTPA and Dullstroom Wildflower Club	Emphasised the importance of Lakenvlei
Gary Marneweck	Wetland Consulting Services	Identified a range of priority wetlands in consultation with his consulting team.
Hannes Marais	MTPA	Did not identify any priority sites but suggested that Brian Morris be contacted for further information.
Mervyn Lotter	MTPA	Indicated that priority wetlands had been identified as part of the NFEPA project. No additional spatial data was available.
Piet-Louis Grundling	Ixhaphozi Enviro Services CC (I.E.S)	No feedback obtained.
Brian Morris	EnviroTeq	No feedback obtained.
Allan Abel	Witwatersrand orchid Society	No feedback obtained.
Andre Beetge	Working for Wetlands and head of Mpumalanga Wetland Forum	Assisted in providing information on wetlands systems where WFWetlands had undertaken work in the past.
Graham Alexander	WITS University	Indicated that the catchment was not particularly important for amphibians. No priority sites were identified.

3.7.2 FINAL SELECTION OF PRIORITY SITES

Once potential candidate wetlands had been identified through these two different approaches, a stakeholder workshop was arranged to finalise the list of priority sites and to continue with the sub-component and indicator selection process. This was held on 27th and 28th November 2013 and was attended by the following stakeholders:

- Wietsche Roets (DWA);
- Valerie Killian (DWA);
- Namisha Muthraparsad (DWA);
- Anton Linström (Wet-earth eco-specs);

- Gary Marneweck (Wetland Consulting Services);
- Douglas Macfarlane (Eco-Pulse Environmental Consulting Services).

This process was supported by a broad-scale assessment of the current status and importance of wetlands in providing ecosystem goods and services and involved systematically evaluating candidate wetlands in each IUA and then selecting the most appropriate sub-set for RQO determination[3]. The extent of each of these wetland ecosystems were then mapped as a final output of the prioritisation process.

3.8 DAMS ECOSYSTEM PRIORITISATION FOR THE OLIFANTS WMA

Step 4 of the RQO determination procedure uses the information that was gathered during the previous steps, especially step 3 to determine those priority areas or resource units where RQOs should be determined for the protection of the resource quality. The purpose of the development of RQOs for dams is to ensure adequate releases from the priority dams to provide the quantity and quality of water required for the protection of the aquatic ecosystems downstream of the dams.

The dams that were identified from the various sources of information (DWA database, Water Situation Assessment Model (WSAM) database, Internal Strategic Perspective (ISP) documents, reconciliation strategy documents and any other relevant studies' reports) were used and the following criteria was used to select the final priority dams:

- All dams from the DWA Hydrological Information System (HIS) database
- Additional dams identified through any other study or by stakeholders
- Other dams constructed with the specific purpose to provide water for urban and/or rural water use
- Where a dam was specifically built for irrigation water supply (mainly some of the smaller dams).

3.9 GROUNDWATER RESOURCE UNIT AND ECOSYSTEM PRIORITISATION FOR THE OLIFANTS WMA

The framework selected for the purpose of groundwater RU prioritisation, was based on the DWA RQO method (DWA, 2011) which was focussed on the prioritisation of surface RUs. The RQO development approach (DWA, 2011) requires a set of criteria and sub-criteria to be weighted and rated to calculate a priority rating which is then normalised.

The set of criteria and sub-criteria that were selected for the groundwater prioritisation process was largely dictated by available datasets as well as input from the public participation process. The resultant table with the selected criteria as and the relative weights applied is shown in Table 7.

Table 7: Groundwater prioritisation criteria

Criterion	Relative weighting	Sub-criteria	Relative weighting
Importance for users (Current & anticipated future use)	30	Water character of a high quality	30
		Major aquifers	40
		Activities that contribute to economy	30
Threat posed to users	30	Aquifers which are highly stressed	40
		Water quality is currently threatened	40
		Vulnerable aquifers	20

[3] Note that the number of wetlands to be selected was somewhat arbitrary but was at a minimum of 24 by the Project Steering Committee.

Criterion	Relative weighting	Sub-criteria	Relative weighting
Ecological Importance	30	Groundwater importance to wetlands	45
		Ground-surface water interactions	50
		Important groundwater fauna	5
Management Considerations	10	Management plans already exist	100

Sub-criteria can have a spatial variability across the resource unit extent, but any sub-criteria can only have one rating in the proposed prioritisation model. To address this constraint the following rule set was applied:

a) The sub-criteria category which covers the largest part of the resource unit is assigned.
b) Rule (a) can be overridden through public participation if consensus was reached among the relevant role players.

3.9.1 IMPORTANCE FOR USERS

The sections that follow discuss the sub-criteria linked to the importance for users and the rating guideline that applies to each of the sub-criteria.

3.9.1.1 Water character of high quality

All available water quality data was obtained from the NGA for each of the RU's and the water quality data for these sites were used in generating an expanded Durov diagram which utilises the major anions and cations to produce a plot that characterises water in nine different regions. The plotting procedure of the expanded Durov diagram is available in Appendix E. A water quality score was assigned (Figure 3) to each of the nine regions to assist in evaluating the status of each RU. Since a Durov diagram only gives information about the character of the water, the EC parameter was also displayed to give an indication of the salinity of the water in question. The average values for the Olifants sites are displayed in Figure 4 and were evaluated against the SANS 241:2005 drinking water guidelines.

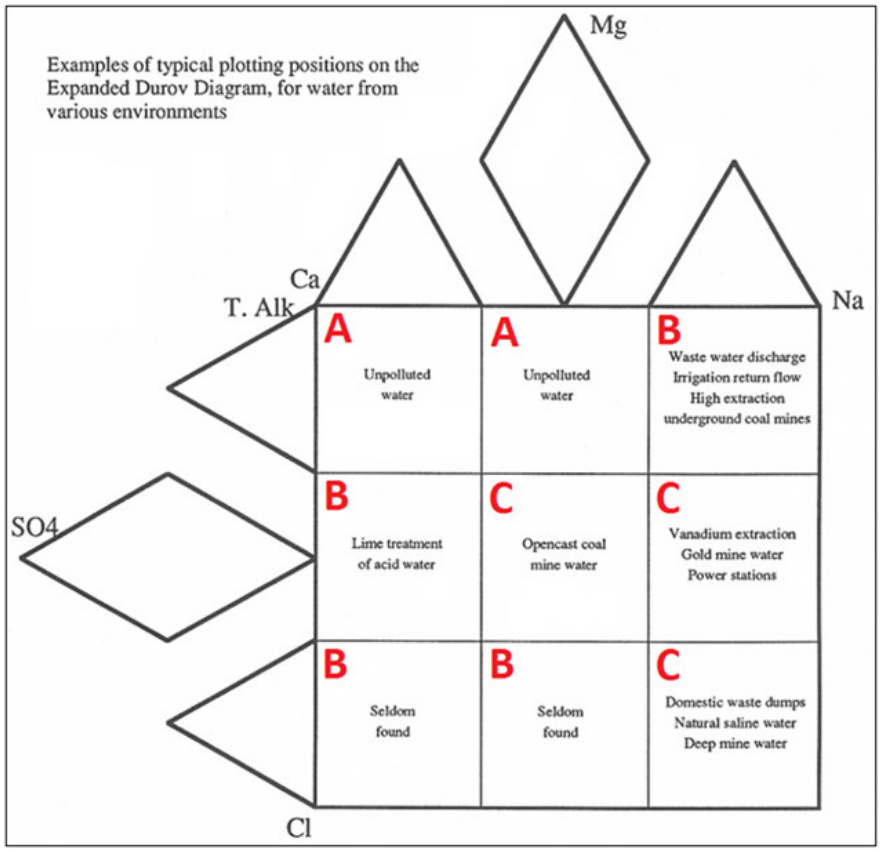

Figure 3: Class assignment of expanded Durov diagram

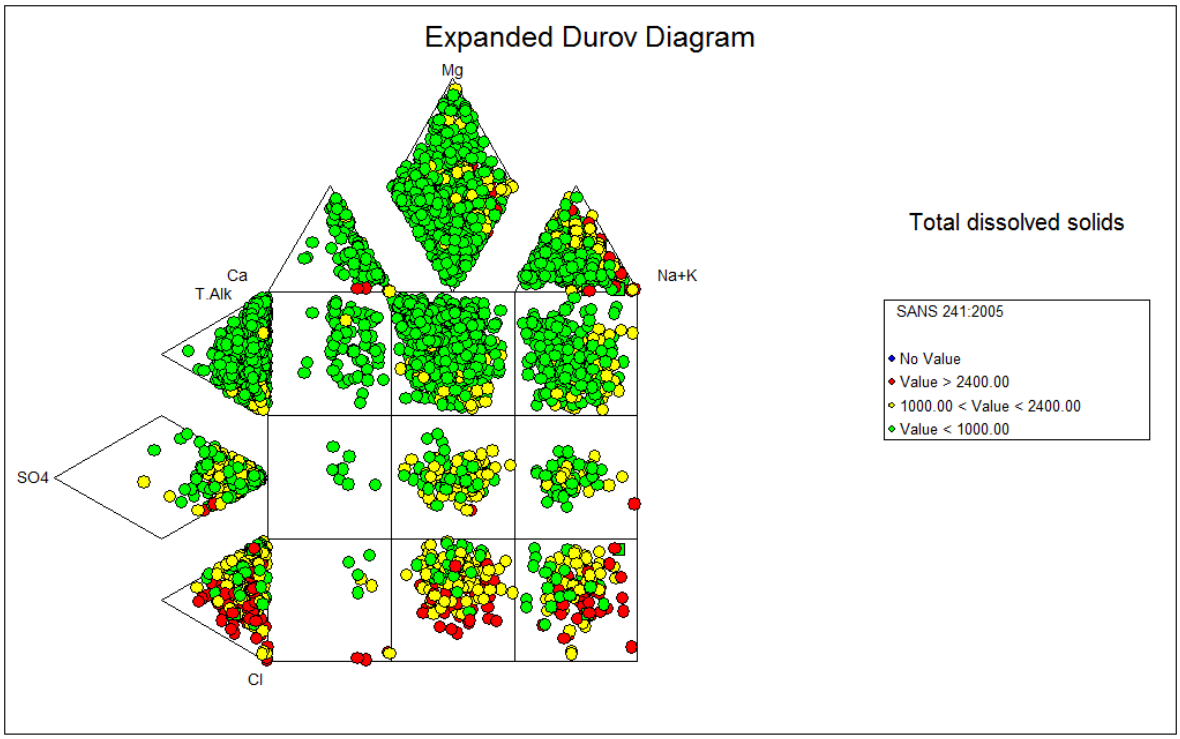

Figure 4: Expanded Durov diagram with evaluation of EC

It should be noted that the chemistry data used, span over the entire time line available in the database. Applied date filters resulted in little or no data for various areas.

The rating guideline applied to each RU for evaluating the water character is presented in Table 8 and the spatial distribution of the final ratings is shown in Figure 5.

Table 8: Water character rating guideline

Rating	Guideline
0.0	RUs which contain a C water quality score
0.5	RUs which contain a B water quality score
1.0	RUs which contain an A water quality score

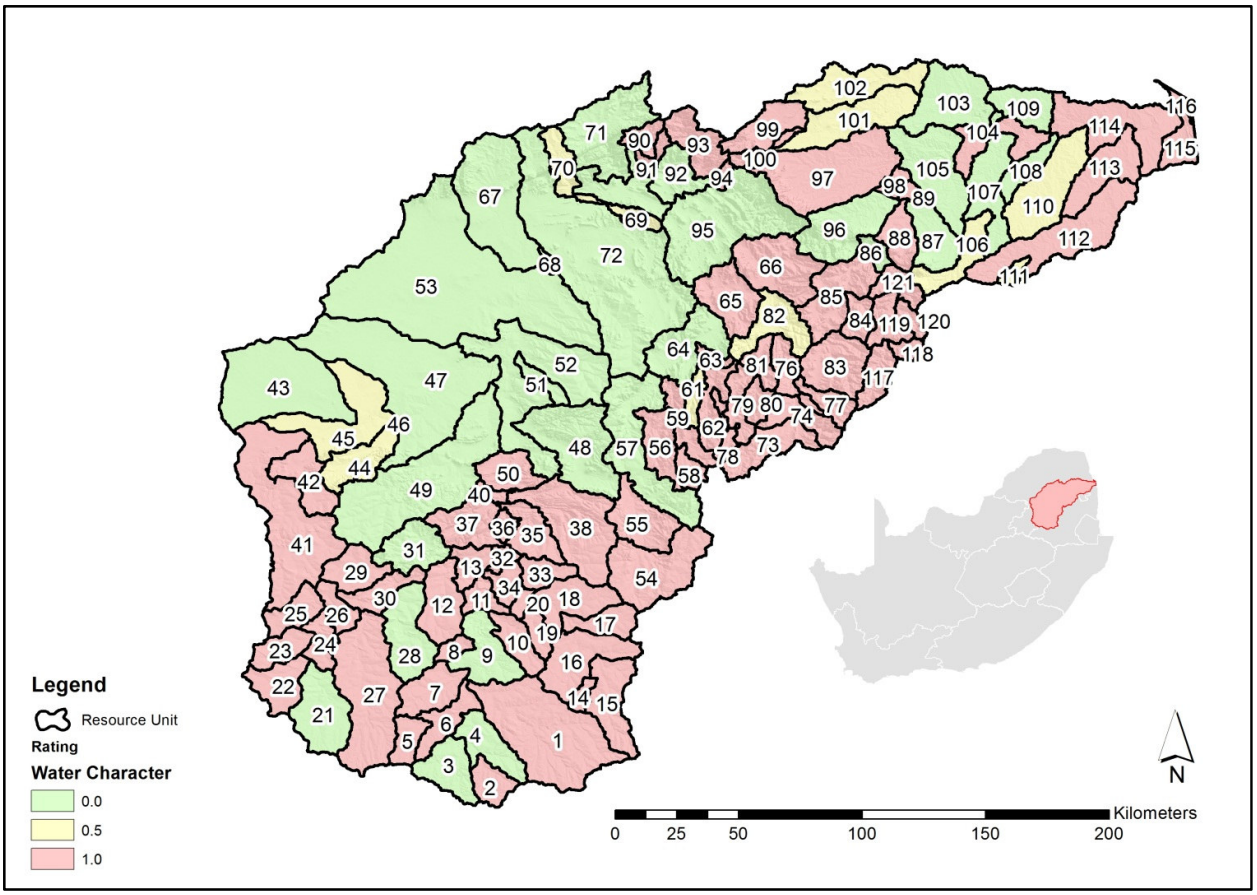

Figure 5: Spatial distribution of water character rating

3.9.1.2 Major aquifers

Groundwater occurrence was identified using the Geohydrological Yield map (DWAF, 2009) obtained from DWA. Three aquifer yield classes were defined as high, medium and low irrespective of the aquifer type as shown in Table 9. The resultant yield classification map is shown in Figure 6.

Table 9: Aquifer yield class

Aquifer Yield Class	Aquifer Yield Range
High	2.0 – 5.0 L/s
Medium	0.5 – 2.0 L/s
Low	0.0 – 0.5 L/s

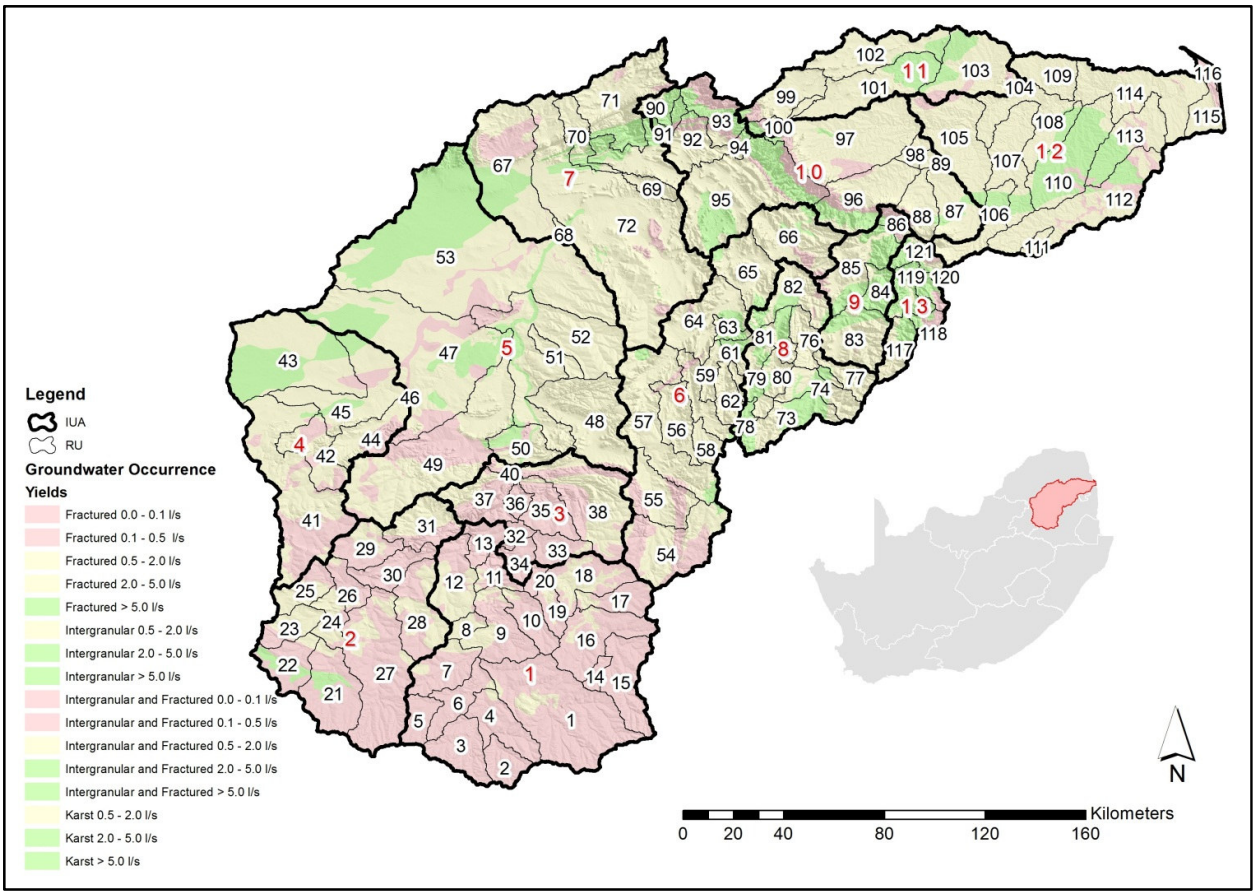

Figure 6: Major aquifer classification map

The rating guideline applied to each RU for evaluating major aquifers are presented in Table 10 and the spatial distribution of the final ratings is shown in Figure 7.

Table 10: Major aquifer rating guideline

Rating	Guideline
0.0	RUs which contain or are dominated by poor aquifers (< 0.5 L/s)
0.5	RUs which contain or are dominated by minor aquifers (0.5 - 2 L/s)
1.0	RUs which contain or are dominated by major aquifers (> 2L/s)

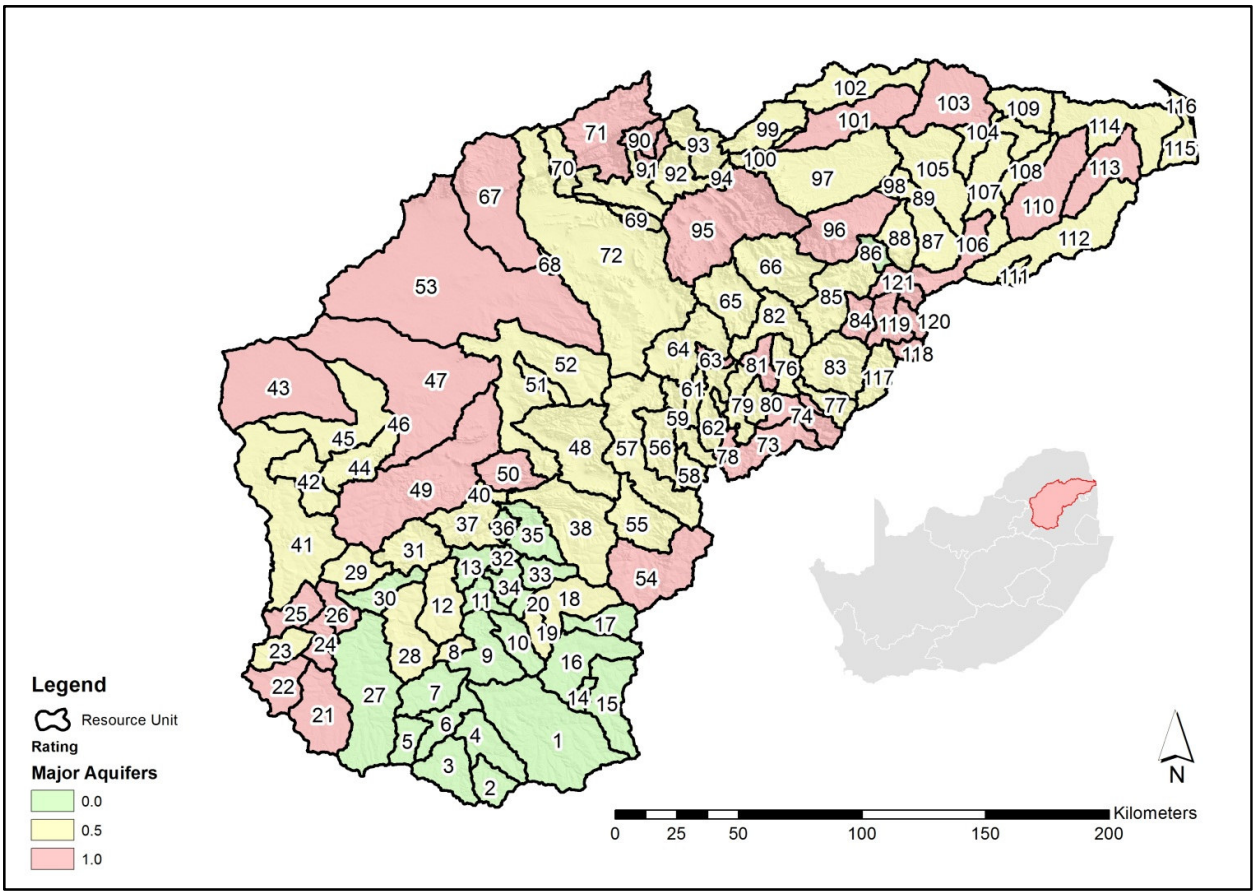

Figure 7: Spatial distribution of major aquifers rating

3.9.1.3 Activities that contribute to the economy

Activities that contribute to the economy that could be dependent on groundwater were identified as farming, parks and mines. The datasets used to depict the aforementioned activities is as follows:

- Protected Areas (DWAF Groundwater Resource Assessment Phase 2, 2006)
- Cultivated Lands (SANBI Land Cover, 2009)
- Registered Groundwater Use (WARMS Data, 2013)
- High Yielding Aquifers as discussed in previous section

The resulting map of the aforementioned covers is shown in Figure 8. The mining activities are not explicitly shown due to the fact that if they utilise groundwater it should be included in the registered use as obtained from the WARMS database.

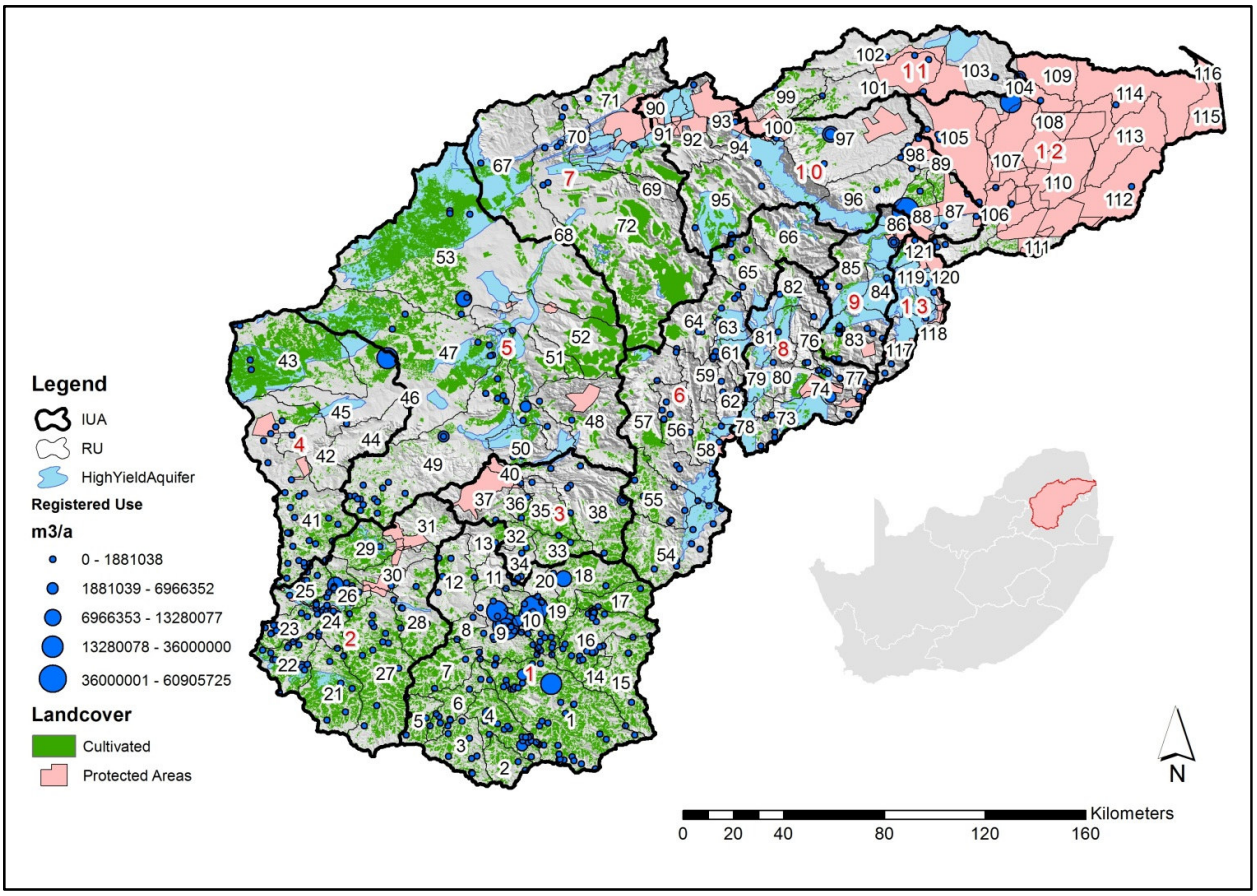

Figure 8: Activities that contribute to the economy

The rating guideline applied to each RU for evaluating the activities that contribute to the economy is presented in Table 11 and the spatial distribution of the final ratings is shown in Figure 9.

Table 11: Contribution to economy rating guideline

Rating	Guideline
0.0	RUs which do not directly support any activities which contribute to the economy
0.5	RUs which support activities which provide a moderate contribution to the economy
1.0	RUs which support activities which contribute significantly to the economy

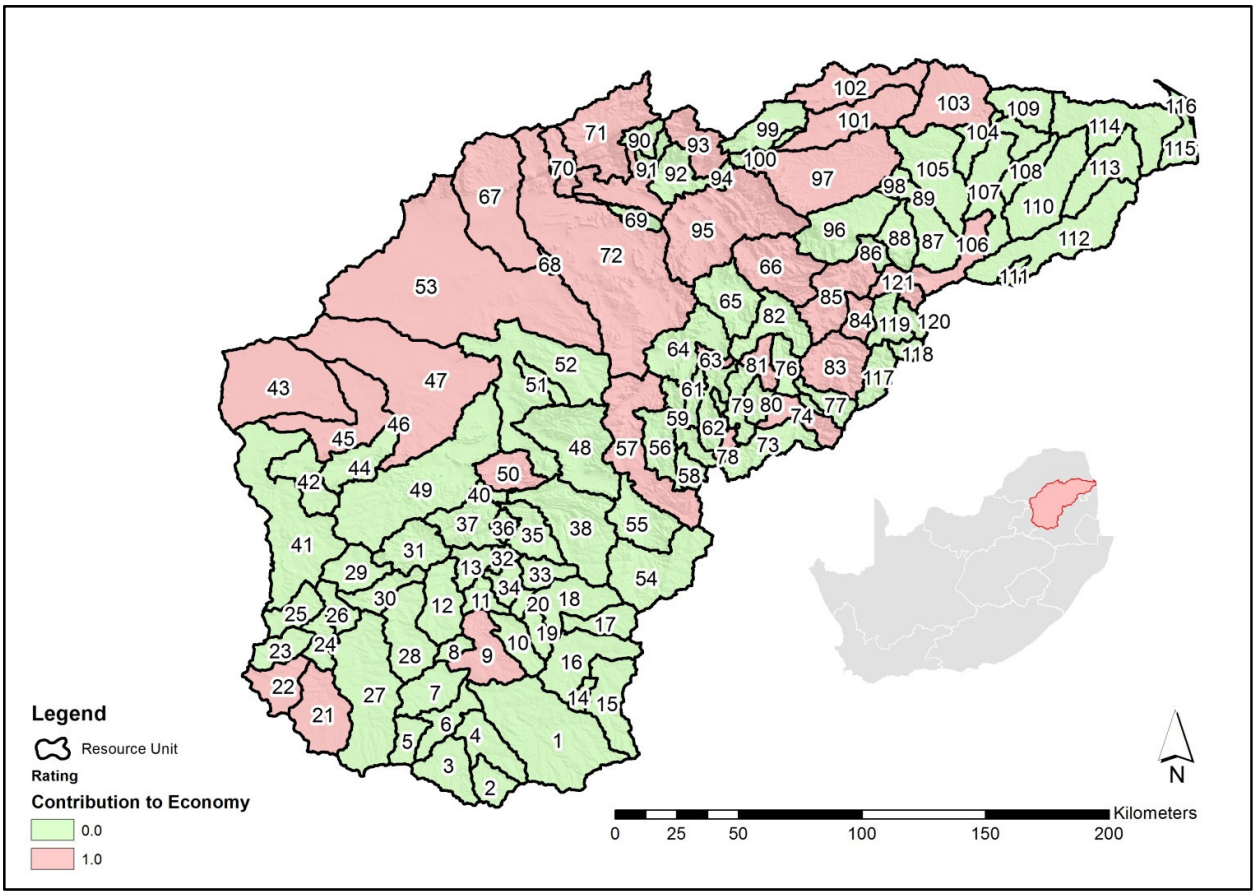

Figure 9: Spatial distribution of contribution to the economy rating

3.9.2 THREAT POSED TO USERS

The sections that follow discuss the sub-criteria linked to the threat posed to users and the rating guideline that applies to each of the sub-criteria.

3.9.2.1 Aquifers which are highly stressed (relative aquifer stress)

The AFYM (Murray *et al*, 2011) was used to calculate the aquifer firm yield per quaternary catchment that comprises the various RUs. The existing use was expressed as a percentage of the firm yield to calculate a stress index. It is important to note that the firm yield model is very conservative. The default values for the quaternaries were used that was supplied with the model, which was sourced through the GRAII project. The stress indices were classified as high, medium and low and the class breaks were chosen by selecting the highest and lowest stress index and assigning the high class low class respectively. The remainder of the remainder of the indices were scaled accordingly.

The rationale behind the approach outlined above is to highlight quaternaries that are more stressed than others, even though they may not currently be stressed. There is a huge uncertainty in the current groundwater use figures and therefore it is not possible to calculate high confidence stress indices. The purpose of the prioritisation tool is only to highlight differences between RUs to assist in the prioritisation process and the relative stress index calculation allows for the generation of contrasts between the RUs.

The resulting aquifer stresses are shown in Figure 10.

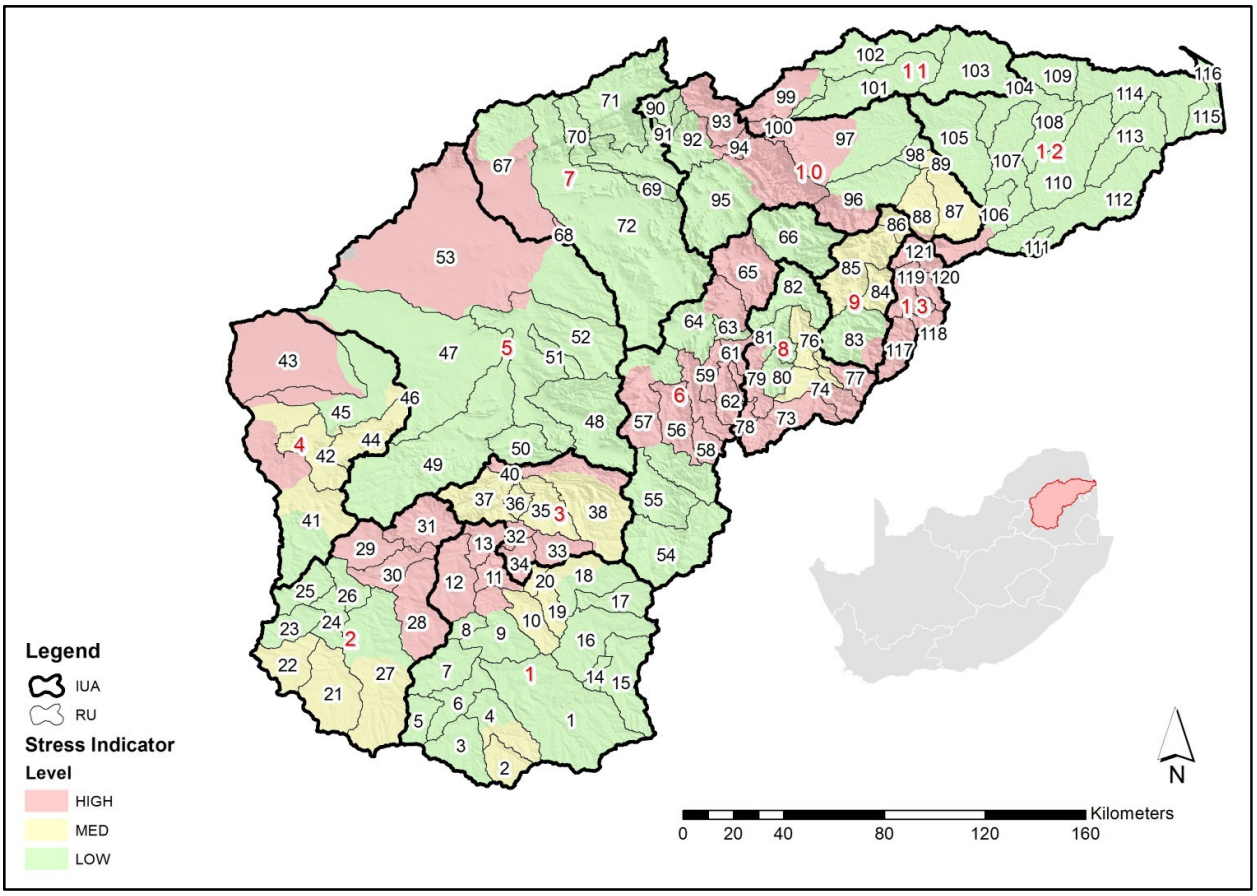

Figure 10: Relative aquifer stress

The rating guideline applied to each RU for evaluating the relative aquifer stress is presented in Table 12 and the spatial distribution of the final ratings is shown in Figure 11.

Table 12: Relative aquifer stress rating guideline

Rating	Guideline
0.0	RUs which contain or are dominated by aquifers which are not stressed
0.5	RUs which contain or are dominated by aquifers which are moderately stressed
1.0	RUs which contain aquifers which are highly stressed

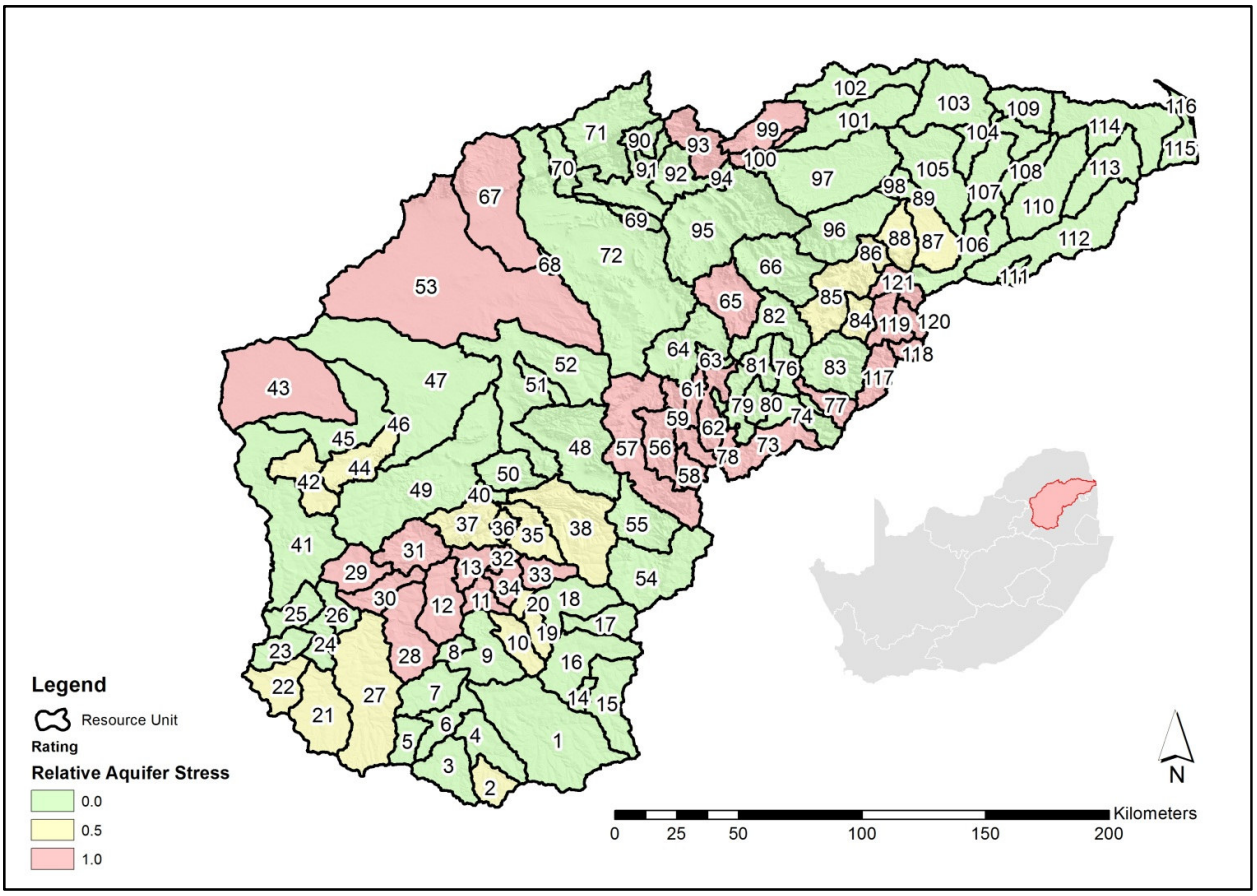

Figure 11: Spatial distribution of relative aquifer stress rating

3.9.2.2 Water quality currently threatened

There is not enough historic data available with good distribution across the study area to allow for the generation of a detailed groundwater quality map. The datasets used to visually show the current water quality across the area are:

- The TDS map to give indication of the regional groundwater salinity levels (DWAF Vegter Map, 1995)
- Current and Abandoned Mines (NWU Geography Department, author unknown)

Background groundwater quality is inherently related to the host geology and can be spatially highly variable depending on the geological and physical setting. Although mining operations can be indicative of potential groundwater quality issues, the evaluation of this sub-criterion relies heavily on the public participation process. The resultant map produced is shown in Figure 12.

