DETERMINATION OF WATER RESOURCE CLASSES, RESERVE AND RESOURCE QUALITY OBJECTIVES STUDY FOR SECONDARY CATCHMENTS A5 – A9 WITHIN THE LIMPOPO WATER MANAGEMENT AREA (WMA 1) AND SECONDARY CATCHMENT B9 IN THE OLIFANTS WATER MANAGEMENT AREA (WMA 2)

RESOURCE QUALITY OBJECTIVES REPORT

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DOCUMENT INDEX

The project reports are indicated below.

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REPORT INDEX	REPORT NUMBER	REPORT TITLE
01	WEM/WMA01&02/00/CON/RDM/0122	Inception Report
02	WEM/WMA01&02/00/CON/RDM/0222	Water Resources Information Gap Analysis Report
03	WEM/WMA01&02/00/CON/RDM/0322	Delineation and Status Quo Report
04	WEM/WMA01&02/00/CON/RDM/0422	Linking the value and condition of the Water Resources Report
05	WEM/WMA01&02/00/CON/RDM/0522	EWR Site Selection and verification Report
06a	WEM/WMA01&02/00/CON/RDM/0123	EWR Report – Rivers (Vol 1) EcoCategorisation
06s	WEM/WMA01&02/00/CON/RDM/0123	EWR Report – Rivers (Vol 2) Data Collection and Analysis
06c	WEM/WMA01&02/00/CON/RDM/0123	EWR Report – Rivers (Vol 3) Ecological Water Requirements
07	WEM/WMA01&02/00/CON/RDM/0223	EWR Report - Groundwater
08a	WEM/WMA01&02/00/CON/RDM/0323a	Wetland Assessment Volume 1 – Ecostatus and Priority Wetlands
08b	WEM/WMA01&02/00/CON/RDM/0323b	Wetland Assessment Volume 2 – EWR of Nylsvley and Makuleke Floodplain Wetlands
09	WEM/WMA01&02/00/CON/RDM/0124	Main EWR Report
10	WEM/WMA01&02/00/CON/RDM/0224	Ecological Base Configuration Scenario Report
11	WEM/WMA01&02/00/CON/RDM/0324	Scenarios Evaluation and Draft Water Resource Classes Report
12	WEM/WMA01&02/00/CON/RDM/0125	Final Scenarios Report
13	WEM/WMA01&02/00/CON/RDM/0225	Evaluation of Resource Unit Report
14	**WEM/WMA01&02/00/CON/RDM/0325**	**Draft Resource Quality Objectives Report**
15	WEM/WMA01&02/00/CON/RDM/0425	Monitoring Programme to support RQOs and Reserve Implementation Report
16	WEM/WMA01&02/00/CON/RDM/0525	Water Resources Classes, Reserve and RQOs Gazette Template
17	WEM/WMA01&02/00/CON/RDM/0625	Project Close-Out Report

TERMINOLOGY AND ABBREVIATIONS

ACRONYMS	DESCRIPTION
ASPT	Average Score Per Taxon
CD	Chief Directorate
DO	Dissolved Oxygen
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EC	Electrical Conductivity
EI	Ecological Importance
EIS	Ecological Importance and Sensitivity
ES	Ecological Sensitivity
EWR	Ecological Water Requirement
FRAI	Fish Response Assessment Index
FSC	Full Supply Capacity
GDP	Gross Domestic Product
GEP	Groundwater Exploitation Potential
GRU	Groundwater Resource Units
GW	Groundwater
GWBF/EWR	Groundwater Baseflow/Ecological Water Requirements
GWBF/RE	Groundwater Baseflow/Recharge
Ha	Hectares
HDAM	Hydrological Drought Analysis Model
HGM	Hydrogeomorphic
IAP	Invasive Alien Plants
IEI	Integrated Environmental Importance
IR	Irreplaceable
IS	Importance Score
IUA	Integrated Unit of analysis
MAR	Mean Annual Runoff
MCB	Macro Channel Bank
MCM	Million Cubic Metres
MIRAI	Macroinvertebrate Response Assessment Index
N/A	Not applicable
NEC	Nest Ecological Category
NH_3-N	Ammonia
PES	Present Ecological Status
PESEIS	Present Ecological State Ecological Importance and Sensitivity
PO_4-P	Orthophosphates

ACRONYMS	DESCRIPTION
QUAT	Quaternary
RDM	Resource Directed Measures
REC	Recommended Ecological Category
RHP	River Health Programme
RQOs	Resource Quality Objectives
RRU	River Resource Unit
RU	Resource Unit
RUPT	Resource Unit Prioritisation Tool
SANLC	South African National Landcover
SARCOF	South African Regional Climate Outlook Forum
SASS5	South African Scoring System version 5
SAWS	South African Weather Service
SCI	Socio-cultural Importance
SOF	System Operating Forum
SQ	Sub-quaternary
STCCs	Short Term Characteristic Curves
SWSA-GW	Strategic Water Source Area - Groundwater
TDS	Total Dissolved Salts
TEC	Target Ecological Category
TIN	Total Inorganic Nitrogen
VU	Vulnerable
WEM	Water Ecosystems Management
WMA	Water Management Area
WRUI	Water Resource Use Importance

EXECUTIVE SUMMARY

Resource Quality Objectives (RQOs) are numerical and/or descriptive statements about the biological, chemical and physical attributes characterising a resource for a level of protection defined by its Water Resource Class. The purpose of RQOs is to establish clear goals for the Resource Unit relating to the quality of the water resource and which balances social needs and ecological requirements. They provide limits or boundaries from which it can be deduced whether existing management practices are stressing the resource and provide a baseline for measuring the success of management and reviewing the effectiveness of source-directed controls and regulatory activities.

Resource units, which were considered the most useful for RQO determination, were selected for rivers, dams, wetlands and groundwater resources using the Resource Unit Prioritisation Tool or modifications thereof. Table E 1 provides the prioritised resource units across the study area for which RQOs were defined.

Table E 1. Prioritised Resource Units in the study area

IUA	River Resource Unit	Dam Resource Unit	Wetland Resource Unit	Groundwater Resource Unit
Upper Lephalala	RRU-Riv11 A50B-00262			
	RRU-Riii3 A50H-00110			
Lower Lephalala	RRU-Ri8 A50H-00110			A50-2 (A50G)
				A50-3 (A50H)
Kalkpan se Loop	RRU-Rvi1 A63C-00033			A50-4 (A63C)
Upper Nyl/Sterk	RRU-Ri4 A61J-00267	Doorndraai	Nyl River floodplain	A61-1 (A61A,B,C,D,E)
	RRU-Ri1 A61B-00489	Donkerpoort	Nyl Pans	A61-2 (A61H)
	RRU-Ri1-1 A61B-00552		Wonderkrater	A61-3 (A61F, G)
	RRU-Ri3 A61G-00297			
	RRU-Ri5 A61G-00248			
Mogalakwena	RRU-Ri14 A63A-00071	Glen Alpine	Mokamole	A62-2 (A62E)
	RRU-Rii3 A63D-00034			A63-1 (A63A,D)
Mapungubwe	RRU-Rvi2 A63E-00011		Maloutswa Floodplain	A63/71-3 (A63E, A71L)
	RRU-Riv32 A63E-00008		Kolope riverine wetlands	
Upper Sand	RRU-Riv16 A71C-00156			A71-1 (A71A, B)
				A71-2 (A71C, D, H)
				A71-3 (A71E, F, G, A72A)
Lower Sand	RRU-Ri20 A71D-00118			A71-4 (A71J, A72B)
	RRU-Ri22 A71D-00118			A71-5 (A71K)
	RRU-Ri25			

IUA	River Resource Unit	Dam Resource Unit	Wetland Resource Unit	Groundwater Resource Unit
	A71K-00019			
Nzhelele/Nwanedi	RRU-Ri26 A80G-00053	Nzhelele		A80-1 (A80A, F)
	RRU-Riv33 A80G-00054			A80-2 (A80G)
	RRU-Ri27 A80G-00026			A80-3 (A80J)
	RRU-Ri28 A80J-00028			
Upper Luvuvhu	RRU-Riii6 A91D-00108	Albasini		A91-1 (A91A, B, C, E, F, G)
	RRU-Ri30 A91G-00091	Vondo		
Lower Luvuvhu/Mutale	RRU-Ri32 A91H-00045	Mvuwe	Luvuvhu Floodplain (Makuleke)	A91-2 (A91H, A92B, C, D)
	RRU-Rvii33 A92B-00051	Nandoni	Lake Fundudzi	
	RRU-Ri33 A92B-00051		Mutale wetlands	
	RRU-Ri34 A92D-00030			
	RRU-Ri36 A91K-00035			
Shingwedzi	RRU-Riv28 B90H-00113		Malahlapanga	B90-1 (B90B, F)
	RRU-Ri37 B90H-00145		Bububu	

Using the Resource Unit Evaluation Tool, a rationalisation process identified the key sub-components and indicators for which RQOs should be set for each resource unit. Draft RQOs and Numerical Limits were developed for the prioritised RUs, describing the following:

- Quantity, pattern and timing of instream flow;
- Water quality, including the physical, chemical and biological characteristics of the water,
- The character and condition of the instream and riparian habitat and
- The characteristics, condition and distribution of the aquatic biota.

These RQOs will be updated based on stakeholder comments and published through government notice in the government gazette.