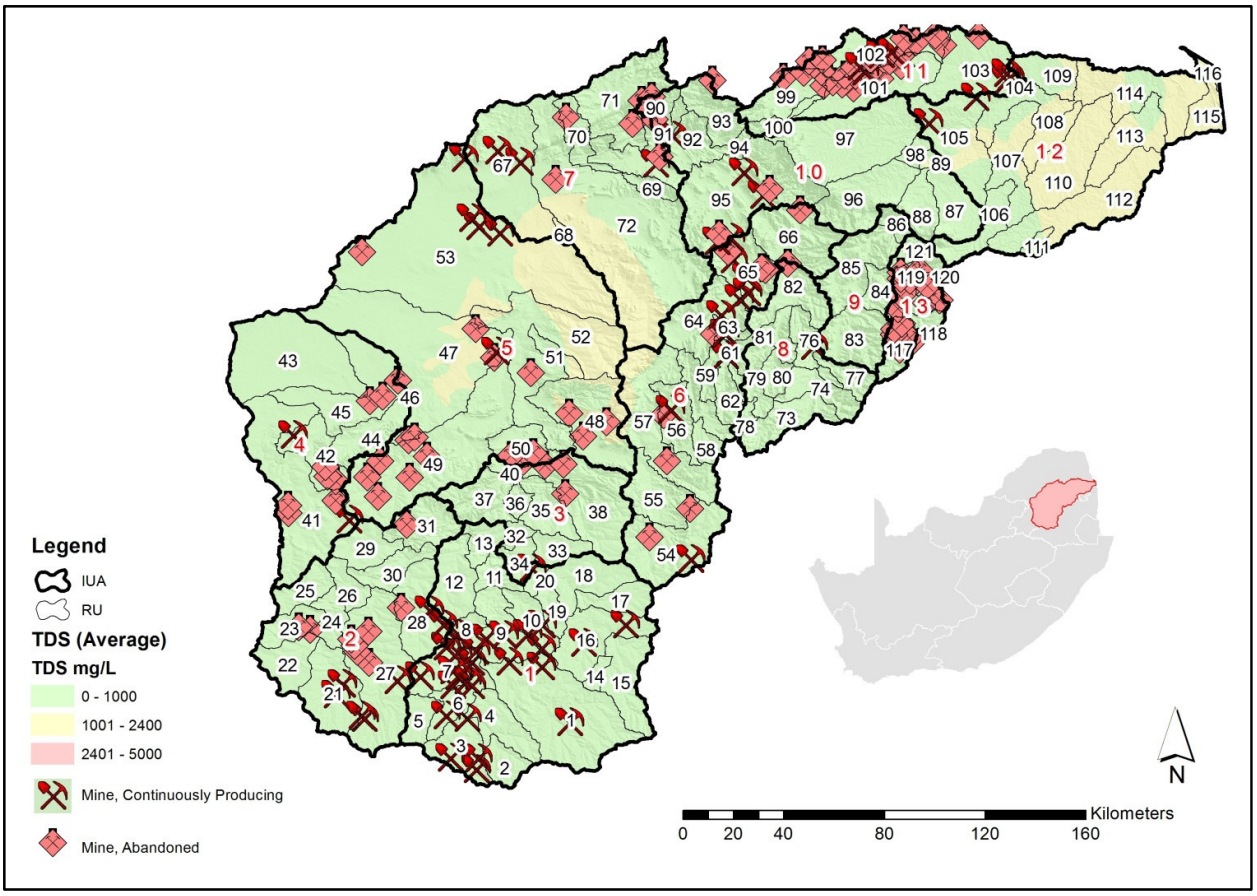

Figure 12: Groundwater quality distribution map

The rating guideline applied to each RU for evaluating water qualities that are currently threatened is shown in Table 13 and the spatial distribution of the final ratings is shown in Figure 13.

Table 13: Water quality that is threatened rating guideline

Rating	Guideline
0.0	RUs where potential threat to water quality is low
0.5	RUs where potential threat to water quality is moderate
1.0	RUs where potential threat to water quality is high

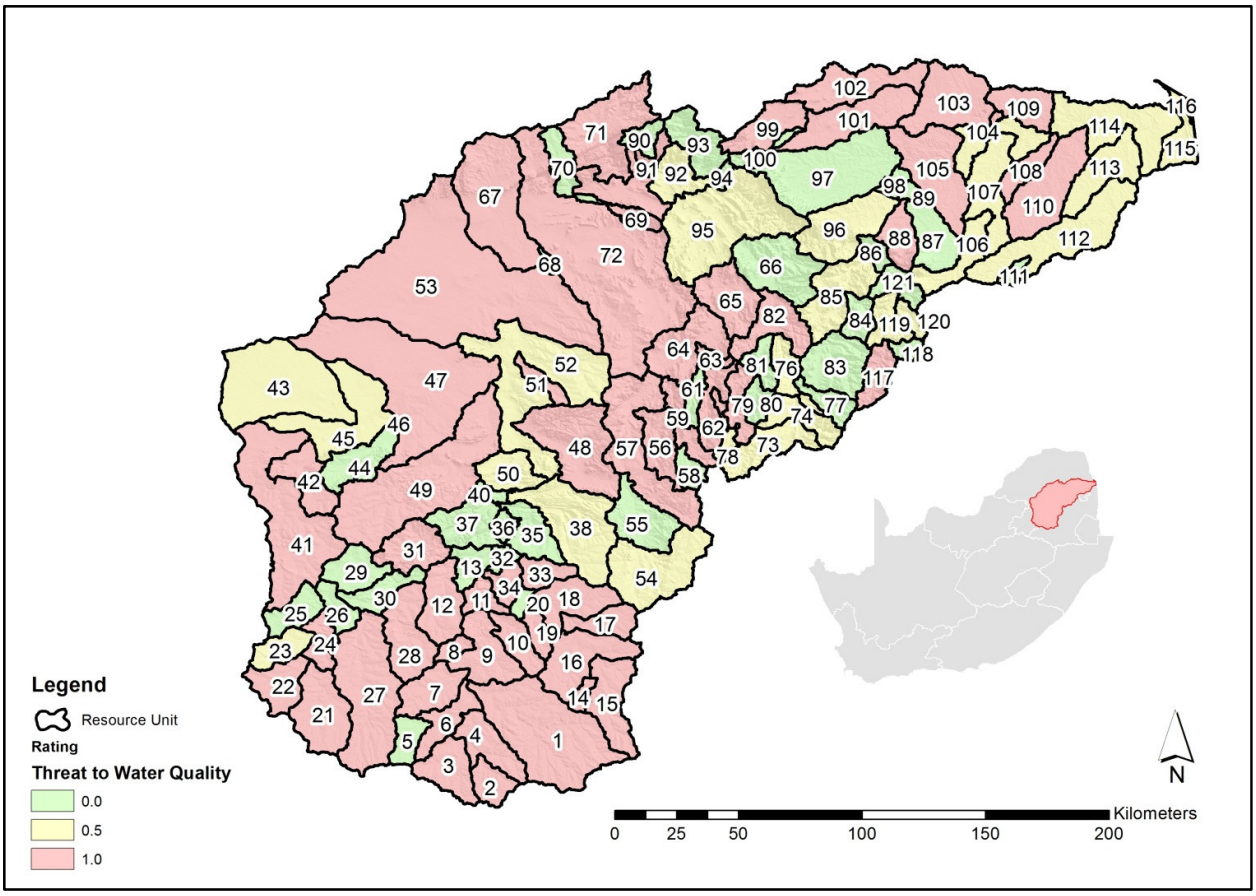

Figure 13: Spatial distribution of threat to water quality rating

3.9.2.3 Vulnerable aquifers

Aquifer vulnerability is addressed through the DRASTIC map (DWAF, 2011). The map comprise of the following parameters:

Table 14: DRASTIC Parameters

Parameter	Input dataset
Depth to water table (D)	126 263 groundwater levels from the NGDB (for 4 280 of these, the mean groundwater level was calculated from time-series data) were interpolated to a groundwater level grid.
Recharge (R)	Recharge calculated as part of GRAII-3 project.
Aquifer material (A)	1:1 million Geology from CGS
Soils (S)	WR90 soils data set
Topography and slope (T)	DWAF 20m DTM resampled to 1X1km
Impact of the vadose (unsaturated) zone (I)	1:1 million Geology from CGS
Hydraulic conductivity (C)	1:1 million Geology from CGS

The DRASTIC index has a maximum index of 200 which represents the highest aquifer vulnerability with respect to pollution. For the purpose of the prioritisation tool the following classes of DRASTIC index were adopted based on the index range for the study area:

- High Vulnerability (122-178)
- Medium Vulnerability (90-121)
- Low Vulnerability (60-89)

The resulting map is shown in Figure 14.

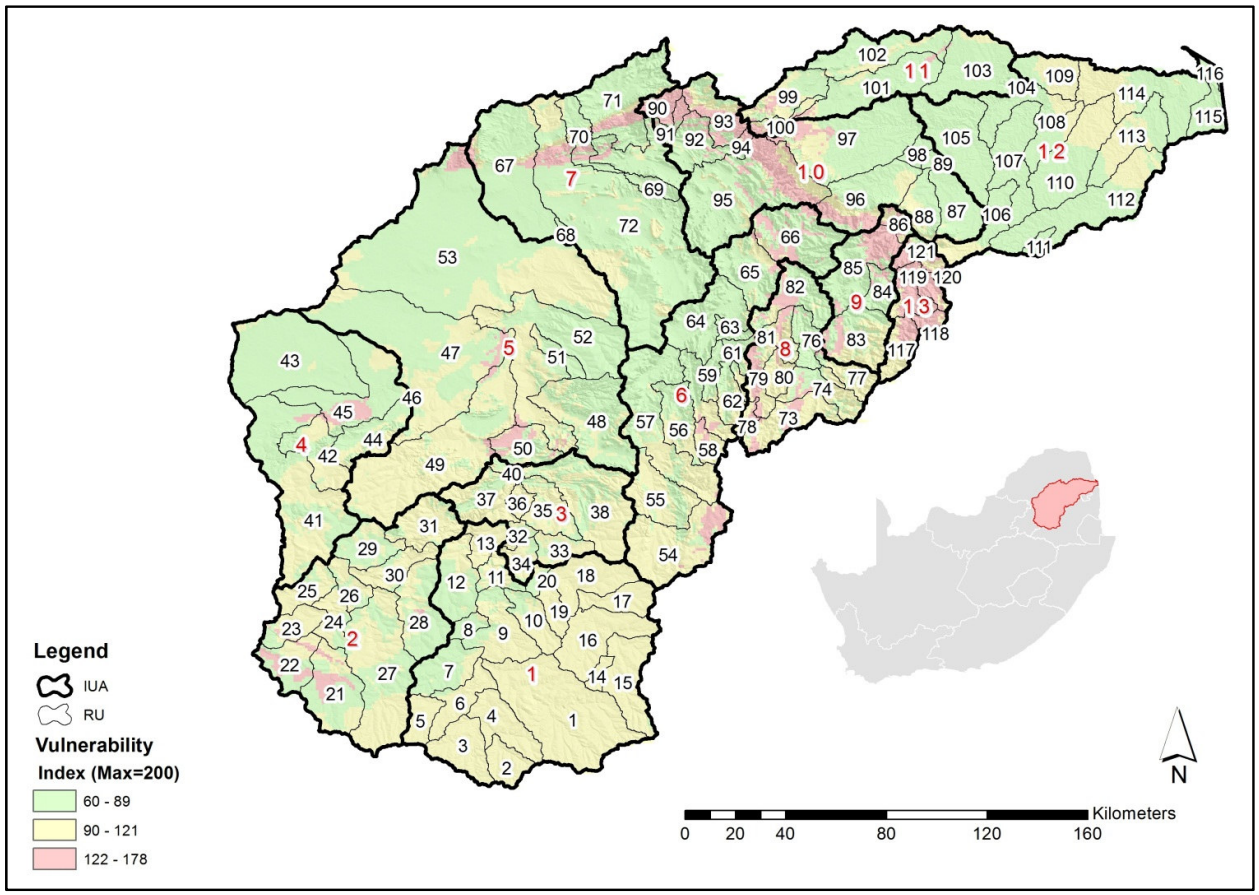

Figure 14: DRASTIC aquifer vulnerability

The rating guideline applied to each RU for evaluating aquifer vulnerabilities are shown in Table 15 and spatial distribution of the final ratings is shown in Figure 15.

Table 15: Aquifer vulnerability rating guideline

Rating	Guideline
0.0	RUs that are not vulnerable to pollution
0.5	RUs that are moderately vulnerable to pollution
1.0	RUs that are highly vulnerable to pollution

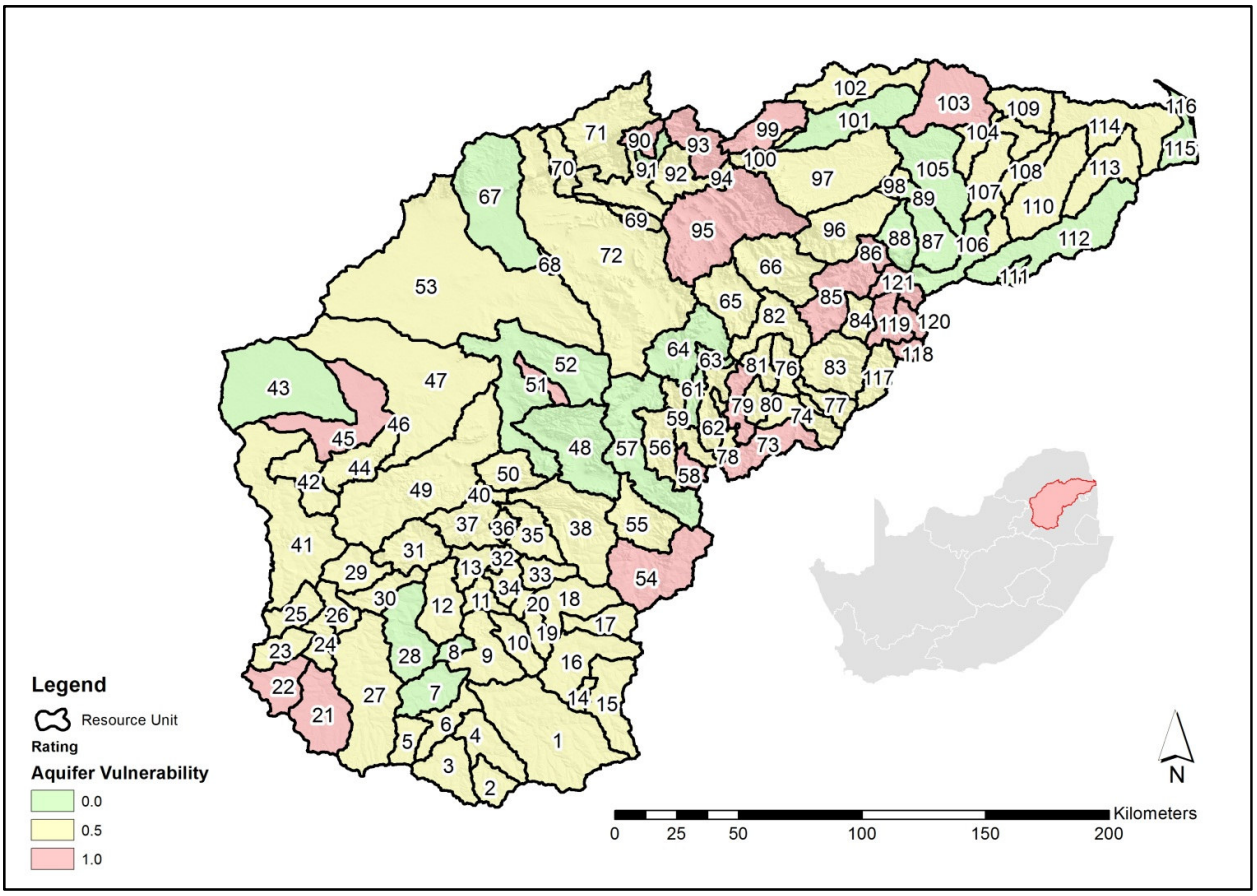

Figure 15: Spatial distribution of aquifer vulnerability rating

3.9.3 ECOLOGICAL IMPORTANCE

The sections that follow discuss the sub-criteria linked to the ecological importance and the rating guideline that applies to each of the sub-criteria.

3.9.3.1 Groundwater importance to wetlands

The wetland cover generated for the study area was used and only wetlands associated with possible groundwater dependence were considered. The spatial distribution of the wetlands directly affected by groundwater are shown in Figure 16.

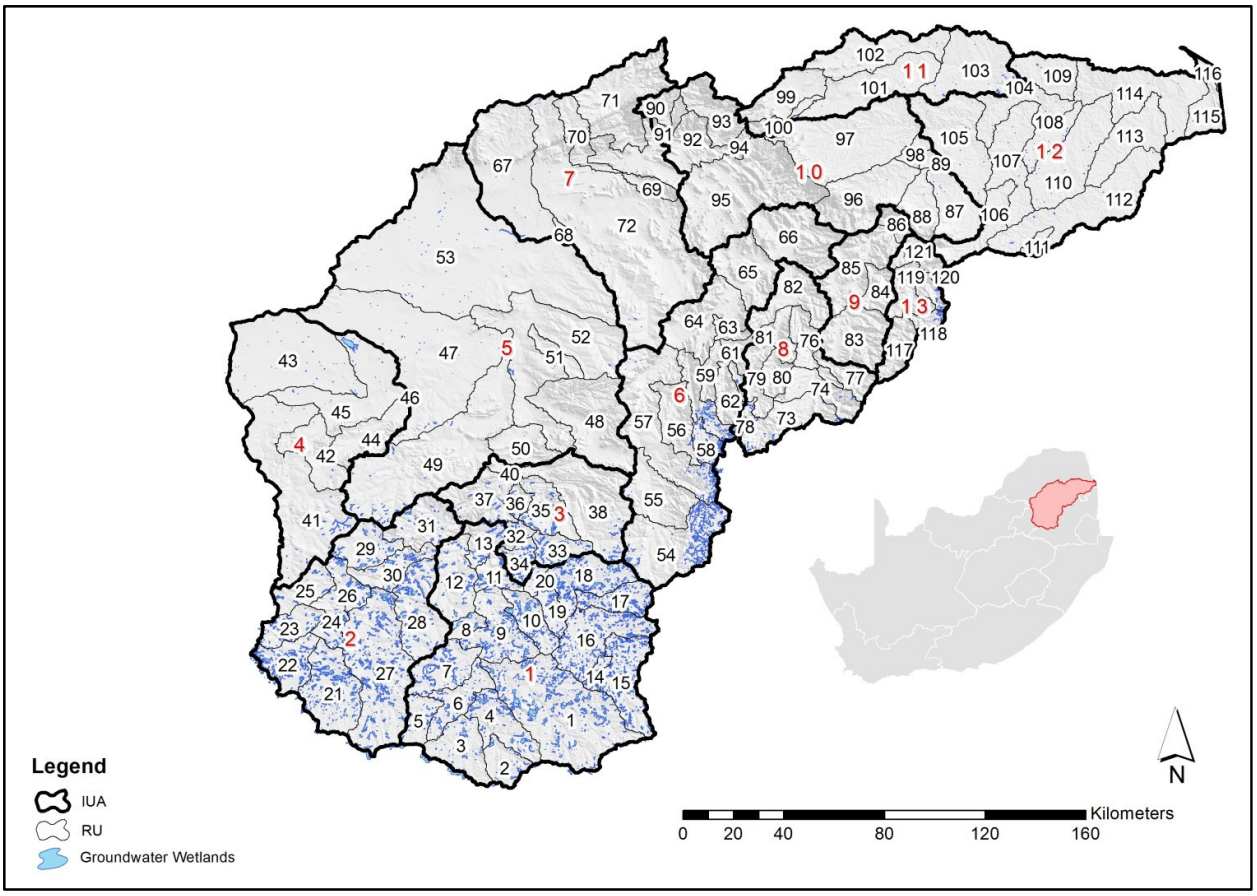

Figure 16: Wetlands directly affected by groundwater in the study area.

Evaluation of the wetlands posed difficult due to the large number and the uncertainty with regard to groundwater, therefore the wetland densities per RU was used in the evaluation. The rating guideline applied to each RU for evaluating groundwater importance to wetlands is shown in Table 16 and the spatial distribution of the final rating is shown in Figure 17.

Table 16: Groundwater importance to wetlands rating guideline

Rating	Guideline
0.0	RUs which contain wetlands with low groundwater importance
0.5	RUs which contain wetlands with moderate groundwater importance
1.0	RUs which contain wetlands with high groundwater importance

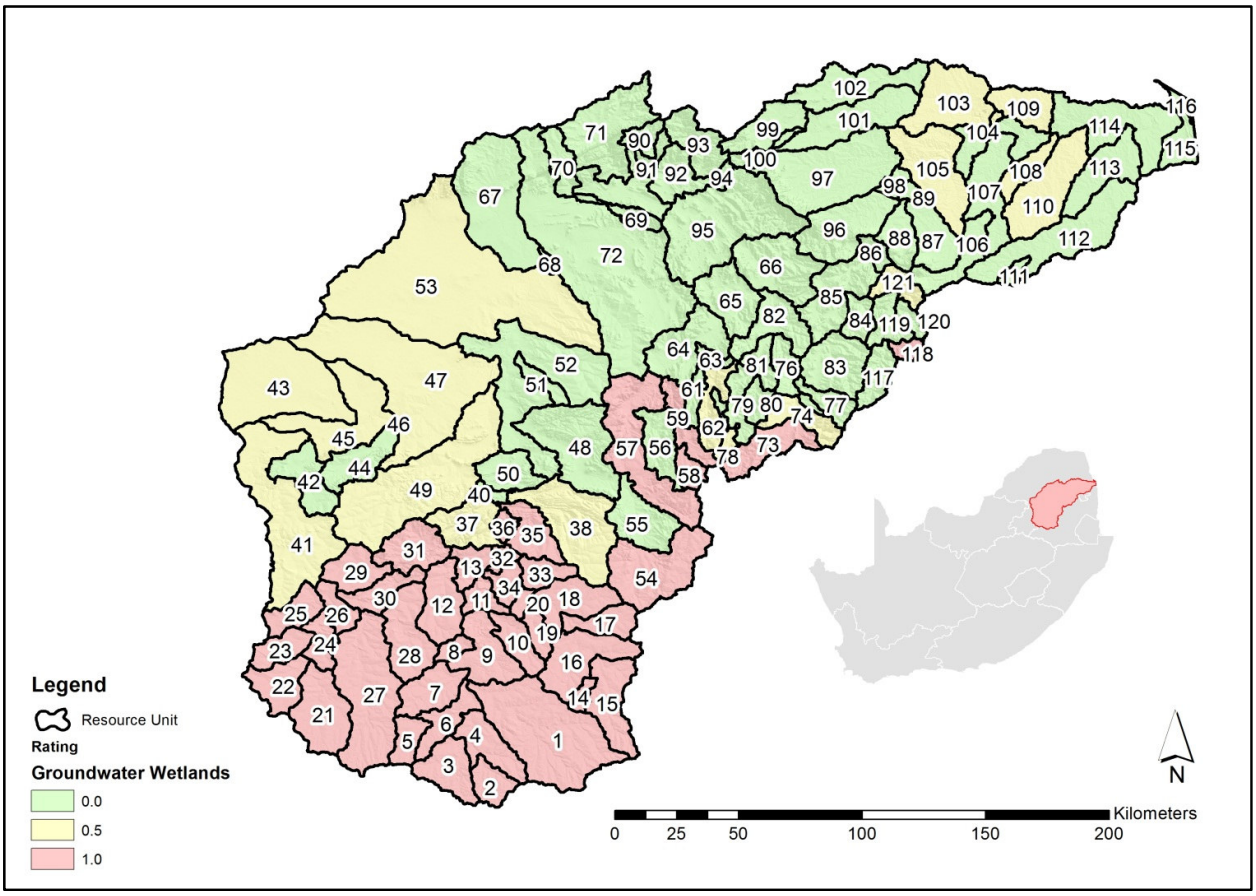

Figure 17: Spatial distribution of wetlands directly affected by groundwater rating.

3.9.3.2 Surface-groundwater water interaction

Surface-groundwater interaction is an on-going field of research and this component is very expensive to measure. This has resulted in models being used to predict the groundwater contribution to baseflow. For the purpose of the prioritisation tool the estimated groundwater contribution to baseflow (GRDM, Van Tonder, 2000) was expressed as a percentage of the MAR. The resultant map is shown in Figure 18.

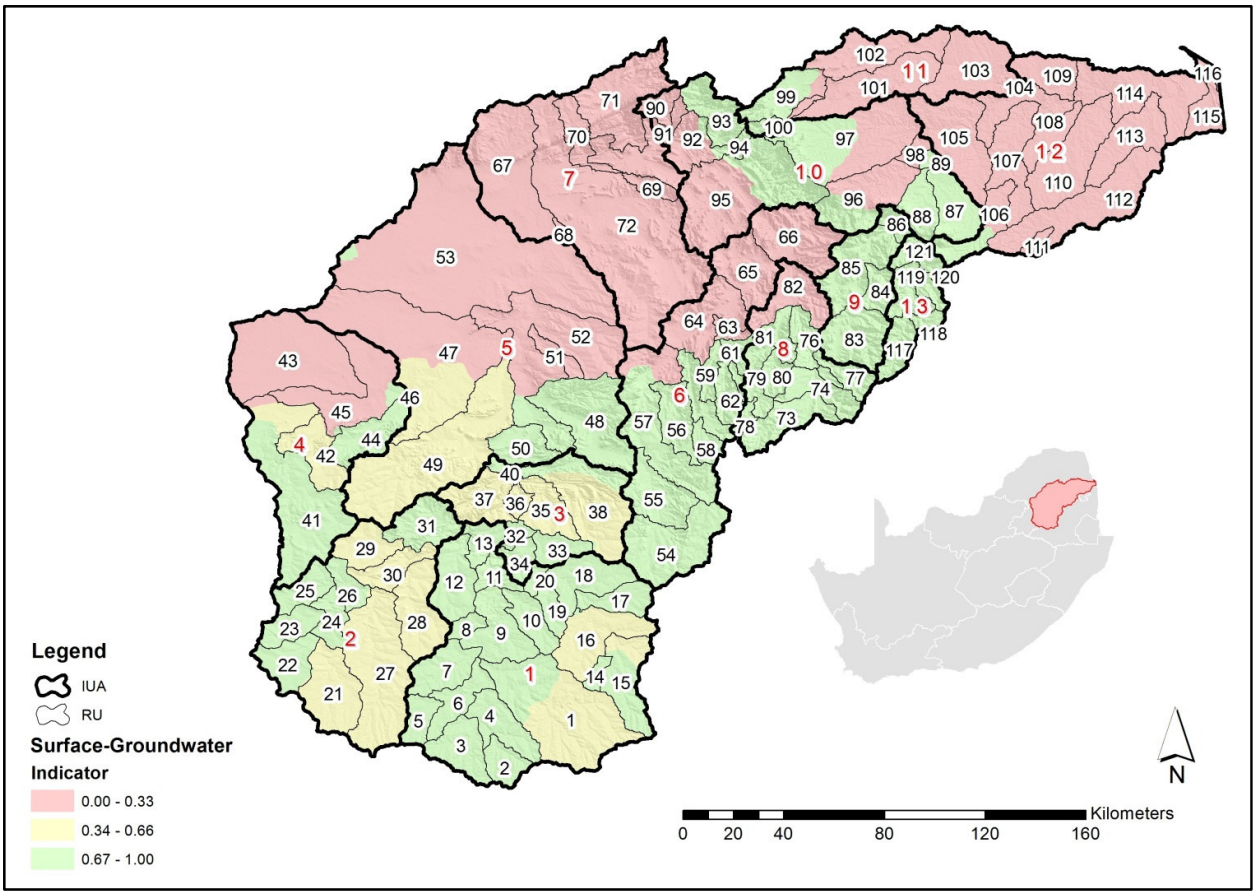

Figure 18: Surface-groundwater interaction

The rating guideline applied to each RU for evaluating the surface-groundwater interaction is shown in Table 17 and the spatial distribution of the final ratings is shown in Figure 19.

Table 17: Surface-groundwater interaction rating guideline

Rating	Guideline
0.0	RUs which contain insignificant GW-SW interaction
0.5	RUs which contain moderate GW-SW interaction
1.0	RUs which contain significant GW-SW interaction

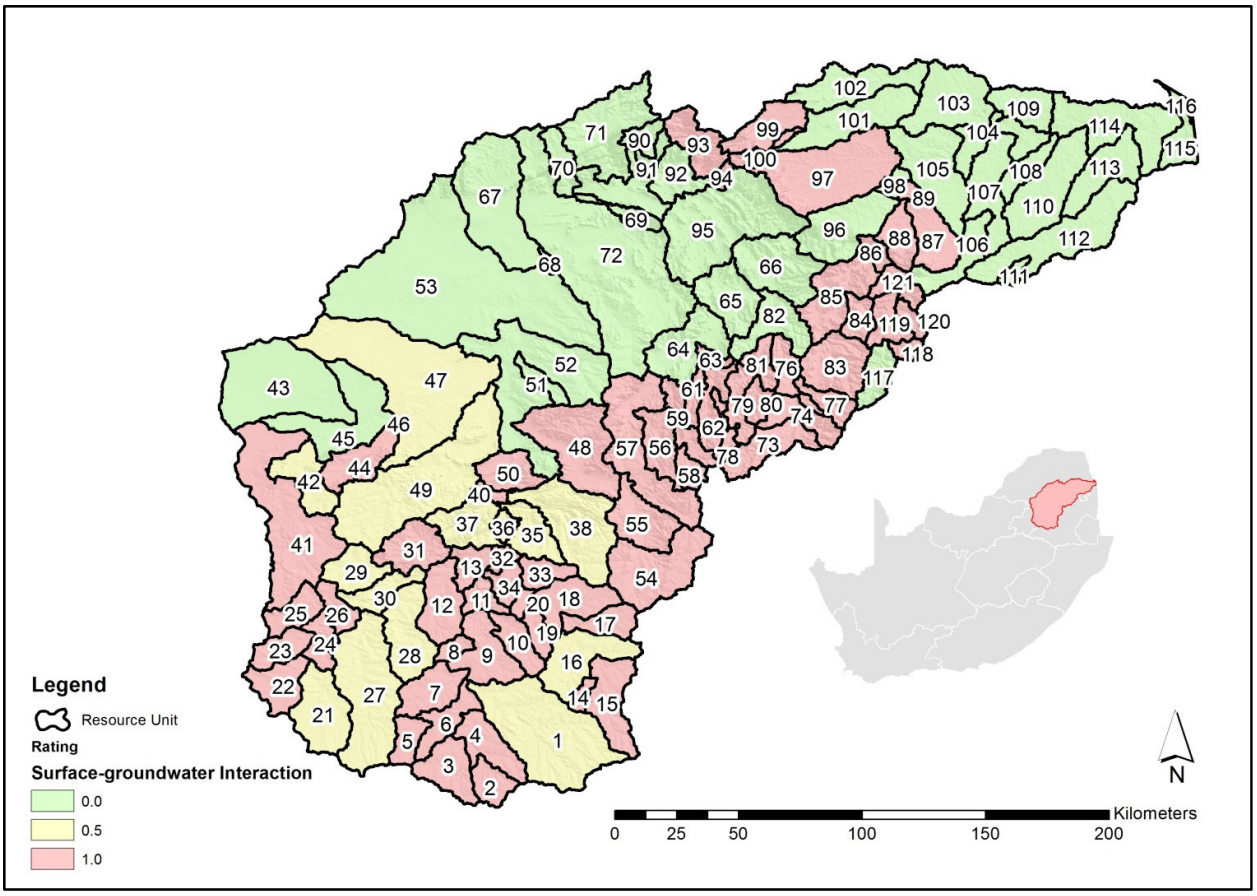

Figure 19: Spatial distribution of surface-groundwater interaction rating

3.9.3.3 Important groundwater fauna

This sub-criteria has been included for the sake of completeness, but no database exist that can be used to apply this specific sub-criteria. Table 18 shows the rating guideline to be used once this type of data is available.

Table 18: Important groundwater fauna rating guideline

Rating	Guideline
0.0	RUs which contain little groundwater fauna
0.5	RUs which contain moderate groundwater fauna
1.0	RUs which contain major groundwater fauna

3.9.4 MANAGEMENT CONSIDERATIONS

A dataset that shows the existence of management plans is not available and this criterion relies heavily on the inputs from the public participation. It is assumed that existing mines will have management plans and therefore existing mining locations is used as secondary indicator to where management plans might exist. Figure 20 shows existing mining positions (reference of dataset is unknown, obtained from the NWU Geography Department).

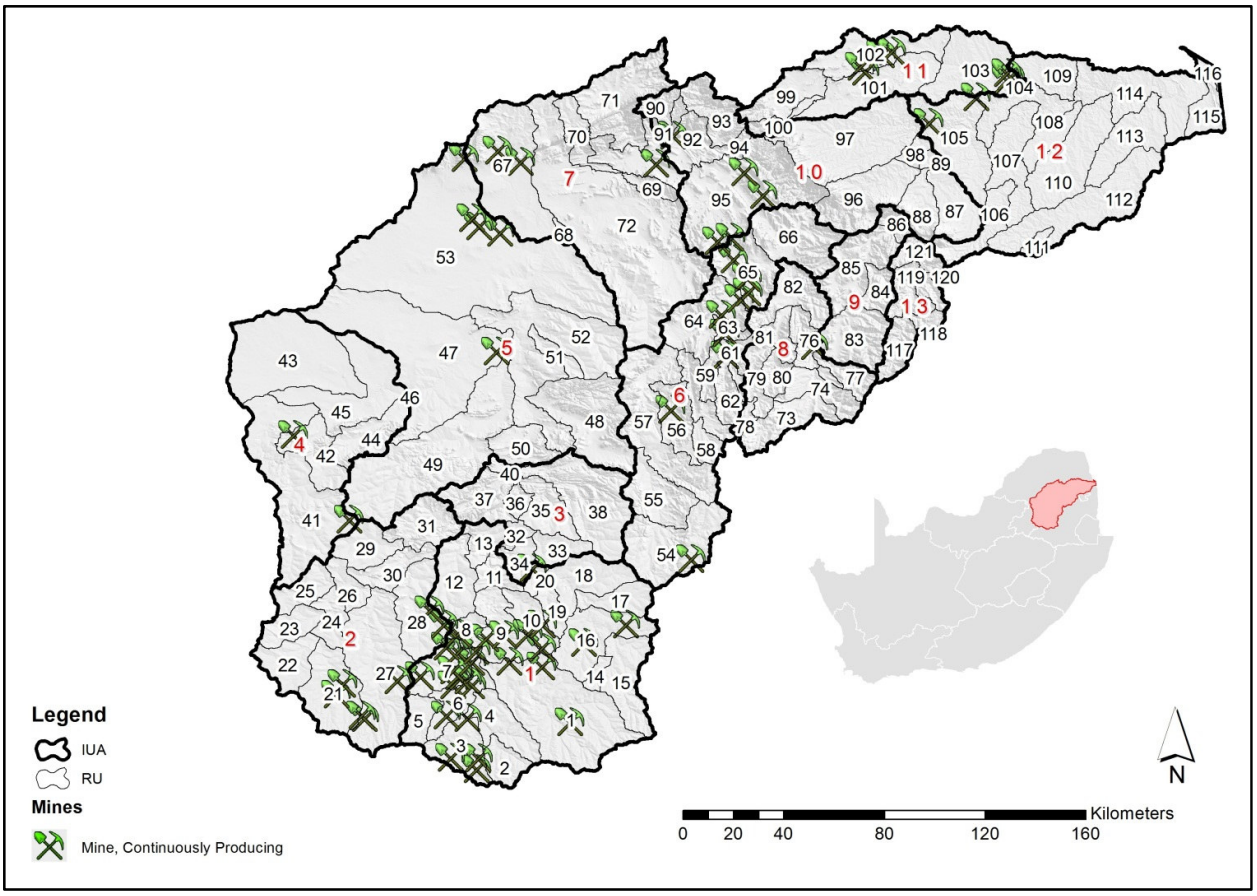

Figure 20: Current mining positions assumed to have management plans

Table 19 shows the rating guideline to be applied to the selected RUs and the spatial distribution of the final ratings is shown in Figure 21.

Table 19: Contribution to economy rating guideline

Rating	Guideline
0.0	RUs which do not contain groundwater resources for which management plans exist
1.0	RUs which contain groundwater resources for which management plans exist

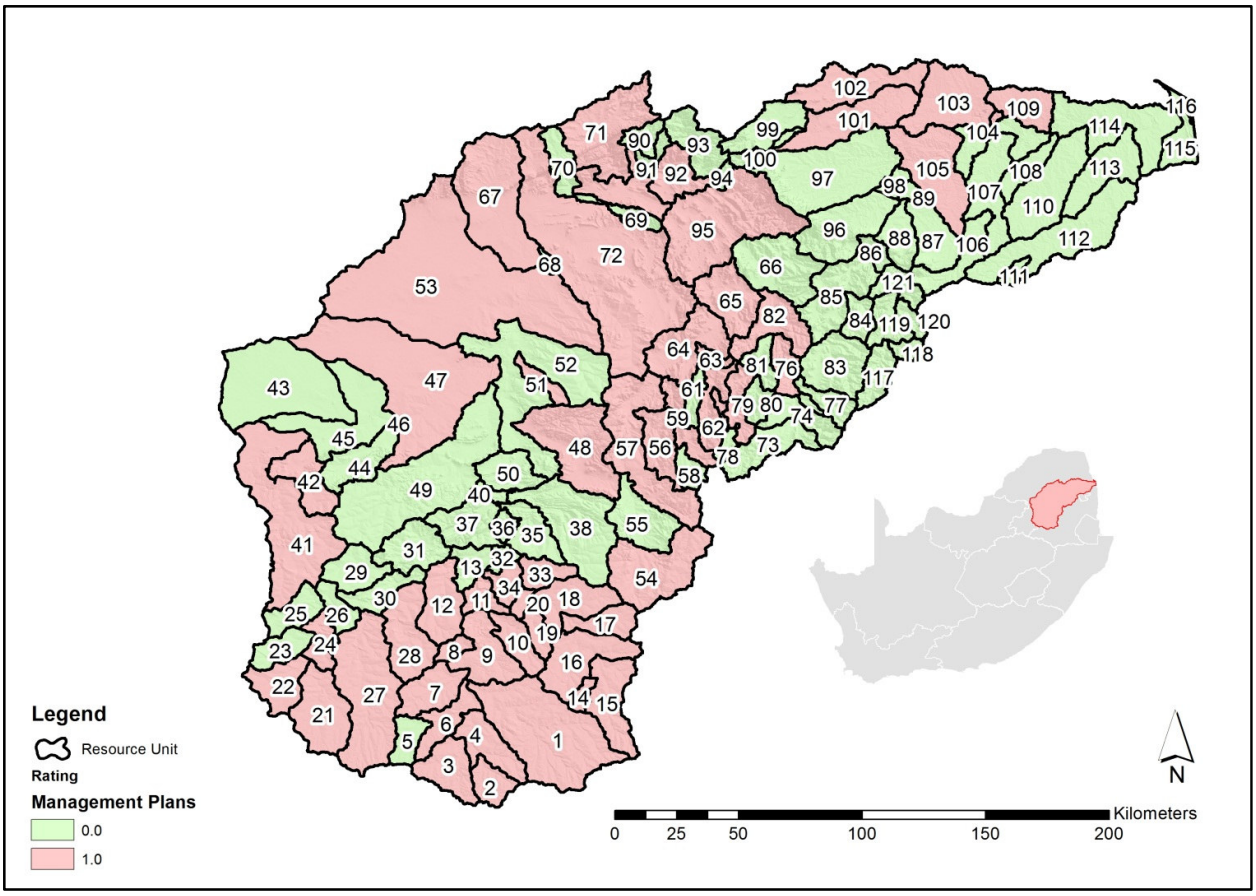

Figure 21: Spatial distribution of management plans rating

4 FINDINGS

4.1 PRIORITY RIVER RESOURCE UNITS FOR THE OLIFANTS WMA

The application of the RUPT and refinement by stakeholders resulted in the selection of 30 priority RUs for the Olifants WMA. These RUs and associated IUAs as well as their relationship to the PES-EIS desktop study, Water Resource Classification study, and Reserve studies are detailed in Table 20. The location of these Resource Units is shown in Figure 22.

Table 20: Priority River Resource Units selected for the Olifants WMA.

RU	IUA	Reach (PES-EIS)	Hydronode (WRC)	EWR site	Level of Reserve
9	1	B11J-01155	HN9		
11	1	B11J-01086	HN11		
12	1	B11L-01051	HN12		
13	1	B11L-01024	HN13		
24	2	B20D-01146	HN24		
31	2	B20J-00998	HN31	EWR4	Comprehensive
40	3	B32D-00855	HN40		
46	4	B31G-00769	HN46		
47	5	B31J-00648	HN47		
49	5	B32H-00698	HN49		
52	5	B51B-00589	HN52		
53	5	B51C-00509	HN53		
54	6	B41A-01025	HN54		
56	6	B41C-00766	HN56		
57	6	B41E-00689	HN57		
62	6	B41G-00674	HN62		
66	6	B41K-00487	HN66	EWR10	Comprehensive
72	7	B71A-00390	HN72		
82	8	B42H-00553	HN82		
83	9	B60F-00632	HN83		
86	9	B60H-00485	HN86		
95	10	B71F-00393	HN95		
96	10	B71G-00428	HN96	EWR11	Comprehensive
97	10	B72A-00405	HN97		
98	10	B72C-00406	HN98		
103	11	B72K-00260	HN103	EWR14b	Comprehensive
104	11	B72K-00260	HN104		
105	12	B72D-00326	HN105	EWR13	Comprehensive
116	12		HN116		
121	13	B60D-00525	HN121		

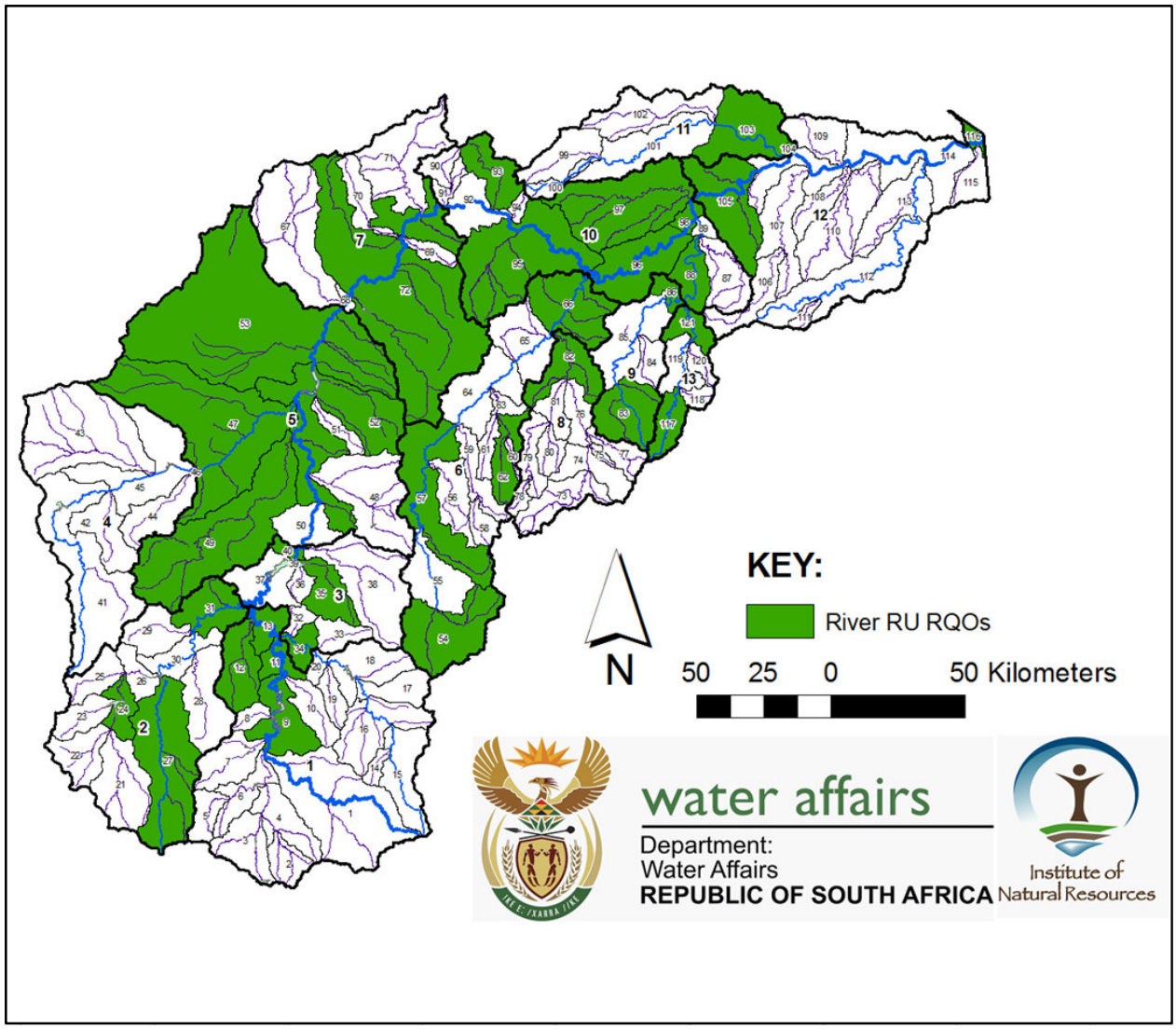

Figure 22: River Resource Units prioritised for the Olifants WMA

4.2 PRIORITY WETLAND ECOSYSTEMS FOR THE OLIFANTS WMA

4.2.1 EXTENT OF MAPPED WETLANDS IN THE OLIFANTS CATCHMENT

The extent of mapped wetlands used to inform the prioritisation of wetlands in the Olifants catchment is presented in Figure 23, below. Whilst the concentration of wetlands in the upper Olifants is exacerbated to some extend by the increased mapping intensity in this area, the upper catchment is characterized by a much higher occurrence of wetlands than the remaining catchment. Poor mapping of wetlands across much of the study area is a serious limitation in this study however and should be refined for future assessments of this nature.

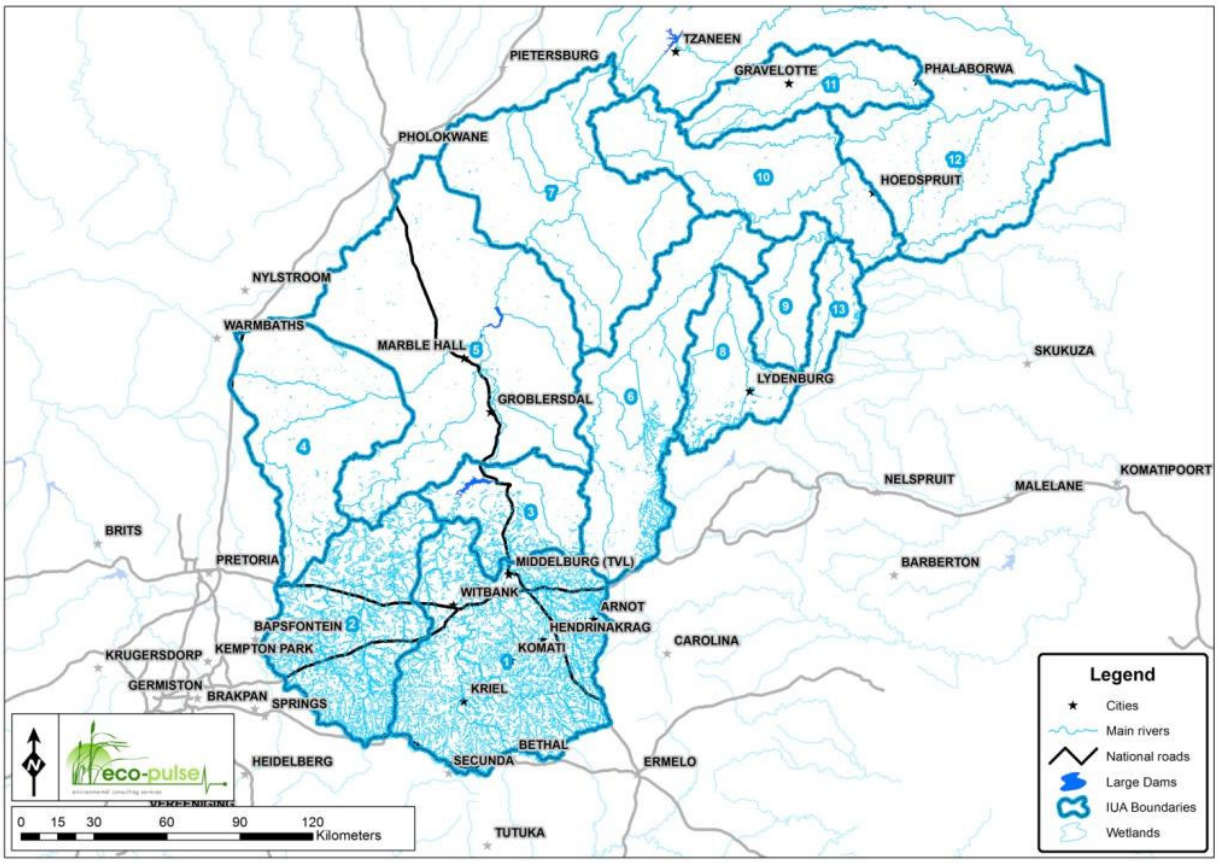

Figure 23: Distribution of mapped wetlands in the Olifants catchment.

4.2.2 RESULTS OF THE DESKTOP PRIORITISATION EXERCISE

A brief summary of the results of the wetland prioritisation exercise undertaken for the Olifants catchment is presented here. This includes relevant maps indicating the relative importance of mapped wetlands for each of the primary criteria used to inform the prioritisation and selection process.

4.2.2.1 Location of wetlands within each IUA

The rating of wetlands based on their location relative to primary drainage lines and IUA outlets in presented in Figure 24, below. This identifies wetlands which would be worth selecting based on their potential usefulness in providing a measure of the effectiveness of upstream management measures in meeting water resource classification commitments. It is worth noting here that sparse mapping of wetlands in lower catchment areas sometimes meant that no wetlands were flagged in some IUAs.

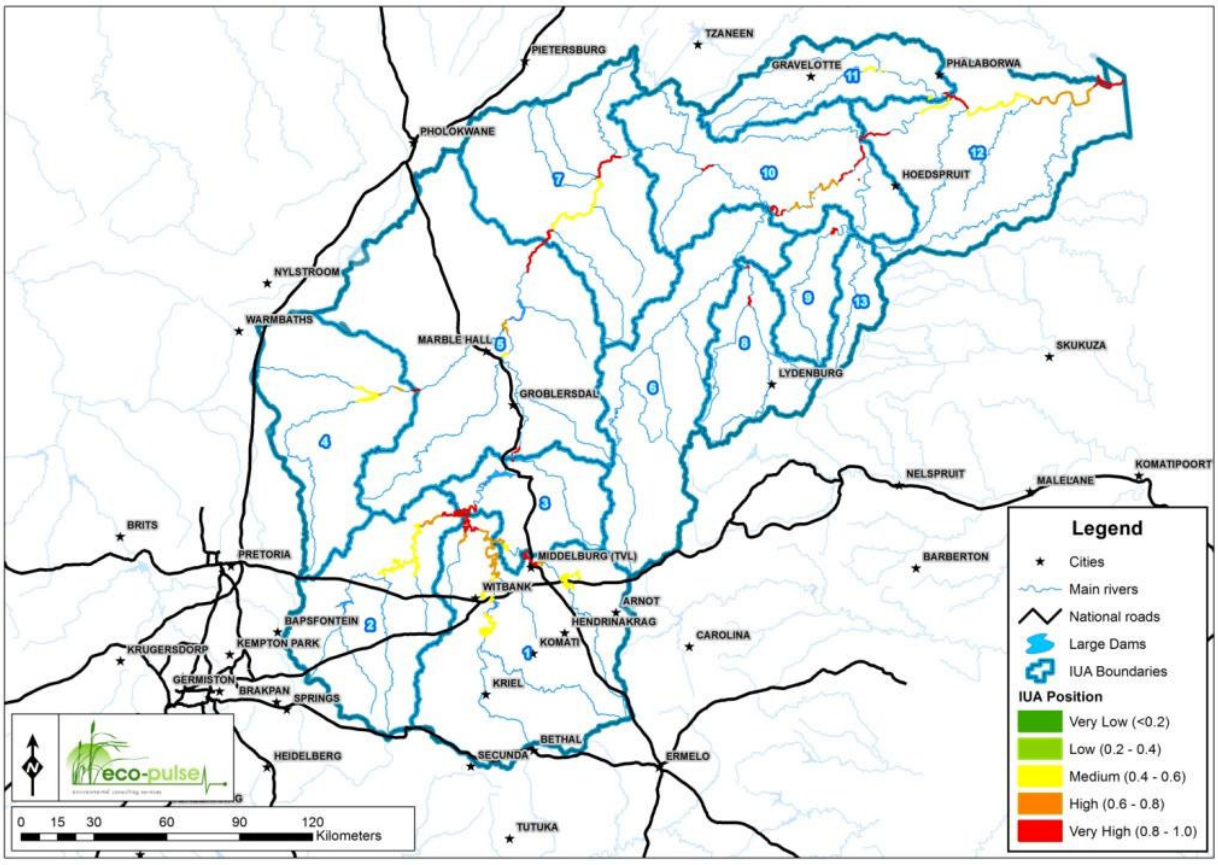

Figure 24: Rating of wetlands based in their location along main stem rivers and potential for integrating impacts associated with the upstream IUA.

4.2.2.2 Concern for users

The outcome of this exercise was a rating of wetlands based on an assessment of the importance of wetland resources to users and the threat posed to wetland systems (Figure 25). Not surprisingly, this highlights wetlands in the upper Olifants that are subject to high threats from mining activities. Wetlands identified as being potentially important in providing regulating and supporting services (regarded as particularly important in this catchment) also feature prominently.

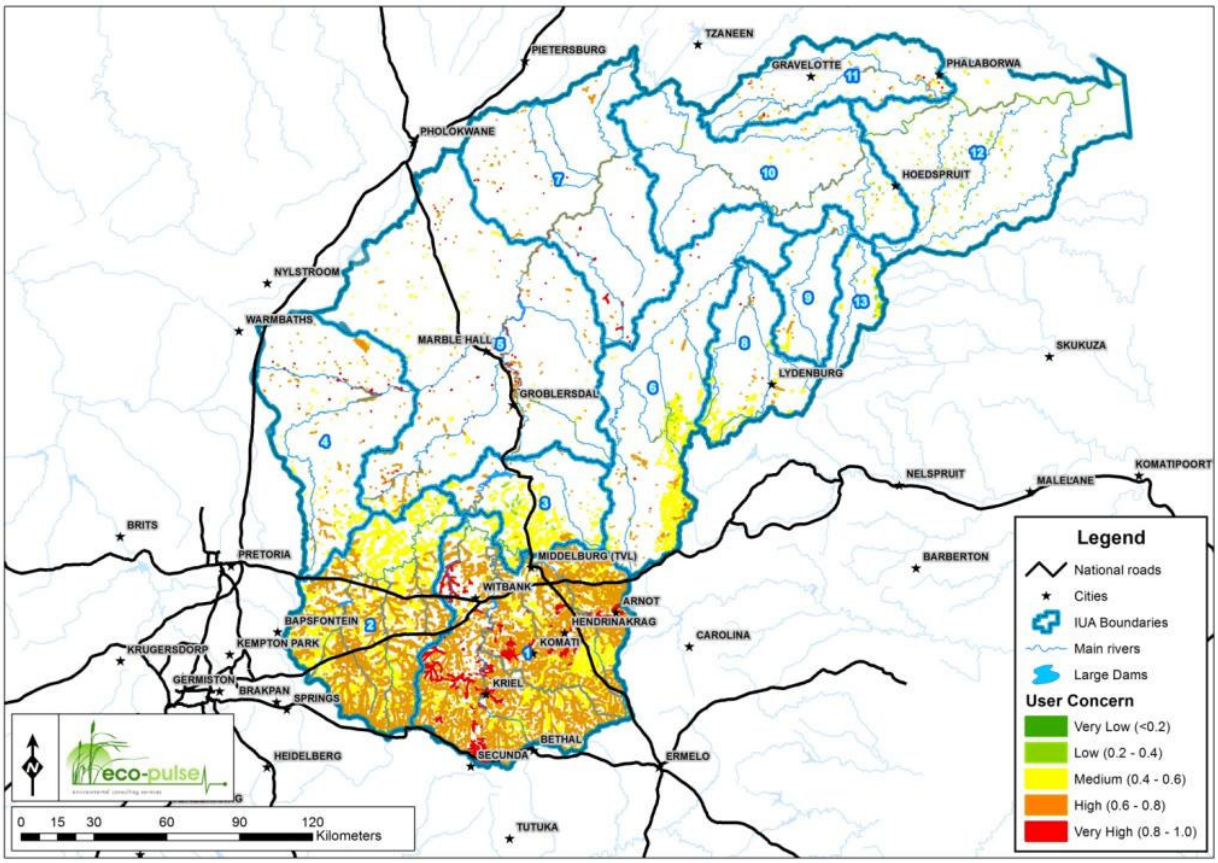

Figure 25: Prioritisation of wetlands based on concern for users in the Olifants catchment.

4.2.2.3 Concern for environment

Wetlands were also rated based on the importance of water resources from a conservation / protection perspective and threats posed to these resources (Figure 26). This paints a somewhat different picture, with wetlands in upper (largely un-impacted) catchment areas and those associated with protected areas featuring highly in the assessment.

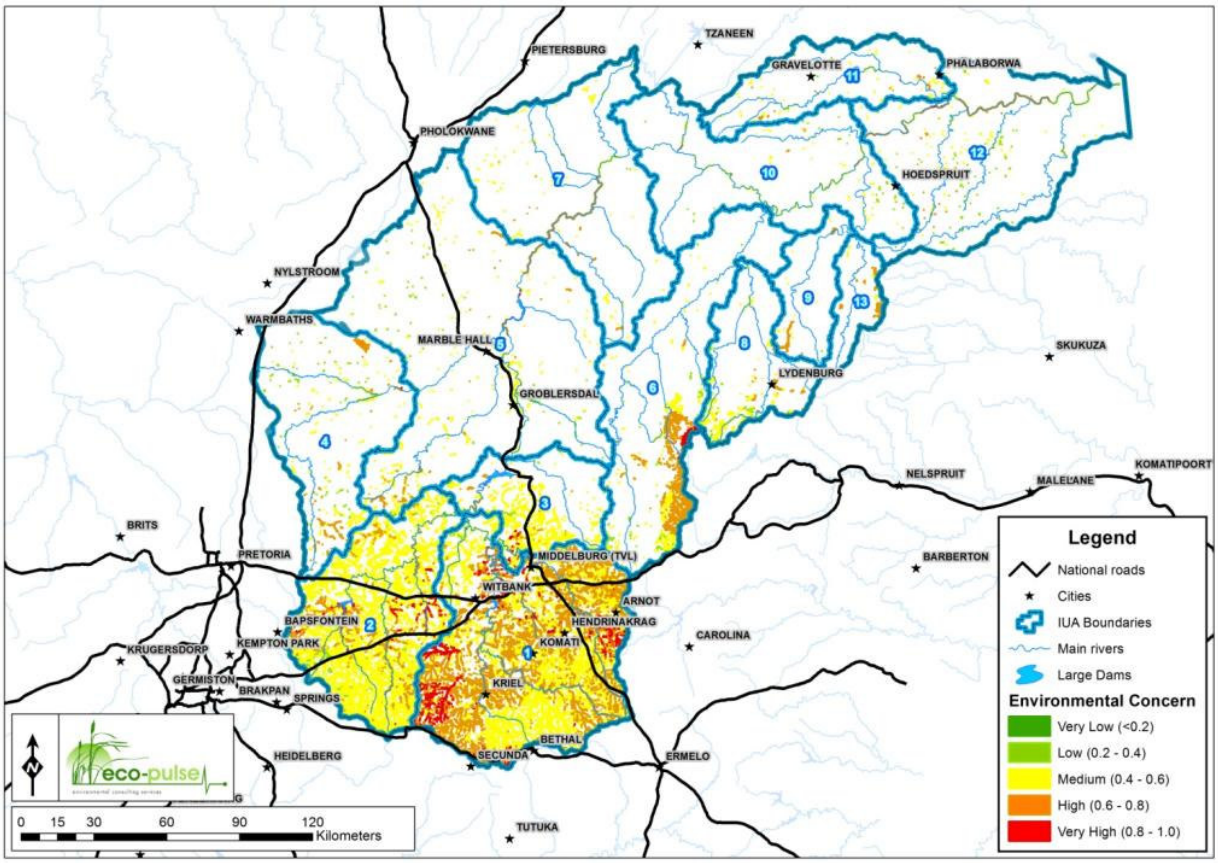

Figure 26: Map indicating the ratings of wetlands based on environmental criteria.

4.2.2.4 Practical considerations

For this component of the assessment, wetlands were prioritised based on the anticipated availability of baseline data that could inform the RQO process (Figure 27). There is unfortunately very little information available for the study area with only two known sites selected by DWS for wetland monitoring and a handful of sites where the Working for Wetland programme has been working.

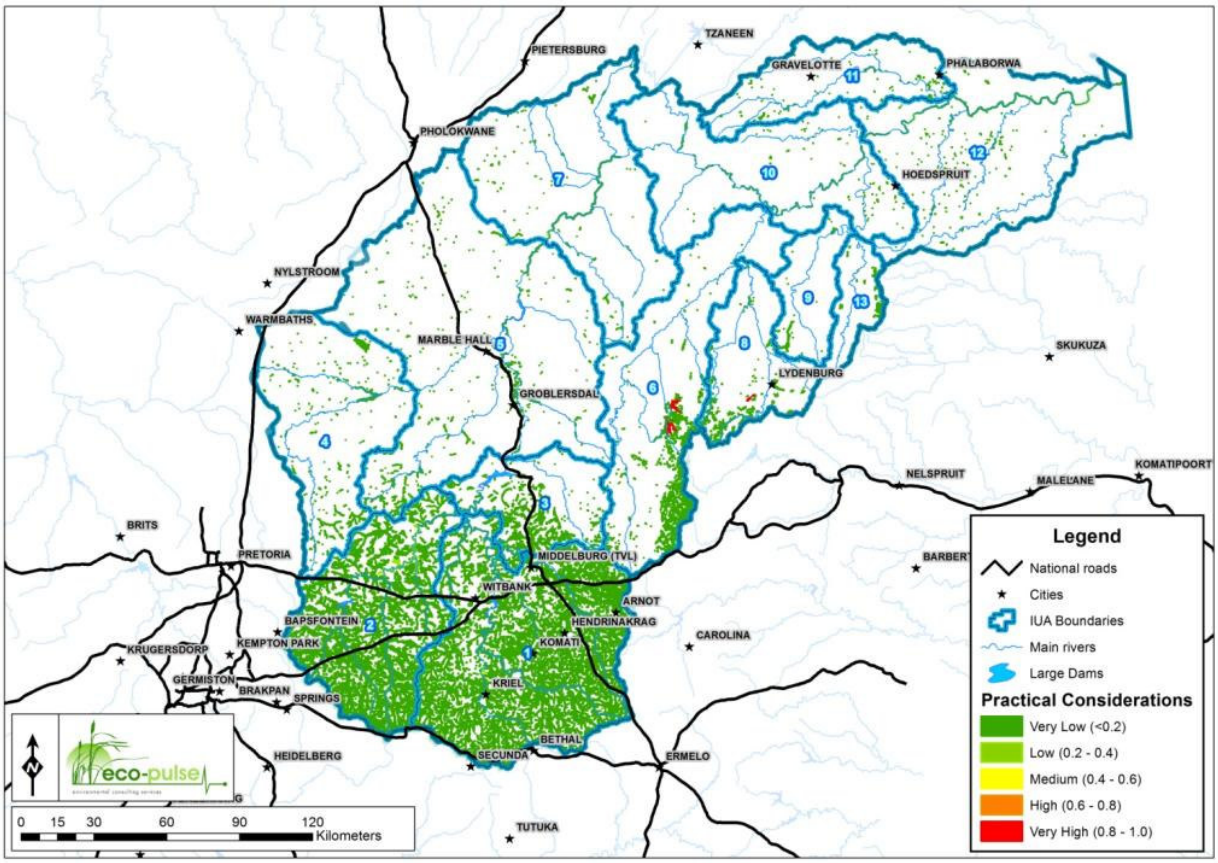

Figure 27: Wetland rating based on practical considerations (reflecting available data sources).

4.2.3 WETLANDS INITIALLY IDENTIFIED BY KEY STAKEHOLDERS

A wide range of candidate wetland systems were identified independently through engagement with local stakeholders. The location of these sites is indicated in Figure 28 below and includes a large number of wetlands in IUA6 (Steenkampsberg area) and a range of other sites in the Upper Olifants catchment[4].

[4] Note that this excludes sites identified by Gary Marneweck which were identified and discussed as part of the final selection process.

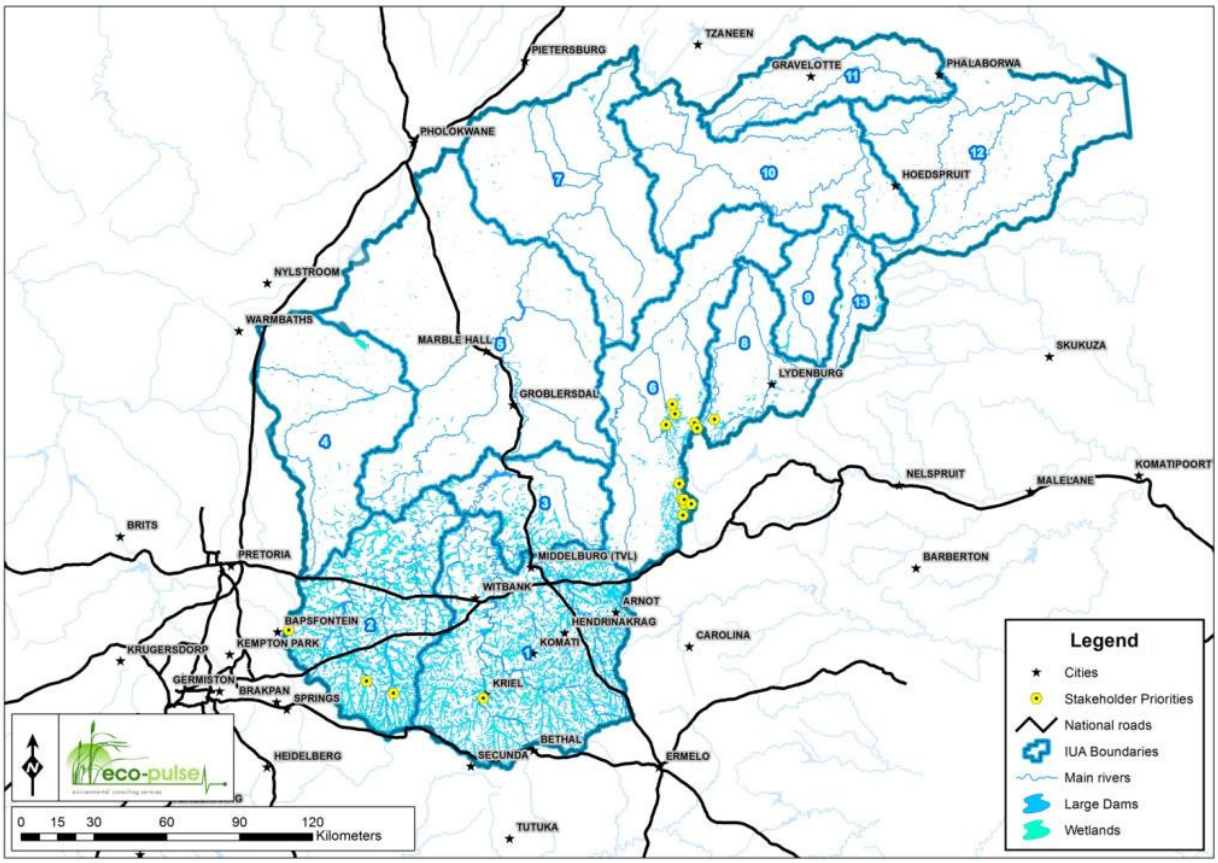

Figure 28: Priority wetlands identified by local stakeholders.

4.2.4 WETLANDS SELECTED FOR RQO DETERMINATION

Once candidate wetlands had been identified, these were screened in consultation with key stakeholders. The location of priority wetlands selected through the process is indicated in Figure 29, below. Further details including a review of the importance of wetlands in providing goods and services within each IUA which informed the selection process is documented for each IUA in this section of the report presented below.

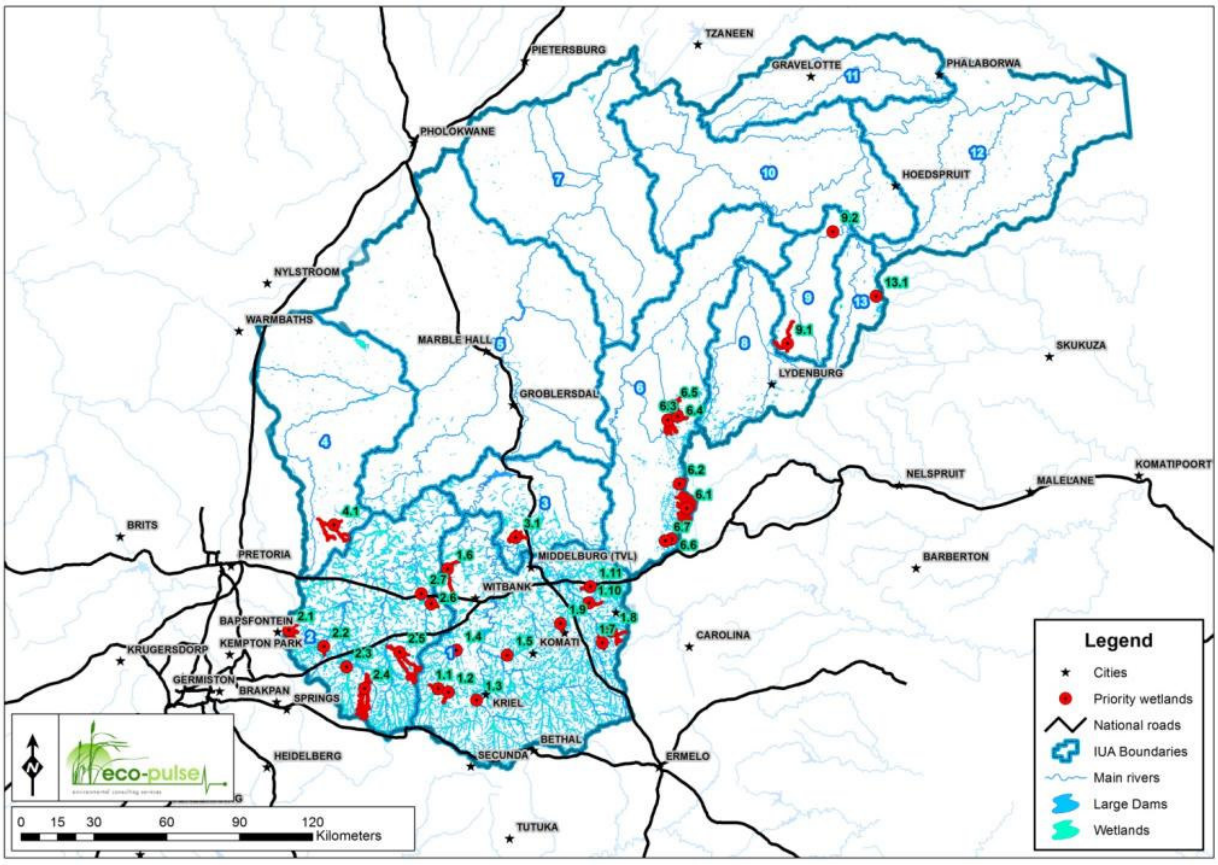

Figure 29: Map indicating the distribution and location of wetlands prioritized for RQO determination in the Olifants catchment.

4.2.4.1 IUA 1: Upper Olifants WMA

Overview of water resources in the IUA

The river ecosystems in the IUA are degraded and mainly in an E category presently due to the coal mining activities, large dams and urbanisation. Based on available wetland information, approximately 49% of wetlands in the catchment occur in this IUA. As such, wetland management should be regarded as a key focus in this IUA if wetland protection targets are to be achieved and functional characteristics maintained. Most wetlands are moderately to largely modified (C-D PES) although some good condition wetlands still persist (Figure 30). Incision of wetland systems is a common occurrence and has significantly undermined the ability of wetlands in this catchment to perform regulating and supporting services.

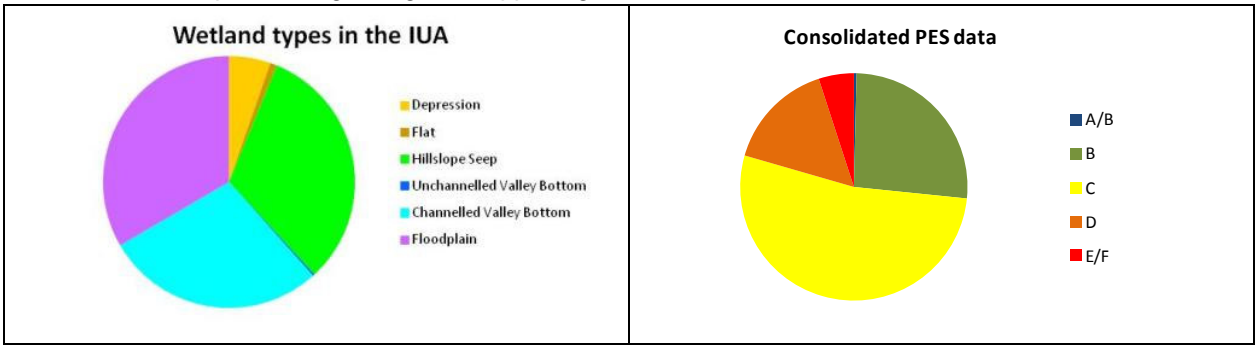

Figure 30: Wetland types and consolidated PES data for IUA 1.

Goods and services provided by wetlands

Regulating & supporting services			**Provisioning services**	**Cultural Support**	**Biodiversity maintenance**
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Moderate	Moderate	**Very High**	Very Low	Very Low	**High**

An evaluation of flood attenuation suggests that a large number of floodplain and unchannelled valley bottom wetlands are potentially important in providing this service. The report by Anchor Environmental (DWA, 2010) suggests that the value of this service is quite low relative to other wetlands such as those located in the Pongola catchment.

Wetlands in the upper reaches of the catchment have been flagged as having a potentially high importance for sediment and erosion control. Wetlands lower in the catchment are typically regarded as having a lower importance for this service.

Coal mining and power generation results in significant impacts on water quality with significant impacts on electrical conductivity and sulphate concentrations (DWA, 2012). Defunct coal mines also contribute significantly to acid mine drainage (low pH). This has been reported in the Middelburg dam where the pH, nitrate, nitrite and ammonia fall within the unacceptable range. Available information on heavy metals shows unacceptably high levels in parts of the catchment. Indeed, high aluminium concentrations have been cited as possible cause of fish deaths in Loskop dam (DWA, 2012). Extensive agricultural areas are also likely to contribute nutrients and toxic organic chemicals associated with herbicides and pesticides. As such, water quality enhancement functions are regarded as very important in this IUA. This is clearly reflected in the prioritisation process which highlighted a large number of wetlands as having a very high water quality enhancement potential. The importance of wetlands and rivers in providing a water purification function was also highlighted by Anchor Environmental (DWA, 2010) as highest in the Upper Olifants catchment.

While many wetlands are heavily impacted, some wetlands of high ecological importance do occur, particularly in the upper reaches of the catchment. Such wetlands are typically associated with critically endangered wetland types. Overall importance of wetlands from a biodiversity maintenance perspective is regarded as high.

Focus of wetland selection

Given the extremely high importance of water quality enhancement functions provided by wetlands, it is important to ensure that these services are maintained and enhanced where possible. As such, ***a series of wetlands providing this service have been prioritised and selected for RQO determination.***

Wetlands have also been flagged as having a high biodiversity maintenance function with a large number of wetlands flagged as NFEPA wetlands. As such, ***a series of wetlands have also been selected to monitor changes to wetlands flagged as having a high biodiversity priority.***

Selected wetlands

The location of wetlands selected for RQO determination in this IUA is indicated in Figure 31 whilst details of each of the selected wetlands is included in Table 21.