TABLE OF CONTENTS

DOCUMENT INDEX ..... **iii**

TERMINOLOGY AND ABBREVIATIONS ..... **iv**

EXECUTIVE SUMMARY ..... **vi**

TABLE OF CONTENTS ..... **viii**

LIST OF FIGURES ..... **x**

LIST OF TABLES ..... **xi**

1 Introduction **1**

1.1 Background **1**

1.2 Objectives of the Study **1**

1.3 Study area **1**

1.4 Purpose of this report **1**

2 APPROACH **3**

2.1 OVERVIEW OF THE RESOURCE QUALITY OBJECTIVE PROCESS **3**

2.2 Resource Quality Objectives and Numerical Limits overview **4**

2.3 Stakeholder engagement workshops overview **5**

2.4 Ecologically important quaternary catchments **5**

2.4.1 Hydrological Resource Quality Objectives: all nodes 6

3 Results **12**

3.1 River Resource Quality Objectives **12**

3.1.1 Water quantity 16

3.1.2 Water quality 16

3.1.3 Habitat 17

3.1.4 Biota – Riparian vegetation 17

3.1.5 Biota – Fish 18

3.1.6 Biota – Macroinvertebrates 20

3.1.7 Prioritised river resource units in the study area 21

3.2 Dam Resource Quality Objectives and numerical limits **111**

3.2.1 Dams in the Upper Nyl/Sterk and Mogalakwena IUAs 111

3.2.2 Dams in the Nzhelele/Nwanedi IUA 113

3.2.3 Dams in the Upper Luvuvhu IUA 114

3.2.4 Resource Quality Objectives for water quality and biota in Dams 117

3.3 Wetland Resource Quality Objectives and numerical limits 135
3.4 Groundwater Resource Quality Objectives and numerical limits 146
4 REFERENCES 179

LIST OF FIGURES

Figure 1-1. Locality map of the study area showing the priority resource units. 2

Figure 2-1. Seven-step RQO process 3

Figure 2-2. Ecologically Important quaternary catchments 6

Figure 3-1. Map of the prioritised river resource units (red = high priority, orange = medium priority, blue = low priority) 15

Figure 3-2. Map of the priority resource units in the Upper Lephalala IUA 21

Figure 3-3. River resource units within the Lower Lephalala IUA 28

Figure 3-4. River resource units in the Kalkpan se Loop IUA 32

Figure 3-5. River resource units in the Upper Nyl/Sterk IUA 35

Figure 3-6. River resource units in the Mogalakwena IUA 48

Figure 3-7. River resource units in the Mapungubwe IUA 56

Figure 3-8. River resource units in the Upper Sand IUA 61

Figure 3-9. River resource units in the Lower Sand IUA 64

Figure 3-10. River resource units in the Nzhelele/Nwanedi IUA 72

Figure 3-11. River resource units in the Upper Luvuvhu IUA 83

Figure 3-12. River resource units in the Lower Luvuvhu/Mutale IUA 90

Figure 3-13. River resource units in the Shingwedzi IUA 105

LIST OF TABLES

Table 2-1. Monthly flow volumes (MCM) for all river nodes and the Target Ecological Category (TEC) predicted to be maintained 7

Table 3-1. High priority River Resource Units (EWR sites are in bold) 13

Table 3-2. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv11) in the Upper Lephalala IUA 22

Table 3-3. Resource Quality Objectives for the prioritised river resource unit (RRU_Riii3) in the Upper Lephalala IUA 26

Table 3-4. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri8) in the Lower Lephalala IUA (LIMCOM site LEPH-A50H-SEEKO) 29

Table 3-5. Resource Quality Objectives for the prioritised river resource unit (RRU_Rvi1) in the Kalkpan se Loop 33

Table 3-6. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri4) in the Upper Nyl/Sterk IUA 36

Table 3-7. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri1) in the Upper Nyl/Sterk IUA 38

Table 3-8. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri1-1) in the Upper Nyl/Sterk IUA 41

Table 3-9. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri3) in the Upper Nyl/Sterk IUA 43

Table 3-10. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri5) in the Upper Nyl/Sterk IUA 45

Table 3-11. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri14) in the Mogalakwena IUA 49

Table 3-12. Resource Quality Objectives for the prioritised river resource unit (RRU_Rii3) in the Mogalakwena IUA (LIMCOM Site MOGA-A63D-LIMPK) 53

Table 3-13. Resource Quality Objectives for the prioritised river resource unit (RRU_Rvi2) in the Mapungubwe IUA 57

Table 3-14. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv32) in the Mapungubwe IUA 59

Table 3-15. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv16) in the Upper Sand IUA 62

Table 3-16. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri20) in the Upper Sand IUA 65

Table 3-17. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri22) in the Upper Sand IUA 68

Table 3-18. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri25) in the Lower Sand IUA (LIMCOM Site SAND-A71K-R508B) 70

Table 3-19. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri26) in the Nzhelele/Nwanedi IUA 73

Table 3-20. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv33) in the Nzhelele/Nwanedi IUA 75

Table 3-21. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri27) in the Nzhelele/Nwanedi IUA 77

Table 3-22. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri28) in the Nzhelele/Nwanedi IUA 80

Table 3-23. Resource Quality Objectives for the prioritised river resource unit (RRU_Riii6) in the Upper Luvuvhu IUA 84

Table 3-24. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri30) in the Upper Luvuvhu IUA 87

Table 3-25. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri32) in the Lower Luvuvhu/Mutale IUA 91

Table 3-26. Resource Quality Objectives for the prioritised river resource unit (RRU_Rvii33) in the Lower Luvuvhu/Mutale IUA 94

Table 3-27. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri33) in the Lower Luvuvhu/Mutale IUA 96

Table 3-28. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri34) in the Lower Luvuvhu/Mutale IUA 99

Table 3-29. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri36) in the Lower Luvuvhu/Mutale IUA (LIMCOM Site LUVU-A91K-OUTPO) 102

Table 3-30. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv28) in the Shingwedzi IUA 106

Table 3-31. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri37) in the Shingwedzi IUA (LIMCOM Site SHIN-B90H-POACH) 108

Table 3-32. Proposed priority classification of water users including EWRs in the Mogalakwena System 111

Table 3-33. Monthly flow requirements of Doorndraai Dam 112

Table 3-34. Monthly Flow Requirements from Glen Alpine Dam 113

Table 3-35. Monthly Flow Requirements from Nzhelele Dam 114

Table 3-36. Proposed priority classification of water user including EWRs in the Luvuvhu System ... 115

Table 3-37. Monthly Flow Requirements from Albasini Dam 115

Table 3-38. Monthly Flow Requirements from Vondo Dam 116

Table 3-39. Amended Monthly Flow Requirements from Nandoni Dam 117

Table 3-40. Resource Quality Objectives for water quality and biota in the Donkerpoort Dam 119

Table 3-41 Resource Quality Objectives for water quality and biota in the Doorndraai Dam 121

Table 3-42 Resource Quality Objectives for water quality and biota in the Glen Alpine Dam 123
Table 3-43 Resource Quality Objectives for water quality and biota in the Nzhelele Dam 125
Table 3-44 Resource Quality Objectives for water quality and biota in the Vondo Dam 127
Table 3-45 Resource Quality Objectives for water quality and biota in the Nandoni Dam 129
Table 3-46 Resource Quality Objectives for water quality and biota in the Albasini Dam 131
Table 3-47 Resource Quality Objectives for water quality and biota in the Mvuwe Dam 133
Table 3-48. Wetland Resource Quality Objectives for priority wetland resource units 136
Table 3-49. Groundwater Resource Quality Objectives for GRU A50-2 in the Lower Lephalala 147
Table 3-50. Groundwater Resource Quality Objectives for the GRU A50-3 in the Lower Lephalala .. 148
Table 3-51. Groundwater Resource Quality Objectives for the GRU A50-4 in the Kalkpan se Loop . 149
Table 3-52. Groundwater Resource Quality Objectives for GRU A61-1 for the Nyl River Valley 150
Table 3-53. Groundwater Resource Quality Objectives for GRU A61-2 in the Sterk area 153
Table 3-54. Groundwater Resource Quality Objectives for GRU A61-3 in the Upper Mogalakwena . 154
Table 3-55. Groundwater Resource Quality Objectives for GRU A62-2 in the Matlala 156
Table 3-56. Groundwater Resource Quality Objectives for GRU A63-1 in the Lower Mogalakwena . 157
Table 3-57. Groundwater Resource Quality Objectives for GRU A63/71-3 for the Limpopo Tributaries/Mapungubwe 158
Table 3-58. Groundwater Resource Quality Objectives for GRU A71-1 in the Upper Sand IUA 160
Table 3-59. Groundwater Resource Quality Objectives for GRU A71-2 in the Middle Sand 162
Table 3-60. Groundwater Resource Quality Objectives for GRU A71-3 in the Hout 164
Table 3-61. Groundwater Resource Quality Objectives for GRU A71-4 and A71-5 in the Sandbrak/Lower Sand 167
Table 3-62. Groundwater Resource Quality Objectives for GRU A80-1 in the Upper Nzhelele 169
Table 3-63. Groundwater Resource Quality Objectives for GRU A80-2 in the Lower Nzhelele 170
Table 3-64. Groundwater Resource Quality Objectives for GRU A80-3 in the Nwanedi 171
Table 3-65. Groundwater Resource Quality Objectives for GRU A91-1 in the Upper Luvuvhu 172
Table 3-66. Groundwater Resource Quality Objectives for GRU A91-2 in the Mutale/Luvuvhu 176
Table 3-67. Groundwater Resource Quality Objectives for GRU B90-1 in the Shingwedzi 178

1 INTRODUCTION

1.1 Background

The Department of Water and Sanitation (DWS), Chief Directorate (CD): Water Ecosystems Management (WEM) initiated a study to determine Water Resource Classes, the Reserve and Resource Quality Objectives for Secondary Catchments A5-A9 in the Limpopo Water Management Area (WMA 1) and Secondary Catchment B9 in the Olifants Water Management Area (WMA 2).

The suite of Resource Directed Measures tools being implemented in these catchments aims to ensure sustainable utilisation of water resources to meet the ecological, social and economic needs of the communities dependent on them.

1.2 Objectives of the Study

The overall objective of this project is to classify and determine the Reserve and Resource Quality Objectives (RQOs) for all significant water resources in the Secondary catchments (A5-A9) of the Limpopo WMA and B9 in the Olifants WMA.

The Scope of Work as stipulated in the Terms of Reference calls for the following:

- Coordinate the implementation of the Water Resources Classification System, as required in Regulation 810 in Government Gazette 33541, by classifying all significant water resources in the Limpopo WMA (secondary catchments A5-A9) and Olifants WMA (secondary catchment B9).
- Determine the water quantity and quality components of the groundwater and surface water (rivers and wetlands) Reserve.
- Determine RQOs using the DWS Procedures to Determine and Implement RQOs.

1.3 Study area

The study area is the Secondary catchments (A5-A9) of the Limpopo WMA and B9 in the Olifants WMA. The study area was delineated into twelve Integrated Units of Analysis (IUAs) and the Water Resource Classes were determined for each IUA. Resource Units were delineated and prioritised for the rivers, dams, groundwater and wetlands (Figure 1-1).

1.4 Purpose of this report

This report documents the RQOs for the priority river, wetlands, dams and groundwater resource units in the study area.