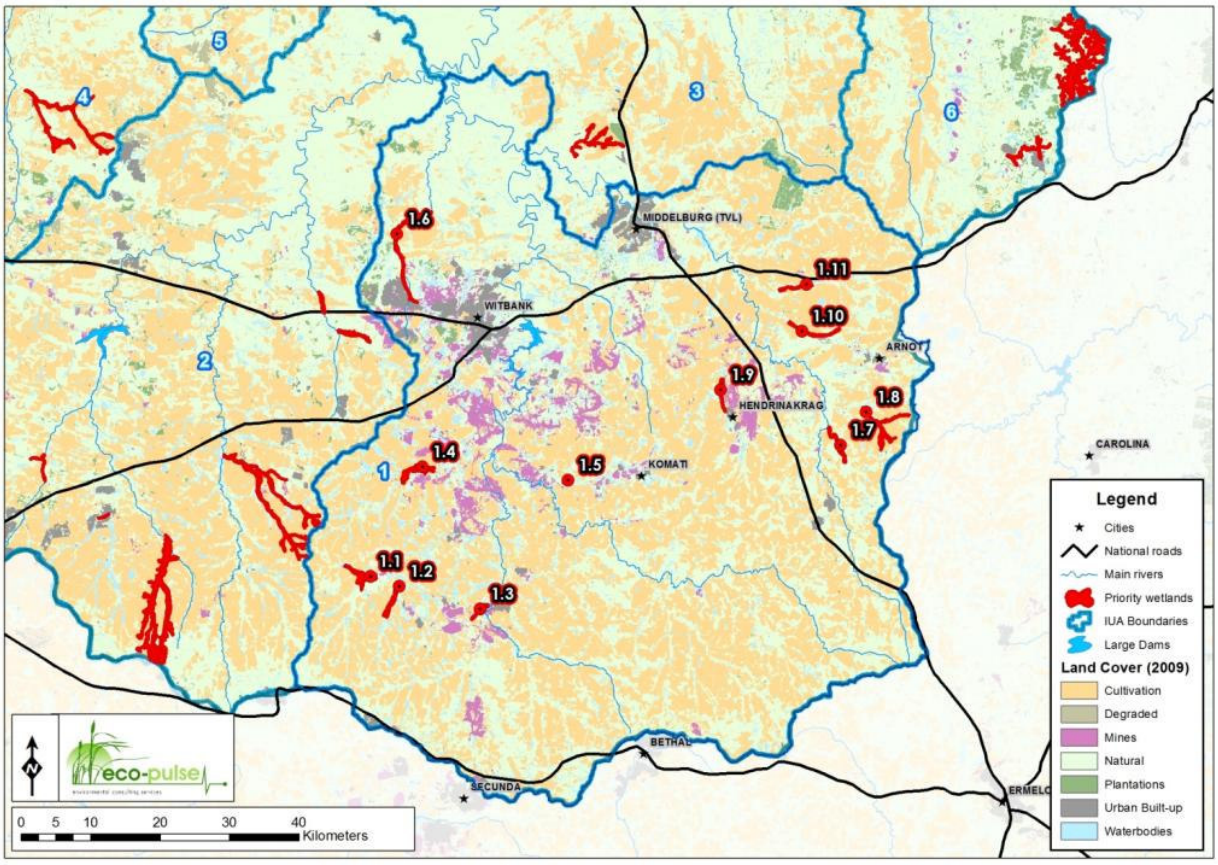

Figure 31: Map showing the location of prioritised wetlands for RQO determination in IUA1.

Table 21: Motivation for selected wetlands in IUA1.

Wetland	Motivation
1.1 Blesbokspruit wetland	While identified as a wetland FEPA, there is no information on the specific conservation values identified. The wetland is well placed to provide a water quality and flood protection function but is threatened by headward erosion. Wetland components have been prioritized to ensure that water quality enhancement and biodiversity maintenance functions are not undermined
1.2 Rietspruit wetland	Little information exists about the importance of this particular wetland. It has however been flagged for protection through the NFEPA process. Preventing incision is regarded as critical for maintaining habitat attributes. It also provides a corridor for species movement, with otters utilising the area. The wetland is also well placed to provide a water quality and flood protection function. Wetland attributes have therefore been prioritized to help ensure that key services identified are maintained.
1.3 Kriel wetland	The wetland is located directly downstream of mining operations in the catchment upstream of Witbank Dam. Livestock watering is also important downstream but can be jeopardized by poor water quality. While being well placed to provide an important water quality enhancement function, the wetland is affected by headward erosion that is undermining these functions
1.4 Klippoortjiespruit wetland	Little information exists about the importance of this particular wetland. It has however been flagged for protection through the NFEPA process and is one of the more intact unchannelled valley bottom wetlands remaining in the upper Olifants catchment.
1.5 Koringspruit wetland	This wetland is located within a mining landscape upstream of the Witbank dam. Most wetlands have been significantly affected by mining operations and channel

Wetland	Motivation
	incision that has significantly undermined their functional value. This wetland includes a section of unchannelled valley bottom habitat important for water quality enhancement but is threatened by headward erosion.
1.6 Klipspruit wetland	This extensive unchannelled valley bottom wetland is located directly downstream of Witbank Town and receive water from old mines, urban areas and waste water treatment works. Given the sites location downstream of these impacts and upstream of Loskop dam and other areas used for recreational activities, the wetland clearly provides a critical water quality enhancement function.
1.7 Klein Olifants tributary	This wetland is largely intact and is likely to be a representative wetland of this wetland vegetation group. The wetland also falls within an area where wetlands have been flagged as important for crane conservation. Maintenance of wetland vegetation and associated wetland habitat for cranes is therefore regarded as a priority.
1.8 Matla wetland	This wetland is located in the upper catchment and is largely intact and is therefore a useful intact example of wetlands within this wetland vegetation group. The wetland also falls within an area where wetlands have been flagged as important for crane conservation. Maintenance of wetland vegetation and associated wetland habitat for cranes and other wetland-dependant biota is therefore regarded as a priority.
1.9 Woes-Alleenspruit wetland	The wetland is located in the Middleburg Dam catchment and directly downstream of extensive coal mining operations. It is therefore well placed to provide a water quality enhancement function.
1.10 Bosmanspruit wetland	The wetland is located in the Middleburg Dam catchment and directly adjacent extensive coal mining operations. It is therefore well placed to provide a water quality enhancement function.
1.11 Kopermyn wetland	This is a large example of reasonably intact valley bottom wetland downstream of mining operations with further mining anticipated in the catchment (high mining potential). The wetland provides useful habitat for wildlife & provides a range of regulating and supporting services important for downstream users.

4.2.4.2 IUA 2: Wilge River catchment area

Overview of water resources in the IUA

The rivers in the IUA are in a moderately modified state (category C) with less developed areas in the catchment. Impacts within the catchment are related to agriculture, dams and some mining. Based on available wetland information, approximately 34% of wetlands in the catchment occur in this IUA. As such, wetland management should also be regarded as a key focus in this IUA if wetland protection targets are to be achieved and functional characteristics maintained. While most wetlands are moderately modified (C PES), fairly extensive wetland areas still remain in good condition (B PES) (Figure 32).

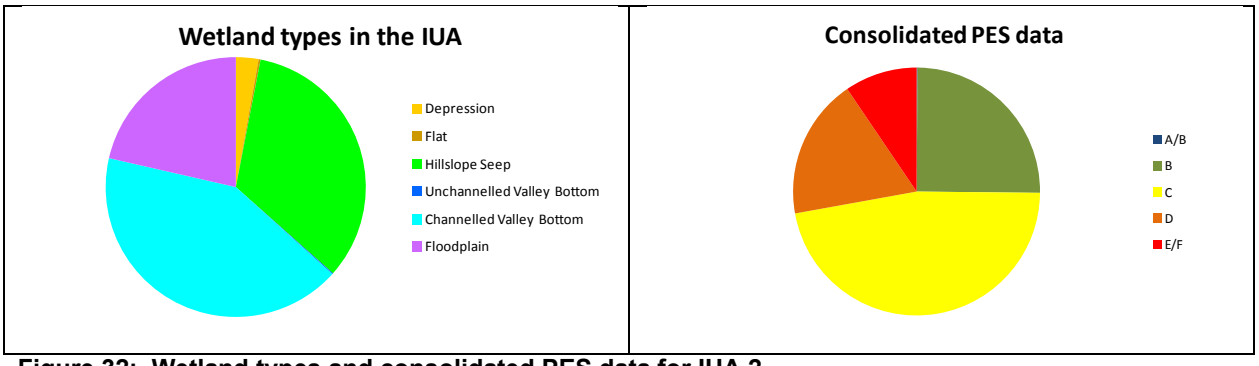

Figure 32: Wetland types and consolidated PES data for IUA 2.

Goods and services provided by wetlands

Regulating & supporting services			**Provisioning services**	**Cultural Support**	**Biodiversity maintenance**
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Low	Moderate	**High**	Low-Moderate	Very Low	Moderate - **High**

An evaluation of flood attenuation functions suggests that a fair number of floodplain and unchannelled valley bottom wetlands are potentially important in providing this service. The report by Anchor Environmental (DWA, 2010) however suggests that the value of this service is quite low relative to other wetlands such as those located in the Pongola catchment.

Wetlands in the upper reaches of the catchment have been flagged as having a potentially high importance for sediment and erosion control. Wetlands lower in the catchment are typically regarded as having a lower importance for this service.

Extensive agricultural areas are also likely to contribute nutrients and toxic organic chemicals associated with herbicides and pesticides. Wetlands in this catchment are generally rated as having a moderate to high value in terms of improving water quality. This is consistent with the findings of Anchor Environmental (DWA, 2010) who emphasised the importance of water resources in the Upper Olifants catchment in providing this service.

Most wetlands in the catchment have a moderate ecological importance. There are however a number of wetlands that have been flagged as having a high ecological importance.

Focus of wetland selection

Given the high importance of water quality enhancement functions provided by wetlands, it is important to ensure that these services are maintained where possible. As such, ***a series of wetlands providing this service have been prioritised and selected for RQO determination in this IUA.***

A number of wetlands were also flagged as having a high biodiversity maintenance function. ***A sub-set of wetlands were therefore also selected to monitor changes to wetlands of high biodiversity value.***

Selected wetlands

The location of wetlands selected for RQO determination in this IUA is indicated in Figure 33 whilst details of each of the selected wetlands is included in Table 22.

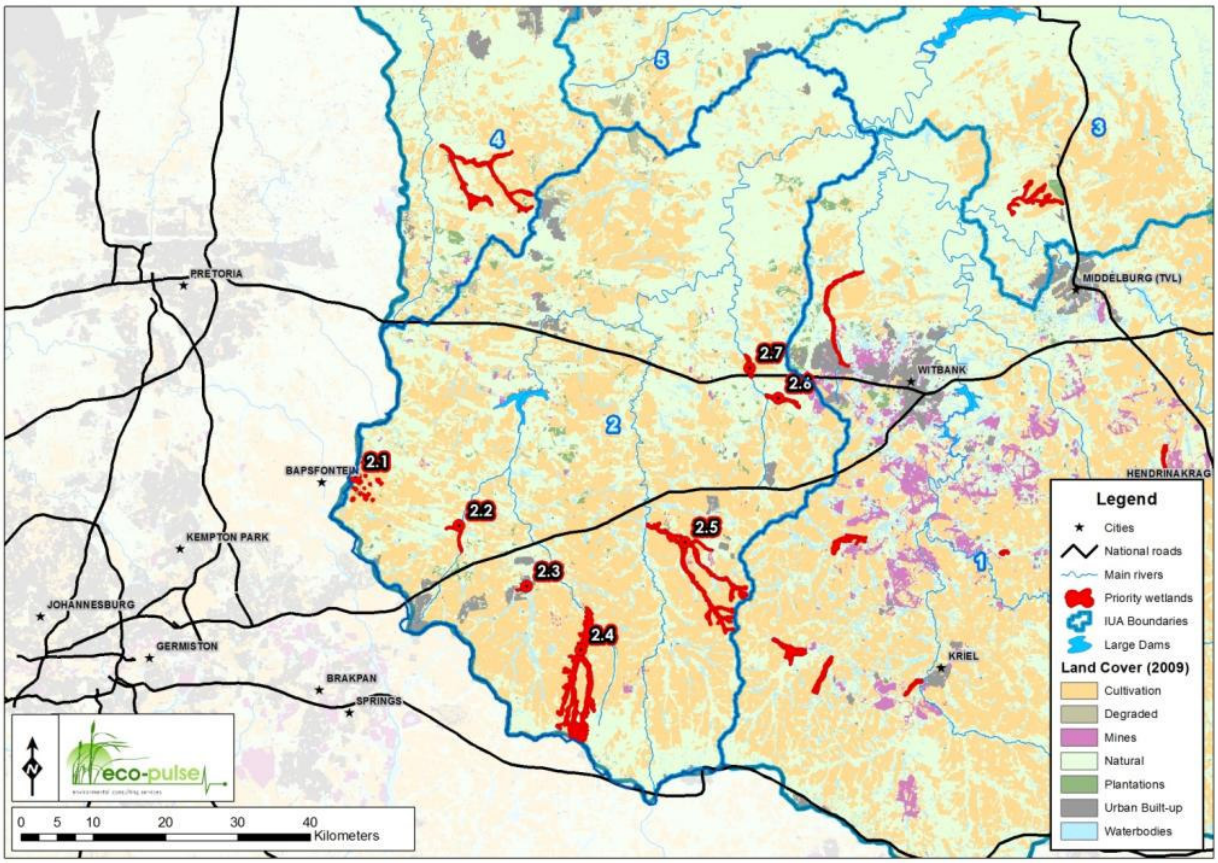

Figure 33: Map showing the location of prioritised wetlands for RQO determination in IUA2.

Table 22: Motivation for selected wetlands in IUA2.

Wetland	Motivation
2.1 Elandsvlei pan system	This cluster of pans was identified as an area of exceptional biodiversity importance as part of the NFEPA process. They have also been highlighted as providing important habitat for grass owls within a largely transformed catchment.
2.2 Koffiespruit tributary	This wetland is largely intact and is likely to be a representative wetland of this wetland vegetation group. Maintaining vegetation characteristics is regarded as most important from a biodiversity perspective.
2.3 Delmas wetland	This wetland is located in an urban context and downstream of a waste water treatment works and old waste disposal facilities. Management of the waste water treatment works is reportedly problematic with a blue drop score of 18% obtained in 2011. The wetland is therefore well placed to improve poor water quality and reduce potential negative health effects for local communities.
2.4 Bronkhorstspruit tributary	This large, extensive unchannelled valley bottom wetland FEPA provides important habitat for the African Grass Owl (Tyto Capensis). Given the agricultural context and anticipated expansion of future mining operations, the wetland is also well placed to improve water quality.
2.5 Wilge tributary	This is one of few largely intact valley bottom wetlands that remain in the upper Wilge catchment. The wetland system is also located within a priority mining area and is therefore well placed to reduce water quality impacts.
2.6 Zaalklap wetland	This naturally unchannelled valley bottom has been flagged as a wetland FEPA based on its importance for biodiversity maintenance. The wetland supports healthy populations of marsh owls whilst the reed beds are used for roosting by large numbers of Cattle Egrets. Given the wetlands location directly downstream of coal mining operations, the wetland is also well placed to improve water quality

Wetland	Motivation
	for downstream users. Rehabilitation efforts are currently underway to improve the functionality of the system.
2.7 Saalboomspruit wetland	This naturally unchannelled valley bottom has been flagged as a wetland FEPA and is known to support unusually large populations of African Snipe (Gallinago nigripennis). Given the wetlands location directly downstream of coal mining operations, it is also well placed to improve water quality for downstream users.

4.2.4.3 IUA 3: Selons River area including Loskop Dam

Overview of water resources in the IUA

The state of the rivers in the IUA have been moderately degraded (B to C category), mainly due to the upstream impacts from the Olifants and Klein Olifants Rivers. The PES of the main stem of the Olifants River is a C with the REC of a B due to upstream flow regulation and water quality problems. The extent of wetlands are limited and are generally moderately modified with few intact areas (A/B PES) remaining (Figure 34.

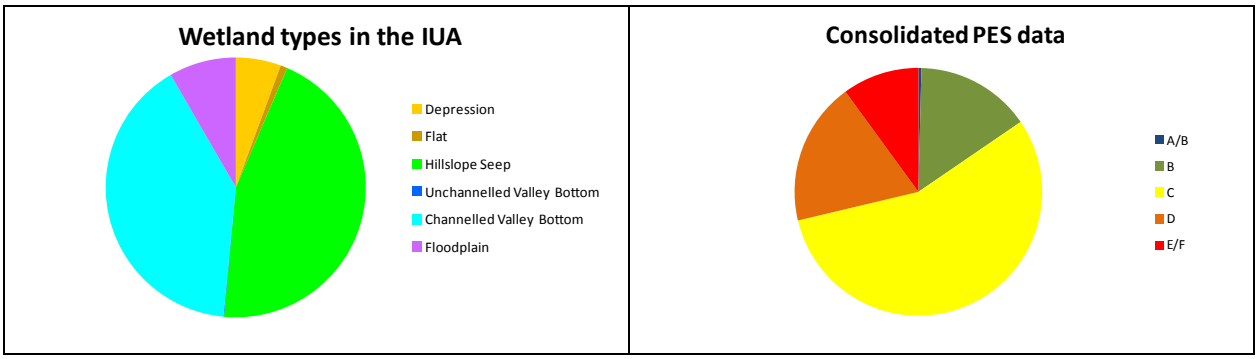

Figure 34: Wetland types and consolidated PES data for IUA 3.

Goods and services provided by wetlands

Regulating & supporting services			Provisioning services	Cultural Support	Biodiversity maintenance
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Low	Low-Moderate	Low (**High above Loskop Dam**)	Low-Moderate	Low	Low-Moderate (**High for few local sites**)

While some wetlands score moderately high in relation to flood attenuation and sediment trapping, wetlands are generally regarded as having a low to moderate value in relation to these services.

Coal mining and power generation results in significant impacts on water quality with significant impacts on electrical conductivity and sulphate concentrations coming from the upstream IUA (DWA, 2012). Available information on heavy metals shows unacceptably high levels in parts of the catchment. Indeed, high aluminium concentrations have been cited as possible cause of fish deaths in Loskop dam (DWA, 2012). The majority of wastewater treatment works associated with the local municipalities is producing an effluent which does not meet their licence requirements (DWA, 2012). Works discharge water with high organic, nutrient and microbial loads and have resulted in eutrophic conditions of the upper reaches of Loskop Dam. Wetlands directly upstream of Loskop dam are therefore likely to provide a high water quality enhancement functions. The importance of other wetlands is generally low.

While Loskop Nature Reserve is an important area for recreational and tourism purposes, few wetlands occur in this protected area. As such, the importance of wetlands in providing cultural services is regarded as low.

The importance of wetlands in maintaining biodiversity is generally low with few wetlands prioritised from a biodiversity conservation perspective. Wetlands flagged as potentially important for protection were generally degraded, with few intact wetland areas remaining.

Focus of wetland selection

The most important service highlighted is that associated with water quality enhancement above Loskop Dam. Wetlands flagged as potentially providing this service are better treated as riparian zones however and should be incorporated as part of the river assessment. While some wetland FEPAs has been identified in the IUA, few were well suited to RQO determination. ***As a consequence only a single wetland system was selected for RQO determination in this IUA.***

Selected wetlands

The location of the wetland selected for RQO determination in this IUA is indicated in Figure 35 whilst details of each of the selected wetlands is included in Table 23.

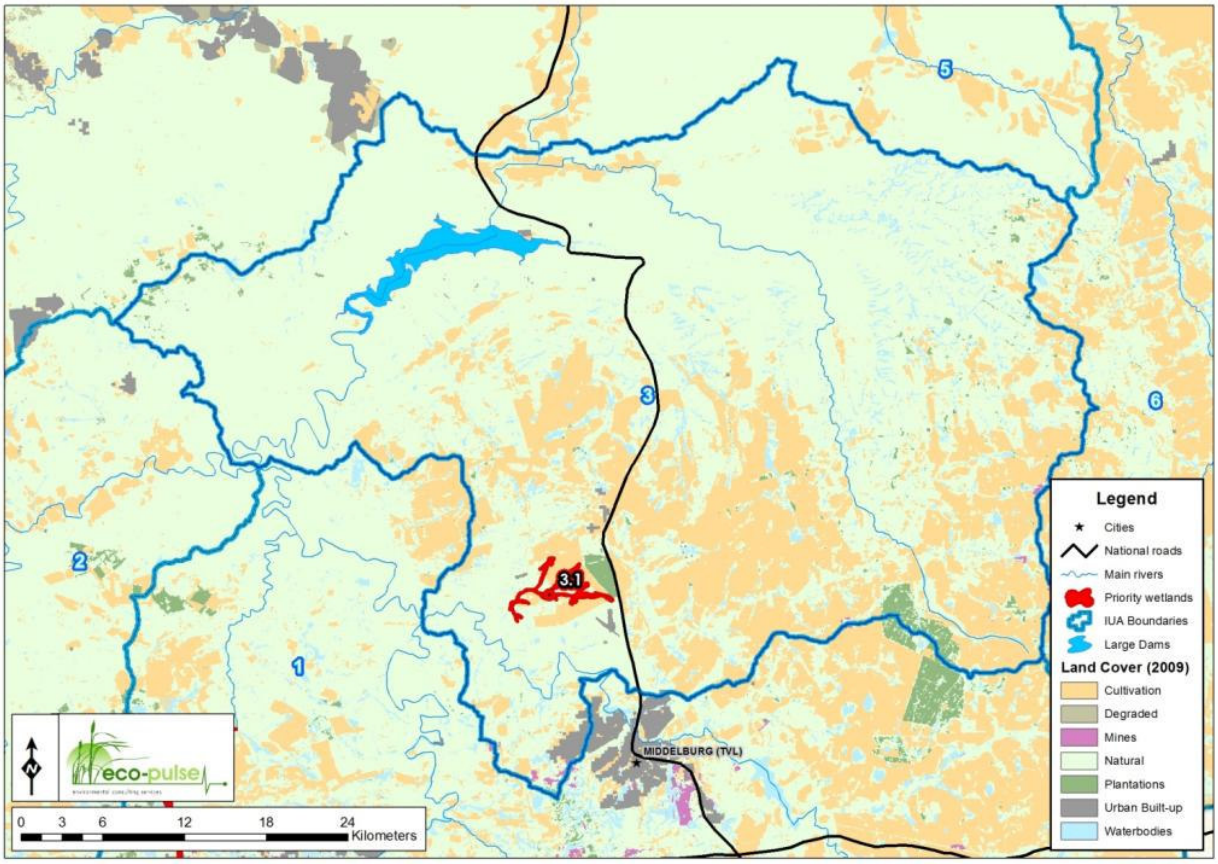

Figure 35: Map showing the location of prioritised wetlands for RQO determination in IUA3.

Table 23: Motivation for the selection of wetlands in IUA3

Wetland	Motivation
3.1 Klein Olifants Tributary	This wetland FEPA is largely intact and is a useful example of this wetland vegetation group. The wetland also falls within an area prioritized for crane conservation. Maintenance of wetland vegetation and associated wetland habitat is therefore regarded as a priority.

4.2.4.4 IUA 4: Elands River catchment area

Overview of water resources in the IUA

The IUA is mainly rural in the upper reaches of the catchment with impacts from agriculture, dams, towns and informal settlements in the lower reaches of the catchment. The upper reaches of the Elands River are in a moderately modified ecological state (C category), but degrades along the river to a D category below the dams. Wetland extent is very limited and conditions are highly variable with approximately equal extents of wetlands in good (A/B PES), moderately modified (C PES) and seriously modified (E/F PES) (Figure 36).

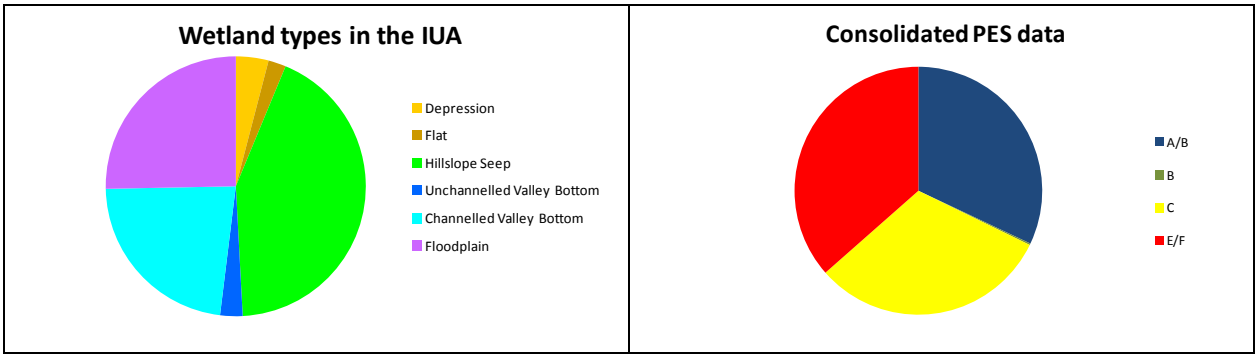

Figure 36: Wetland types and consolidated PES data for IUA 4.

Goods and services provided by wetlands

Regulating & supporting services			**Provisioning services**	**Cultural Support**	**Biodiversity maintenance**
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Low – Moderate	Low - Moderate	Moderate	Low - Moderate	Low	Low - Moderate

While wetlands in this IUA were generally characterized as providing limited flood attenuation and sediment retention values, wetlands located close to and downstream of the confluence of the Elands and Gotwane Rivers were flagged as having a potentially high flood attenuation and sediment retention capacity. On further interrogation, these features were found to be artificial in nature and associated with the inflow into the Mkhombo dam.

Intensive agricultural practices in the Elands River catchment could contribute pesticide and herbicides to the local river and wetland ecosystems (DWA, 2012). While some wetlands have been highlighted as being potentially important in providing this service, water quality issues are significantly lower in this IUA than in others in the catchment.

The ecological importance and sensitivity of wetlands in this catchment generally scored low. A few areas were flagged as important for biodiversity conservation however. Information on these systems was generally lacking, with no supporting information provided by biodiversity stakeholders consulted as part of the process.
The prioritisation exercise did serve to highlight a number of priority wetland resource units however which were interrogated further.

Focus of wetland selection

The importance of wetlands in providing ecosystem goods and services is generally regarded as low when compared with other IUAs. ***A single wetland was however selected from a biodiversity maintenance perspective.***

Selected wetlands

The location of the single wetland selected for RQO determination in this IUA is indicated in (Figure 37) whilst details of each of the selected wetlands is included in Table 24.

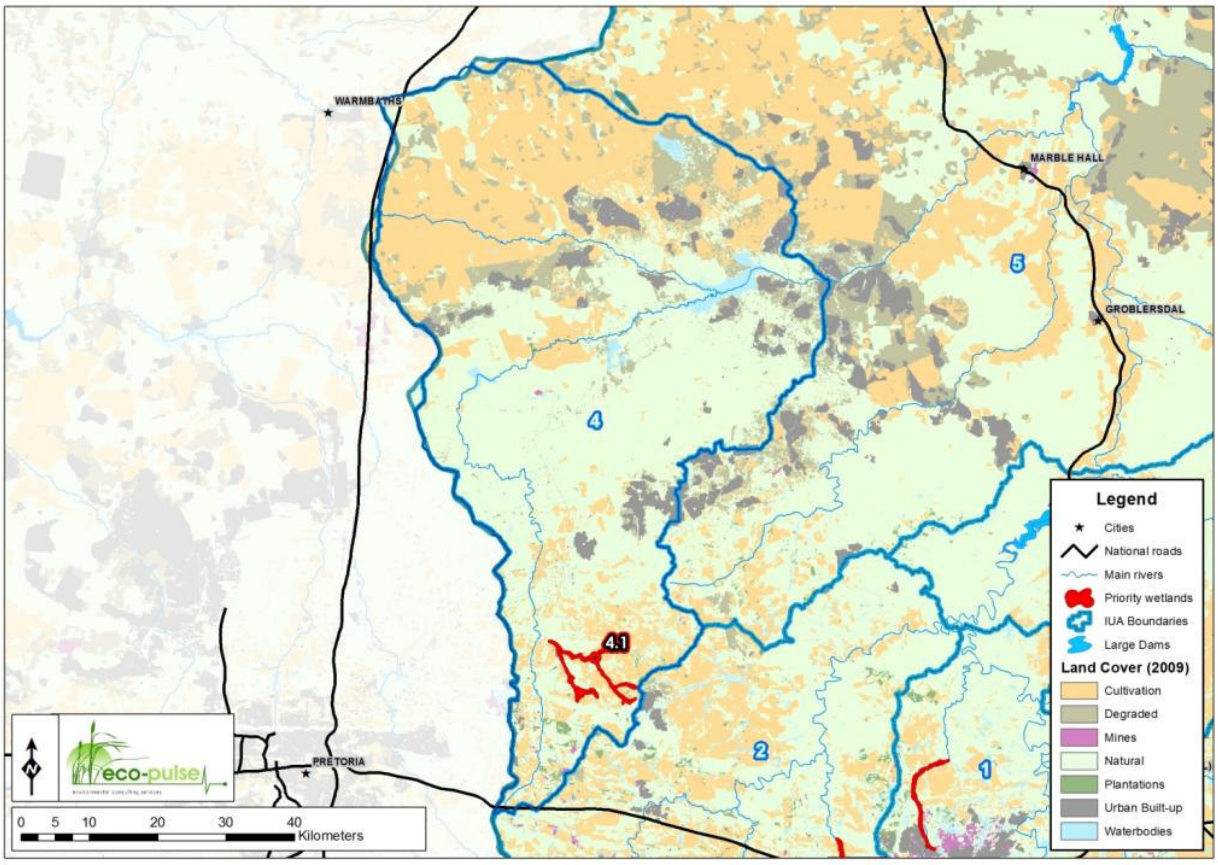

Figure 37: Map showing the location of the single wetland prioritised for RQO determination in IUA4.

Table 24: Motivation for selecting wetlands in IUA4.

Wetland	Motivation
4.1 Elands tributary wetland	Despite being moderately modified, this large wetland has been identified as wetland FEPA supporting crane populations. Maintenance of appropriate habitat attributes is therefore regarded as important.

4.2.4.5 IUA 5: Middle Olifants up to Flag Bashielo Dam

Overview of water resources in the IUA

The rivers in this IUA are mainly in a C category as the upstream impacts (mainly water quality related) are somewhat mitigated by Loskop Dam. The ecological importance of the rivers in the IUA is moderate with a few conservation areas present. Large areas of this IUA are almost endoreic and groundwater is the major source of water in these catchments. While the extent of wetlands is extremely limited, a large proportion of wetlands remain in good condition (A/B PES) although more than 50% are moderately to seriously modified (Figure 38).

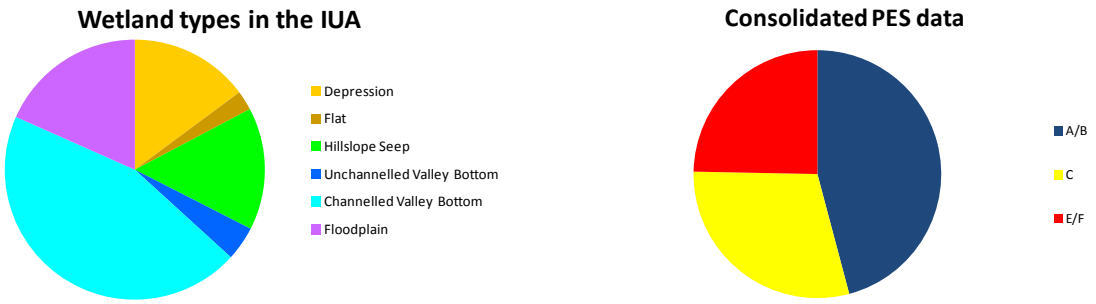

Figure 38: Wetland types and consolidated PES data for IUA 5.

Goods and services provided by wetlands

Regulating & supporting services			**Provisioning services**	**Cultural Support**	**Biodiversity maintenance**
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Low (**Moderate – High along Lower Olifants**)	Low (**Moderate – High along Lower Olifants**)	Low - Moderate	Low - Moderate	Low - Moderate	Low

The flood attenuation and sediment trapping capacity of wetlands is generally regarded as low in this IUA. The lower Olifants (towards the IUA outlet) was however been highlighted as a potential priority area.

Unacceptable EC concentrations in the lower reaches of the Elands River are due to irrigation return flows and concentration due to evaporation of water from the low flows (DWA, 2012). Intensive agricultural practices in the Moses River catchment could also contribute pesticide and herbicides to the local river and wetland ecosystems (DWA, 2012). This, together with an evaluation of the water quality enhancement service value of wetlands undertaken as part of this project, suggest a low-moderate importance of wetlands in providing this service. This is supported by Anchor Environmental (DWA, 2010) whose calculations suggested a moderate value of this service in the mid reaches of the Olifants catchment.

The importance of wetlands in maintaining biodiversity generally scored low in this catchment.

Focus of wetland selection

While the importance of wetlands is generally low in this IUA, some wetlands were flagged as potentially important for flood attenuation and sediment trapping along the lower reaches of the Olifants catchment. Following further interrogation, a decision was made ***not to include any wetlands from this IUA for RQO determination.***

Selected wetlands

No wetlands were selected in this IUA.

4.2.4.6 IUA 6: Steelpoort River catchment

Overview of water resources in the IUA

While some river tributaries remain in good condition, the present state of the lower reaches of Steelpoort River has been modified from the natural (D category) due to impacts from agriculture and settlements. The Klip and Dwars rivers are still in a good present state. However, the impacts from mining on the Dwars River have resulted in a moderately modified state (B/C category).

Most wetlands in the catchment are in a good condition (A/B PES) (Figure 39). These are typically located in the upper catchment area with few wetlands in the lower reaches of the IUA.

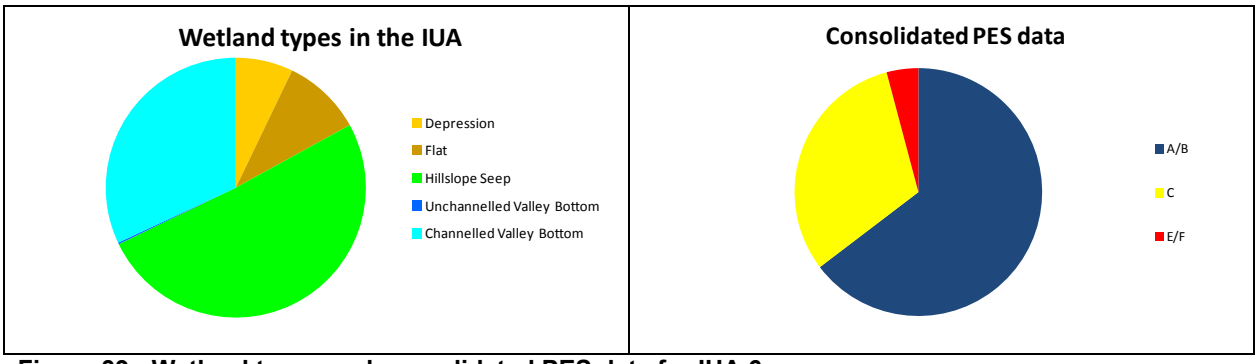

Figure 39: Wetland types and consolidated PES data for IUA 6.

Goods and services provided by wetlands

Regulating & supporting services			**Provisioning services**	**Cultural Support**	**Biodiversity maintenance**
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Moderate	Moderate	Low	Moderate	Low (**High for Verloren Valei**)	**High – Very High**

The flood attenuation and sediment trapping capacity of wetlands is generally regarded as moderate in this IUA.

Levels of land transformation are typically low in this catchment relative to other IUAs with moderate levels of cultivation, restricted largely to the upper reaches of the Steelpoort River. Mining, forestry and urban areas are present but are limited in extent. As a consequence, the demand for water quality enhancement functions of wetlands in this IUA is generally regarded as low.

Based on climatic conditions, demographics and settlement patterns, provisioning services provided by wetlands are likely to be moderately important across much of this catchment. This is supported by Anchor Environmental (DWA, 2010) who highlighted a high reliance of communities on rivers and springs for domestic supply in sections of this IUA. Sections of this IUA were also highlighted as moderately important for raw material harvesting (DWA, 2010).

The importance of wetlands in contributing towards recreational and tourism values (Cultural support) is generally low but with high values associated with Verloren Valei Nature reserve and Ramsar site in the upper catchment.

This IUA is one of the most important from a conservation perspective with a large number of wetlands (particularly in the upper catchment) highlighted as having a high to very high ecological importance. Working for Wetlands has worked in a number of priority areas in the catchment providing some baseline data for these sites. Protection and management of priority wetlands is regarded as a key priority in this IUA, particularly in areas under current or future threat.

Focus of wetland selection

Wetlands in the upper reaches of the Steelpoort catchment have been flagged as being very important for biodiversity maintenance (and supporting tourism activities in Verloren Valei and surrounds). As such, ***a***

number of wetlands have been selected for RQO determination based on their biodiversity priority, threats of degradation and need for appropriate protection and management.

Selected wetlands

The location of wetlands selected for RQO determination in this IUA is indicated in Figure 40 whilst details of each of the selected wetlands is included in Table 25.

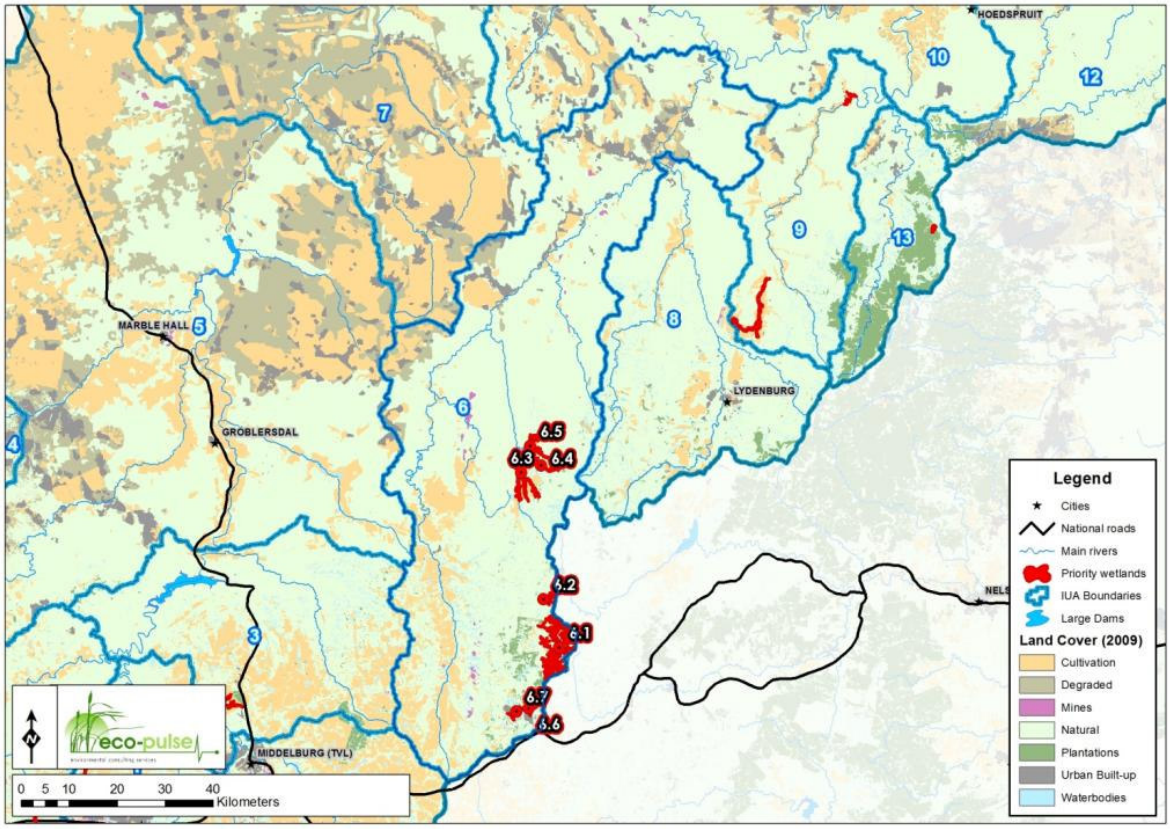

Figure 40: Map showing the location of wetlands prioritized for RQO determination in IUA6.

Table 25: Motivation for selecting wetlands in IUA6

Wetland	Motivation
6.1 Lakenvlei wetland complex	The Lakenvlei wetland complex is one of the largest, pristine peatland wetland systems in Mpumalanga. The wetland supports important populations of threatened bird species including the Grey Crowned Crane (EN), Wattled Crane (CR) and White-winged Flufftail (CR). Some rehabilitation has taken place on sections of the wetland. It is also a major supplier of high quality water.
6.2 Welgevonden wetland	This FEPA wetland system is located in the upper reaches of the catchment and forms part of a priority wetland cluster. The wetland is important for biodiversity conservation as it contains peatland areas and supports important crane populations.
6.3 Draaikraal wetland_1	This large FEPA wetland system is located within an agricultural context and important for biodiversity conservation as it contains peatland areas and supports important crane populations. The site has been historically targeted for rehabilitation by WFWetlands.
6.4 Draaikraal wetland_2	This NFEPA wetland system contains important peatland areas and supports threatened crane populations. The wetland is still in good condition despite surrounding agricultural land use pressures.

Wetland	Motivation
6.5 Draaikraal wetland_3	This large unchannelled peatland has been identified as a FEPA and supports breeding populations of cranes. Wetland rehabilitation was previously implemented in this wetland to address impacts of historical drainage.
6.6 Belfast wetland_1	This valley bottom wetland is located in an urban setting alongside Belfast town and upstream of the Belfast dam. It is therefore well placed to improve water quality in this important local catchment.
6.7 Belfast wetland_2	This valley bottom wetland is located in an urban setting and directly upstream of Belfast dam which is used to supply Belfast town with potable water. Upstream mining activities together with overflow from the waste water treatment works pose a threat to water quality. This wetland has therefore been prioritized based on its water quality enhancement functions.

4.2.4.7 IUA 7: Middle Olifants below Flag Boshielo Dam to upstream of Steelpoort River

Overview of water resources in the IUA

The present state of the main stem river is in a B/C category that is mainly due to agricultural impacts. Wetlands are extremely limited in extent in this catchment. Wetlands along the main Olifants have been modelled as having an A/B PES but this is unlikely to reflect reality (Figure 41). The actual condition of wetlands is therefore likely to be lower than suggested by available data. The extent of wetlands is very limited in this IUA with most wetlands associated with river systems.

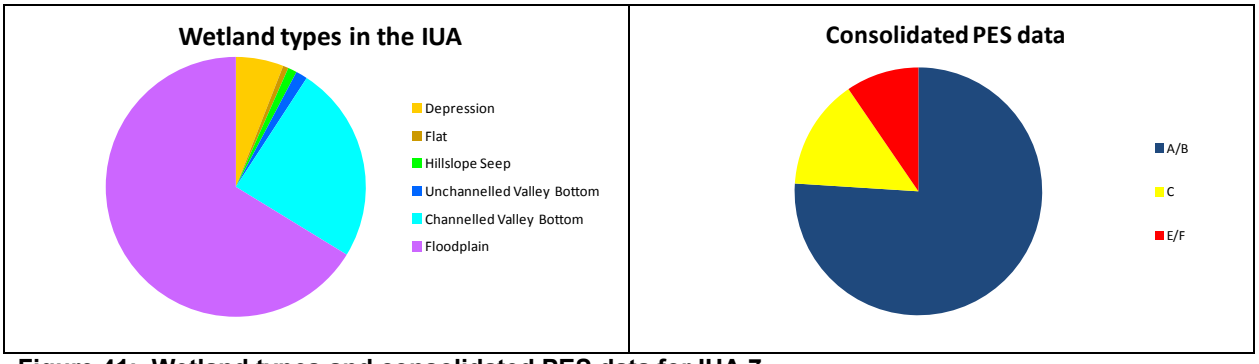

Figure 41: Wetland types and consolidated PES data for IUA 7.

Goods and services provided by wetlands

Regulating & supporting services			Provisioning services	Cultural Support	Biodiversity maintenance
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Low (**High along Olifants**)	Low (**High along Olifants**)	Low (**High along Olifants**)	Moderate	Low	Low

The flood attenuation and sediment retention functions of wetlands are generally regarded as low except for wetlands located along the Olifants River. The same applies to water quality enhancement functions.

Based on climatic conditions, demographics and settlement patterns, provisioning services provided by wetlands are likely to be moderately important across much of this catchment. This is supported by Anchor

Environmental (DWA, 2010) who highlighted a high reliance of communities on rivers and springs for domestic supply in sections of this IUA.

While the Bewaarkloof Nature Reserve and IBAs occur in this study area, few wetlands are associated with these areas. As such, wetlands are likely to contribute little to tourism and recreational use.

The ecological importance of wetlands is generally regarded as low in this catchment.

Focus of wetland selection

While the importance of wetlands is generally low in this IUA, some wetlands were flagged as potentially important for flood attenuation, sediment trapping and water quality enhancement along the Olifants mainstem. On closer investigation, wetland features were limited in extent and are likely to have a low-moderate functional value. ***No wetlands were therefore selected in this IUA.***

Selected wetlands

No wetlands were selected in this IUA.

4.2.4.8 IUA 8: Spekboom catchment

The distribution of mapped wetlands is again limited in this IUA, with most wetland identified as occurring in the upper catchment. The prioritisation process served to highlight potentially useful wetland areas along the lower reaches of the Spekboom River (Figure 16). Two potential wetland areas have been identified, one of which should be selected for RQO determination in this catchment.

Map showing the location of prioritised wetlands and prioritized candidate sites for RQO determination in IUA8. This

Overview of water resources in the IUA

The present state of the Spekboom, Dorps and Waterfalls rivers range from almost natural (Waterfalls source) to degraded (Dorps). The impacts are mainly from urbanisation and some agriculture in the catchment. The extent of wetlands in this IUA is limited and mainly occurs in the upper reaches of the IUA. Wetlands in the upper catchment remain in a largely untransformed state (A/B PES) with wetlands associated with more developed areas typically falling within a moderately modified state (C PES category) (Figure 42).

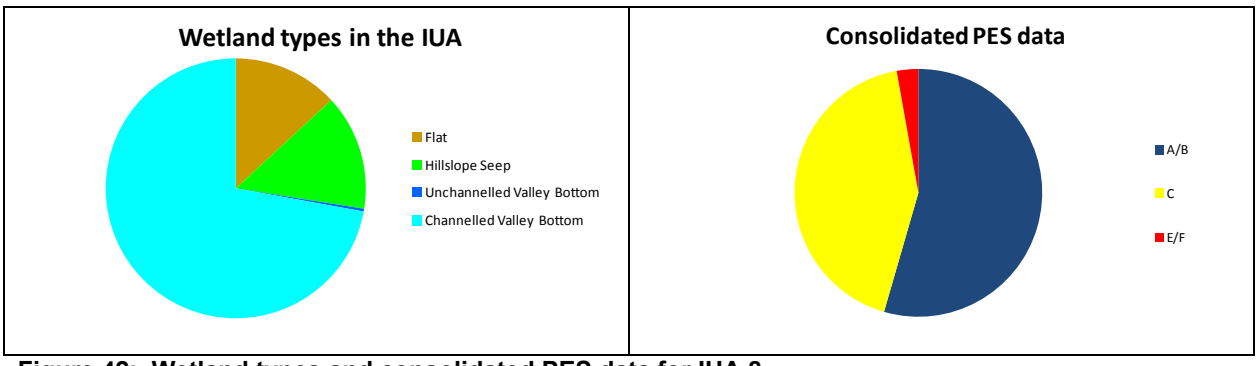

Figure 42: Wetland types and consolidated PES data for IUA 8.

Goods and services provided by wetlands

Regulating & supporting services			**Provisioning services**	**Cultural Support**	**Biodiversity maintenance**
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		

Moderate	Moderate	Low	Low - Moderate	Low	Low - Moderate

The flood attenuation and sediment retention function of wetlands is generally regarded as moderately important in this IUA.

Much of the catchment remains untransformed with only localised water quality concerns. The importance of wetlands in providing water quality enhancement functions is therefore generally regarded as low.

Based on climatic conditions, demographics and settlement patterns, provisioning services provided by wetlands are likely to be low - moderately important across much of this catchment.

While some protected areas occur in the catchment, these contain few wetlands. As such, the value of wetlands in providing cultural support (recreation and tourism) is regarded as low.

From a biodiversity maintenance perspective, some wetlands have a moderate to high ecological importance. Most wetlands are however regarded as being of a low conservation importance with no high priority wetlands that are under threat identified through the assessment.

Focus of wetland selection

The extent of wetlands in this catchment is limited. Ecosystem goods and services values are also regarded as low and as such, ***no wetlands have been selected in this IUA***.

Selected wetlands

No wetlands were prioritized for RQO determination in this IUA.

4.2.4.9 IUA 9: Ohrigstad River catchment area

Overview of water resources in the IUA

While much of the catchment remains untransformed, the Ohrigstad River has been impacted by agriculture (occurring along the main river) and is presently in a C category. The extent of wetlands in this IUA is extremely limited with only one extensive wetland mapped in the upper reaches of the IUA. Wetland conditions are generally moderately modified (C PES) (Figure 43).

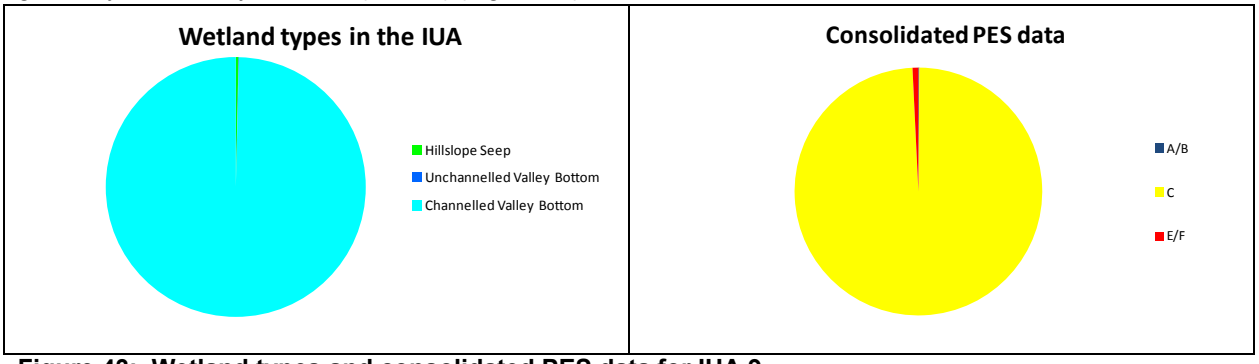

Figure 43: Wetland types and consolidated PES data for IUA 9.

Goods and services provided by wetlands

Regulating & supporting services			**Provisioning services**	**Cultural Support**	**Biodiversity maintenance**
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		

Moderate	Moderate	Low	Low (**High**)	Low	Low (**High**)

The flood attenuation and sediment retention function of wetlands is generally regarded as moderately important in this IUA.

Much of the catchment remains untransformed with only localised water quality concerns. Mapped wetlands are typically not associated with areas of water quality concerns. As such, water quality enhancement functions provided by wetlands in this catchment are generally regarded as low.

The importance of wetlands in maintaining livelihood support and promoting cultural services was rated as extremely limited based on the desktop assessment. A number of wetlands are used extensively for subsistence purposes however, suggesting that some wetland areas provide an important livelihood support function.

Wetlands are generally regarded as being of low ecological importance in this catchment. A large wetland in the upper catchment has however been flagged as being of high ecological concern.

Focus of wetland selection

The extent of wetlands in this catchment is limited. Ecosystem goods and services values are also regarded as low with few wetlands flagged as playing an important functional role. ***A single wetland along the lower reaches of the Ohrigstad River has been prioritised as an indicator wetland where a balance between maintenance of regulating and supporting services and subsistence use has been flagged as important. An additional wetland flagged as being of high ecological concern has also been selected for RQO determination in the upper catchment of this IUA.***

Selected wetlands

The location of wetlands selected for RQO determination in this IUA is indicated in Figure 44 whilst details of each of the selected wetlands is included in Table 26.

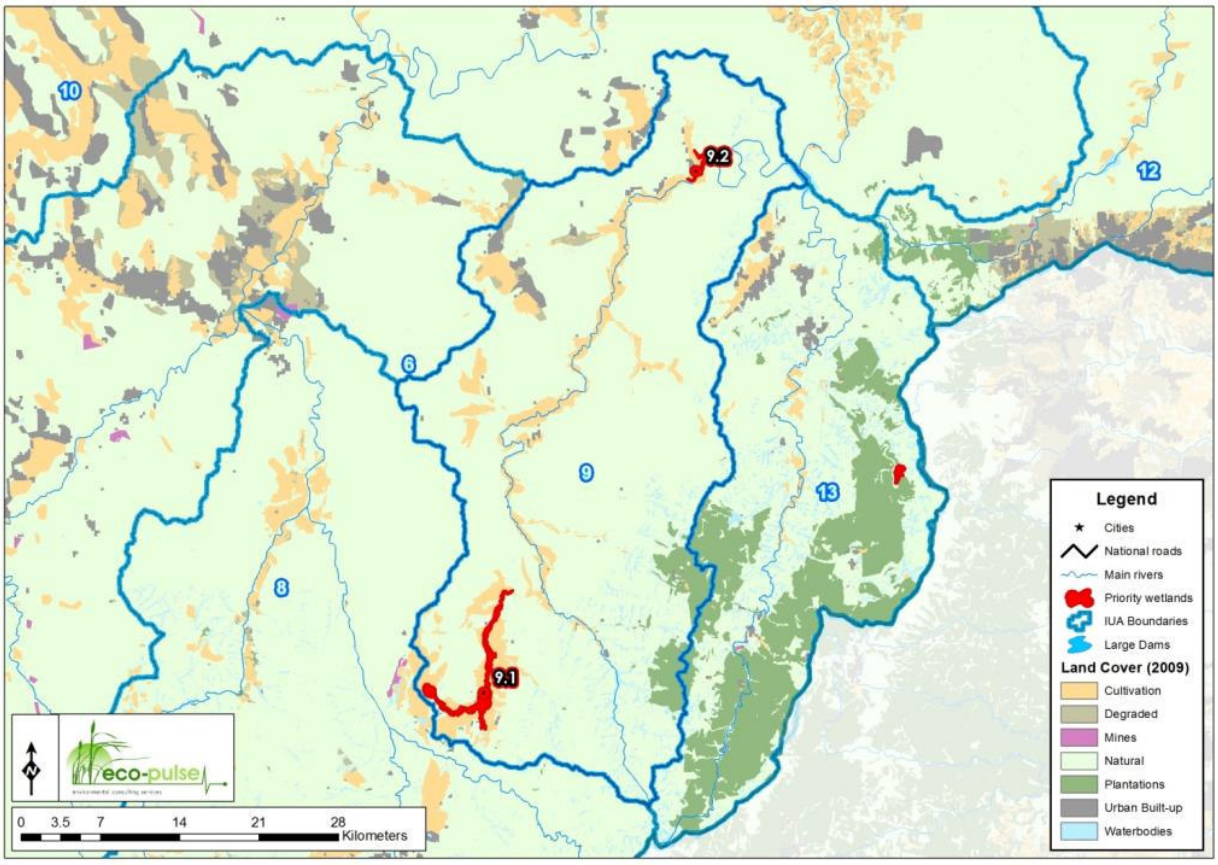

Figure 44: Map showing the location of prioritised wetlands for RQO determination in IUA9.

Table 26: Motivation for wetlands selected in IUA9.

Wetland	Motivation
9.1 Krankloofspruit tributary	This is an unusually large unchannelled valley bottom wetland is located in the upper reaches of this IUA. Despite significant impacts, the wetland was to ameliorate impacts from agricultural activities.
9.2 Ohrigstad wetland	While identified as a wetland FEPA, this floodplain system has been heavily degraded by subsistence cultivation. Few wetlands are located in this IUA however, and given the anticipated water quality impacts associated with agricultural use upstream, this wetland was prioritized for water quality enhancement.

4.2.4.10 IUA 10: Lower Olifants

Overview of water resources in the IUA

The main stem Olifants is presently in a D category with the lower Blyde and Mohlapitse in a B. The impacts on the Olifants are from irrigation along the river and the Flag Boshielo Dam. While wetlands are very limited in extent, most wetlands are regarded as being in very poor condition (typically linked to poor river condition) (Figure 45). Mapped good condition wetlands are associated with the Mohlapitse River.

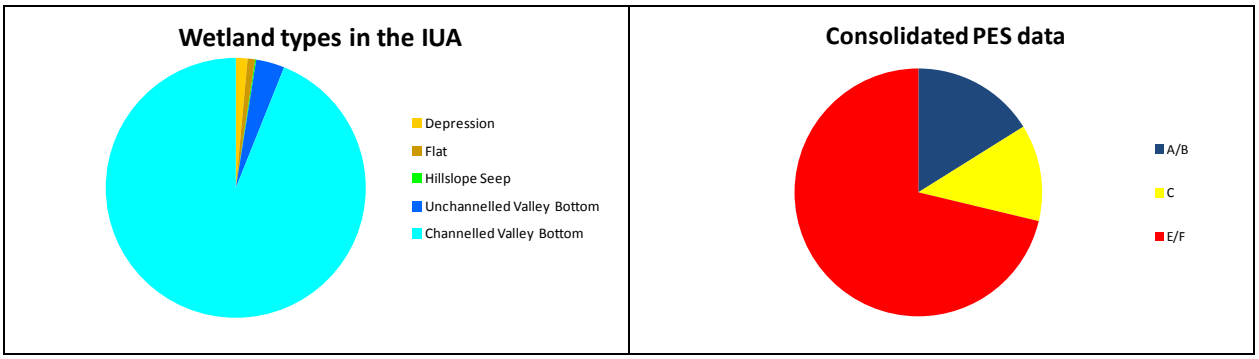

Figure 45: Wetland types and consolidated PES data for IUA 10.

Goods and services provided by wetlands

Regulating & supporting services			Provisioning services	Cultural Support	Biodiversity maintenance
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Moderate	Moderate	Low	Low	Low	Low

The flood attenuation and sediment retention functions of wetlands are generally regarded as moderately important in this IUA.

While there is a demand for water quality enhancement, wetlands present in the IUA are typically poorly suited to provide this service. As such, the importance of wetlands in improving water quality is regarded as low in this IUA.

While some protected areas occur in the catchment, these contain few wetlands. As such, the value of wetlands in providing cultural support (recreation and tourism) is regarded as low.

Wetlands are generally regarded as being of low ecological importance in this catchment.

Focus of wetland selection

The extent of wetlands in this catchment is limited. Ecosystem goods and services values are also regarded as low and as such, ***no wetlands have been selected in this IUA***.

Selected wetlands

No wetlands were prioritized for RQO determination in this IUA.

4.2.4.11 IUA 11: Ga-Selati River area

Overview of water resources in the IUA

The present state of the Ga-Selati River ranges from a C (in the upper reaches) to an E category just before the confluence with the Olifants. This is mainly due to the impacts from mining and town development in the lower reaches. The extent of wetlands in this IUA is extremely limited with most wetlands regarded as being highly impacted (Figure 46).

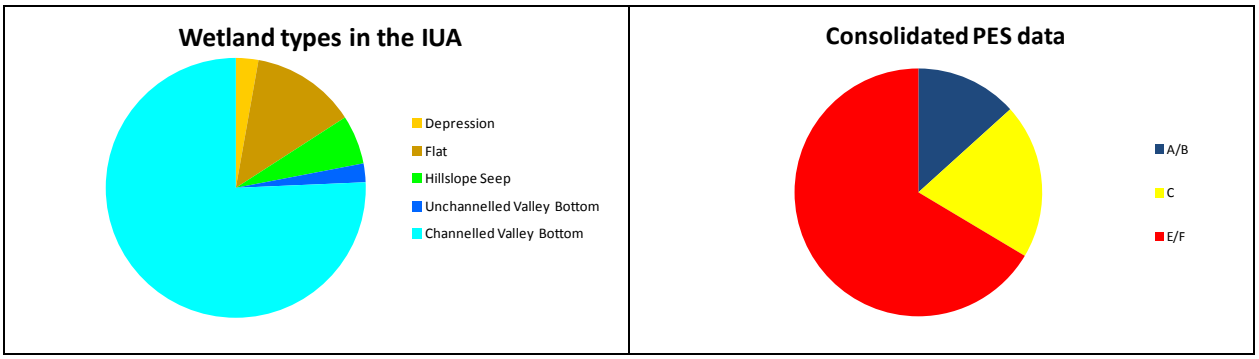

Figure 46: Wetland types and consolidated PES data for IUA 11.

Goods and services provided by wetlands

Regulating & supporting services			Provisioning services	Cultural Support	Biodiversity maintenance
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Low	Moderate	Low - Moderate	Low - Moderate	Low	Low

The flood attenuation functions of wetlands is generally regarded as low while that for sediment retention is regarded as moderately important in this IUA.

There are unacceptable phosphate concentrations in the Selati. These are associated with irrigation return flows and effluents from the mining and industrial activities around Phalaborwa (DWA, 2012). Serious water quality problems have also been identified along the lower reaches of this IUA (associated with Foskor Mine). Wetlands are typically not well suited to provide this service however and therefore score low from a water quality enhancement perspective.

The ecological importance of wetlands and associated biodiversity maintenance values are generally regarded as low in this IUA.

Focus of wetland selection

The extent of wetlands in this catchment is limited. Ecosystem goods and services values are also regarded as low and as such, ***no wetlands have been selected in this IUA***.

Selected wetlands

No wetlands were prioritized for RQO determination in this IUA.

4.2.4.12 IUA 12: Lower Olifants within the Kruger National Park

Overview of water resources in the IUA

The water resources of this IUA all flow into and through the Kruger National Park and surrounding protected areas. The ecological importance is thus very high. However, the present state is in a C category which is mainly due to the impacts of the upstream developments on the Olifants River Figure 47).

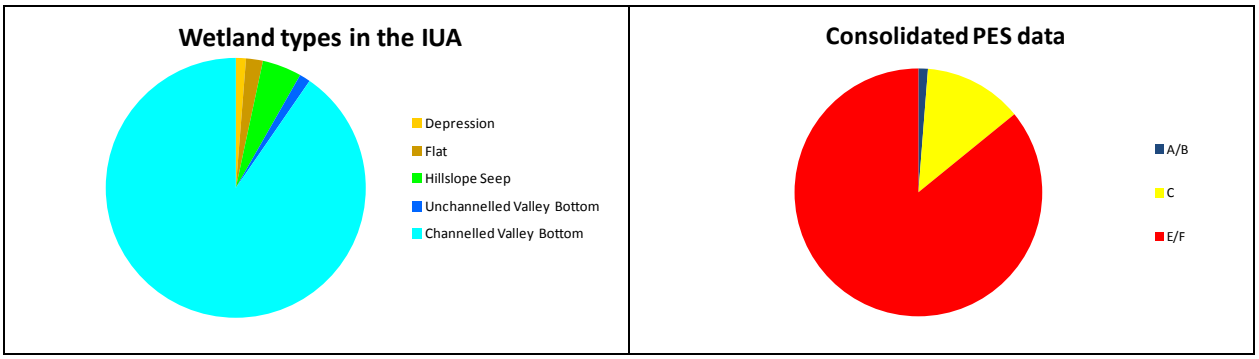

Figure 47: Wetland types and consolidated PES data for IUA 12.

Goods and services provided by wetlands

Regulating & supporting services			**Provisioning services**	**Cultural Support**	**Biodiversity maintenance**
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Low	Low	Low	Low	Moderate	Moderate (**High along Olifants**)

The flood attenuation and sediment retention functions of wetlands are generally regarded as being of low importance in this IUA.

There are unacceptable phosphate concentrations in the lower Olifants below the Selati Confluence. These are associated with irrigation return flows and effluents from the mining and industrial activities around Phalaborwa (DWA, 2012). Wetlands along this river are however not well suited for water quality enhancement. Wetlands were generally rated as having low water quality enhancement functions.

The Olifants and Timbivati Rivers flow into the Kruger National Park at the lower reaches of this IUA. Although limited in extent, wetlands do contribute towards tourism value of these areas. Cultural values supplied by wetlands are regarded as moderately important in this IUA.

While many wetlands were rated as having a low ecological importance, some wetlands, particularly riparian areas associated with the Olifants River have been highlighted as having a high importance.

Focus of wetland selection

The extent of wetlands in this catchment is limited. Ecosystem goods and services values are also regarded as low. Riparian fringe wetlands highlighted as most important from an ecological perspective are better catered for through RQOs for the river resource. As such, ***no wetlands were selected in this IUA.***

Selected wetlands

No wetlands were prioritized for RQO determination in this IUA.

4.2.4.13 IUA 13: Blyde catchment area

Overview of water resources in the IUA

Despite large areas of plantations in the upper catchment, agricultural and urban land use impacts are limited. In response, the Treur and upper Blyde rivers are currently in good condition. Wetlands are very limited in

extent and are confined largely to the upper catchment area within forestry estates. Wetlands are regarded as being largely intact although degradation of some wetlands has been highlighted (Figure 48).

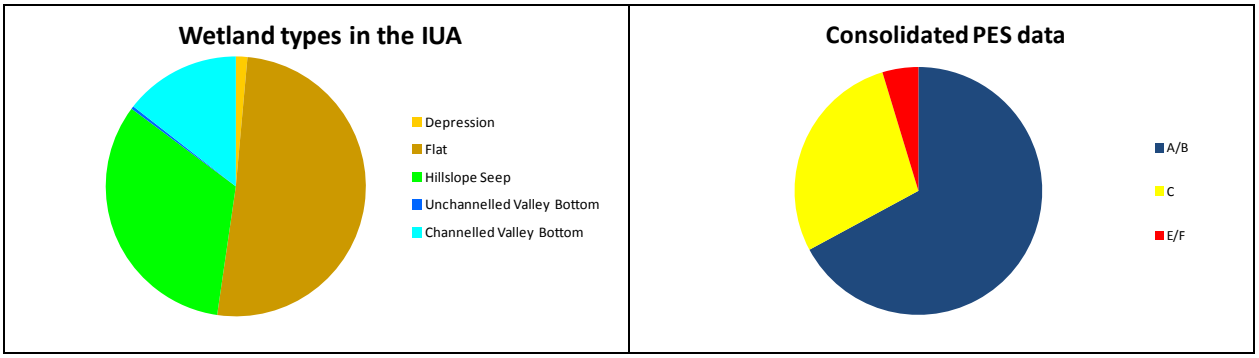

Figure 48: Wetland types and consolidated PES data for IUA 13.

Goods and services provided by wetlands

Regulating & supporting services			Provisioning services	Cultural Support	Biodiversity maintenance
Flood attenuation	Sediment trapping & erosion Control	Water Quality Enhancement	Livelihood Support		
Moderate	Moderate	Low	Low - Moderate	Low - Moderate	Moderate (High in Upper Catchment)

The flood attenuation and sediment retention functions of wetlands are generally regarded as moderately important in this IUA.

Wetlands are typically located in areas with low water quality impacts. The importance of wetlands in providing this service is therefore generally regarded as of low importance.

Based on climatic conditions, demographics and settlement patterns, provisioning services provided by wetlands are likely to be low - moderately important across much of this catchment.

A large number of protected areas are present in this IUA. Wetlands occurring in the Motlotse Canyon Provincial Nature Reserve are likely to contribute to the attraction of this protected area. The contribution of wetlands is regarded as moderately important for tourism and recreational purposes.

Wetlands in the upper catchment have been flagged as having a high ecological importance and sensitivity. These wetlands are located near the catchment divide with limited threats.

Focus of wetland selection

The extent of wetlands in this catchment is limited. Ecosystem goods and services values are also regarded as low. While wetlands with high biodiversity value are present in the upper catchment, these fall primarily within the Motlotse Canyon Provincial Nature Reserve and are not likely to be subject to any threats. ***A single wetland has however been selected based on the presence of important biodiversity attributes.***

Selected wetlands

The location of the wetland selected for RQO determination in this IUA is indicated in Figure 49 whilst details of each of the selected wetlands is included in Table 27.

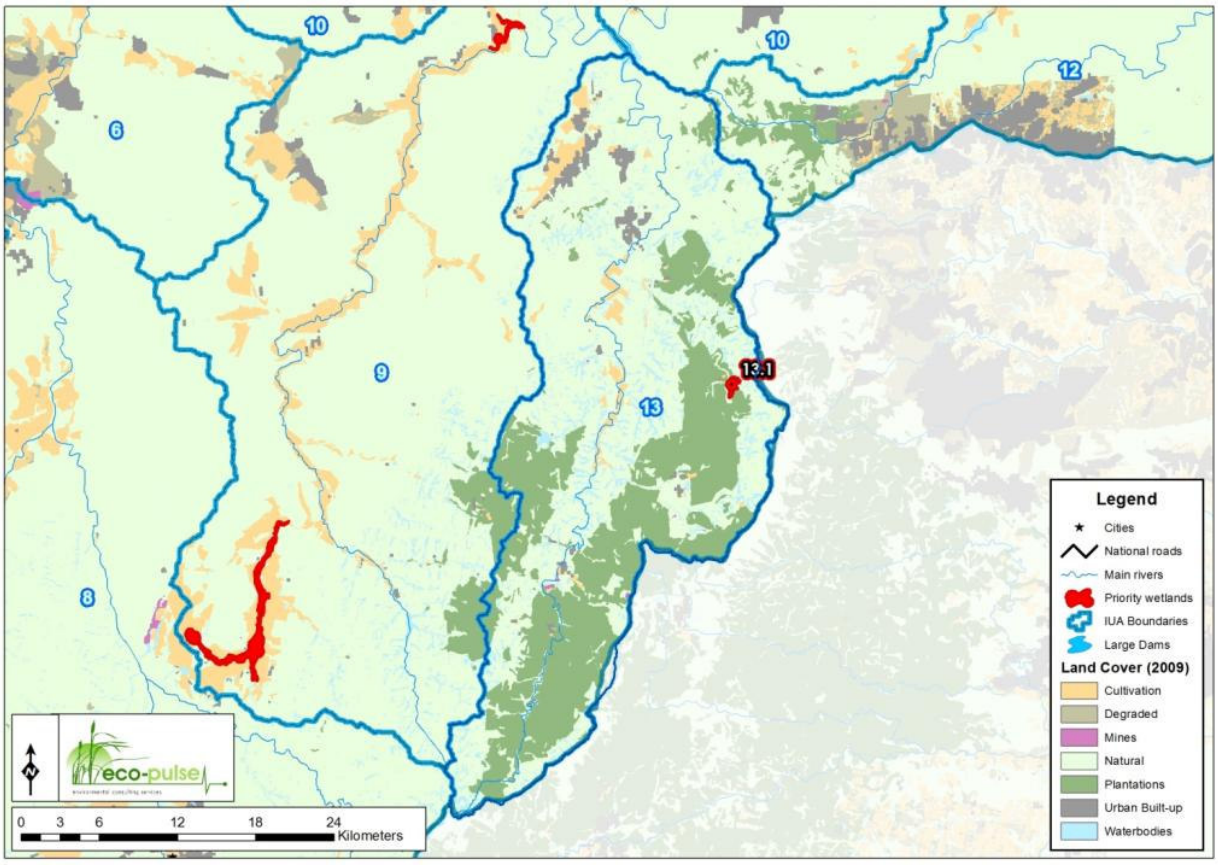

Figure 49: Map showing the location of the wetland selected for RQO determination in IUA13.

Table 27: Motivation for the wetland selected in IUA13.

Wetland	Motivation
13.1 Treur wetland	This is an important peatland system. The associated river supports the endemic Treur River Barb (*Barbus treurensis*) which has an extremely limited distribution. The wetland and associated biota are threatened by existing forestry & proposed future mining activities.

4.3 PRIORITY DAM ECOSYSTEMS FOR THE OLIFANTS WMA

The application of the methodology resulted in the selection of 23 priority dams for the Olifants catchment. The final selected priority dams are presented in Table 28 below.

Table 28: Final selected priority dams for the Olifants WMA

IUA	Resource Unit	Dam Name	Quaternary	Dam number	River	Year Established	FSC (Mm^3)	Purpose
1	9	Witbank	B11G	B1R001	Olifants	1971	104.0	Domestic (urban), industrial use
	9	Doornpoort	B11J	-	Olifants	1925	9.2	Recreation, domestic (urban)
	18	Middelburg	B12C	B1R002	Klein Olifants	1978	48.4	Domestic (urban), industrial
2	24	Bronkorstspruit	B20C	B2R001	Bronkhorstspruit	1950	57.9	Industrial, domestic (urban)
	27	Wilge Dam (Premier Mine)	B20F	-	Wilge	1909	1.7	Domestic (urban), industrial, mining
3	37	Loskop	B32A	B3R002	Olifants	1939	374.3	Irrigation, domestic (rural), recreation
	38	Roodepoort	B32B	B3R004	Selons	1968	1.8	Irrigation
4	41	Rust De Winter	B31C	B3R001	Elands	1934	27.2	Irrigation
	45	Mkhombo/ Weltevreden Weir	B31F	B3R005	Elands	1980	205.8	Domestic (urban & rural), industrial, irrigation
5	48	Rooikraal	B32F	B3R003	Bloed	1921	2.1	Irrigation
	52	Flag Boshielo	B51B	B5R002	Olifants	1987	103.0	Irrigation, industrial, domestic (urban & rural)
6	54	Belfast	B41A	-	Langspruit	1973	4.4	Domestic (urban)
	56	Tonteldoos	B41C	B4R001	Tonteldoos	1954	0.6	Irrigation
	56	Vlugkraal	B41C	B4R002	Vlugkraal	1959	0.4	Irrigation
	62	Der Bruchen	B41G	-	Groot Dwars	1989	7.3	Irrigation, mining
	64	De Hoop	B41H	B4R007	Steelpoort	2012	347.4	Domestic (urban & rural), mining, industrial
8	74	Lydenburg Dam	B42B	-	Sterk	1977	1.1	Domestic (urban), industrial
	79	Buffelskloof	B42F	B4R004	Watervals	1972	5.4	Irrigation
9	83	Ohrigstad Dam	B60E	B6R001	Ohrigstad	1955	14.4	Irrigation
10	88	Blyderivierpoort	B60D	B6R003	Blyde	1974	56.5	Irrigation, domestic (urban),

IUA	Resource Unit	Dam Name	Quaternary	Dam number	River	Year Established	FSC (Mm³)	Purpose
								recreation
11	99	Tours	B72E	B7R003	Ngwabitsi	1988	5.5	Domestic
12	114	Phalaborwa Barrage	B72D	B7R002	Olifants	1966	5.7	Domestic (urban), industrial
	106	Klaserie	B73A	B7R001	Klaserie	1959	5.8	Irrigation

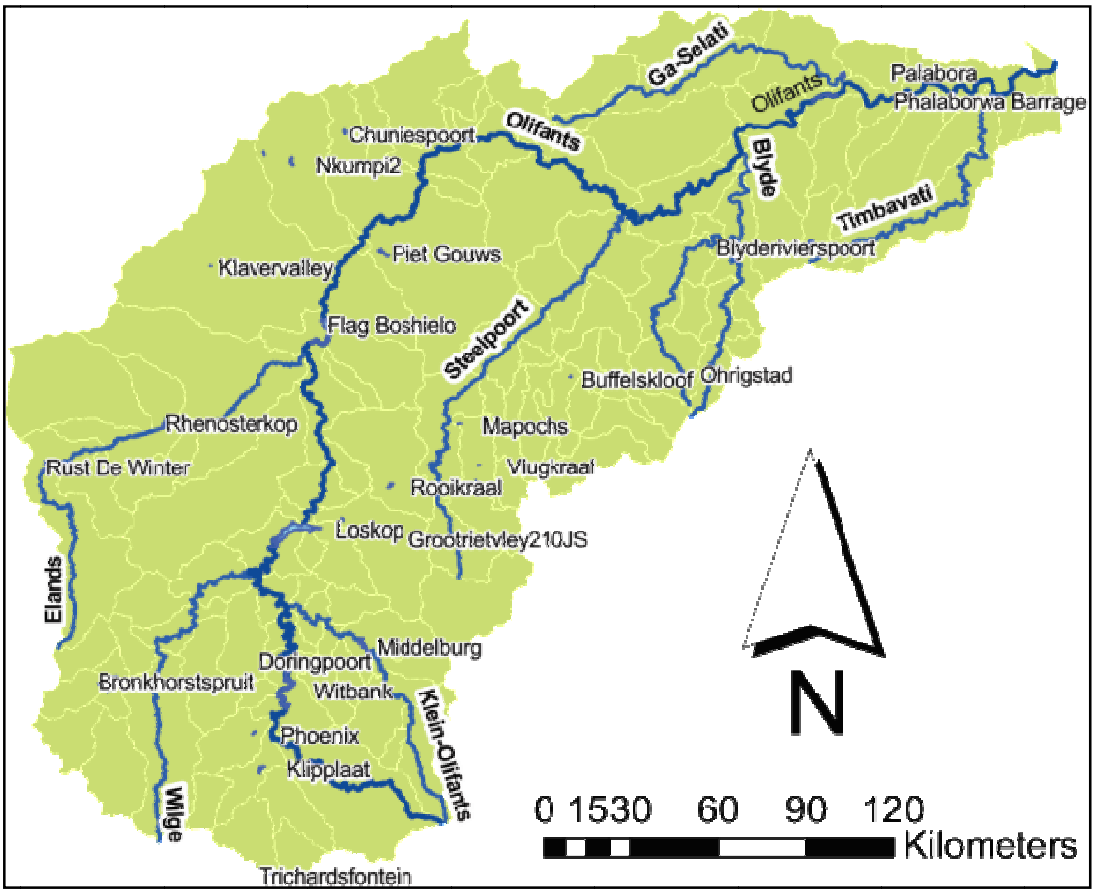

Figure 50: Prioritised dam ecosystems selected for the Resource Quality Objectives determination study through the Resource Unit Prioritisation process.