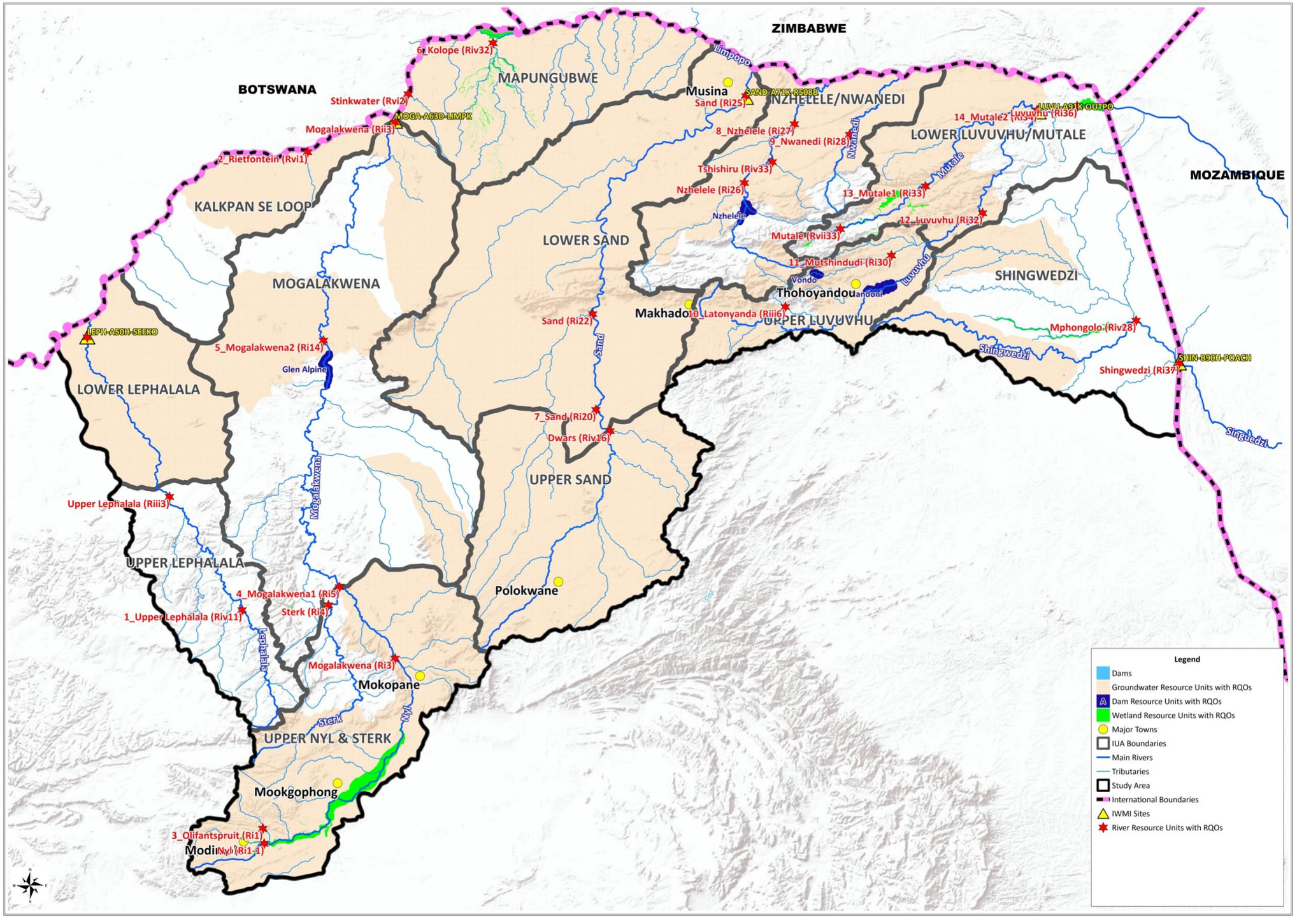

Figure 1-1. Locality map of the study area showing the priority resource units.

2 APPROACH

2.1 OVERVIEW OF THE RESOURCE QUALITY OBJECTIVE PROCESS

RQOs are numerical and/or descriptive statements about the biological, chemical and physical attributes that characterise a resource for a level of protection defined by its Water Resource Class. They are important management objectives that represent a goal for a desired protection toward which management can be directed. It therefore aids in providing guidance on what activities and impacts are acceptable or not. RQOs provide a baseline for measuring the success of management and for reviewing the effectiveness of source directed controls and regulatory activities.

The development of the RQOs is a seven-step process Figure 2-1 established by the DWA (2011).

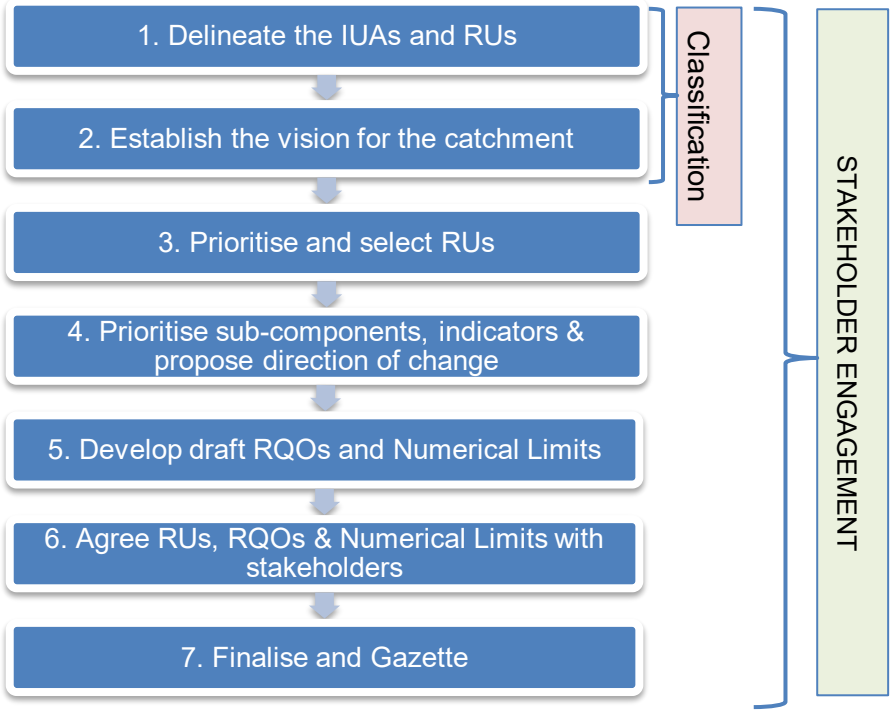

Figure 2-1. Seven-step RQO process

Step 1 of the RQOs process, is to delineate the IUAs and define the Resource Units (RUs). This is required to facilitate effective management of the water resource. Step 2 of the process is to establish a vision for the catchment. Steps 1 and 2 were completed during the Classification phase of the study.

The objective of Step 3 is to prioritise and select the most useful RUs for RQO determination. Many RUs were delineated in the study area, however in reality it is not practical nor feasible to monitor every RU in the study area. A rationalisation process using the Resource Unit Prioritisation Tool (RUPT), which is a decision support tool, was used to guide the selection process (DWA, 2011).

The RUPT is used to assess a range of criteria that would indicate the importance of monitoring each RU as part of management operations. This would include the position of RUs within an IUA, user and ecological considerations, practical constraints and management considerations. For the dam, wetland

and groundwater prioritisation process the RUPT tool was modified to address current limitations in the methodology. The specific approaches to prioritise the water resources within the study area are discussed in the sections that follow.

Step 4 of the RQO process has two key objectives: (i) to identify and prioritise sub-components that may be important to either users or the environment and (ii) to select those sub-components and associated indicators for which RQOs and Numerical Limits should be developed. This step bears relevance to the consideration of the impacts of land-based activities on the water resource.

Although there is a wide range of sub-components for which RQOs can be set, it is not necessary or practical to set RQOs for all sub-components in all selected RUs. A rationalisation process was therefore undertaken to evaluate and prioritise sub-components for RQO determination, using the Resource Unit Evaluation Tool (DWA, 2011).

Step 5 is to develop the draft RQOs and Numerical Limits for the prioritised RUs which may relate to all or some of the components of the water resource, including quantity, quality, habitat and biota. These RQOs are then published by way of government notice in the government gazette in Step 7. The draft RQOs and Numerical Limits are provided in this report.

Engagement with stakeholders is important in the RQO process to have consensus in selecting the RUs, indicators, RQOs and Numerical Limits for future monitoring and management of the water resources in the study area.

2.2 Resource Quality Objectives and Numerical Limits overview

The purpose of RQOs is to establish clear goals for the catchment, IUA or Resource Unit, relating to the quality of the water resource and which balances social needs and ecological requirements. They provide limits or boundaries from which it can be deduced whether the resource is being stressed by existing management practices. RQOs may relate to all components of the water resource, including quantity, quality, habitat and biota and are set for all or part of every significant water resource.

RQOs might describe, among other things,

- The quantity, pattern and timing of instream flow;
- Water quality, including the physical, chemical and biological characteristics of the water,
- The characteristics and condition of the instream and riparian habitat, and
- The characteristics, condition and distribution of the aquatic biota.

They must be quantifiable, measurable, verifiable and enforceable and ensure protection of all components of the resource, which makes up its ecological integrity.

In setting RQOs, it is important to have a good understanding of the present state of the indicators that have been selected for RQO determination, as this information provides a baseline against which aspirations and management objectives can be compared. This ensures that the RQOs are set at an appropriate level.

Numerical Limits translate the narrative RQOs into numerical values which can be monitored and assessed for compliance. The Numerical Limit is set as a fixed point rather than a range, as the system will usually be managed to the lowest point in this range. Thresholds of Potential Concern (TPCs) are then set at a level which is “better” than the Numerical Limit.

2.3 Stakeholder engagement workshops overview

Two RQO workshops were held at which the selection of the RUs, the sub-components and indicators for the priority sites were workshopped. Workshop 1, from the 3-5 March 2025, focused on the Upper and Lower Sand, Mapungubwe, Nzhelele/Nwanedi, Upper Luvuvhu, Lower Luvuvhu/Mutale and Shingwedzi IUAs. Workshop 2, took place from the 6-7 March 2025 and focussed on the IUAs of the Upper and Lower Lephalala, Nyl/Sterk, Mogalakwena and Kalkpan se Loop.

Valuable input was received from the stakeholders at these workshops and these have been taken forward in drafting the RQOs and Numerical limits.

2.4 Ecologically important quaternary catchments

One of the considerations in creating and balancing the STCD was to increase flows in quaternary catchments with high and very high priority, where possible. This was done by balancing flows that:

- resulted in no D category rivers
- maintained the RECs at all the EWR and LIMCOM study sites
- improved C/D or C category rivers up by half a category.

The ecological importance across the study area was assessed using a range of conservation-focused spatial layers from different sources, including:

- Protected areas (wildlife based landuse)
- Critical Biodiversity Areas (CBA) and Ecological Support Areas (Esa)
- Strategic Water source areas (SWSA, groundwater and surface water)
- High priority wetlands
- Rivers that are fish sanctuaries for critically endangered and threatened fish species
- Rivers in very good condition with a PES (Present Ecological Status) of an A or B category
- Rivers with a high Ecological Importance and or high Ecological Sensitivity
- Rivers that are National Freshwater Ecosystem Priority Areas (NFEPA).

Figure 2-2 is a map that shows the outcome of the analysis that highlights the high and very high priority quaternary catchments in light and dark blue respectively. These quaternary catchments represent areas with important ecological infrastructure that deserve special attention when considering water resource planning and future developments. It is proposed that should there be plans to develop water resource infrastructure or other developments in these sensitive areas OR if developments in neighbouring catchments are likely to threaten their ecological integrity, then all requirements of Conservation of Agricultural Resources Act (CARA), National Environmental Management Act (NEMA) and the National Water Act (NWA), as required, must be fulfilled. This may include but not be limited to a General Authorization (GA), a Water Use License Application (WULA), an Ecological Reserve study, an Environmental Impact Assessment (EIA), a Maintenance Management Plan (MMP) and so on.

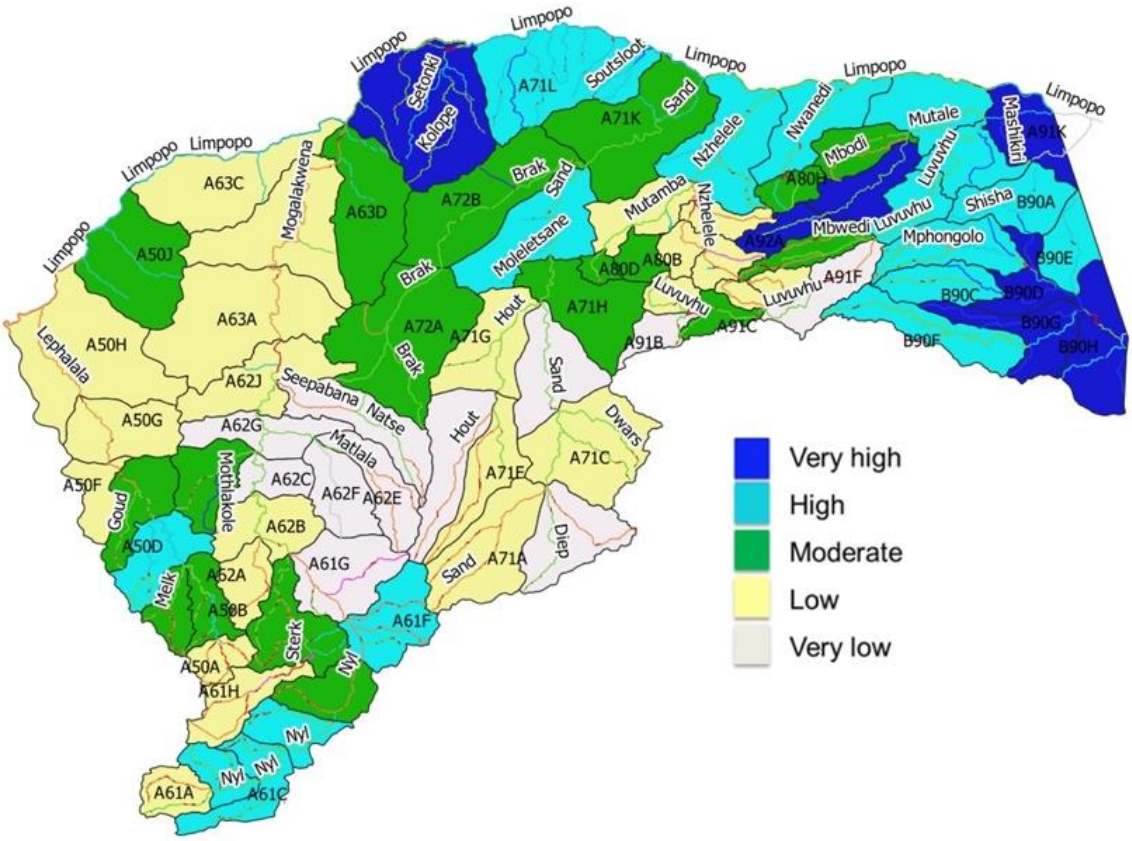

Figure 2-2. Ecologically Important quaternary catchments

2.4.1 Hydrological Resource Quality Objectives: all nodes

The monthly volumes for all the river nodes are provided in Table 2-1. **Note that these are TOTAL volumes that INCLUDE all the floods, large and small. These data were generated from the monthly modelled time series used in the analysis of the Classification scenarios and are the outcome of the STCD scenario. They are NOT the same as the data given in the 19 RQO tables (Section 3.1.7 because the water quantity data provided there are the outcome from the EWR study that was first based on data modelled in the DRIFT software that uses modelled hydrology at a monthly time step and then generates the monthly values that EXCLUDE the inter-annual floods (larger than a 1:2 year and greater).** For further explanation on this point please read Section 3.1.1.

In Table 2-1, the Target Ecological Category (TEC) is the ecological condition of the river at that point (node) that is predicted to be maintained by the monthly flows given. The Recommended Ecological Category (REC) for each of the EWR sites is given, along with the Present Ecological State (PES). For reference purposes, the quaternary catchment in which each node is located and the river names are given. The nodes are listed in the same order in which they have been modelled in the 'Balancing Tool', *viz.* from East to West across the study area and from South to North as they flow down to the Limpopo River.

Table 2-1. Monthly flow volumes (MCM) for all river nodes and the Target Ecological Category (TEC) predicted to be maintained

Quat	Node	River	PES	REC	TEC	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Upper and Lower Lephalala IUA																		
A50A	Riv8	Lephalala	B		B/C	0.134	0.259	0.794	2.003	4.321	4.693	3.399	2.240	1.321	0.621	0.159	0.076	20.016
A50B	Riv11	Lephalala	C	B/C	C	0.681	1.264	3.084	6.145	10.691	10.971	8.002	5.360	3.505	1.998	0.907	0.538	53.150
A50C	Riv10	Melk	C		C	0.187	0.274	0.462	1.205	3.061	2.418	1.958	1.305	0.636	0.337	0.239	0.144	12.222
A50D	Riv13	Boklandspruit	B		B	0.248	0.561	0.725	1.834	3.294	2.384	1.242	0.810	0.616	0.498	0.371	0.249	12.827
A50E	Riii3	Lephalala	D		D	0.761	2.255	4.302	10.832	22.249	19.887	13.147	8.436	5.299	3.207	1.841	0.862	93.081
A50H	Ri8	Lephalala	C	C	C	0.610	2.224	3.765	12.119	26.798	22.196	13.387	7.763	4.435	2.349	1.149	0.420	97.211
Kalkpan se Loop IUA																		
A50J	Ri38	A63C Trib 1	B		B	0.006	0.085	0.163	0.372	0.508	0.218	0.027	0.001	0.000	0.000	0.000	0.000	1.378
A50J	Rvi15	A63C Trib 2	B		B	0.005	0.067	0.129	0.294	0.402	0.172	0.021	0.001	0.000	0.000	0.000	0.000	1.089
A63C	Rvi1	Rietfontein	B/C	B/C	B/C	0.000	0.002	0.008	0.030	0.064	0.034	0.006	0.000	0.000	0.000	0.000	0.000	0.142
Upper Nyl and Sterk IUA																		
A61H	Rvii4	Sterk	E		D	0.421	3.053	3.908	5.843	6.738	2.745	1.695	0.847	0.396	0.349	0.352	0.318	26.670
A61H	Rv1	Sterk	E		D/E	0.064	0.278	2.249	2.735	5.466	1.844	1.203	0.385	0.105	0.104	0.101	0.084	14.615
A61J	Ri4	Sterk	C		C	0.289	0.792	2.046	3.274	7.472	2.715	1.321	0.716	0.513	0.506	0.421	0.363	20.427
A61B	Ri1	Olifantspruit	C	B/C	C	0.143	0.581	1.103	1.359	1.601	1.376	0.745	0.290	0.138	0.106	0.091	0.079	7.607
A61A	Ri1-1	Nyl	C		C	0.478	1.211	1.845	2.473	3.389	2.868	2.077	1.510	1.133	0.889	0.663	0.492	19.032
A61C	Riv3	Nyl	C		C	0.376	1.536	3.002	3.721	4.909	3.985	2.041	0.762	0.362	0.278	0.238	0.206	21.419
A61E	Riii1	Nyl	D		C/D	0.018	1.225	2.970	5.740	8.506	4.150	1.641	0.332	0.023	0.000	0.000	0.000	24.602

Quat	Node	River	PES	REC	TEC	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
A61F	Ri3	Mogalakwena	D		C/D	0.604	2.405	4.519	9.415	14.208	6.496	2.890	1.312	0.892	0.822	0.735	0.681	44.979
A61G	Ri5	Mogalakwena	C	C	C	1.009	3.979	7.893	16.529	27.543	11.280	5.057	2.579	1.819	1.689	1.425	1.229	82.032
Mogalakwena IUA																		
A62B	Riv12	Mogalakwena	C		C	1.008	4.091	7.978	16.858	28.355	11.702	5.288	2.752	1.928	1.751	1.454	1.237	84.403
A62A	Ri6	Mokamole	D		D	0.001	0.495	0.524	1.892	4.039	2.510	1.658	0.969	0.337	0.086	0.024	0.002	12.532
A62B	Rv2	Mogalakwena	C		B/C	0.876	4.889	8.734	19.904	35.336	15.734	7.794	4.357	2.657	2.047	1.560	1.232	105.118
A62D	Rvii12	Klein Mogolakwena	C		C	0.028	0.309	0.144	0.478	1.649	0.627	0.177	0.149	0.125	0.105	0.079	0.056	3.929
A62C	Ri10	Mogalakwena	C		B/C	0.825	4.993	8.779	20.196	36.403	16.257	8.126	4.599	2.796	2.103	1.571	1.224	107.869
A62F	Ri12	Matlalane	C		C	0.019	0.791	0.396	1.096	2.319	1.550	1.195	0.421	0.131	0.106	0.073	0.043	8.137
A62H	Ri13	Seepabana	D		D	0.017	0.314	0.204	0.476	1.139	0.747	0.662	0.266	0.095	0.082	0.056	0.025	4.087
A62J	Rvii13	Mogalakwena	C		C	0.912	6.821	9.779	22.867	42.957	20.124	10.979	5.760	3.264	2.495	1.844	1.379	129.177
A63A	Ri14	Mogalakwena	C	C	C	0.700	6.070	8.305	20.613	42.112	19.069	10.021	4.627	2.262	1.704	0.911	0.547	116.939
A63D	Rii3	Mogalakwena	C	C	C	0.273	5.688	8.258	21.999	45.638	21.122	10.301	4.331	1.954	1.404	0.668	0.294	121.927
Kolope IUA																		
A63E	Rvi2	Stinkwater	C		B	0.000	0.000	0.000	0.014	0.078	0.039	0.006	0.000	0.000	0.000	0.000	0.000	0.109
A63E	Riv32	Kolope	C	B/C	C	0.000	0.003	0.021	0.120	0.559	0.292	0.065	0.000	0.000	0.000	0.000	0.000	1.037
A71L	Rvi4	Kongoloop	C		C	0.000	0.000	0.000	0.348	1.591	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.911
A71L	Rvi7	A71L Trib 4	C		B	0.000	0.000	0.000	0.024	0.124	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.110
A71L	Rvi9	Soutsloot	A		A	0.000	0.000	0.000	0.120	0.558	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.642