4.4 PRIORITY GROUNDWATER RESOURCE UNITS AND ECOSYSTEMS FOR THE OLIFANTS WMA

One of the most important findings to highlight was the fact that a lot of intimate knowledge about the areas represented by the RUs resides with the public. The available datasets however fail to address some of the critical issues in certain areas and this highlights the importance of the public participation process. Although public participation can address gaps in the data, it can also skew the prioritisation process if not all areas are equally represented.

The final results of the prioritisation tool are shown in Figure 51.

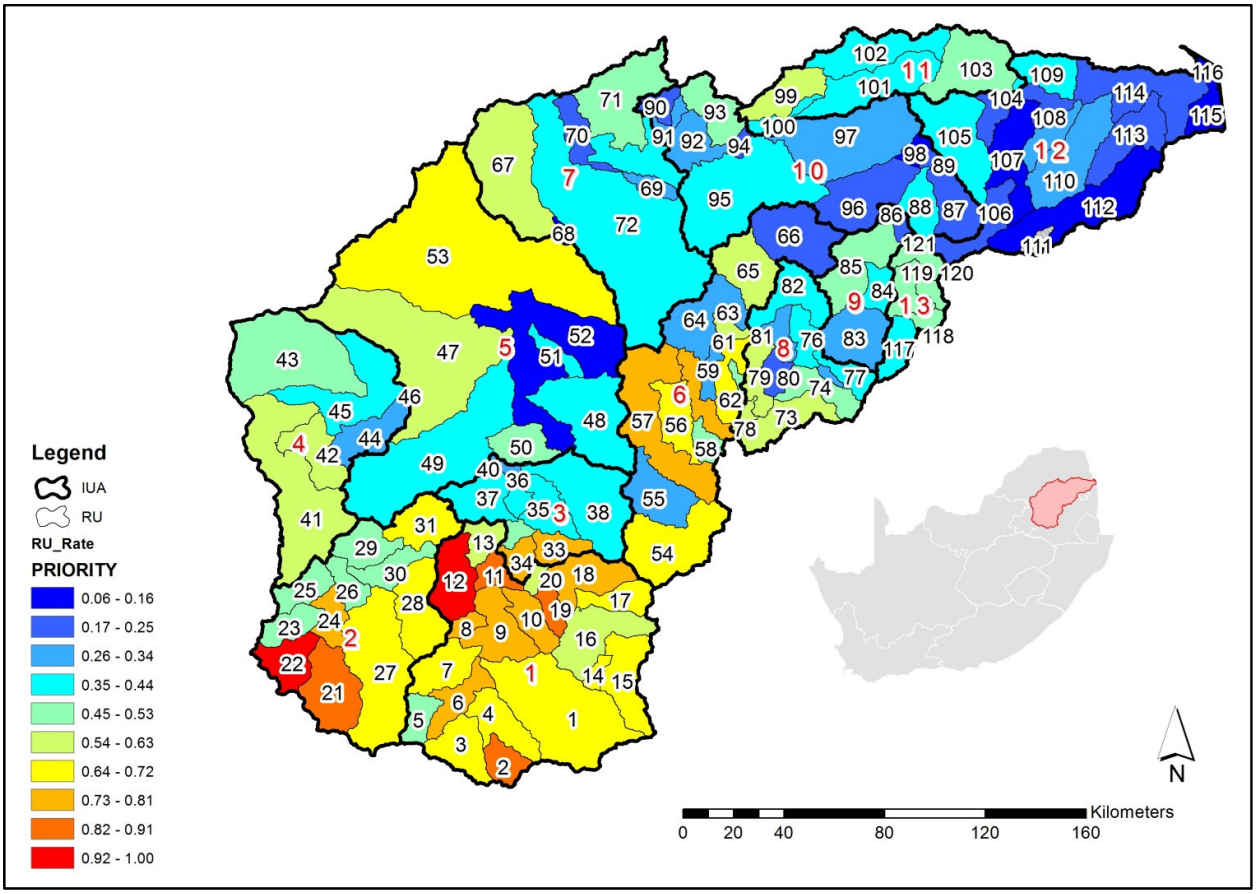

Figure 51: Olifants groundwater RU prioritization outcomes.

Due to the large number of groundwater resources units that were prioritised, stakeholders (regulators) promoted a cut-off point of 30 resource units which were then assessed for RQO determination. The top 30 priority groundwater resources units are shown in Figure 52.

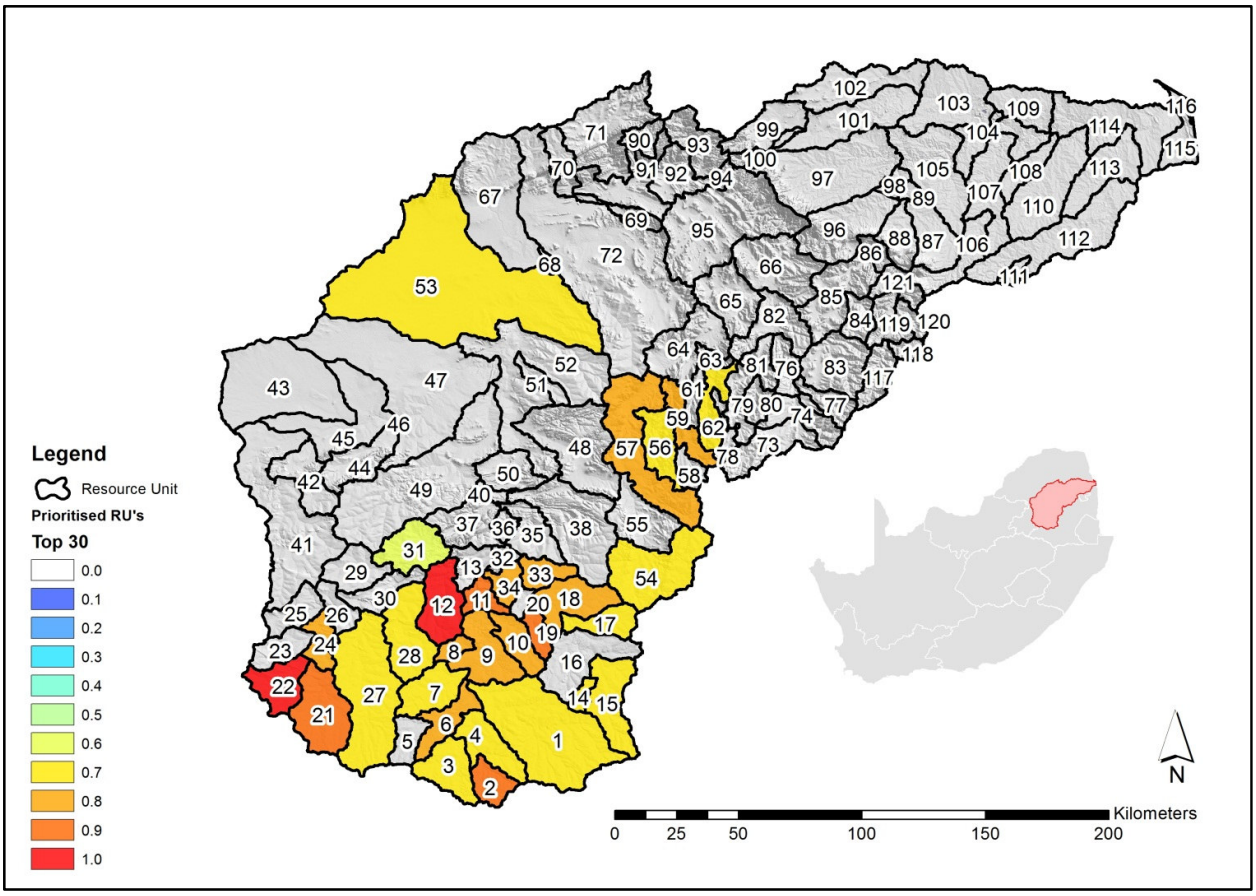

Figure 52: Top 30 groundwater resource units selected for the determination of Ground Water Resource Quality Objectives in the study.

4.5 STAKEHOLDERS COMMENT MANAGEMENT

Participants at the Olifants WMA Resource Unit Prioritisation workshop held on the 29th to the 31st of July 2013 were invited to evaluate the workshop by completing a workshop evaluation questionnaire (APPENDIX F). The questions were structured to assess five areas namely:

- The purpose of the workshop,
- The participation level,
- The availability of information,
- The timing or scheduling of activities within the workshop and
- The facilitation of the workshop.

In total 23 evaluation sheets were received which is summarised below with questions and analysis of the responses.

4.5.1 THE PURPOSE OF THE WORKSHOP

Do you feel that the workshop achieved the stated objectives?

In response to the above question, a significant proportion (78%) of respondents found that the workshop had achieved its stated objectives and the remaining 22% felt it only partially achieved its objectives. The reasons stated for this is that some participants felt that the wetland and dam presentations were not due for release yet i.e. premature release of information which needed to be supplemented. Another respondent found that the pace was too fast as they were not a professional in the field.

4.5.2 THE PARTICIPATION LEVEL

Were you able to contribute meaningfully?

When asked whether they were able to make a meaningful contribution towards the prioritisation of resource units, 65 % of participants stated that they had. An equal number (13 %) of participants responded that they were not fully able to contribute. The other 13 % responded that they weren't able to able to contribute at all.

Two Null responses were received from two respondents who did not submit an answer in the provided fields. One of the afore mentioned respondents was new to the system and felt that (s)he could not make a meaningful contribution. The second respondent in the "Null" response category indicated that his/her contributions were limited to the Upper Vaal and this was a restriction to their contribution in the workshop. Other respondents added that they prefer to have received background information prior to the workshop.

4.5.3 THE AVAILABILITY OF INFORMATION

Were you provided with sufficient information?

The large majority (78%) of respondents agreed that they had received sufficient information to prioritise resource units. Seventeen percent (17%) of respondents only partially agreed while 1 respondent (4%) provide a Null response.

Some participants indicated that there were gaps in the provided information by marking the "Partially" field in the evaluation form. Reasons for this response are shown by two respondents. One respondent felt that the cultural information was not considered as highly as other sub-criteria. Another stated that during the workshop sufficient information was provided, but prior to the workshop (s)he would have like some information.

4.5.4 THE TIMING OR SCHEDULING OF ACTIVITIES WITHIN THE WORKSHOP

Were you provided with sufficient time to contribute to the process?

Most respondents (91%) indicated that they were afforded sufficient time to contribute to the process. One respondent (4%) was not fully satisfied with the allocated time for stakeholder input and another respondent (4%) did not answer the question.

Was the length of the workshop adequate?

When asked about the duration of the workshop, 87 % of respondents indicated that they found the length of the workshop to be adequate. One (4 %) respondent indicated that (s)he found that the workshop was too long. Two responses (8%) were classified in the "Null" category. One belongs to a respondent who ticked two boxes and the other to a respondent who did not answer the question.

4.5.5 THE FACILITATION OF THE WORKSHOP

Was the workshop facilitation adequate?

Almost all (96%) of the respondents indicated that they found the workshop facilitation adequate with 1 null response (4%) from a respondent that did not answer the question.

Specific issues and comments highlighted by workshop participants are documented in Table 29.

Table 29: Comments on workshop process by workshop participants who attended the Olifants RQO prioritisation workshop from 29 – 31 July 2013.

No	Comment	Commentator
1	Thank you for the workshop. The department should bring the monitoring data from in house monitoring programmes and mining (external) programme to facilitate decisions and validate models.	Respondent 1
2	Draft report to please be circulated timeously for comments (and review).	Teboho Motinyane
4	The groundwater component of the study should be beefed up. Information should be groundtruthed as there is recent reliable data on the ground.	Respondent 4
5	The inclusion of AMD and climate change effects on the water resource, especially on river ecosystems. I believe they have impacts and therefore should also be included or made provisions for.	Respondent 5
7	Generally very satisfactory. More consideration /refinement of lakes and to a lesser extent wetlands. Groundwater approaches would be welcome.	Respondent 7
9	Workshop was very informative and I learned a lot from it. I am pleased with the outcome.	Respondent 9
10	This workshop needs to be include the community members as they are the users of the RQOs at large because what we are doing is for them, they therefore need to be effectively included in the participation process.	Respondent 10
12	This workshop needs to be spread to cover local communities who are at the receiving end of the process.	Respondent 12
19	Please check that the Olifants River Forfum (ORF) is part of your I &AP list. I am aware of a number of regular participants that were part of the OR Water Classification System in 2011/12 that did not get either the initial invitation or agenda. Please check future correspondence to include these people for the rest of this process. Thank you.	Respondent 19
20	1) Liked the methodology and sequential presentation leading to the conclusion. 2) Lack of data for groundwater was frustrating.	Respondent 20
22	Purpose of the workshop cannot be establish which pans/wetlands to conserve but rather to identify highly significant areas which should have "protection rights" and strenuous RQOs.	Respondent 22

5 LIMITATIONS AND UNCERTAINTIES

SOME OF THE KEY LIMITATIONS WHICH MAY INFLUENCE THE CONFIDENCE OF THE OUTCOMES OF THE RESOURCE UNIT AND ECOSYSTEM PRIORITISATION PROCESS WHICH SHOULD BE CONSIDERED WHEN IMPLEMENTING THESE PRIORITY RUS AND ECOSYSTEMS INCLUDE:

5.1 RIVERS

- Quantitate data availability was limited which necessitated the use of qualitative data and specialist solicitations. This limitation was particularly evident in the moderately to minimally impacted areas of the Water Management Area. Through the implementation of RQOs real data would be generated to evaluate the accuracy of RU prioritisation process.
- Stakeholder representation of some IUAs (particularly IUAs 4, 5 and 7) were limited which may have resulted in these areas being neglected during the prioritisation process.
- The requisite simplicity principal was adopted in the study to prioritise RUs. In addition, stakeholders considered the capacity and resource availability of the regional regulators to prioritise RUs for RQO determination. These may result in the prioritisation of insufficient RUs for RQO determination which may inadequately address the protection requirement of the vision of the RQO determination process (available from the WRC study).

5.2 WETLANDS

- It should be noted that available datasets used, were either datasets generated at a national scale or surrogate datasets. Therefore, the prioritisation of wetlands is based on broad scale datasets.
- The number of specialist / stakeholders who were able to attend the final stakeholder / specialist workshops.
- The requisite simplicity principal was adopted in the study to prioritise wetlands. In addition, stakeholders considered the capacity and resource availability of the regional regulators to prioritise wetlands for RQO determination. These may result in the prioritisation of insufficient RUs for RQO determination which may inadequately address the protection requirement of the vision of the RQO determination process (available from the WRC study).

5.3 DAMS

- Quantitate data availability was limited which necessitated the use of qualitative data and specialist solicitations. This limitation was particularly evident in the moderately to minimally impacted areas of the Water Management Area. Through the implementation of RQOs real data would be generated to evaluate the accuracy of RU prioritisation process.
- Stakeholder representation of some IUAs (particularly IUAs 4, 5 and 7) were limited which may have resulted in these areas being neglected during the prioritisation process.

5.4 GROUNDWATER

- Quantitate data availability was limited which necessitated the use of qualitative data and specialist solicitations. This limitation was particularly evident in the moderately to minimally impacted areas of the Water Management Area. Through the implementation of RQOs real data would be generated to evaluate the accuracy of RU prioritisation process.

- Stakeholder representation of some IUAs (particularly IUAs 4, 5 and 7) were limited which may have resulted in these areas being neglected during the prioritisation process.
- The requisite simplicity principal was adopted in the study to prioritise groundwater RUs. In addition, stakeholders considered the capacity and resource availability of the regional regulators to prioritise groundwater RUs for RQO determination. These may result in the prioritisation of insufficient RUs for RQO determination which may inadequately address the protection requirement of the vision of the RQO determination process (available from the WRC study).

6 WAY FORWARD

Step 4 of the RQO methodology entails prioritising sub-components for RQO determination and the selection of indicators for monitoring. Each of the prioritised Resource Units (detailed in this report) will therefore by subjected to more detailed analyses to identify which sub-components present in these Resource Units should be protected in order to support water resource dependent activities and/or maintain the integrity and ecological functioning of the water resource. This information is then used to prioritise sub-components for RQO determination.

Wetlands were prioritized for RQO determination through a systematic desktop GIS process and supplemented with priorities identified by key local stakeholders. A final subset of wetlands was then selected at a focussed stakeholder meeting based on their importance for biodiversity conservation and / or their functional importance. The focus during subsequent steps will be to select sub-components and indicators for RQO determination for these prioritised wetlands. Regional-level RQOs will also be developed to cater for the plethora of other wetland ecosystems not catered for through this resource unit based approach.

7 ACKNOWLEDGEMENTS

We would like to acknowledge the contributions made by the stakeholders of the Olifants Water Management Area who participated in the stakeholder workshop to the RQO determination process. The information and direction provided by these stakeholders has made a noticeable contribution to the study. In addition we acknowledge the contributions made by scientists and consultants who provided information to the study team.

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9 APPENDICES

9.1 Appendix A: Summary of the Data Used to Score the Desktop Application of the RU Prioritisation Tool for Rivers in the Study.

Appendix A1: Summary of the data and associated processing methods used to score each criterion and sub-criterion in the RUPT for rivers in the study.

1. Position of the Resource Unit within the IUA

a. Location of the Resource Unit

Resource Units on large mainstem rivers at the downstream end of the IUAs are located at the edge of socio-economic zones where user requirements are likely to differ. Such Resource Units also aggregate the upstream impacts from the entire IUA and thus enable the assessment of management performance at meeting objectives for the upstream catchment.

The Olifants WMA contains a total of thirteen IUAs. The following Resource Units are located at the base of each of the IUAs and have therefore been assigned a score of 1. The remainder of the Resource Units were scored as 0.

IUA number	Associated RU at the base of the IUA
1	RU 13
2	RU 31
3	RU 40
4	RU 46
5	RU 53
6	RU 66
7	RU 72
8	RU 82
9	RU 86
10	RU 98
11	RU 104
12	RU 116
13	RU 121

2. Importance to users

a. Presence of cultural services

Cultural services are defined as the non-material benefits that people obtain from contact with ecosystems. They include recreational, aesthetic and spiritual benefits (TEEB, 2010). Resource Units which provide these benefits should be protected as they contribute to the wellbeing of society.

The Water Resource Classification identified and valued the following cultural services per sub-area of the Olifants WMA:

- value of river based adventure tourism
- value of recreational angling
- ecotourism value
- property values
- scientific and educational value.

These values were generated per sub-area of the Oilfants WMA and were aggregated within four categories namely tourism, recreation, aesthetic value and education.

	Upper	Middle	Steelpoort	Lower	Total
Tourism	37.4	38.4	38.8	249.6	364.2
Recreation	5.1	5.3	5.3	34.3	50.1
Aesthetic value	0	0	0	5.7	5.7
Education	0.1	0.2	0.1	0.1	0.5
Total	**42.65**	**43.88**	**44.24**	**289.75**	**420.52**

These values were then converted into percentages relative to one another. Thus all Resource Units in the Lower sub-area were assigned 100%, while relative percentages for Resource Units in Upper, Middle and Steelpoort sub-areas were calculated as 14.72%, 15.14% and 15.27% respectively. These percentages were then converted into three classes namely 0-33%, 34-66% and 67-100% and scored as 0, 0.5 and 1 respectively within the Resource Unit prioritisation tool. Thus all Resource Units located in the Lower sub-area were scored as 1 while the remainder were scored as 0.

b. Presence of significant vulnerable communities

Many poor communities are directly reliant on water resources for domestic water use, food, grazing, medicine, and building materials. Rivers provide an important source of water for many vulnerable communities in the Olifants Water Management Area. The Census 2011 data identifies the source of water for households across the country and classifies the source according to 11 categories. Two of these categories, namely dam/pool/stagnant water and rivers/streams have been used to identify the location of vulnerable communities who are dependent on natural surface water resources in the Olifants Water Management Area.

All categories provided in Statistics South Africa 2011 Census data	Categories used as indicators of vulnerable communities
Piped water inside dwelling	Dam/pool/stagnant water River/stream
Piper water inside yard	
Piped water on community stand: distance less than 200m from dwelling	
Piped water on community stand: distance greater than 200m from dwelling	
Borehole	
Spring	
Rain-water tank	
Dam/pool/stagnant water	
River/stream	
Water vendor	
Other	

The number of households within each of the selected categories was calculated per ward. Households were assumed to be uniformly distributed across each ward. Where a ward was located across two Resource Units, an area percentage was used to calculate the number of households within the portion of the ward occurring in each Resource Unit. The total number of households for all wards occurring within a Resource Unit was then summed to give an indication of the total number of households dependent on natural surface water resources within each Resource Unit.

In order to identify Resource Units which include more vulnerable communities than another, quantiles were used. This method divides the total number of Resource Units into three equal categories. All Resource Units

occurring in the category with the highest number of vulnerable households were scored as a 1, while all Resource Units falling into the middle category were scored as 0.5. All Resource Units falling into the category containing the least number of vulnerable households were scored as 0.

The WRC study also valued harvested natural products obtained from river ecosystems in the Olifants WMA. This data is presented at sub-area scale as follows:

	Upper	Middle	Steelpoort	Lower	Total
Harvested products	11	28.2	10.2	17.5	66.9

These values were then converted into percentages relative to one another. Thus all Resource Units in the Middle sub-area were assigned 100%, while relative percentages for Resource Units in Upper, Steelpoort and Lower sub-areas were calculated as 39.01%, 36.17% and 62.06% respectively. These percentages were then converted into three classes namely 0-33%, 34-66% and 67-100% and scored as 0, 0.5 and 1 respectively.

The scores for both the dependence on natural water sources as well as the use of harvestable natural products were then compared. The highest score for either of these sub-criteria was then used to denote the importance of the Resource Unit for vulnerable communities. This score was included in the RUPT.

c. Use in meeting strategic requirements

Strategic water requirements in the Olifants WMA refer to are those reserved for Eskom for power generation. The Reconciliation Strategy delineates the Olifants into three socio-economic zones namely the Upper, Middle and Lower Olifants. Power stations located in the Upper Olifants zone utilise 228 million m3/a for cooling purposes, from the upper Komati or the Vaal Systems. No strategic requirements have been identified in the middle and lower zones. All Resource Units in the Upper Zone were therefore considered to play an important role in meeting strategic requirements and were scored 1 while the remainder of Resource Units were deemed to be of little importance in meeting strategic requirements and were scored 0.

d. Presence of important regulating and supporting services

The Economics of Ecosystems and Biodiversity (TEEB) assessment identifies a number of important regulating and supporting services. Regulating services are the services that ecosystems provide by acting as regulators e.g. regulating the quality of air and soil or by providing flood and disease control. Habitat or Supporting services underpin almost all other services. These services acknowledge that ecosystems provide living spaces for plants or animals and also maintain a diversity of different breeds of plants and animals.

Turpie et al. (2010) undertook a study to determine the nature, distribution and value of aquatic ecosystem services in the Oilfants, Inkomati, and Usutu to Mhlatuze WMAs. This study identified and valued a number of important regulating and supporting services supplied by riverine and wetland ecosystems in the study area. The services particularly relevant to riverine ecosystems include water treatment, water regulation and carbon sequestration. The values for water regulation and carbon sequestration have also been adjusted and included in the Water Resource Classification study. The estimated total value of the water purification service of rivers by sub-area (as given by Turpie et al. 2010) as well as the values for the water regulation and carbon sequestration (as adjusted for in the Water Resource Classification study) are included in the table below.

	R million				
	Upper	Middle	Steelpoort	Lower	Total
Water treatment function	8.5	1.9	1.4	8.2	20
Water regulation	4.5	3.1	1.4	3.8	12.8
Carbon sequestration	0.1	1	0.2	1.4	2.7

These values were then converted into percentages relative to one another for each service. Thus, for water treatment all Resource Units in the Upper sub-area were assigned 100%, while relative percentages for

Resource Units in Middle, Steelpoort and Lower sub-areas were calculated as 22.35%, 16.47% and 96.47% respectively. The same approach was used for the water regulation and carbon sequestration functions.

These percentages were then converted into three classes namely 0-33%, 34-66% and 67-100% and scored as 0, 0.5 and 1 respectively. All three resulting scores were then compared and the highest score for any of the sub-criteria was used to denote the importance of the Resource Unit for providing regulating and supporting services. This score was included in the Resource Unit prioritisation tool.

e. Presence of activities supporting the economy

Major economic sectors which depend directly on water resources in the Olifants WMA include agriculture, mining and manufacturing. Each of these sectors was considered in the prioritisation process and scored separately. The contribution of agriculture to the GDP in each IUA was calculated as part of the Water Resource Classification for this WMA. This information was converted to a relative score for inclusion in the prioritisation tool. Unfortunately this data was only available at an IUA level and thus all Resource Units contained in the respective IUA were scored the same. Resource Units which contributed less than 33% to the highest contributor were scored as 0; Resource Units which contributed between 33% and 66% relative to highest contributor were scored as 0.5 and Resource Units which contributed greater than 66% relative to highest contributor were scored as 1. The same scoring system was applied to the assessment of mining. These scores were assigned by the socio-economic team responsible for undertaking the Water Resource Classification for the WMA. The maximum score of any of these activities was included as the final score for this criterion in the Resource Unit prioritisation tool.

IUA number	Agriculture		Coal	PGM	Copper
	Contribution to GDP (R'million)	Resulting score	Scores assigned by the socio-economic specialists of the WRC		
1	46	0	1	0	0
2	77	0	0.5	0	0
3	15	0	0	0	0
4	14	0	0	0	0
5	457	1	0	0.5	0
6	53	0	0	1	0
7	73	0	0	0	0
8	62	0	0	0	0
9	79	0	0	0	0
10	160	0.5	0	0	0
11	83	0	0	0	1
12	22	0	0	0	0

3. Level of threat posed to users

The data used to assess the threat posed to users of the resource unit was sourced from Dr Neels Kleynhans at the DWA. This data forms part of the 2011/2012 desktop assessment of the PES/EIS of the WMA. For the purposes of the RUPT, three metrics were considered based on their potential to alter the in-stream condition of rivers within the resource unit. These included:

- Potential Instream Modification Activities
- Potential Flow Modification Activities
- Potential Physico-Chemical Modification Activities

Each of these metrics was scored as follows:

Threat description	Rating
None	0
Small	1
Moderate	2
Large	3
Serious	4
Critical	5

The maximum score from any of the three metrics was incorporated into the RUPT.

4. Ecological importance

a. Resource units with a high or very high EIS category

The Management Class report of the Water Resource Classification for the Olifants WMA details the categories for both the Ecological Importance and the Ecological Sensitivity of each biophysical node in the study area. However, for some biophysical nodes, these categories have been excluded in this report and thus the categories for these biophysical nodes detailed in the Ecologically Sustainable Base Configuration (ESBC) Scenario Report were used. The categories assigned to both the EI and ES range from “very high” to “very low”. These categories were converted to scores for both EI and ES with “very high” assigned a score of 1, “high” assigned a score of 0.5 and the remainder of the categories scored as 0. The maximum score for either the EI or ES was used in scoring the respective Resource Units within the prioritisation tool.

b. Resource units which have an A/B NEC and / or PES

The Present Ecological State information contained in the Management Class report of the Water Resource Classification was used in the current prioritisation process. Similarly this report details the proposed ecological category for each biophysical node which must be met if the recommended Management Class is to be attained. In most cases, the Present Ecological State is recommended except where the PES is an E category. In such cases a D category has been proposed as an E category is considered unsustainable and cannot be recommended as an ecological condition. The ecological categories for both the PES and those proposed to meet the management class were interrogated to identify those which were currently or required to be in an A or B state. These categories were converted to a score with an A or A/B category scored as 1, a B category scored as 0.5 and the remainder of the categories scored as 0. Given that the PES has been used as the proposed ecological category for attaining the management class (with the exception of the lower categories) within the WRC, the scores for both the “NEC” and PES were the same. These scores were assigned to the respective Resource Units within the prioritisation tool.

c. Resource units identified as National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project identifies a number of freshwater ecosystem priority areas necessary to meet national biodiversity goals for freshwater ecosystems. River FEPAs achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category) (Nel et al., 2011). Resource Units which contained a FEPA were scored as 1 in the prioritisation tool. The NFEPA project also identified Phase 2 FEPAs. Phase 2 FEPAs are located in moderately modified (C) rivers and their condition should not be degraded further, as they may in future be considered for rehabilitation once good condition FEPAs (in an A or B ecological category) are considered fully rehabilitated (Nel et al., 2011). Resource Units containing a Phase 2 FEPA were scored as 0.5 in the prioritisation tool.

d. Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans

Aquatic biodiversity plans have been developed for a number of provinces. However, these plans incorporate NFEPA data which has already been considered as a separate sub-criterion in the Resource Unit prioritisation

tool. To avoid double accounting, these plans were excluded from the assessment. However, the presence of conservancies and both formally and informally protected areas was interrogated. The National Protected Areas coverage was overlaid with the study area in a GIS environment to identify the location of protected areas relative to each Resource Unit. Resource Units which contained a formally protected areas were scored as 1 while Resource Units which contained either an informally protected area or a conservancy were scored as 0.5. The maximum score for any Resource Unit was included in the prioritisation tool. The conservancies and protected areas considered during the assessment are detailed in the table below.

Conservancies	Formally protected areas	Informally protected areas
• Balule • Bankenveld • De Berg Conservancy • Kwena Basin • Leutla • Olifants Gorge • Pau Rosa • Tonteldoos	• Bewaarkloof Nature Reserve • Blyde River Nature Reserve • Bronkhorstspruit Municipal Nature Reserve • Gustav Klingbiel Nature Reserve • Kruger National Park • Kwaggavoetpad Nature Reserve • Leeuwfontein Provincial Nature Reserve • Legalameetse Nature Reserve • Loskop Dam Nature Reserve • Mdala Nature Reserve • Morgenzon • Motlatse Canyon Provincial Nature Reserve • Ohrigstad Dam Nature Reserve • Potlake, • Schuinsdraai Nature Reserve • Tweefontein • Verloren Valei Nature Reserve • Witbank Nature Reserve • Wolkberg (serala) Wilderness Area • Wolkberg Caves Nature Reserve	• Andover Game Reserve • Ezemvelo Private Nature Reserve • Kapama/madrid Reserve • Klaserie Private Nature Reserve • Litsitsirupa Private Nature Reserve • Mount Anderson Catchment Nature Reserve • Selati Game Reserve • Timbavati Game Reserve

5. Level of threat posed to ecological components of the resource unit

The same scores as those reflected under the “Level of threat posed to users” criterion were used for this criterion.

6. Management considerations

a. Resource Units with PES lower than a D category

The Resource Directed Measures Integrated Manual (1999) sets out a default rule which states that “the management class is determined in relation to the present state, but at a level which represents a goal of no further degradation for water resources which are largely modified, and at least a move toward improvement for water resources which are critically modified”. Similarly, the National Water Resources Strategy (2002) states that “any water resource which demonstrates ‘Unacceptable’ conditions is deemed to be unsustainable. In these cases the management class will be determined as a minimum of ‘Heavily used/impacted’ (the lowest management class), and management will aim to rehabilitate the water resources to this state”. In line with this thinking, the Water Resource Classification for the Olifants WMA considers that an E category is unsustainable and cannot be recommended as an ecological condition. This principle was also adopted in the RQO methodology. Consequently, any Resource Units with a PES lower than a D category must be prioritised for management action. Eight Resource Units in the Olifants WMA have a PES of an “E” and have therefore received a score of 1 in the prioritisation tool.

7. Practical considerations

a. Monitoring points

The Department of Water Affairs undertakes a number of national monitoring programmes including the National Chemical Monitoring Programme (NCMP), the National Microbiological Monitoring Programme (NMMP) and the River Health Programme (RHP). In addition, the Department has a number of routine water

quality monitoring sites and Ecological Water Requirement (EWR) sites. The location of these monitoring sites relative to each of the Resource Units was identified. Resource Units which contained either a EWR or RHP site were scored as 1 while those Resource Units which contained any other monitoring site received a score of 0.5. The maximum score assigned to each Resource Unit was included as the final score for this sub-criterion in the Resource Unit prioritisation tool.

b. Accessibility

No desktop data was available to score this sub-criterion and it was therefore excluded from the initial prioritisation process.

c. Safety risk

No desktop data was available to score this sub-criterion and it was therefore excluded from the initial prioritisation process.

9.2 APPENDIX A2: RU SCORES FOR EACH CRITERION AND SUB-CRITERION APPLIED IN THE DESKTOP APPLICATION OF THE RUPT FOR RIVERS IN THE STUDY.

RESOURCE UNIT PRIORITISATION TOOL																					
Criterion	**Sub-criteria**	RU 1	RU 2	RU 3	RU 4	RU 5	RU 6	RU 7	RU 8	RU 9	RU 10	RU 11	RU 12	RU 13	RU 14	RU 15	RU 16	RU 17	RU 18	RU 19	RU 20
Position of resource unit within IUA		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Importance for users (Current & anticipated future use)	Cultural services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Presence of significant vulnerable communities	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Use in meeting strategic requirements and international obligations	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1
	Presence of supporting and regulating services	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1
	Presence of activities supporting the economy	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Threat posed to users	Level of threat posed to users	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	0.5	1	1	1	0.5	1
Ecological Importance	Resource units with a high or very high EIS category	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0	0.5	1	0.5	0.5	0.5	0	0.5	0.5	0.5
	Resource units which have an A/B NEC and / or PES	0	0.5	0	0	0.5	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0
	Resource units identified as National Freshwater Ecosystem Priority Areas	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0
	Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans	0	0	0	0	0	0	0	0	1	0	0	0.5	0.5	0	0	0	0	0	0	0
Threat faced by ecological component of the RU	Level of threat posed to ecological components of the resource unit	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	0.5	1	1	1	0.5	1
Management Considerations	Resource units with PES lower than a D Category or lower than the accepted gazetted category (NEC)	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Practical Considerations	Availability of monitoring data	1	0.5	0.5	0.5	0.5	0.5	0.5	1	1	0.5	1	1	1	0.5	1	1	1	1	1	0.5
	Accessibility of resource unit for monitoring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Safety risk associated with monitoring resource units.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PRIORITISATION SCORES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.16	0.16	0.22	0.17	0.17	0.16	0.22
		0.14	0.16	0.14	0.14	0.16	0.14	0.14	0.13	0.17	0.14	0.13	0.15	0.20	0.08	0.08	0.14	0.13	0.14	0.08	0.14
		0.05	0.02	0.02	0.02	0.02	0.02	0.02	0.05	0.05	0.02	0.17	0.17	0.05	0.02	0.05	0.05	0.05	0.05	0.05	0.02
		0.41	0.40	0.38	0.38	0.40	0.38	0.38	0.39	0.43	0.38	0.52	0.54	0.72	0.26	0.28	0.41	0.34	0.36	0.28	0.38
		0.6	0.6	0.5	0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.7	0.8	1.0	0.4	0.4	0.6	0.5	0.5	0.4	0.5

RESOURCE UNIT PRIORITISATION TOOL																					
Criterion	**Sub-criteria**	RU 21	RU 22	RU 23	RU 24	RU 25	RU 26	RU 27	RU 28	RU 29	RU 30	RU 31	RU 32	RU 33	RU 34	RU 35	RU 36	RU 37	RU 38	RU39	RU40
Position of resource unit within IUA		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Importance for users (Current & anticipated future use)	Cultural services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Presence of significant vulnerable communities	0.5	0.5	0.5	0.5	1	1	0.5	0.5	1	0.5	1	0.5	1	0.5	1	0.5	1	1	1	1
	Use in meeting strategic requirements and international obligations	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
	Presence of supporting and regulating services	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Presence of activities supporting the economy	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	0	0	0	0	0	0	0	0
Threat posed to users	Level of threat posed to users	1	1	1	1	1	1	1	0.5	0.5	0.5	0.5	1	1	1	0.5	0	0.5	1	1	1
Ecological Importance	Resource units with a high or very high EIS category	0.5	0.5	0.5	0.5	0.5	1	1	0.5	1	1	0.5	0.5	1	0	1	0.5	0.5	0.5	0.5	0.5
	Resource units which have an A/B NEC and / or PES	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0	0	0.5	0.5	0	0.5	0	0
	Resource units identified as National Freshwater Ecosystem Priority Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5	1	0	0	0	0
	Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans	0	0	1	1	0	0	0	0.5	0.5	0.5	0.5	0	0	0	1	1	1	0.5	1	1
Threat faced by ecological component of the RU	Level of threat posed to ecological components of the resource unit	1	1	1	1	1	1	1	0.5	0.5	0.5	0.5	1	1	1	0.5	0	0.5	1	1	1
Management Considerations	Resource units with PES lower than a D Category or lower than the accepted gazetted category (NEC)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Practical Considerations	Availability of monitoring data	0.5	0.5	0.5	1	1	0.5	1	0.5	0	1	1	0	0	1	1	0	1	1	0.5	1
	Accessibility of resource unit for monitoring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Safety risk associated with monitoring resource units.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PRIORITISATION SCORES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
		0.20	0.20	0.20	0.20	0.22	0.22	0.20	0.14	0.16	0.14	0.16	0.19	0.21	0.19	0.14	0.07	0.14	0.18	0.21	0.21
		0.14	0.14	0.17	0.17	0.14	0.15	0.15	0.09	0.10	0.12	0.09	0.16	0.15	0.14	0.15	0.09	0.10	0.17	0.17	0.17
		0.02	0.02	0.02	0.05	0.05	0.02	0.05	0.02	0.00	0.05	0.05	0.00	0.00	0.05	0.05	0.00	0.05	0.05	0.02	0.05
		0.37	0.37	0.39	0.42	0.41	0.40	0.41	0.26	0.26	0.31	0.55	0.35	0.36	0.38	0.34	0.16	0.29	0.39	0.40	0.67
		0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.8	0.5	0.5	0.5	0.5	0.2	0.4	0.5	0.6	0.9