Quat	Node	River	PES	REC	TEC	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Upper Sand IUA																		
A71A	Rvi3	Hout	C		C	0.000	0.011	0.000	0.150	2.246	0.383	0.020	0.019	0.018	0.015	0.017	0.017	2.883
A71B	Ri21	Hout	C		C/D	0.000	0.073	0.085	0.492	4.205	0.779	0.000	0.000	0.000	0.000	0.000	0.000	5.633
A71C	Ri16	Sand	D		D/E	1.512	1.540	1.599	4.822	7.002	4.155	1.575	1.518	1.525	1.529	1.507	1.501	29.786
A71C	Ri17	Diep	D		D	0.011	0.070	0.156	1.620	3.089	1.036	0.036	0.000	0.000	0.000	0.000	0.000	5.959
A71F	Riv16	Dwars	C		C	0.000	0.005	0.016	0.322	0.776	0.297	0.001	0.000	0.000	0.000	0.000	0.000	1.377
Lower Sand IUA																		
A71D	Ri20	Sand	C	C	C	1.358	1.518	1.735	7.632	12.880	6.159	1.565	1.401	1.417	1.426	1.391	1.381	39.858
A71G	Ri22	Sand	C		B/C	1.146	1.332	1.584	8.111	14.207	6.548	1.402	1.213	1.227	1.236	1.202	1.192	40.395
A71H	Ri23	Sand	C		C	0.000	0.142	0.441	8.281	20.199	6.399	0.128	0.000	0.000	0.000	0.000	0.000	35.592
A71J	Ri24	Sand	C		C	0.038	0.450	1.141	11.211	24.758	7.675	0.297	0.000	0.000	0.000	0.000	0.000	45.478
A72B	Riv17	Brak	C		C	0.159	0.582	0.968	2.523	5.040	2.296	0.440	0.055	0.012	0.007	0.021	0.025	12.132
A71K	Ri25	Sand	C	C	C	0.149	0.941	2.090	15.591	33.748	10.988	0.541	0.000	0.000	0.000	0.000	0.000	63.739
Nzhelele/Nwanedi IUA																		
A80D	Riii4	Mutamba	C		C	0.243	0.248	0.357	0.948	1.513	1.102	0.597	0.475	0.445	0.399	0.344	0.287	6.955
A80F	Riv23	Mutamba	C		C	0.107	0.225	0.596	2.922	5.208	3.066	1.194	0.806	0.741	0.575	0.392	0.205	16.042
A80B	Riii7	Nzhelele	D		D	0.365	0.318	0.388	1.333	2.836	2.431	1.775	1.316	0.987	0.799	0.615	0.467	13.632
A80C	Rvii34	Mufungudi	D		D	0.225	0.239	0.316	0.698	1.203	0.962	0.652	0.474	0.368	0.310	0.265	0.230	5.946
A80C	Riii8	Nzhelele	D		D	1.840	1.812	1.866	5.476	12.598	10.073	6.894	4.044	2.925	2.284	1.983	1.881	53.675

Quat	Node	River	PES	REC	TEC	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
A80F	Ri26	Nzhelele	C		C	0.857	0.703	1.123	7.225	16.870	11.878	6.959	3.568	2.549	2.089	1.336	0.918	56.074
A80G	Riv33	Tshishiru	C/D		C	0.009	0.002	0.005	0.220	0.360	0.122	0.008	0.000	0.000	0.000	0.000	0.000	0.711
A80G	Ri27	Nzhelele	C	C	C	0.495	0.485	1.064	8.108	18.035	12.022	6.559	3.079	2.065	1.619	0.879	0.465	54.871
A80H	Riii9	Ṅwaneḍi	B		B/C	0.240	0.425	0.877	2.734	4.227	2.864	1.364	0.824	0.585	0.479	0.399	0.336	15.355
A80H	Riii10	Luphephe	C		B	0.473	0.829	1.507	2.355	2.874	1.158	0.382	0.259	0.198	0.163	0.148	0.127	10.474
A80J	Ri28	Ṅwaneḍi	C	C	C	0.360	0.577	1.358	4.306	6.968	4.237	1.788	1.092	0.768	0.610	0.503	0.414	22.975
Upper Luvuvhu IUA																		
A91A	Rvi14	Luvuvhu	C		C	0.020	0.086	0.161	2.004	3.499	1.782	0.177	0.133	0.121	0.111	0.050	0.023	8.173
A91B	Rvii19	Doringspruit	C		C	0.119	0.146	0.164	1.583	2.064	1.061	0.197	0.159	0.150	0.144	0.138	0.131	6.052
A91C	Riii5	Luvuvhu	C		B	0.291	0.426	0.826	5.571	10.884	6.524	1.297	0.683	0.385	0.332	0.274	0.312	27.809
A91D	Riii6	Latonyanda	C	C	C	0.410	0.544	1.010	2.405	3.884	3.769	2.392	1.259	0.878	0.683	0.537	0.430	18.198
A91E	Riv18	Dzindi	D		D	1.550	2.095	3.884	9.469	15.634	14.531	7.971	3.492	2.424	1.942	1.686	1.496	66.179
A91F	Riv19	Luvuvhu	C		C	1.009	1.998	4.980	17.660	31.738	25.761	10.855	3.932	2.346	1.681	1.096	0.872	103.934
A91F	Rvii24	Luvuvhu	D		D	1.925	2.119	4.831	17.516	43.440	36.045	23.976	5.541	2.996	2.133	2.041	1.961	144.528
A91G	Ri30	Mutshindudi	C	C	C	0.892	1.505	3.752	5.962	9.860	8.779	4.788	2.405	1.656	1.356	1.115	0.943	43.016
Lower Luvuvhu/Mutale IUA																		
A91H	Ri32	Luvuvhu	C	B/C	C	1.980	4.575	11.723	34.637	71.668	59.208	24.057	9.565	5.336	3.703	2.832	2.180	231.468
A92A	Rvii33	Mutale	C		C	1.408	2.828	5.683	11.565	15.937	13.589	7.055	2.337	1.105	0.975	0.718	0.753	63.947
A92B	Ri33	Mutale	C	C	C	2.106	4.651	10.302	21.034	29.762	22.573	10.601	3.529	1.770	1.559	1.174	1.200	110.263

Quat	Node	River	PES	REC	TEC	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
A92C	Riv24	Mbodi	D		D	0.000	0.108	0.538	0.951	1.810	0.812	0.100	0.000	0.000	0.000	0.000	0.000	4.310
A92D	Ri34	Mutale	C	C	B/C	2.324	5.714	13.407	27.108	39.584	27.510	11.757	4.024	2.075	1.811	1.387	1.387	138.092
A91J	Ri35	Luvuvhu	B		B	1.614	4.031	14.106	38.074	76.494	61.135	24.447	7.522	4.261	3.008	2.300	1.771	238.764
A91K	Ri36	Luvuvhu	C	C	B/C	3.927	9.735	29.276	69.196	122.877	93.280	37.941	11.417	6.322	4.810	3.679	3.151	395.616
Shingwedzi IUA																		
B90A	Rvi10	Shisha	A		A	0.007	0.250	1.015	2.309	2.461	0.931	0.122	0.005	0.000	0.001	0.000	0.002	7.102
B90H	Riv28	Mphongolo	A		A	0.414	1.525	5.230	11.921	13.200	5.712	1.127	0.409	0.390	0.393	0.390	0.397	41.106
B90F	Rvi13	Shingwedzi	C		C	0.014	0.588	2.246	5.177	6.418	3.110	0.521	0.007	0.000	0.000	0.000	0.000	18.064
B90G	Riv27	Shingwedzi	A		A	0.031	1.105	4.198	9.528	11.641	5.606	0.939	0.018	0.000	0.000	0.000	0.005	33.052
B90H	Ri37	Shingwedzi	C	B/C	C	0.463	3.207	11.619	26.346	30.413	13.878	2.490	0.439	0.384	0.391	0.383	0.406	90.424

3 RESULTS

3.1 River Resource Quality Objectives

RQOs over and above the standard Ecological Reserve hydrological data are only generated for priority resource units.

To standardise the selection of priority resource units, a Resource Unit Prioritisation Tool was developed (DWA 2011), which uses criteria, ratings and weights to assist in prioritisation of RUs for which RQOs should be developed. The application of this tool is reported on in the Evaluation of Resource Units Report (DWS 2025). Thirty high priority resource units were identified (Figure 3-1, Table 3-1) and nineteen of these coincide with the sites at which EWR determinations were conducted.

The EWRs are provided in the EWR Report: River Assessment Volume 3 – Ecological Water Requirements Report (DWS 2024) and all the supporting specialist information is provided in the EWR Report: River Assessment Volume 2: Data collection and analysis. The estimation of the EWR at the other hydrological nodes representing the river resource units are provided in the Final Scenario Report (DWS, 2024). The data from these three reports provided the necessary information to complete the RQOs for the prioritised resource units (Section 3.1.7). The RQOs for the priority river resource units are provided in Table 3-2 to Table 3-31.

Table 3-1. High priority River Resource Units (EWR sites are in bold)

Water Resource Class	River Resource Unit	Node	Sub-quaternary reach	River	Priority	PES	EI	ES	TEC
Upper Lephalala IUA									
II	**RRU-Riv11**	**Riv11**	**A50B-00262**	**Lephalala**	**1**	**C**	**High**	**Very High**	**C**
II	RRU-Riii3	Riii3	A50H-00110	Lephalala	1	D	High	High	D
Lower Lephalala IUA									
II	**RRU-Ri8**	**Ri8**	**A50H-00110**	**Lephalala**	**1**	**C**	**High**	**High**	**C**
Kalkpan se Loop IUA									
I	**RRU-Rvi1**	**Rvi1**	**A63C-00033**	**Kalkpan Se Loop**	**1**	**B/C**	**Moderate**	**Very Low**	**B/C**
Upper Nyl/Sterk IUA									
II	RRU-Ri4	Ri4	A61J-00267	Sterk	1	C	Moderate	High	C
II	**RRU-Ri1**	**Ri1**	**A61B-00489**	**Olifantspruit**	**1**	**C**	**High**	**Very High**	**C**
II	RRU-Ri1-1	Ri1-1	A61B-00552	Nyl	1	C	Moderate	High	C
II	RRU-Ri3	Ri3	A61G-00297	Mogalakwena	1	D	Moderate	Moderate	C/D
II	**RRU-Ri5**	**Ri5**	**A61G-00248**	**Upper Mogalakwena**	**1**	**C**	**Moderate**	**Moderate**	**C**
Mogalakwena IUA									
II	**RRU-Ri14**	**Ri14**	**A63A-00071**	**Middle Mogalakwena**	**1**	**C**	**High**	**Moderate**	**C**
II	**RRU-Rii3**	**Rii3**	**A63D-00034**	**Mogalakwena**	**1**	**C**	**Moderate**	**Moderate**	**C**
Mapungubwe IUA									
II	RRU-Rvi2	Rvi2	A63E-00011	Stinkwater	1	C	High	High	B
II	**RRU-Riv32**	**Riv32**	**A63E-00008**	**Kolope**	**1**	**C**	**Moderate**	**Low**	**C**
Upper Sand IUA									
III	RRU-Riv16	Riv16	A71C-00156	Dwars	1	C	Moderate	Moderate	C
Lower Sand IUA									

Water Resource Class	River Resource Unit	Node	Sub-quaternary reach	River	Priority	PES	EI	ES	TEC
III	**RRU-Ri20**	**Ri20**	**A71D-00118**	**Sand**	**1**	**C**	**Moderate**	**Moderate**	**C**
III	RRU-Ri22	Ri22	A71D-00118	Sand	1	C	Moderate	Moderate	B/C
II	**RRU-Ri25**	**Ri25**	**A71K-00019**	**Sand**	**1**	**C**	**High**	**Moderate**	**C**
Nzhelele/ Nwanedi IUA									
II	RRU-Ri26	Ri26	A80G-00053	Nzhelele	1	C	High	Moderate	C
II	RRU-Riv33	Riv33	A80G-00054	Tshishiru	1	C/D	Moderate	Low	C
II	**RRU-Ri27**	**Ri27**	**A80G-00026**	**Nzhelele**	**1**	**C**	**High**	**High**	**C**
II	**RRU-Ri28**	**Ri28**	**A80J-00028**	**Ṅwaneḍi**	**1**	**C**	**High**	**High**	**C**
Upper Luvuvhu IUA									
II	**RRU-Riii6**	**Riii6**	**A91D-00108**	**Latonyanda**	**1**	**C**	**Moderate**	**Very High**	**C**
II	**RRU-Ri30**	**Ri30**	**A91G-00091**	**Mutshindudi**	**1**	**C**	**Moderate**	**High**	**C**
Lower Luvuvhu / Mutale IUA									
II	**RRU-Ri32**	**Ri32**	**A91H-00045**	**Luvuvhu**	**1**	**C**	**High**	**High**	**C**
II	RRU-Rvii33	Rvii33	A92B-00051	Mutale	1	C	High	High	C
II	**RRU-Ri33**	**Ri33**	**A92B-00051**	**Middle Mutale**	**1**	**C**	**High**	**High**	**C**
II	**RRU-Ri34**	**Ri34**	**A92D-00030**	**Lower Mutale**	**1**	**C**	**High**	**High**	**B/C**
II	**RRU-Ri36**	**Ri36**	**A91K-00035**	**Luvuvhu**	**1**	**C**	**Very High**	**High**	**B/C**
Shingwedzi River IUA									
II	RRU-Riv28	Riv28	B90H-00113	Mphongolo	1	A	High	Very Low	A
II	**RRU-Ri37**	**Ri37**	**B90H-00145**	**Shingwedzi**	**1**	**C**	**High**	**High**	**C**

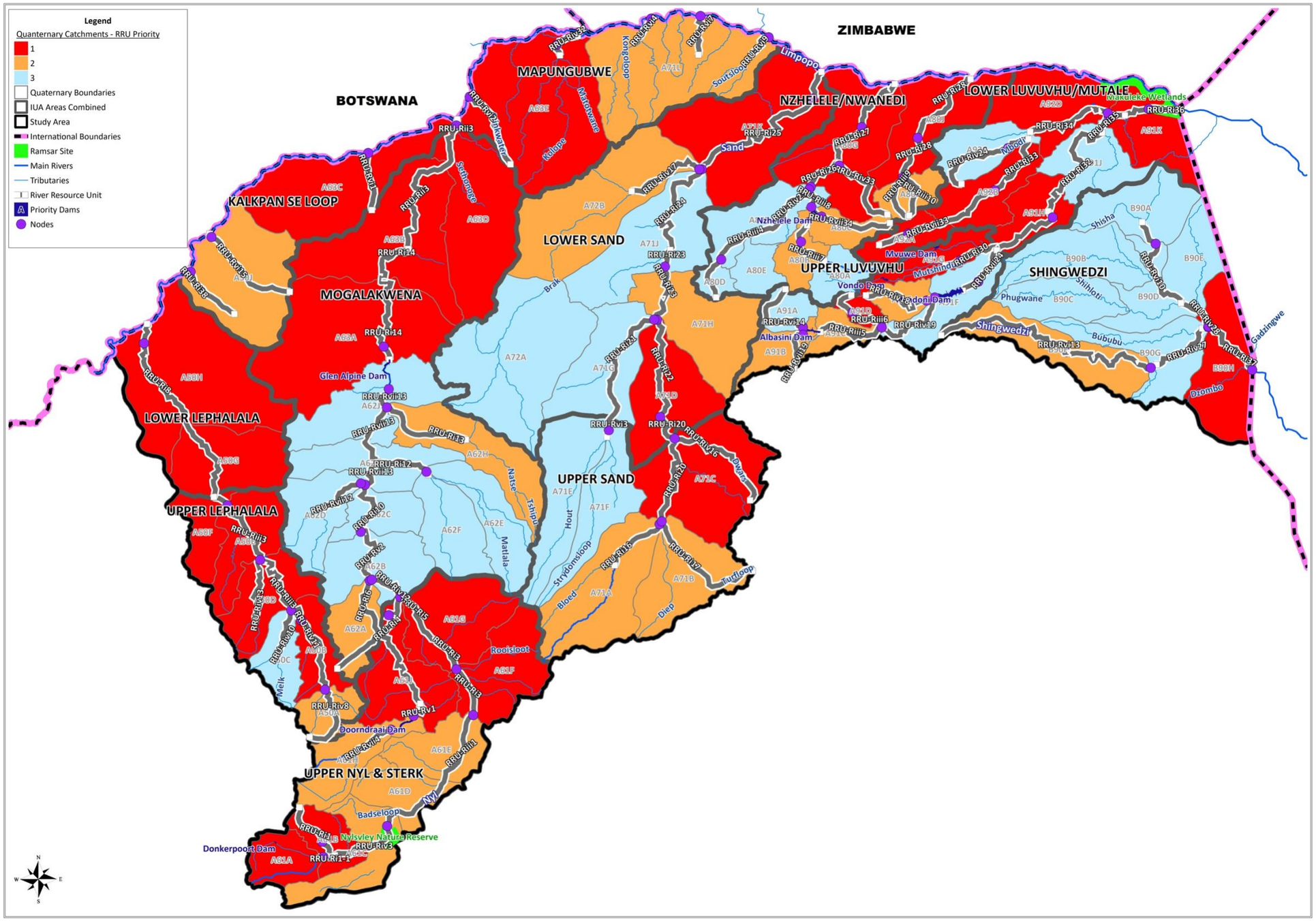

Figure 3-1. Map of the prioritised river resource units (red = high priority, orange = medium priority, blue = low priority)

3.1.1 Water quantity

The RQOs provided for water quantity comprise monthly volumes (in units of Million Cubic Metres, MCM) for maintenance low and high flows. The maintenance high flows are the small intra-annual floods that recur every year on average. This means the maintenance high flow volumes EXCLUDE floods that are greater than the 1:2 year flood, *viz.* the volumes provided are NOT TOTAL flow volumes. This is the standard way of providing EWRs because 1) large floods cannot be managed as many dams do not have the necessary structures to make releases, 2) most large floods overtop gauging weirs so they are not measured accurately and therefore cannot be monitored, and 3) most large floods overtop many dams and move down the rivers unhindered anyway.

Since the RQOs do not provide details to guide management and monitoring for the whole study area (because they are provided for prioritised sites only) some additional information about the ecological importance of all the quaternary catchments is provided in Section 2.4. This information was generated during the analysis of the Classification Scenarios to guide creation of the Spatially Targeted Conservation and Development Scenario (STCD) and is explained in the Scenario Evaluation and Water Resource Classes Report (DWS 2025). These areas should be given special attention and higher protection from future water resource developments.

The other outcome from the analysis of the Classification Scenarios was the configuration of ecological conditions in the STCD scenario for all the river resource units that provided the Water Resource Classes for each IUA. These are the Target Ecological Category (TEC) for each river resource unit and each has average monthly flow volumes that are predicted to maintain the TECs of each river resource unit, in the STCD scenario. These flow volumes were balanced using the 'Balancing Tool' that routes river flow through the river node network of each IUA and in the STCD scenario one of the primary objectives was to ensure that the Recommended Ecological Category of each EWR site was met. This means that the monthly flow volumes for each river node, and the associated TECs of the river nodes, support the maintenance of the flow and ecological conditions at the EWR studies. These monthly flows are not gazetted as RQOs but are provided here because they represent EWRs (river flows) that support maintaining those specified at the EWR sites. This means they should be used to guide management decisions about future water use by being *left behind* in the rivers and for the people when decisions are being made about abstractions or dams in the future. **It is important to note that these volumes are NOT THE SAME as those provided in the EWR reports and the RQO tables because they are TOTAL VOLUMES that INCLUDE ALL FLOODS, both big and small**. The reason total volumes are used in the analysis of the Classification Scenarios is because future developments are planned and modelled using hydrological data in this format (from the yield model).

The monthly TOTAL flow volumes and associated TECs, the outputs from the STCD scenario, are provided in support of the RQOs in Section 2.4.1.