RESOURCE UNIT PRIORITISATION TOOL																					
Criterion	**Sub-criteria**	RU 41	RU 42	RU 43	RU 44	RU45	RU46	RU 47	RU 48	RU 49	RU 50	RU 51	RU 52	RU 53	RU 54	RU 55	RU 56	RU 57	RU 58	RU 59	RU 60
Position of resource unit within IUA		0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Importance for users (Current & anticipated future use)	Cultural services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Presence of significant vulnerable communities	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	0.5	0.5	0.5
	Use in meeting strategic requirements and international obligations	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
	Presence of supporting and regulating services	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0
	Presence of activities supporting the economy	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Threat posed to users	Level of threat posed to users	0.5	0.5	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	0.5	0.5	0.5
Ecological Importance	Resource units with a high or very high EIS category	1	0.5	0.5	0.5	0	0	0	0.5	0.5	0	0.5	0.5	0.5	0.5	0	0.5	1	1	0	1
	Resource units which have an A/B NEC and / or PES	0	0	0	0	0	0	0	0.5	0	0	0.5	0	0	0	0	0	0	0.5	0	0.5
	Resource units identified as National Freshwater Ecosystem Priority Areas	0	0	0.5	0	0	0	0.5	1	1	0	0	0	1	1	0	1	1	1	1	1
	Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans	1	1	1	1	1	0	1	1	1	0	0	1	1	0	0	0.5	0.5	1	1	0.5
Threat faced by ecological component of the RU	Level of threat posed to ecological components of the resource unit	0.5	0.5	1	1	1	1	1	1	1	1	0.5	1	1	1	1	1	1	0.5	0.5	0.5
Management Considerations	Resource units with PES lower than a D Category or lower than the accepted gazetted category (NEC)	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Practical Considerations	Availability of monitoring data	1	0	0	0	1	0.5	0.5	0	1	1	0	1	1	1	1	1	1	0	1	0
	Accessibility of resource unit for monitoring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Safety risk associated with monitoring resource units.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PRIORITISATION SCORES	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.14	0.14	0.21	0.21	0.21	0.21	0.20	0.20	0.23	0.23	0.14	0.20	0.20	0.20	0.20	0.17	0.20	0.11	0.11	0.11
		0.12	0.10	0.18	0.17	0.15	0.13	0.17	0.22	0.20	0.13	0.09	0.17	0.20	0.18	0.13	0.19	0.20	0.17	0.13	0.16
		0.05	0.00	0.00	0.00	0.05	0.15	0.15	0.00	0.05	0.05	0.00	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.05	0.00
		0.31	0.25	0.39	0.37	0.40	0.73	0.52	0.42	0.48	0.41	0.23	0.42	0.70	0.43	0.38	0.41	0.45	0.28	0.28	0.26
		0.4	0.3	0.5	0.5	0.6	1.0	0.7	0.6	0.7	0.6	0.3	0.6	1.0	0.6	0.5	0.6	0.6	0.4	0.4	0.4

RESOURCE UNIT PRIORITISATION TOOL																					
Criterion	**Sub-criteria**	RU 61	RU 62	RU 63	RU64	RU65	RU 66	RU 67	RU 68	RU 69	RU 70	RU 71	RU 72	RU 73	RU 74	RU 75	RU 76	RU 77	RU 78	RU 79	RU 80
Position of resource unit within IUA		0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Importance for users (Current & anticipated future use)	Cultural services	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	1	1	0	0	0
	Presence of significant vulnerable communities	0.5	0.5	0.5	1	1	1	1	1	1	1	1	1	0.5	0.5	0.5	1	1	0.5	0.5	0.5
	Use in meeting strategic requirements and international obligations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Presence of supporting and regulating services	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0	0	0
	Presence of activities supporting the economy	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Threat posed to users	Level of threat posed to users	0.5	1	1	1	1	1	1	1	1	1	1	1	0.5	0.5	0.5	0.5	1	0.5	0.5	0
Ecological Importance	Resource units with a high or very high EIS category	0.5	1	0.5	0	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	0.5	1	1
	Resource units which have an A/B NEC and / or PES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5
	Resource units identified as National Freshwater Ecosystem Priority Areas	1	1	0	0.5	0	1	1	0	0	0	1	0	1	0	0	1	1	0	0	1
	Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans	0.5	0.5	0.5	0.5	0	0	0	0	0	0	1	1	1	1	1	0	1	1	0	0.5
Threat faced by ecological component of the RU	Level of threat posed to ecological components of the resource unit	0.5	1	1	1	1	1	1	1	1	1	1	1	0.5	0.5	0.5	0.5	1	0.5	0.5	0
Management Considerations	Resource units with PES lower than a D Category or lower than the accepted gazetted category (NEC)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Practical Considerations	Availability of monitoring data	0	1	1	1	1	1	0	1	0	0	0.5	1	1	1	0	1	1	0	1	1
	Accessibility of resource unit for monitoring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Safety risk associated with monitoring resource units.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PRIORITISATION SCORES	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.11	0.17	0.17	0.20	0.22	0.22	0.18	0.18	0.18	0.18	0.19	0.19	0.08	0.08	0.08	0.13	0.19	0.08	0.08	0.02
		0.13	0.20	0.15	0.16	0.14	0.18	0.18	0.13	0.14	0.14	0.20	0.17	0.14	0.09	0.10	0.11	0.20	0.10	0.09	0.10
		0.00	0.05	0.05	0.05	0.05	0.05	0.00	0.17	0.00	0.00	0.02	0.05	0.05	0.05	0.00	0.05	0.05	0.00	0.05	0.05
		0.23	0.42	0.37	0.41	0.41	0.69	0.35	0.47	0.31	0.31	0.42	0.65	0.27	0.21	0.18	0.29	0.44	0.18	0.22	0.16
		0.3	0.6	0.5	0.6	0.6	1.0	0.5	0.7	0.4	0.4	0.6	0.9	0.4	0.3	0.3	0.4	0.6	0.3	0.3	0.2

RESOURCE UNIT PRIORITISATION TOOL																					
Criterion	**Sub-criteria**	RU 81	RU 82	RU 83	RU 84	RU85	RU86	RU 87	RU 88	RU 89	RU 90	RU 91	RU92	RU 93	RU 94	RU95	RU96	RU 97	RU98	RU 99	RU 100
Position of resource unit within IUA		0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Importance for users (Current & anticipated future use)	Cultural services	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Presence of significant vulnerable communities	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Use in meeting strategic requirements and international obligations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Presence of supporting and regulating services	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Presence of activities supporting the economy	0	0	0	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5	1	1
Threat posed to users	Level of threat posed to users	0.5	0.5	1	1	1	1	0.5	0.5	1	0	1	1	1	0	1	1	1	1	0.5	0.5
Ecological Importance	Resource units with a high or very high EIS category	0	0.5	1	1	0	1	0.5	0.5	1	1	0.5	0	1	0.5	1	0.5	0.5	0.5	1	1
	Resource units which have an A/B NEC and / or PES	0	0.5	0	0	0	0	0.5	0.5	0	0.5	0.5	0	0.5	0.5	0	0	0	0	0	0
	Resource units identified as National Freshwater Ecosystem Priority Areas	0	1	1	0	0	0	1	1	1	0	0	0	1	1	0	0	0.5	0	0	1
	Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans	0.5	0	1	1	1	1	1	1	0.5	1	1	1	1	1	1	0	1	0.5	1	1
Threat faced by ecological component of the RU	Level of threat posed to ecological components of the resource unit	0.5	0.5	1	1	1	1	0.5	0.5	1	0	1	1	1	0	1	1	1	1	0.5	0.5
Management Considerations	Resource units with PES lower than a D Category or lower than the accepted gazetted category (NEC)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Practical Considerations	Availability of monitoring data	1	1	1	1	1	1	0.5	1	0	1	0	1	1	0	1	1	1	1	1	1
	Accessibility of resource unit for monitoring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Safety risk associated with monitoring resource units.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PRIORITISATION SCORES	0.00	0.25	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.00
		0.08	0.13	0.19	0.19	0.19	0.19	0.14	0.14	0.20	0.08	0.20	0.20	0.20	0.08	0.19	0.20	0.20	0.20	0.16	0.16
		0.08	0.13	0.22	0.18	0.15	0.18	0.16	0.16	0.20	0.07	0.18	0.15	0.23	0.09	0.18	0.14	0.18	0.15	0.12	0.15
		0.05	0.05	0.05	0.05	0.05	0.05	0.02	0.05	0.00	0.05	0.00	0.05	0.05	0.00	0.05	0.17	0.05	0.05	0.05	0.05
		0.20	0.56	0.46	0.42	0.39	0.67	0.32	0.35	0.41	0.20	0.39	0.40	0.49	0.17	0.42	0.52	0.69	0.65	0.32	0.36
		0.3	0.8	0.6	0.6	0.5	0.9	0.4	0.5	0.6	0.3	0.5	0.6	0.7	0.2	0.6	0.7	1.0	0.9	0.4	0.5

RESOURCE UNIT PRIORITISATION TOOL																							
Criterion	**Sub-criteria**	RU 101	RU 102	RU103	RU104	RU 105	RU 106	RU 107	RU 108	RU 109	RU 110	RU 111	RU 112	RU 113	RU114	RU 115	RU116	RU 117	RU 118	RU 119	RU 120	RU 121
Position of resource unit within IUA		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Importance for users (Current & anticipated future use)	Cultural services	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Presence of significant vulnerable communities	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Use in meeting strategic requirements and international obligations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Presence of supporting and regulating services	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Presence of activities supporting the economy	1	1	1	1	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Threat posed to users	Level of threat posed to users	0.5	1	1	1	1	0.5	1	0	1	1	0.5	0.5	1	1	0	1	0.5	0	0.5	0.5	1
Ecological Importance	Resource units with a high or very high EIS category	0	0	0	0.5	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	1	1
	Resource units which have an A/B NEC and / or PES	0	0.5	0	0	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	0	1	0	0	0.5	0.5	1	0.5
	Resource units identified as National Freshwater Ecosystem Priority Areas	0	0	0	0	0	1	0	0	0	0	0	0	1	0.5	1	1	1	1	1	1	1
	Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans	1	0.5	0.5	0	0.5	1	1	1	1	1	0.5	1	1	1	1	1	1	1	1	1	1
Threat faced by ecological component of the RU	Level of threat posed to ecological components of the resource unit	0.5	1	1	1	1	0.5	1	0	1	1	0.5	0.5	1	1	0	1	0.5	0	0.5	0.5	1
Management Considerations	Resource units with PES lower than a D Category or lower than the accepted gazetted category (NEC)	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Practical Considerations	Availability of monitoring data	1	0	1	0	1	1	0	0.5	0	0	0	0	0	1	0	0.5	1	1	1	1	1
	Accessibility of resource unit for monitoring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Safety risk associated with monitoring resource units.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PRIORITISATION SCORES	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.25
		0.16	0.22	0.22	0.22	0.19	0.14	0.19	0.07	0.19	0.19	0.13	0.13	0.19	0.19	0.07	0.19	0.13	0.07	0.13	0.13	0.19
		0.09	0.15	0.14	0.14	0.14	0.14	0.17	0.06	0.18	0.18	0.11	0.12	0.22	0.18	0.11	0.20	0.15	0.11	0.17	0.19	0.23
		0.05	0.00	0.17	0.13	0.05	0.05	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.02	0.05	0.05	0.05	0.05	0.05
		0.29	0.37	0.53	0.73	0.38	0.33	0.36	0.15	0.37	0.37	0.23	0.25	0.41	0.42	0.18	0.67	0.33	0.22	0.35	0.36	0.72
		0.4	0.5	0.7	1.0	0.5	0.5	0.5	0.2	0.5	0.5	0.3	0.3	0.6	0.6	0.2	0.9	0.5	0.3	0.5	0.5	1.0

9.3 APPENDIX A3: MOTIVATION FOR CHANGES TO SCORES FROM DESKTOP RU PRIORITISATION TOOL WHICH RESULTED IN THE AMENDED PRIORITISATION TOOL.

Note shading denotes:

= Increased score

= No change to score

= Decreased score

1. **Resource units located on a large main stem river at the downstream end of an IUA (IUA outlet node)**

RU	Desktop	Workshop	Motivation for change
20	0	1	Query boundary as it seems incorrect
46	1	1	This was not identified in GOB's spread sheet

2. **Resource units which provide important cultural services to society**

RU	Desktop	Workshop	Motivation for change
9	0	1	Swimming is a recreational activity in this RU
11	0	1	Tourism and aesthetics
13	0	1	Tourism and aesthetics
34	0	1	Tourism
35	0	1	Recreational activities
36	0	1	Tourism and aesthetics
37	0	1	Tourism
52	0	1	Baptisms occur in this RU. Water collected from this RU at the confluence
65	1	0	Downgrade – stakeholder input
71	1	0	Downgrade – stakeholder input
72	1	1	Confluence with Olifants very important
76	1	0	Downgrade – stakeholder input
77	1	0	Downgrade – stakeholder input
82	1	0	Downgrade – stakeholder input
83	1	0	Downgrade – stakeholder input
84	1	0	Downgrade – stakeholder input
85	1	0	Downgrade – stakeholder input
86	1	0	Downgrade – stakeholder input
87	1	0	Downgrade – stakeholder input
88	1	1	Canoeing and white water rafting
89	1	1	Canoeing and white water rafting
90	1	0	Downgrade – stakeholder input

RU	Desktop	Workshop	Motivation for change
91	1	0	Downgrade – stakeholder input
92	1	0	Downgrade – stakeholder input
93	1	0	Downgrade – stakeholder input
94	1	0	Downgrade – stakeholder input
96	1	0	Downgrade – stakeholder input

3. **Resource units which are important in supporting livelihoods of significant vulnerable communities**

RU	Desktop	Workshop	Motivation for change
1	0.5	0	Downgrade – stakeholder input
2	0.5	0	
4	0.5	0	
5	0.5	0	
6	0.5	0	
7	0.5	0	
9	0.5	0.5	Witbank area - people living next to the river but not using the water for human consumption
10	0.5	0	Downgrade – stakeholder input
11	0.5	0	
12	0.5	1	Vulnerable communities identified in this RU
13	0.5	0	Downgrade –stakeholder input
14	0.5	0	
15	0.5	0	
16	0.5	0	
17	0.5	0	
19	0.5	0	
21	0.5	0	
24	0.5	0	
25	1	0.5	
26	1	0	
29	1	0.5	
30	0.5	0	
31	1	0	
32	0.5	0	
33	1	0	
34	0.5	0	
35	1	0	
36	0.5	0	
37	1	0	
38	1	0	
39	1	0	
40	1	0	
42	1	0.5	
43	1	0.5	
44	1	0.5	

RU	Desktop	Workshop	Motivation for change
45	1	0.5	
46	1	0.5	
48	1	0	
50	1	0	
51	1	0	
52	1	0.5	
53	1	0.5	
54	1	0	
55	1	0	
56	0.5	0	
57	1	0.5	
58	0.5	0	
59	0.5	0	
60	0.5	0	
61	0.5	0	
62	0.5	0	
63	0.5	0	
64	1	0.5	
65	1	0.5	
66	1	0.5	
67	1	0.5	
68	1	0	
69	1	0	
70	1	0	
71	1	0.5	
73	0.5	0	
74	0.5	0	
75	0.5	0	
76	1	0	
77	1	0	
78	0.5	0	
79	0.5	0	
80	0.5	0	
81	0.5	0	
82	1	0	
83	1	0	
84	1	0	
85	1	0	
86	1	0	
87	1	0	
88	1	0	
89	1	0	
90	1	0	
91	1	0	
92	1	0	

RU	Desktop	Workshop	Motivation for change
93	1	0	
94	1	0	
95	1	0.5	
96	1	1	Lepelle community just past the tunnel there are vulnerable communities here who depend on water falls for water
97	1	0.5	The Ox river - some dependence in the river by the Mabins and Kororo communities.
98	1	0	Downgrade – stakeholder input
99	1	0.5	
100	1	0	
101	1	0	
102	1	0	
103	1	0.5	
104	1	0	
105	1	0	
106	1	0	
107	1	0	
108	1	0	
109	1	0	
110	1	0	
111	1	0	
112	1	0.5	
113	1	0	
114	1	0	
115	1	0	
116	1	0	
117	1	0	
118	1	0	
119	1	0	
120	1	0	
121	1	0	

4. **Resource units which are important in meeting strategic requirements and international obligations**

RU	Desktop	Workshop	Motivation for change
1	1	0	Downgraded as stakeholders indicated that strategic water is from the Komati and Vaal therefore it is not sourced within the WMA.
2	1	0	
3	1	0	
4	1	0	
5	1	0	
6	1	0	
7	1	0	
8	1	0	
9	1	0	

RU	Desktop	Workshop	Motivation for change
10	1	0	
11	1	0	
12	1	0	
13	1	0	
14	1	0	
15	1	0	
16	1	0	
17		0	
18		0	
19	1	0	
20	1	0	
21	1	0	
22	1	0	
23	1	0	
24	1	0	
25	1	0	
26	1	0	
27	1	0	
28	1	0	
29	1	0	
30	1	0	
31	1	0	
32	1	0	
33	1	0	
34	1	0	
35	1	0	
36	1	0	
37	1	0	
38	0	0	
39	1	0	
40	1	0	
41	1	0	
42	1	0	
43	1	0	
44	1	0	
45	1	0	
46	1	0	
47	0	0	
48	0	0	
49	1	0	
50	1	0	
120	0	0	
121	0	1	Releases into Mozambique

5. Resource units that provide supporting and regulating services

RU	Desktop	Workshop	Motivation for change
1	1	0.5	Downgrade – stakeholder input
2	1	0	
3	1	0	
5	1	0	
6	1	0.5	
7	1	0	
8	1	1	Returns just before the dam
10	1	0	Downgrade – stakeholder input
12	1	1	Industrial waste and there is a wetland here (?)
14	1	0	Downgrade – stakeholder input
15	1	0	
16	1	0.5	
17	0	0.5	
18	0	0.5	
19	1	0	
20	1	0.5	
21	1	0	
22	1	0	
23	1	0	
24	1	1	Bronkhorstpruit and Enkangala industrial area
25	1	0	Downgrade – stakeholder input
26	1	1	Bronkhorstpruit and enkangala industrial area
27	1	0.5	Downgrade – stakeholder input
28	1	0	
29	1	0	
30	1	1	Bronkhorstpruit and Enkangala industrial area
31	1	1	Bronkhorstpruit and Enkangala industrial area
32	1	0	Downgrade – stakeholder input
33	1	0	
34	1	0.5	
35	1	0	
36	1	0	
38	1	0	
39	1	0	
41	1	0	
42	1	0	
43	1	0.5	
44	1	0.5	WWTW in upper reaches
45	1	0.5	Downgrade – stakeholder input
46	1	0.5	Downgrade – stakeholder input
49	1	1	Community, agriculture and sewage problems
50	1	1	Bronkhorstpruit and Enkangala industrial area- cascading effect of

RU	Desktop	Workshop	Motivation for change
			the industrial area in this RU
51	1	0	Downgrade – stakeholder input
54	1	0	
55	1	0	
56	0	1	Two dams and sewage works in this RU
57	1	0.5	Downgrade – stakeholder input
58	0	1	Belfast WWTW
59	0	0.5	Downstream catchment of the two WWTWs and poor water quality
64	1	0.5	Downgrade – stakeholder input
65	1	0.5	
67	1	0	
68	1	0	
69	1	0	
70	1	0	
71	1	0	
74	0	1	Sewage in Dorpspruit
76	1	0.5	Downgrade – stakeholder input
77	1	0	
81	0	1	Main stem river
83	1	1	Sewage in Dorpspruit -future developments (prospecting intense in this area -proliferation if informal settlements)
84	1	0	Downgrade – stakeholder input
85	1	0.5	Future sewage problems
86	1	0.5	Future sewage problems
87	1	0	Downgrade – stakeholder input
89	1	1	Main stem
90	1	0	Downgrade – stakeholder input
91	1	0	
93	1	0	
94	1	0	
97	1	0	
98	1	1	Main stem
99	1	0	Downgrade – stakeholder input
100	1	0	
101	1	0	
102	1	0	
103	1	1	Raw sewage and effluent
106	1	0	Downgrade – stakeholder input
107	1	0	
108	1	0	
109	1	0	
110	1	0	
111	1	0	

RU	Desktop	Workshop	Motivation for change
112	1	0	
113	1	0	
114	1	0	
115	1	0	
116	1	1	Main stem
117	1	0	
118	1	0	
119	1	0	Downgrade – stakeholder input
120	1	0	
121	1	0	

6. Resource units most important in supporting activities contributing to the economy in the catchment

RU	Desktop	Workshop	Motivation for change
12	1	0	Closed mines of Anglo
13	1	1	Tourism
14	1	1	Tourism
18	1	0	Downgrade-No activities
20	1	0	Downgrade-No activities
21	0.5	1	Mines and Delmas area
22	0.5	1	Significant agriculture
23	0.5	1	Significant agriculture
24	0.5	1	Agricultural activities
25	0.5	0.5	Grazing areas in this RU
26	0.5	1	Industrial area
27	0.5	1	Tourism and mining and agriculture (extensive)
28	0.5	1	New Mine
31	0.5	1	Tourism
33	0	1	Mines and agriculture intensive (irrigation farming)
38	0	1	Mines and agriculture intensive (irrigation farming)
40	0	1	Tourism. Some irrigation schemes in this region too
47	1	0	No activities identified
53	1	0	No activities identified
54	1	1	Extensive agriculture
58	1	0	Downgrade in escarpment- not used
74	0	1	Lydenburg smelter
81	0	1	Intensive farming
83	0	1	Intensive agriculture
85	0	1	Intensive agriculture

88	0.5	1	Increase
89	0.5	1	Agriculture (intensive)
95	0.5	1	Atok Platinum mine -two mines on either side of the R37
96	0.5	1	Farming extensive, mainly citrus
98	0.5	1	Agriculture (intensive)
99	1	0.5	Downgraded –stakeholder input
100	1	0.5	
101	1	0.5	
102	1	0.5	
104	1	1	Intensive agriculture
105	0	1	Intensive agriculture
106	0	0.5	Farming
113	0	0.5	Farming
114	0	1	Agricultural until boundary of KNP
115	0	1	KNP
116	0	1	KNP

7. Level of threat posed to users

RU	Desktop	Workshop	Motivation for change
14	0.5	1	Effects from upper Olifants considering the economic activities above these RUs
15	0.5	1	
18	1	0	Downgrade – stakeholder input
19	0.5	1	High threat to ecosystem
20	1	0	Scores changed as the criterion had to be reconsidered therefore changes relate to high use and high threats to the ecosystem. Where scores have been decreased, the score reflects the lessened threat to users in terms of use and threat to ecosystem.
25	1	0	
28	0.5	0	
29	0.5	0	
30	0.5	0	
31	0.5	0	
32	1	0	
34	1	0	
35	0.5	0	
36	0	0	
37	0.5	0	
39	1	0	
40	1	0	
41	0.5	0	
42	0.5	0	
43	1	0	
44	1	0	
45	1	0	
46	1	0	
47	1	0	
48	1	0	
51	0.5	0	
53	1	0	
58	0.5	0	
59	0.5	0	
60	0.5	0	

RU	Desktop	Workshop	Motivation for change
61	0.5	0	
67	1	0	
68	1	0	
69	1	0	
70	1	0	
71	1	0	
72	1	0	
73	0.5	0	
74	0.5	0	
75	0.5	0	
76	0.5	0	
77	1	0	
78	0.5	0	
79	0.5	0	
81	0.5	0	
82	0.5	0	
86	1	0	
87	0.5	0	
88	0.5	0	
89	1	0	
91	1	0	
92	1	0	
93	1	0	
96	1	0	
97	1	0	
99	0.5	0	
100	0.5	0	
101	0.5	0	
102	1	0	
106	0.5	0	
107	1	0	
109	1	0	
110	1	0	
111	0.5	0	
112	0.5	0	
113	1	0	
114	1	0	
117	0.5	0	
119	0.5	0	
120	0.5	0	
121	1	0	

8. Resource units with a high or very high EIS category

RU	Desktop	Workshop	Motivation for change
114	0.5	1	Tygerfish in this RU
115	0.5	1	Mermaids in this RU –cultural/spiritual significance
116	0.5	1	KNP area

9. **Resource units which have an A/B NEC and / or PES**

RU	Desktop	Workshop	Motivation for change
11	0	1	Information from stakeholder (KP)
35	0.5	1	Information from stakeholder (RS)

10. **Resource units identified as National Freshwater Ecosystem Priority Areas**

No changes to this sub-criterion.

11. **Resource units identified as a priority in provincial / fine scale aquatic biodiversity plans**

RU	Desktop	Workshop	Motivation for change
17	0	0.5	Input from stakeholder (KP)
18	0	0.5	Input from stakeholder (KP)
53	1	0	Downgrade –stakeholder input
54	0	1	Belfast- MBCP –Steenkoolspruit Presence of wetlands in this RU (Langspruit)

12. **Level of threat posed to ecological components of the resource unit**

No changes made to this sub-criterion.

13. **Resource units with PES lower than a D Category or lower than the accepted gazetted category (NEC)**

RU	Desktop	Workshop	Motivation for change
1	0	1	
3	0	1	
6	0	1	
7	0	1	
16	0	1	
53	0	1	
65	0	1	
66	0	1	
67	0	1	
72	0	1	
95	0	1	
114	0	1	Updated from the latest PES EIS study data

14. **Availability of EWR site data or other monitoring data(RHP, DWAF gauging weirs etc) located within reach**

No changes made for this sub-criterion.

15. **Accessibility of resource unit for monitoring**

No changes made for this sub-criterion.

16. **Safety risk associated with monitoring resource units**

No changes made for this sub-criterion.

9.4 APPENDIX B. GIS METADATA INCLUDING SCORES APPLIED TO SELECTED ATTRIBUTES WITHIN EACH OF THE GIS DATASETS USED TO INFORM THE PRIORITISATION PROCESS.

1.1. Ramsar sites

File description:

File Name:	Olifants_Ramsar_Areas
Description:	RAMSAR sites within Olifants Catchment
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
Quaternary	Indicates the quaternary catchment the RAMSAR sites intersect
Name	Official RAMSAR wetland name
Site_Id	Official RAMSAR site ID
Score	RAMSAR importance score. Scores ranged from 0 -1
weight	RAMSAR composite weight 0.20
RAM_score	RAMSAR weighted score. Calculated by scaling RAMSAR score to between 0 – 0.20

1.2. Important bird areas

File description:

File Name:	Olifants_IBA_Areas
Description:	IBA areas within Olifants Catchment
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
IBA_SA	Official IBA SA ID code
Protection	Official IBA protection status
Name	Official IBA name
Global_Sub	Official IBA global sub ID
IBA_ZA	Official IBA ZA ID code
Quaternary	Indicates the quaternary catchment the IBA sites intersect
Score	IBA importance score. Scores ranged from 0 -1
weight	IBA composite weight 0.20
IBA_score	IBA weighted score. Calculated by scaling IBA score to between 0 - 0.20

1.3. Protected areas

File description:

File Name:	Olifants_Prot_Areas
Description:	Protected areas within Olifants Catchment
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
Quaternary	Indicates the quaternary catchment the PA sites intersect
Reservenam	Official PA reserve name
Spec_type	Official PA type
Global_Sub	Official IBA global sub ID

Score	PA importance score. Scores ranged from 0 -1
weight	PA composite weight 0.60
PA_score	PA weighted score. Calculated by scaling PA score to between 0 - 0.6

1.4. Cultural services

File description:

File Name:	CS_layer
Description:	Combination of RAMSAR, IBAs and Protected areas datasests
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
RAM_score	RAMSAR weighted score. Calculated by scaling RAMSAR score to between 0-0.2
PA_score	PA weighted score. Calculated by scaling PA score to between 0 - 0.6
IBA_score (ram_score_1)	IBA weighted score. Calculated by scaling IBA score to between 0 - 0.2
CS_score	Calculated by adding Ram, PA and IBA scores. Scores range between 0 -1
CS_weight	CS composite weight 0.105
CS_l3_score	CS weighted score. Calculated by scaling CS score to between 0-0.105

1.5. Monthly income

File description:

File Name:	monthly_income_dissolve_ward
Description:	STATSSA enumerated data for monthly income per ward. Monthly income categories were based on percent low and very low income levels. The following categories were used: 0 – 50 % low/very low income = 0 51 – 70 % low/very low income = 0.25 71 – 80 % low/very low income = 0.50 81 – 90 % low/very low income = 0.75 91 – 100 % low/very low income = 1
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
Ward	Ward Number.
no_income	# of people with no income
R1_R400	# of people earning between specified range
R401_800	# of people earning between specified range
R801_R1600	# of people earning between specified range
R1601_R3200	# of people earning between specified range
R3201_R6400	# of people earning between specified range
R6401_R12800	# of people earning between specified range
R12801_R25600	# of people earning between specified range
R25601_R51200	# of people earning between specified range
R51201_R102400	# of people earning between specified range
R102401_R204800	# of people earning between specified range
R204801_more	# of people earning between specified range
unspec	# of people with unspecified income
not_applic	# of people that are not applicable
very_low	0 < Sum of earnings <= 800
low	800 < Sum of earnings <= 6400
medium	6400 < Sum of earnings <= 25600
high	Sum of earnings > 25600
total_incom	Sum of all income earners (excl. unspec. And not applic. Classes)

per_low	Sum of low income earners per total income earners
perc_very_low	Sum of very low income earners per total income earners
Perc_low_very_low	Sum of per_low and Perc_very_low earners
Rank	Scores based on perc_low_very_low values. Scores range from 0 - 1
IM_weight	IM composite weight 0.20
IM_score	IM weighted score. Calculated by scaling IM score to between 0 - 0.20

1.6. Population density

File description:

File Name:	Pop_Density_dissolve_ward
Description	STATSSA enumerated data for population density per ward. Population density categories were based on number of people per square kilometre. The following categories were used: 0 – 200 people = 0 201 – 400 people = 0.25 401 – 600 people = 0.50 601 – 1000 people = 0.75 More than 1000 people = 1
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
WARD_ID	Ward Number.
person	# of people per ward
Sqkm	Total area of ward (square kms)
Pop_Density	# of people per sqr km
Score	Scores based on number of people per square kilometre. Scores range from 0 - 1
PD_weight	PD composite weight 0.20
PD_Score	PD weighted score. Calculated by scaling PD score to between 0 - 0.20

1.7. Unemployment

File description:

File Name:	employment_status_dissolve_ward
Description:	STATSSA enumerated data for employment status per ward. Unemployment categories were based on percent of unemployed people per ward. The following categories were used: 0 – 5 % unemployed = 0 5.1 – 10 % unemployed = 0.25 10.1 – 15 % unemployed = 0.50 15.1. – 20 % unemployed = 0.75 More than 20 % unemployed = 1
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
WARD_ID	Ward Number.
unemploy	# of people unemployed per ward
employ	# of people employed per ward
disc_work_seek	# of discouraged work seekers per ward
not_econ_active	# of non-economic active people per ward
not_aplic	# of not applicable per ward
percen_uempl	Percentage of unemployed people per total ward (excl. not_aplic)
Score	Scores based on percentage unemployed. Scores range from 0 - 1
ES_weight	ES composite weight 0.20
ES_score	ES weighted score. Calculated by scaling ES score to between 0 - 0.20

1.8. Dwelling type

File description:

File Name:	settlement_type_dissolve_ward
Description:	STATSSA enumerated data for dwelling type per ward. Dwelling type categories were based on percent of summed traditional dwellings and informal settlements per ward. The following categories were used: 0 – 5 % very low informal dwellings = 0 5.1 – 10 % low informal dwellings = 0.25 10.1 – 20 % moderate informal dwellings = 0.50 20.1 – 40 % high informal dwellings = 0.75 More than 40 % very high informal dwellings = 1
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
WARD_ID	Ward Number.
House_brick_structure	# of people living in specified dwelling type
Traditional_dwelling	# of people living in specified dwelling type
Flat	# of people living in specified dwelling type
Cluster	# of people living in specified dwelling type
Townhouse	# of people living in specified dwelling type
Semi_detached_house	# of people living in specified dwelling type
backyard_room	# of people living in specified dwelling type
Informal_dwelling_backyard	# of people living in specified dwelling type
Informal_dwelling__settlememt	# of people living in specified dwelling type
granny_flat	# of people living in specified dwelling type
Caravan	# of people living in specified dwelling type
Other	# of people living in specified dwelling type
Unspecified	# of people living in unspecified dwelling type
Not_applicable	# of people that are not applicable
Total_settle	Sum of all people in dwellings (excl. unspec. And not applic. Classes)
perc_informal	Percent of summed Informal_dwelling__settlememt and Traditional_dwelling per total _settle (excl. unspecified and not_applic.)
Score	Scores based on Percent of summed Informal_dwelling__settlememt and Traditional_dwelling per total _settle. Scores range from 0 - 1
ST_weight	ST composite weight 0.20
ST_score	ST weighted score. Calculated by scaling ST score to between 0 - 0.20

1.9. WetWin climatic conditions

File description:

File Name:	wetwin_climatic_cond
Description:	Wet-Win Quaternary datasets (OWMA_EcoServices_Updated_DM) linked to Quaternary catchment feature class. Data ranked by number of months without rainfall (Provisioning tab) and reclassified as follows: 0 = 0; 1 = 0.25; 2 = 0.5; 3 = 0.75; 4 = 1
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
Quaternary	Indicates the quaternary catchment the that relate to the WetWin climatic conditions
dry_month	# of months without rain
months	# of months in the year
Score	# of months without rain in the year, scale to 0-1
CC_weight	Climatic conditions weight: 0.2
CC_score	Climatic conditions score after 0.2 weight applied

1.10. Livelihood support services

File description:

File Name:	LS_layer
Description:	Combination of monthly income, population density, employment status, dwelling type and climatic conditions datasests
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
WARD_ID	Ward Number
ST_score	Dwelling type score
PD_Score	Population density score
ES_score	Employment status score
IM_score	Income level score
QUATERNARY	Indicates the quaternary catchment the that relate to the WetWin climatic conditions
CC_score	Climatic conditions score
LS_score	Sum of ST, PD, ES, IM and CC score
LS_weight	Livelihood weight: 0.258
LS_L3_score	Livelihood score after weight applied

1.11. Flood attenuation

File description:

File Name:	Flood_attenuation_1
Description:	Ranked wetlands according to demand and supply influence on flood attenuation
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Mapping Resolution:	1:2 000 – 1:3 000
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
Quaternary	Indicates the quaternary catchment the entire or portions of the wetland(s) fall into
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
Supply_score	Allocated a supply score to all wetlands based on HGM type as follows: Floodplain = 1; Valley-bottom – channelled = 0.5; Valley-bottom – unchannelled = 0.75; Hillslope seep = 0.25; Flat = 0; Depression = 0. Rescaled the wetland type scores to 0.5
Demand_score	Used Wet-Win Quaternary datasets to create a feature class showing the relative demand for flood attenuation. Flood attenuation demand score calculated by summing relative scores per quaternary catchment for catchment slope, dams in catchment, landuse flows and rainfall intensity and rescaling to 0.5
FA_score	Flood attenuation score before level 4 weight is applied. Calculated by adding together the wetland demand and wetland supply scores for flood attenuation. Scores are between 0-1
FA_L4_weight	Level 4 weight: 0.149
FA_L4_score	Flood attenuation score after level 4 weight applied. Scores range from 0 – 0.12665

1.12. Water quality enhancement

File description:

File Name:	Water_quality_enhancement
Description:	Ranked wetlands according to demand and supply influence on water quality and enhancement
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
Quaternary	Indicates the quaternary catchment the entire or portions of the wetland(s) fall into.
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression.
Supply_score	Allocated a supply score to all wetlands based on the perceived capacity of different HGM types to assimilate pollutants as follows: Floodplain = 0.5; Valley-bottom – channelled = 0.5; Valley-bottom – unchannelled = 1.0; Hillslope seep = 0.25; Flat = 0; Depression = 0. Rescaled the wetland type scores to 0.5.
Demand_score	Phase 1: Used Wet-Win Quaternary datasets to create a feature class showing relative demand for Wet-Win water quality and enhancement (WQE). Demand score calculated by summing relative scores per quaternary catchment for non-point source pollution, mining activities and population density and rescaling to between 0 - 0.5. Phase 2: Created a feature class reflecting PES/EIS physico-chemical impacts by extracting relevant data from the desktop PES/EIS datasets (Potential physic-chemical mod activities) and adjusting scores to a range from 0-1. These scores were then rescaled to range from 0 - 0.5. Phase 3: Added the scaled scores for the Wetwin demand and PES/EIS physico-chemical impacts. Scores ranged between 0-1. Rescaled scores to range between 0-0.5.
WQ_score	WQ score before level 4 weight is applied. Calculated by adding together the wetland demand and wetland supply scores for water quality enhancement. Scores are between 0-1.
WQ_L4_weight	Level 4 weight: 0.691.
WQ_L4_score	WQE score after level 4 weight applied.