3.1.2 Water quality

The river water temperature RQOs should be determined using the protocols described in "A protocol and tools for setting environmental water temperature guidelines for perennial rivers in South Africa" (Dallas and Rivers-Moore, 2022). A Reference Thermograph can be developed from locally observed daily water temperature data or estimated from locally observed daily air temperature data using equations for upland and lowland rivers (Dallas and Rivers-Moore, 2022). The water temperature RQO is described as the deviation from the Reference Thermograph. For an A/B ecological category the

water temperature falls within the reference 95% band; for a C/D eco-category it falls within the 95% reference band plus/minus one standard deviation; and for an E/F eco-category it falls within 95% reference band plus/minus two standard deviations.

Due to absence of data on the state of agrochemicals in rivers, specifically agricultural toxins such as pesticides and herbicides, a conservative approach was followed in setting ROQs for toxic substances by setting objectives for a B aquatic ecosystems category. This should be revised once the National Toxicity Monitoring Programme (NTMC) provides better data on the state of toxins in the study area.

3.1.3 Habitat

The ecosystem services and biological diversity of the river systems are largely dependent on diverse physical habitat and morphological structure that are available across a wide range of flows. The baselines and habitat RQOs took the geomorphological drivers, physical habitat template and disturbance to the habitat into account. The RQOs were influenced by previous geomorphological RQOs for the Inkomati River by Mark Rountree (DWA, 2010) and the Umzimvubu River by Kate Rowntree (DWS, 2018) and the Rapid Habitat Assessment Method (RHAM) (DWA, 2009b).

The first habitat indicator is the Geomorphological Driver Assessment Index (GAI) that integrates subjective scores to the alterations of the geomorphic drivers (flow and sediment), the reach geomorphology (landscape connectivity, sediment dynamics, reach type) and the site geomorphology (disturbance to bed, banks and benches) (Rowntree, 2013). The remaining indicators include more quantitative observations on changes to the bed elevation (compared to previous cross-sectional surveys), the extent of bank erosion (channel width and dominance of erosional processes), the dominant size of riffle sediment (indicates sedimentation or armouring), the level to which the riffle sediment is embedded by fine sediment (excess fine sediment that smothers larger clasts), the extent to which pools are filled in by sediment (loss of deep slow-flowing habitats) and the presence and width of marginal depositional features such as flood benches that are important growth medium for riparian vegetation. Tracking these indicators over time will allow thresholds of concern to be observed and flagged for further investigation.

The general lack of existing geomorphic and habitat data for these rivers and their variability lowers the confidence of these RQOs. The RQOs were set on a single observation, which is a limitation. The RQOs need to be reviewed in the future after several field observations are conducted.

3.1.4 Biota – Riparian vegetation

The approach to setting RQOs for riparian vegetation was via the generation of EcoSpecs and TPCs in relation to the general riparian character of each EWR site. The following vegetation components, assessed in the field for higher confidence, and when considered together, describe the overall state of the riparian zone:

- Dominant vegetation cover within the riparian zone and sub-zones.
- Invasion by perennial alien species.
- Terrestrialisation (the disproportionate abundance of terrestrial species within the riparian zone).

- General vegetation structure as shown by proportions of riparian woody species, reeds and non-woody species (grasses, sedges and dicotyledonous forbs) expressed by measures such as aerial cover (% of sub-zone).
- General vegetation composition as shown by taxon richness, rarity and endemism and key species (usually obligate riparian species).
- Threatened or protected riparian plant species.

Different types of riparian ecosystems are characterised by different dominant riparian vegetation e.g. grass-dominated Highveld / mountainous streams, tree and shrub-dominated Lowveld / lowland rivers flowing through Bushveld, tall tree-dominated (forest) streams through forested / kloof areas, or mixed vegetation e.g. reed and tree / shrub dominated rivers. The dominant vegetation type (riparian) is a key component of the structure and function of the riparian zone as a whole, but also to sub-zone for example: the marginal zone may frequently be dominated by reeds or grasses while the Macro Channel Bank (MCB) may be dominated by tall, dense woody vegetation.

General vegetation structure is characterised by relative proportions of riparian and terrestrial woody species, reeds and non woody species, including grasses, sedges and dicotyledonous forbs, as well as open unvegetated areas. The exact relative proportions characterise the site, usually expressed by measures such as aerial cover, density, abundance (numbers of individuals) or population structure (diversity of cohorts / age). This measure is based on a dynamic whereby riparian vegetation in infrequently flooded zones or along banks will usually tend towards increased woody cover with diminishing non-woody cover (including reeds), this being "reset" by large flood events. "Reset" here refers to the removal of woody plants by floods, the resulting open space being available for quick colonising non-woody species (including reeds). The RQO assumes that if woody cover increases beyond a given value and remains high, that the flooding regime has been changed so that large floods are smaller or less frequent or both.

Terrestrialisation is the disproportionate abundance, density or occurrence of terrestrial species within the riparian zone. Under reference conditions woody terrestrial species are not expected in the marginal or lower zones; are expected to be transient (if any) along flood features in the upper zone due to frequent flooding disturbance; and are expected to occur on the MCB in numbers concurrent with natural flooding frequency, magnitude and duration for the reach (i.e. hydrologically controlled abundance). In cases where RQOs were set for the riparian obligate/terrestrial species mix, it was always for flood features along the upper zone since this is the area where terrestrialisation first manifests.

3.1.5 Biota – Fish

Fish represent one of the higher-order biological responders within the aquatic environment, with their presence requiring the balanced interaction between the biophysical drivers and the lower-order biological responders (vegetation and aquatic macro-invertebrates) within the aquatic system. The presence or absence of fish within a river reach therefore provides an insight into the overall ecological health of an aquatic habitat unit as they respond to the physical habitat and water quality drivers. Fish form an integral part of the aquatic environment and their ecological role within the environment cannot be discounted.

Fish also provide an important socio-economic role within the catchment area, providing a sought-after source of protein often where no alternatives are available, and supporting a recreational angling sector. Setting the RQOs are therefore vital in conserving the fish diversity and abundance of fish within a river reach.

The RQOs associated with the supporting of selected target species that have known specific habitat requirements were thought to be particularly relevant as ensuring that the RQOs are met to provide for those species would ensure suitable conditions are being met to support the occurrence of the general fish species communities known from the river reaches that were surveyed.

The fish species communities at each survey site were assessed through deriving a present ecological state score using the Fish Response Assessment Index (FRAI) EcoStatus model developed by Kleynhans (2009). Relevant reference species for each survey site were sourced from various databases and refined according to the habitat features present at each site. The basis of the FRAI model is that it derives a fish ecological integrity score by determining how much the present survey scores deviate from the baseline reference data, taking into consideration the various habitat drivers.

One of the limitations to accurate fish surveys is the relatively high amount of variables that determine whether fish occur within a river reach. Accurate determinations of the fish species assemblages that occur within a river reach therefore depend on data from a relatively high number of surveys, with the confidence level in the data generated at a site increasing with an increasing number of surveys.

Fish are able to move through a system and tend to inhibit different zones within a river in response to natural seasonal drivers. Surveys therefore need to be undertaken during different seasons to account for this variability. Once-off surveys tend to allow for a very limited dataset and therefore historical databases are provided for various river reaches that represent the cumulative knowledge of what fish have occurred within that river zone and therefore provides for an indication of the potential fish species that should be occurring. These historical datasets are vital in accurately determining the fish species assemblages and the more historical data that are available for a river reach, the greater the confidence level associated with a current survey dataset.

The data gathered from fish assessments are further hindered by the fish survey field methods. Various collection methods are employed that take into consideration the characteristics of the target habitat, but not all the fish that inhabit a site are surveyed due to the inherent limitations associated with the methods. Fish can also merely evade capture as they are highly mobile. Another limitation to accurate fish assessments is the recent and ongoing changes to taxonomy that has seen the recognition of species status to a variety of what were historically considered to be subpopulations of the same species. In some cases, this has led to an incongruency between historical datasets and present-day surveys. A further limitation was that there were certain sites that were not physically surveyed for fish. Much of the data used to derive present ecological scores for the fish at these sites were inferred according to habitat type, assessment of applicable migratory barriers, and expert opinion. This was not thought to be a significant limitation, however, as historical datasets were available.

An increase in the number of monitoring surveys at each site with result in a greater level of confidence in the results of fish assessments. Multiple surveys will allow for the analysis of ecological trends pertaining to the fish data. This, in turn, will allow for the detection of survey values that do not confirm to the expected trends. Deviations from the expected values once a reliable trend dataset can then be used as early warning signs of an undesirable ecological driver within the system. For this reason, Thresholds of Potential Concern (TPCs) are set for each site, which highlight the type and level of deviations that would be considered significant. Only significant aspects are considered for the TPCs to provide for a streamlined approach to the monitoring and include aspects that are highly predictable at a site and represent species that are susceptible to habitat transformations. The sudden absence of such species would indicate a significant change to the system. The numerical values associated with the TPCs are purposely set to represent the lower spectrum of changes so that the negative drivers

within the system can be identified at the early stages so that management intervention can be implemented before more significant deleterious impacts to the system manifest.

3.1.6 Biota – Macroinvertebrates

Ecological monitoring allows for the collection and assessment of ecological data. This in turn provides an indication of the ecological state or integrity of the resource and furthermore, an indication of whether management objectives are being met or not. Ecological Specifications (EcoSpecs) are broad ecological objectives that are developed for a particular resource and can be in the form of numerical values or narrative statements or both (Kleynhans & Louw, 2007). EcoSpecs are set for a specific Ecological Category. Thresholds of Potential Concern (TPCs) are usually set at the lower range of the EcoSpecs and thus function as a "red flag" or warning system that should elicit management response before ecological damage occurs. TPCs are scientific endpoints which represent probable trends or levels of undesirable change of a component within an ecosystem, which allow for an early warning or "red flag" system which will elicit an appropriate scientific and management response.

To develop and implement an effective TPC approach for a specific resource, certain criteria are required and need to be determined, including an understanding of the system for which TPCs are being developed, agents and indicators of change and limits of acceptable change. Once these criteria have been determined, TPCs can then be set for the resource.

Each site is described according to the data used, the range of SASS and ASPT scores present in the data used, the MIRAI Ecological Category percentage and reference SASS and ASPT scores.

Indicator taxa were selected according to the following criteria:

- Taxa must have a reasonably strong preference for a certain habitat type or velocity type, i.e. normally a 4 or 5 preference value (as indicated in the MIRAI), sometimes even a 3 value is used when no other appropriate taxa are present;
- Taxa must occur frequently enough i.e., a FROC (Frequency of Occurrence) value of 4 or 5, or minimally at least 50% of the time;
- Taxa must be at least moderately sensitive to changes in water quality.