1.13. Sediment & Erosion Control

File description:

File Name:	Sediment_erosion_1
Description:	Ranked wetlands according to demand and supply influence on sediment and erosion control
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
Quaternary	Indicates the quaternary catchment the entire or portions of the wetland(s) fall into.
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
Supply_score	Allocated a supply score to all wetlands based on the perceived importance of different HGM types to trap sediments and control erosion: Floodplain = 0.75; Valley-bottom – channelled = 0.5; Valley-bottom – unchannelled = 1.0; Hillslope seep = 0.5; Flat = 0; Depression = 0. Rescaled the wetland type scores to 0.5.
Demand_score	Used Wet-Win Quaternary datasets to create a feature class showing the relative Wet-Win demand for sediment trapping and erosion control (STE). STE control Wet-Windemand score calculated by summing relative scores per quaternary catchment for sediment sources and landuse erodibility and rescaling to 0.5
SE_score	Sediment and Erosion score before level 4 weight is applied. Calculated by adding together the wetland demand and wetland supply scores for sediment and erosion. Scores are between 0-1
SE_L4_weight	Level 4 weight: 0.16
SE_L4_score	Sediment and erosion score after level 4 weight applied. New scores scaled from 0 -0.153

1.14. WetWin: Impact levels

File description:

File Name:	Impact_levels_wetwin
Description:	Impact levels determined at a quaternary catchment level through the Wet-Win project which used available data to assess the potential impact of catchment-related activities on wetland condition. Aspects considered as part of this assessment included: Hydrological threats, geomorphological threats, modifications to wetland vegetation, the PES of rivers in the quaternary catchment; and the population density as a surrogate for

	potential water quality impacts.
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
Quaternary	Indicates the quaternary catchment the that relate to the WetWin impact levels
SCORE	Phase 1: Adjusted health scores from (OWMA_WETHealth – "Health" dataset) to a score from 0-1 by adjusting existing scores (scale of 0-10). Linked "Health" Scores for each quaternary catchment to the Quaternary Catchment feature class. Phase 2: Summed scores (scaled to 0-0.2) for: hydro threats, geomorphic threats, vegetation modification, river PES and population density. New score(s) are scaled from 0-1
IL_weight	Impact level weight: 0.75
IL_weighted_score	Impact level scores after 075 weights applied. New score scaled from 0 - 0.75

1.15. PES/EIS: Pressures

File description:

File Name:	PES_EIS_pressures_layer
Description:	Used the PES/EIS project data (DWA, 2012) to provide an indication of current pressures on aquatic resources. The most relevant used from a wetland perspective were: • Riparian – Wetland Zone Modification; • Potential Flow Modification; and • Potential Physico-Chemical modifying activities. These threat scores were integrated to provide another surrogate measure of threats facing wetland ecosystems. Scores from this and the Wet-Win datasets were then integrated to provide an indication of pressures facing wetlands across the study area
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
SQ_ID	Sub-quaternary catchment ID
pot_phys_chem_score	Pot Physico-Chemical Modification rescaled to 0 - 1
RW_mod_score	Rip-Wet Modification value rescaled to 0 - 1
pot_flow_score	Pot Flow Modification rescaled to 0 - 1
PES_EIS_comb_score	Summed scores for input datasets above
PES_EIS_press_weight	PES/EIS: Pressures weight: 0.25
PES_EIS_comb_score_weighted	PES_EIS_comb_score after level 4 weight of 0.25 applied

1.16. Wetland threats

File description:

File Name:	Wetland_threats_2
Description:	Combined dataset containing WetWin impact level final scores and PES/EIS final scores
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
SQ4_ID	Sub-quaternary catchment ID (1)

PES_EIS_press_score	PES_EIS_comb_score after level 4 weight of 0.25 applied
IL_weighted_score	Impact level scores after 075 weights applied. New score called from 0 - 0.75
WT_score_0_1	Summed IL_weighted_score and PES_EIS_press_score sacled to scores from 0-1

1.17. Threat to users

File description:

File Name:	Wet_threat_to_user
Description:	Effectively, the wetland threats dataset exported to a threat to users dataset
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
SQ4_ID	Sub-quaternary catchment ID (1)
QUATERNARY	Indicates the quaternary catchment the that relate to the WetWin impact levels
WT_score	Summed IL_weighted_score and PES_EIS_press_score
Threat_Use_score	The same as the WT_score
Threat_Use_score_0_1	As above but adjusted to a score from 0-1.
TTU_weight	Threat to user weight: 0.333
TTU_weighted_score	Threat to user scores after 0.333 weights applied. New score scaled from 0 - 0.333

1.18. Threat to resources

File description:

File Name:	Wet_threat_to_resources
Description:	Effectively, the wetland threats dataset exported to a threat to resources dataset
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
SQ4_ID	Sub-quaternary catchment ID (1)
QUATERNARY	Indicates the quaternary catchment the that relate to the WetWin impact levels
WT_score	Summed IL_weighted_score and PES_EIS_press_score
Threat_resource_score	The same as the WT_score
Threat_ resource_score _0_1	As above but with scores normalised from 0-1.
TTR_weight	Threat to resource weight: 0.333
TTR_weighted_score	Threat to resource scores after 0.333 weights applied. New score scaled from 0 - 0.333

1.19. NFEPA

File description:

File Name:	NFEPA_all_combined_ammended
Description:	Combined selected NFEPA datasets for ecological importance and sensitivity analysis. The sum total of all consolidated NFEPA datasets ranked between 0 – 1.
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
NWCS_L4	Original NFEPA wetland classification

Combined_score_rank_wetfepa	Field contains summed scores for NFEPA wetland rank and WETFEPA after respective weights have been applied. Phase 1: **Wetland Rank (importance)** Wetlands were ranked (1=most important to 6=least important) in terms of their importance. This provides a useful basis for comparing the relative importance of wetlands in contributing towards biodiversity objectives. We applied the following ratings based on the rank of wetlands: 1 = 1; 2 = 0.8; 3 = 0.6; 4 = 0.4; 5 = 0.3; 6=0. Scores were then rescaled to 0 - 0.388. Phase 2: **WETFEPA** Here, priority wetlands have been selected to meet national wetland conservation targets. We applied the following ratings based on WETFEPA status: 1 = 1; Others=0. Scores were then rescaled to 0 - 0.243 Phase 3: Summed wetland rank and WETFEPA weighted scores
Combined_score	Field contains summed scores for NFEPA wetland vegetation groups, wetland clusters and FEPA catchments after respective weights have been applied. Phase 1: **Wetland clusters** Wetland clusters are groups of wetlands within 1 km of each other and embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands. 1. We applied the following ratings based on FEPA field: 1 = 1; Others=0. Scores were then rescaled to 0 - 0.067. Phase 2: **Threat status of the wetland vegetation group** The threat status of the wetland vegetation group is based on levels of transformation and protection of wetland ecosystems with similar characteristics. Wetlands occurring within a threatened wetland group are regarded as having a greater ecological importance than those occurring within wetland vegetation groups of lower threat status. Apply the following ratings based on the threat status of wetland vegetation groups: CR = 1; EN = 0.5; VU = 0.25; NT = 0. Scores were then rescaled to 0 - 0.228. Phase 3: **FEPA catchment** FEPAs support the biodiversity sector's input into the development of Catchment Management Strategies and into the Water Resource Classification process5. This database including FEPAs, RehabFEPAs, Fish Support Areas and Upstream management areas therefore highlights catchments where water resource management (including wetland management) is important to meet biodiversity targets. We applied the following ratings based on the FEPA Code: 1 = 1; 2 = 0.75; 3 = 0.5; 4 = 0.25; Others=0. Scores were then rescaled to 0 - 0.074 Phase 4: Summed wetland vegetation group, wetland cluster and FEPA catchment weighted scores with Combined_score_rank_wetfepa score.
Nfepa_wght	NFEPA weight: 0.536
NFEPA_wght_score	NFEPA scores after 0.536 weight applied. New scores scaled from 0 - 0.4944

1.20. PES/EIS: riparian-wetland instream vertebrates (ex fish) rating

File description:

File Name:	Instream_invert
Description:	The importance of threatened taxa was assessed by experts for river reaches at a desktop level as part of the desktop PES/EIS assessment (DWA, 2012). This provided another level of information on ecological importance that was integrated into this assessment. We applied the following ratings based on the "Ecological Importance: Riparian-Wetland-instream vertebrates (Ex fish) rating": Very High = 1; Moderate = 0.5; Low = 0.25; None=0.
Type:	ArcMap GIS polygon feature class

Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
SQ_ID	Sub-quaternary catchment ID (1)
SQ_Name	Official SQ name
Metric_four	PES/EIS: Riparian-Wetland Instream vertebrates (ex fish) rating
Met4_scale	Metric four rank scaled to 0 - 1
Scaled_ranked	Metric four weight: 0.058
ISIV_score	PES/EIS: Riparian-Wetland Instream vertebrates (ex fish) scores after 0.058 weights applied. New score scaled from 0 - 0.058

1.21. PES/EIS: riparian-wetland vegetation importance

File description:

File Name:	wetland_veg_importance
Description:	Effectively, the wetland threats dataset exported to a threat to resources dataset
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
SQ_ID	Sub-quaternary catchment ID (1)
SQ_Name	Official SQ name
Metric_eight	PES/EIS: Riparian-Wetland vegetation Importance
Met8_scaled_score	Metric eight rank scaled to 0 - 1
weight	Metric four weight: 0.073
RWVI_score	PES/EIS: Riparian-Wetland vegetation Importance scores after 0.073 weights applied. New score scaled from 0 - 0.073

1.22. PES

File description:

File Name:	PES_ammen
Description:	Resource Units with an A/B PES or an agreed A/B NEC (in the case where Water Resource Classification has been undertaken) need to be carefully managed to prevent deterioration of these reaches. This is particularly relevant given the poor state of South Africa's rivers and the need to protect aquatic biodiversity. PES was based on information available in the Wetland FEPA feature class and that provided in the Exigent dataset. We applied the following ratings based on wetland condition: NFEPA Data: AB = 1; C = 0.5; Other classes = 0 Exigent Data (Status): 5=1; 4=0.75; 3=0.5; 2=0.25, 1=0 Where Exigent information was available, this was used to determine the combined PES score. Where such information was lacking, scores were allocated based on the NFEPA dataset.
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
NWCS_L4	Original NFEPA wetland classification
WETCON	Original wetland condition (NFEPA Data)
STATUS	Original wetland status (Exigent Data)
Nfepa_score	NFEPA score based on wetland condition. Scale to 0 - 1
exigent_score	Exigent score based on wetland condition. Scaled to 0 – 1
combined_score	PES condition score based on Exigent data where available. Where not available, the NFEPA data was used.
PES_weight	PES weight:0.13
PES_score	Summed NFEPA and Exigent ranks scaled to PES weight: new scores scale from 0 – 0.13

1.23. Sensitivity: high flows

File description:

File Name:	wetland_sens_floods
Description:	We scored wetlands based on their sensitivity to floods. Floodplains are regarded as most sensitive, followed by valley bottoms, seeps and pans. We applied the following ratings based on wetland type: Floodplain = 1; Valley-bottom – channelled = 0.75; Valley-bottom – unchannelled = 0.5; Hillslope seep = 0; Depression = 0
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
wet_score	Score given based on wetland type and sensitivity to flooding
Weight	High flow weight: 0.25
SHF_score	Wetland sensitivity to floods scores after 0.25 weight applied. New scores scaled from 0 - 0.25

1.24. Sensitivity: low flows

File description:

File Name:	wetland_sens_lowflow
Description:	We scored wetlands based on their sensitivity to low flows. Unchannelled valley bottom wetlands are regarded as most sensitive, followed by seeps and other wetland types. We applied the following ratings based on wetland type: Floodplain = 0.5; Valley-bottom – channelled = 0.5; Valley-bottom – unchannelled = 1; Hillslope seep = 0.75; Depression = 0.5
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
wet_score	Score given based on wetland type and sensitivity to low flows
Weight	Low flow weight: 0.25
SLF_score	Wetland sensitivity to low flows scores after 0.25 weight applied. New scores scaled from 0 - 0.25

1.25. PES/EIS: Sensitivity (Intolerance to water level / flow changes)

File description:

File Name:	PES_EIS_sensitivity
Description:	Vertebrate taxon (excluding fish) and vegetation that are sensitive / intolerant to water level changes were assessed at a desktop level as part of the desktop PES/EIS process (DWA, 2012). Phase 1 We applied the following ratings based on the "Riparian-wetland-instream vertebrates (Ex fish) intolerance water level / flow changes description) rating": Very High = 1; Moderate = 0.5; Low = 0.25; None=0. Phase 2 We also applied the following ratings based on the "Riparian-wetland veg intolerance water level changes description) rating": Very High = 1; Moderate = 0.5; Low = 0.25; None=0. Phase 3 Both scored datasets were then scale to 0-0.5 by using a weight factor of 0.5. these scores were then summed to form the PES/EIS sensitivity scores and then scaled to 0-0.5 using a 0.5 weight factor
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31

Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
SQ_NAME	Official SQ name
SQ_ID	Sub-quaternary catchment ID (1)
PES_EIS_sens_score	Scored and weighted PES/EIS: Riparian-Wetland Instream vertebrates (ex fish) intolerance water level / flow changes description and PES/EIS: Riparian-Wetland Vegetation intolerance to water level changes. Scores scaled to 0 – 0.5

1.26. Sensitivity

File description:

File Name:	Sensitivity
Description:	Combined: Sensitivity: High Flows, Sensitivity: Low flows and PES/EIS: Sensitivity datasets
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
SQ_ID	Sub-quaternary catchment ID (1)
SQ_NAME_1	Official SQ name
PES_EIS_sens_score	Scored and weighted PES/EIS: Riparian-Wetland Instream vertebrates (ex fish) intolerance water level / flow changes description and PES/EIS: Riparian-Wetland Vegetation intolerance to water level changes. Scores scaled to 0 – 0.5
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
Wet_flow_combined_score	Combined SLF_score and SHF_score. Scores scale to 0 - 0.5
SENS_Score	Summed PES_EIS_sens_score and Wet_flow_combined_score
SENS_weight	Sensitivity weight: 0.25
SENS_L4_score	Sensitivity score after weight applied. New score are between 0 – 0.25

1.27. Ecological importance

File description:

File Name:	Ecological_importance_ammended
Description:	Combined: protected areas, Ramsar sites, NfEPA, PES/EIS: Riparian-Wetland Instream vertebrates (ex fish), PES/EIS: Riparian-Wetland vegetation Importance and PES datasets
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
Comb_PA_RAM_score	Combined protected areas and RMSAR scores
QUATERNARY	Quaternary catchment ID
SQ_NAME	Official SQ name
PES_NFEPA_score	Combined PES and NFEPA scores
EI_score	Combined comb_wetfepa_PES_score and pa_ram_wetveg_inv_comb_score
EI_weight	Ecological importance weight: 0.75
EI_weightscore	Ecological importance after weight applied. New scores are between 0 -0.658

1.28. Regulating and supporting services

File description:

File Name:	Reg_Support_services_ammended
Description:	Combined: flood attenuation, sediment and erosion control and water quality enhancement datasets
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31

Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
SQ_ID	Sub-quaternary catchment ID (1)
QUATERNARY	Quaternary catchment ID
WQ_L4_score	Water quality score
FA_L4_score	Flood attenuation score
SE_L4_score	Sediment and erosion score
RS_Serv_score	Summed WQ, FA and SE scores. Scores range between 0 - 1
RS_Serv_weight	Regulating service weight: 0.637
RS_Sev_L3_score	Regulating service score after weight applied. New scores are between 0 – 0.565

1.29. Importance for users

File description:

File Name:	Importance_for_users_ammended
Description:	Combined: cultural services, livelihood and regulating and supporting services datasets
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
SQ_ID	Sub-quaternary catchment ID (1)
QUATERNARY	Quaternary catchment ID
RS_Sev_L3_score	Regulating services score
CS_L3_score	Cultural services score
LS_L3_score	Livelihood support score
IFU_score	Summed RS,CS and LS scores. Scores range between 0 – 0.676
IFU_Score_0_1	IFU Score normalised to a score between 0 & 1.
IFU_weight	Importance for users weight: 0.667
IFU_weighted_score	Importance for users score after applying weighting to normalised IFU Score. New scores are between 0 – 0.667

1.30. EIS

File description:

File Name:	EIS_ammended
Description:	Combined: ecological importance and sensitivity datasets
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
SQ_ID	Sub-quaternary catchment ID (1)
SENS_L4_score	Sensitivity score
EI_weightscore	Ecological importance score
EIS_score	Summed SENS and EL scores. Scores range between 0 - 1
EIS_score_0_1	As above but with scores normalised from 0-1.
EIS_weight	EIS weight: 0.667
EIS_weighted_score	EIS score after weight applied. New scores are between 0 – 0.667

1.31. User concerns

File description:

File Name:	User Concern_ammended
Description:	Combined: importance for users and threats to users dataset
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
SQ_ID	Sub-quaternary catchment ID (1)
TTU_weighted_score	Threat to user scores after 0.333 weights applied. New score scaled from 0 - 0.0.257
IFU_weighted_score	Importance for users score after 0.667 weights applied. New score scaled from 0 - 0.0.488
UC_ score	User concern score calculated by summing above two scores
UC_0_1	User concerns scores normalised to between 0 and 1.

1.32. Environmental concerns

File description:

File Name:	Environmental Concern_ammended
Description:	Combined: threat to resources and EIS
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
SQ_ID	Sub-quaternary catchment ID (1)
TTR_weighted_score	Threat to resources score
EIS_weighted_score	Ecological Importance & Sensitivity Score
EC_score	Environmental concern score calculated by summing above two scores
EC_0_1	Environmental concerns scores normalised to between 0 and 1.

1 33. Monitoring data (Practical Considerations)

File description:

File Name:	Monitor_sites
Description:	We selected wetlands based on (i) WFWetlands intervention point dataset; (ii) DWS monitoring sites & (iii) EWR sites. We then applied the following ratings for wetlands based on intersection with various datasets: Yes = 1; No = 0
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
WFW_score	Score of 1 if wetland is within 60 m of WfW monitor site. Scores were then scale to 0 -0.6
EWR_score	Score of 1 if wetland is within 60 m of EWR monitor site. Scores were then scale to 0 -0.2
DWA_score	Score of 1 if wetland is within 60 m of DWA monitor site. Scores were then scale to 0 -0.2
MON_score	Summed WFW, EWR and DWA scores
MON_weight	Management and practical consideration weight applied: 0.25
MON_weighted_score	monitoring score after weight applied. New scores are between 0 – 0.25

1 34. IUA position

File description:

File Name:	IUA_wetlands
Description:	We select any large wetlands along mainstream rivers closest to the IUA outlet and created a separate GIS feature class. We then allocated a score between 0-1 for each of these wetlands
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
IUA_Scores	Score of either 0, 5, 0.75 or 1 given if wetland was along major rivers leaving the IUA
IUA_weight	IUA weight applied: 0.25
IUA_weighted_score	IUA score after weight applied. New scores are between 0 – 0.25

1 35. Wetland Type

File description:

File Name:	Wetland_delineation
Description:	Combined NFEPA and Exigent wetlands. Where exigent wetlands were present NFEPA wetlands were removed. All artificial wetlands were also removed. We allocate a generalized supply score to all wetlands based on HGM type as follows: Floodplain = 1; Valley-bottom – channelled = 0.25; Valley-bottom – unchannelled = 0.5; Hillslope seep = 0.25; Flat = 0; Depression = 0
Type:	ArcMap GIS polygon feature class
Reference System:	Transverse Mercator WGS LO31
Captured:	Eco-Pulse Consulting Services cc

Field description:

Field Name	Field description
NWCS_L4	Original NFEPA wetland classification
EX_type	Exigent wetland type
HGM_rank	Describes the wetland type based on the HGM model: Floodplain, Valley-bottom – channelled, Valley-bottom – unchannelled, Hillslope seep, Flat, Depression
HGM_score	Scores given to wetlands
HGM_weight	HGM supply weight applied. 0.5
HGM_weighted_score	HGM score after weight applied. New scores are between 0 – 0.5

9.5 APPENDIX C: LIST OF PRIMARY SPATIAL (GIS) INFORMATION USED TO INFORM THE WETLAND PRIORITISATION PROCESS FOR THE OLIFANTS CATCHMENT

Name of Layer	Source/Copyright holder	Report Reference
IBA coverage 2012	Birdlife South Africa (on-line at www.birdlife.org)	BirdLife SA (2012)
Ramsar Sites	Department of Environmental Affairs	DEA (2012)
Formally protected areas	South African National Biodiversity Institute	SANBI (2013)
Statistics South Africa Census Data	Statistics South Africa Census Data	STATSSA (2013)
WetWin Datasets[6]	WetWin Project. International Water Management Institute	IWMI (2011)
Wetland Type	NFEPA Wetlands layer (See below) and Exigent Engineering Consultants.	CSIR (2010a); Exigent (2006)
PES/EIS Assessment	DWA	DWA, 2013
NFEPA Wetlands layer	National Freshwater Ecosystem Priority Areas Project. Centre for Scientific Research. Pretoria, South Africa.	CSIR (2010a)
NFEPA Wetland Clusters	National Freshwater Ecosystem Priority Areas Project. Centre for Scientific Research. Pretoria, South Africa.	CSIR (2010b)
NFEPA Rivers layer	National Freshwater Ecosystem Priority Areas Project. Centre for Scientific Research. Pretoria, South Africa.	CSIR (2010c)
NFEPA River FEPAs	National Freshwater Ecosystem Priority Areas Project. Centre for Scientific Research. Pretoria, South Africa.	CSIR (2010d)
NFEPA Wetland Vegetation Groups	National Freshwater Ecosystem Priority Areas Project. Centre for Scientific Research. Pretoria, South Africa.	CSIR (2010e)

[6] Includes a range of data captured at a quaternary catchment level and eextracted from the PES & EcoServices spreadsheets for the Olifants catchment.

9.6 APPENDIX D. CRITERIA AND ASSOCIATED WEIGHTINGS USED IN PRIORITIZING WETLANDS FOR RQO DETERMINATION. INITIAL GIS DATASETS ARE SHADED IN GREY.

Level 1	Weight	Level 2	Weight	Level 3	Weight	Level 4	Weight	Level 5	Weight	Level 6	Weight	Level 7	Weight	Level 8
	N/A	**IUA Position**	1	**Position in IUA**										
					0.105	Cultural Services	0.2	Ramsar sites						
							0.2	IBAs						
							0.6	Protected areas						
					0.258	Livelihood support	0.2	Income levels						
							0.2	Population density						
							0.2	Unemployment (%)						
							0.2	Dwelling type						
							0.2	Wet-Win: Climatic conditions						
					N/A	Strategic requirements	N/A							
Wetland Priority	**N/A**	**Users - Concern**	0.667	**Importance for users**	0.637	Regulating and supporting services	0.149	Flood attenuation	0.5	Supply	1	Wetland Type		
									0.5	Demand	1	WetWin: Demand	0.25	Catchment Slope
													0.25	Dams in catchment
													0.25	Landuse – flows
													0.25	Rainfall intensity
							0.16	Sediment & erosion control	0.5	Supply	1	Wetland Type		
									0.5	Demand	1	WetWin: Demand	0.5	Sediment sources
													0.5	Landuse - erodibility
							0.691	Water Quality enhancement	0.5	Supply	1	Wetland Type		
									0.5	Demand	0.5	WetWin: Demand	0.333	Non-point pollution

Level 1	Weight	Level 2	Weight	Level 3	Weight	Level 4	Weight	Level 5	Weight	Level 6	Weight	Level 7	Weight	Level 8
													0.333	Mining activities
													0.333	Population density
											0.5	PES/EIS: Physico-Chemical		
						Economic contribution	N/A							
			0.333	**Threat to users**	1	Wetland threats	0.75	WetWin: Impact Levels	0.2	Hydro Threats				
									0.2	Geomorphic Threats				
									0.2	Vegetation Modificstion				
									0.2	River PES				
									0.2	Population Density				
	N/A	**Environment - Concern**	0.333	**Threat to resources**	1		0.25	PES/EIS: Pressures	0.311	Rip-Wet Modification				
									0.493	Pot Flow Modification				
									0.196	Pot Physico-Chemical Modification				
			0.667	**EIS**	0.75	Ecological Importance	0.128	Protected areas						
							0.075	Ramsar sites						
							0.536	NFEPA	0.228	Wetland Vegetation Groups				
									0.388	Rank (Importance)				
									0.243	WETFEPA				
									0.067	Wetland Clusters				
									0.074	FEPA				

Level 1	Weight	Level 2	Weight	Level 3	Weight	Level 4	Weight	Level 5	Weight	Level 6	Weight	Level 7	Weight	Level 8
										Catchments				
							0.058	PES/EIS: Riparian-Wetland Instream vertebrates (ex fish) rating						
							0.073	PES/EIS: Riparian-Wetland vegetation Importance						
							0.13	PES						
					0.25	Sensitivity	0.25	Sensitivity: High Flows	1	Wetland Type				
							0.25	Sensitivity: Low flows	1	Wetland Type				
							0.5	PES/EIS: Sensitivity	0.5	PES/EIS: Riparian-Wetland Instream vertebrates (ex fish) intolerance water level / flow changes description				
									0.5	PES/EIS: Riparian-Wetland Vegetation intolerance to water level changes				
	Not considered	***Management & practical considerations***	*1*	***Monitoring data***	*0.6*	*WFWetland Sites*								
					0.2	*DWA Monitoring Sites*								
					0.2	*EWR Sites*								

9.7 APPENDIX E – PLOTTING PROCEDURE FOR EXPANDED DUROV DIAGRAM

Data Interpretation with Piper and Durov Diagrams

Many facilities for the interpretation of water quality monitoring data exist. Some of these are well-known methodologies, such as statistical evaluations, line and bar charts, or plots of borehole and water-level information. Other methodologies are less known. These are, for instance, the so-called specialized chemical diagrams. Of these, only the Piper and Expanded Durov Diagrams will be discussed.

Piper and Expanded Durov Diagrams

The Piper and Expanded Durov Diagrams allow the plotting of eight chemical parameters for a single water sample. Either surface or ground-water chemistries may be plotted.

The procedure is as follows:

- Calculate concentrations for Ca, Mg, Na, K, Cl, SO_4, NO_3, T. Alk. in units of milli-equivalents per litre.
- Calculate relative percentages for the cations and anions.
- Plot the percentages cations in the bottom left triangle.
- Plot the percentages anions in the bottom right triangle.
- Project the two points to the central block on the Piper or Durov Diagrams and make a mark where the two projections cross.

Interpretation is as follows:

- It is a matter of personal preference whether the Piper or Durov Diagrams are used.
- Both diagrams should primarily be used as visual displays, summarizing the chemistry of all samples taken at a site, or at many sites.
- Of particular value is the identification of pollution trends, through the aid of these diagrams. A comparison between plots of successive sampling exercises, will clearly show whether or not trends in the chemistry of the water are developing. Trends to observe are:

  1) Sodium enrichment - typical of processes such as waste water discharge, chemical extraction of minerals from ore, dewatering of deep mines, return flow from irrigation or natural deterioration of the ground-water quality by ion exchange within the aquifer.

  2) Sulphate enrichment - typical of most mining environments.

  3) Calcium enrichment - typical of lime dosing to neutralize acid water.

  4) Chloride enrichment - typical of leachate from domestic waste and dewatering of deep mines.

A word of caution though: the ground-water chemistry is one of the most complex natural systems to predict, because of the many natural processes/parameters that could affect it. The following are but a few examples of chemical changes which could occur within an aquifer:

- Dissolution of soluble elements, such as Na, K, Cl and HCO_3.
- Precipitation of oversaturated species.
- Ion exchange and adsorption onto clays, such as Ca-adsorption and Na-release.
- Chemical reaction between two waters mixing.
- Natural decay of substances, such as modern pesticides.
- Bacterial oxidation/reduction, such as pyrite oxidation and sulphate reduction.
- Dispersion of pollutants through the aquifer.
- Convection during flow of pollutants through the aquifer.
- The aquifer hydraulic constants, such as transmissivity, storativity, gradients and boundary conditions.

The specialized diagrams and other techniques for the interpretation of the data, included within WasteBase and WasteManager, should therefore be used with circumspection. The identification of trends should be done by all waste disposal managers. However, if undesirable pollution trends develop, which cannot obviously be linked to operations, it should best be left to the geohydrologist to suggest remedial action.

PIPER DIAGRAM

The chemical composition of ground water reflects the processes which are responsible for the different constituents it contains: Wind blowing over the ocean carries mainly sodium chloride landwards. Oxygen, nitrogen and carbon dioxide dissolve when the humidity in the air condenses. Additional carbon dioxide and humic acids dissolve when water percolates through the soil containing organic matter.

The ground water changes its composition as the water moves through the aquifer. Minerals dissolve and release salts; sulphides may oxidize; cations are exchanged; sulphides and nitrates can be reduced through bacterial action; evaporation leads to concentration; and once the solubility products are exceeded minerals are precipitated. Mixing with water of different origin also influences the composition.

Trilinear diagrams are used for the investigation of ions or groups of ions as a function of the concentration. On these diagrams the milli-equivalent percentages of the major cations and anions are plotted; and it has been found that the point at which an analysis plots is of considerable diagnostical value.

The Piper diagram is a combination of two trilinear diagrams and a central diamond field. In the diamond field the cations Ca^{2+}, Mg^{2+}, $Na^{+} + K^{+}$; and the anions SO_4^{2-}, Cl^{-} and $HCO_3^{-} + CO_2^{2-}$ are represented by a point, in the trilinear diagrams cat- and anions each separately.

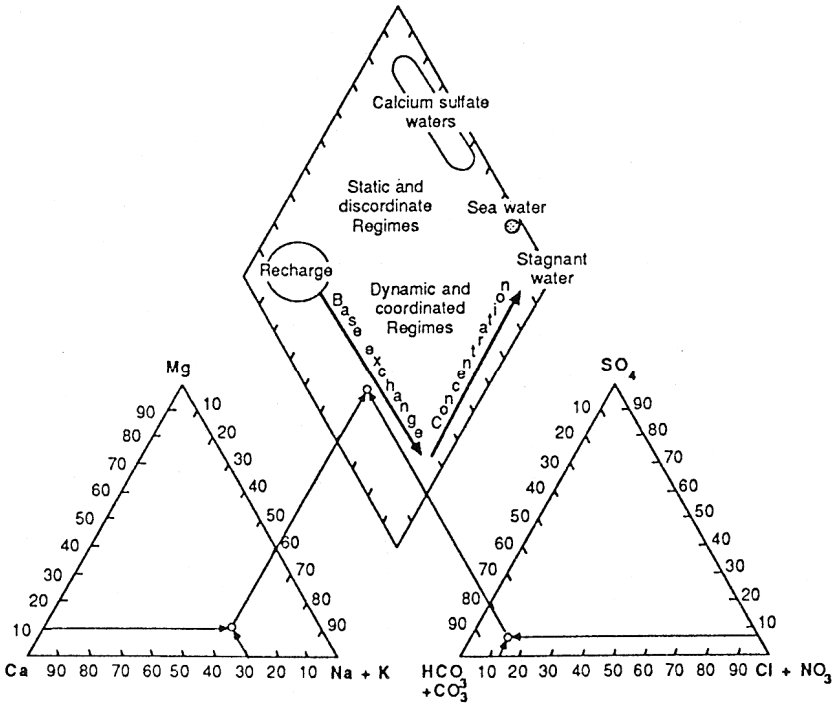
To convert the units mg/L normally given in an analysis to milliequivalents the determined quantities must be divided by the molecular weight of the respective ion and its valence. The constants for the conversion of the different ions are:

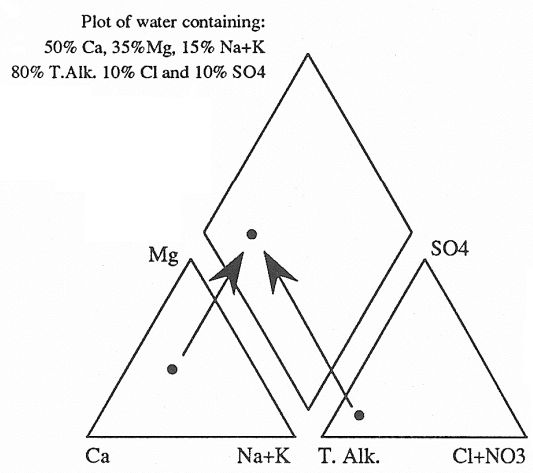
Cations		Anions	
Ca	1/20	HCO_3	1/61
Mg	1/12	CO_3	1/30
Na	1/23	Cl	1/35.5
K	1/39	NO_3	1/62
		SO_4	1/48

The percentage milli-eqivalents for the different cations are calculated by dividing the respective milli-equivalent values by the sum of the milli-equivalents of the cations. The percentage milli-equivalents for the anions are calculated accordingly.

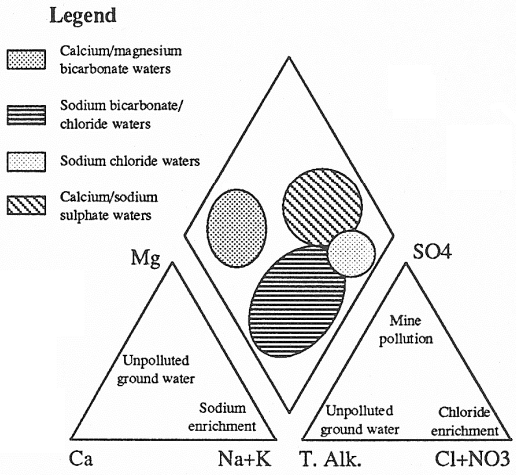
After the cat- and anions are plottes in the trilinear fields their position is projected in the central diamond field. Based on the position in the diamond field ground water can be divided into four categories, nl.:

- Recently recharged ground water rich in calcium and/or magnesium and bicarbonate.
- A dynamic regime with water rich in bicarbonate with increasing sodium (and potassium) concentrations.
- "Stagnant" or relatively old ground water at the end of the cycle with high sodium, chloride and/or sulphate values. It plots near the point for sea water.
- Calcium sulfate water as well as other relatively seldom encountered water which plots in the upper half of the diamond field.



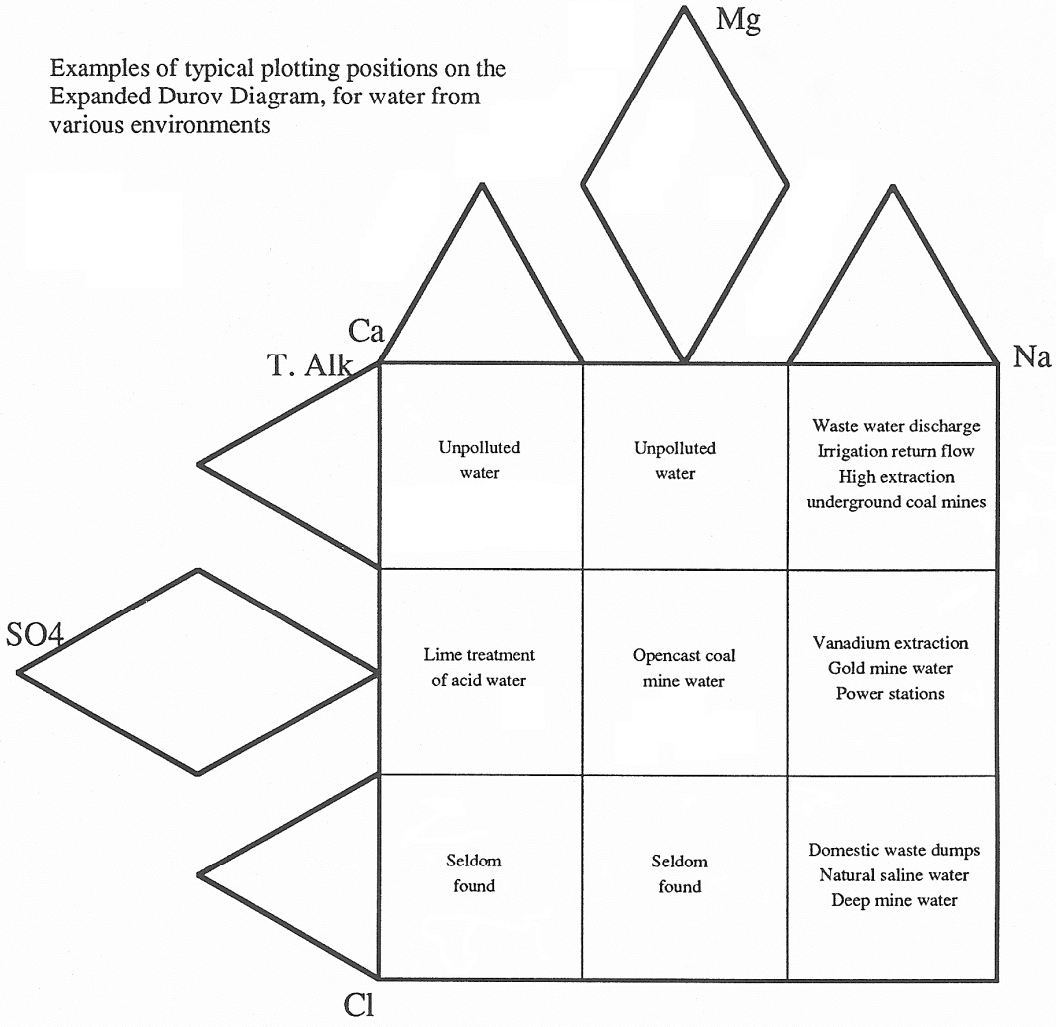


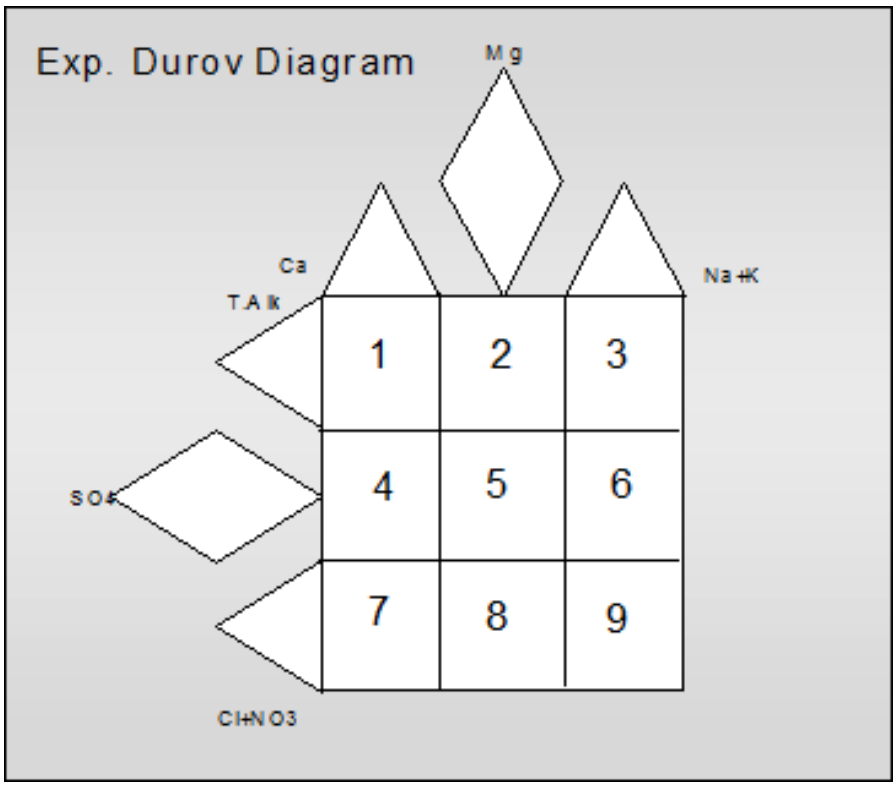
Plotting procedure on the Piper Diagram



Examples of typical plotting positions on the Piper Diagram, for water from various environments

Examples of typical plotting positions on the Expanded Durov Diagram, for water from various environments





Field 1: Fresh, very clean recently recharged groundwater with HCO_{3-} and CO_3 dominated ions.
Field 2: Field 2 represents fresh, clean, relatively young groundwater that has started to undergo Mg ion exchange, often found in dolomitic terrain.
Field 3: This field indicates fresh, clean, relatively young groundwater that has undergone Na ion exchange (sometimes in Na-rich granites or other felsic rocks), or because of contamination effects from a source rich in Na.
Field 4: Fresh, recently recharged groundwater with HCO_{3-} and CO_3 dominated ions that has been in contact with a source of SO_4 contamination, or that has moved through SO_4 enriched bedrock.
Field 5: Groundwater that is usually a mix of different types – either clean water from Fields 1 and 2 that has undergone SO_4 and NaCl mixing / contamination, or old stagnant NaCl dominated water that has mixed with clean water.
Field 6: Groundwater from Field 5 that has been in contact with a source rich in Na, or old stagnant NaCl dominated water that resides in Na-rich host rock / material.
Field 7: Water rarely plots in this field that indicates NO_3 or Cl enrichment, or dissolution.
Field 8: Groundwater that is usually a mix of different types - either clean water from Fields 1 and 2 that has undergone SO_4, but especially Cl mixing / contamination, or old stagnant NaCl dominated water that has mixed with water richer in Mg.
Field 9: Very old, stagnant water that has reached the end of the geohydrological cycle (deserts, salty pans, etc.); or water that has moved a long time and / or distance through the aquifer and has undergone significant ion exchange.

9.8 APPENDIX F: WORKSHOP EVALUATION QUESTIONNAIRE

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

RESOURCE QUALITY OBJECTIVE DETERMINATION STUDY FOR THE OLIFANTS WMA - RESOUCE UNIT PRIORITISATION WORKSHOP (29 – 31 JULY 2013)

WORKSHOP EVALUATION

NAME:			
1. Do you feel that the workshop achieved the stated objectives?	Yes	Partially	No
Comments:			
2. Were you able to contribute meaningfully?	Yes	Partially	No
Comments:			
3. Were you provided with sufficient information?	Yes	Partially	No
Comments:			
4. Were you provided with sufficient time to contribute to the process?	Yes	Partially	No
Comments:			
5. Was the workshop facilitation adequate?	Yes	Partially	No
Comments:			
6. Was the length of the workshop adequate?	Too long	Adequate	Too short
Comments:			
Additional comments/recommendations:			