SASS and ASPT EcoSpecs and TPCs are then determined, as well as specific EcoSpecs and TPCs for the indicator taxa. When determining the SASS and ASPT EcoSpecs and TPCs, the following should be taken into consideration:

- The data set;
- The range of present day scores;
- Outliers should be discarded;
- The median and average values for the time period should be considered;
- The present scores should be compared to the reference scores and a judgment call made in terms of the appropriate EcoSpec/TPC value.

Note: For the Taxon Dominance indicator in Table 3.2, no TPC is set because individuals are not counted (only estimates are made) and therefore no specific amount can be assigned as a TPC.

3.1.7 Prioritised river resource units in the study area

3.1.7.1 Upper Lephalala IUA

Figure 3-2 shows the river resource units within the Upper Lephalala IUA. The priority resource units are shown in red. Table 3-2 and Table 3-3 provides the RQOs for the river resource unit (RRU) Riv11 and RRU-Riii3.

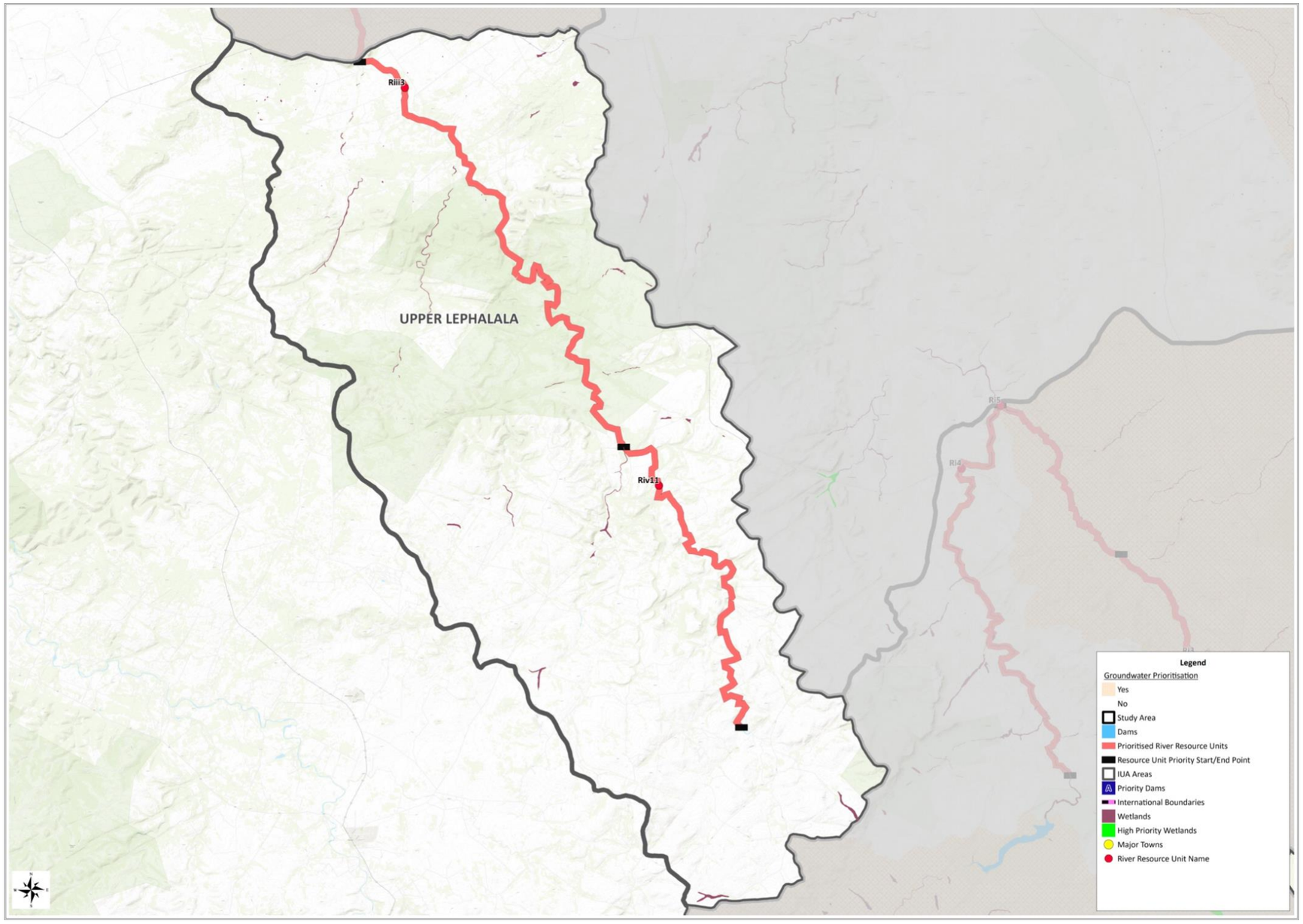

Figure 3-2. Map of the priority resource units in the Upper Lephalala IUA

Table 3-2. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv11) in the Upper Lephalala IUA

IUA	Class	Quaternary catchment	Resource Name	RU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Upper Lephalala IUA	II	A50B	Lephalala	Riv11 - A50B-00262 (EWR site 1_Lephalala)	C	Water quantity		Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep	
							Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Lephalala River in a condition equal to or better than a C category.	0.419 / 0.775 / 1.833 / 3.380 / 6.007 / 7.550 / 6.342 / 4.807 / 3.314 / 2.000 / 0.905 / 0.492	
							High flows	Maintenance high flows (MCM)		0.050 / 0.277 / 0.970 / 1.550 / 1.356 / 1.410 / 1.208 / 0.604 / 0.295 / 0.117 / 0.010 / 0.023	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 55 mS/m	95 percentile Electrical conductivity greater than 44 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 1.75 mg/l	Median TIN greater than 1.40 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.075 mg/l	Median PO_4-P greater than 0.060 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l	Dissolved oxygen concentrations lower than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5	6.5 - 7.0 ≥ pH ≤ 8.0 - 8.5
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins/Biocides	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)	95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle reach type.	Maintain a GAI PES score of at least a 'C' or > 63%	GAI PES score < 63%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average

IUA	Class	Quaternary catchment	Resource Name	RU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Bank erosion	Maintain low to moderate proportion of bank length actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain riffle sediment size to include largely gravel and cobble	Maintain riffle with mobile sediment in the range of a D50 of 25 mm, D16 of 9 mm and D84 of 58 mm	Riffle dominated by sand or only cobble
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain upstream pool with deep open water	Maintain upstream pool with water > 0.5 m deep for > 60% of pool area	Downstream pool is > 60% filled with sediment and forming largely shallow habitat
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 8 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 8 m and no signs of recent fine sediment deposition on the benches
						Biota	Aquatic zone	Key Species	*Potamogeton schweinfurthii* and *Stuckenia pectinatus* must be present in the wet season.	2 listed species should be present in the wet season.	Absence of 1 or more listed species
							Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 60% (aerial cover).	Non-woody cover below 60%
								Key species	*Miscanthus junceus* and *Ischaemum fasciculatum* must be present.	2 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial aliens
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 10% (aerial cover).	Woody cover below 10%
								Non-woody cover		Non-woody cover >= 60% (aerial cover).	Non-woody cover below 60%
								Reed cover		Reed cover <= 15% (aerial cover).	Reed cover more than 15%
							Non-marginal (lower - flood benches)	Dominant vegetation	Non-woody vegetation should dominate the flood features	Non-woody cover >= 60% (aerial cover).	Non-woody cover below 60%
								Key species	*Miscanthus junceus* and *Ischaemum fasciculatum* must be present.	2 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition on the flood features should	Perennial alien plant species <= 20% (aerial cover).	Cover by alien pants more than 20%

IUA	Class	Quaternary catchment	Resource Name	RU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Terrestrial woody cover	maintain desired dominance and non-dominance.	No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 20% (aerial cover).	Woody cover more than 20%
								Non-woody cover		Non-woody cover >= 60% (aerial cover).	Non-woody cover below 60%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 60% (aerial cover).	Woody cover less than 60%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	Perennial alien plant species <= 10% (aerial cover).	Cover by alien pants more than 10%
							Riparian zone	PES	The PES category should be a C at least	VEGRAI score >= 62%	VEGRAI score < 62%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 20 indigenous species.	Less than 20 indigenous plant species present
								Endemic riparian species	*Buxus macowanii* (SA endemic) and *Miscanthus junceus* (southern African endemic) must be present.	2 listed species present.	Absence of 1 or more listed species
							Fish	FRAI score	A diversity of fish representative of the fish species reference list as per the EWR surveys	PES for fish to remain within a C category (FRAI PES C >62%)	FRAI PES value <62% for two or more consecutive surveys for the site
								Overall fish health	Fish should be free of bacterial and parasitic infections	<1% of all fish sampled at the site to be affected by bacterial and/or parasitic infections.	>1% of fish assessed at the site affected by bacterial and parasitic infections
								Species diversity	The site should support the diversity and relative abundance of fish as per the reference list used during the EWR studies	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions during the summer wet season to support the key species identified at the site.	Presence/absence records. Relative abundance of species: *Chiloglanis pretoriae* (2) *Labeobarbus marequensis* (2) *Labeo cylindricus* (1)	The absence of any of these key species
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should be maintained within a minimum of a B/C Category.	To ensure the MIRAI score remains within the range of a B/C category (>78 - ≤82 %), using the same reference data used in the EWR study.	A MIRAI score of 80% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >140; ASPT value: >6.1	SASS5 scores less than 145 and ASPT less than 6.2.
								Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No group/taxon occurs at a C abundance (>100 individuals)	

IUA	Class	Quaternary catchment	Resource Name	RU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Key taxa and abundance	To maintain suitable conditions for the following two key taxa: To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Heptageniidae.	Minimum abundance of an A attained.	If Heptageniidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae. To maintain sufficient quality and quantity of inundated gravel, sand and mud to support the following taxa: Gomphidae	Minimum abundance of an A attained.	Coenagrionidae missing in two consecutive surveys, or has a single individual present in two consecutive surveys. If Gomphidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.

Table 3-3. Resource Quality Objectives for the prioritised river resource unit (RRU_Riii3) in the Upper Lephalala IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Upper Lephalala IUA	II	A50E	Lephalala	RRU_Riii3 - A50H-00110	Riii3	D	Water quantity	Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a D category	
								Total flows	Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
									MCM	Flows shall be sufficient to maintain the Lephalala River in a condition equal to or better than a D category.	0.761 / 2.255 / 4.302 / 10.832 / 22.249 / 19.887 / 13.147 / 8.436 / 5.299 / 3.207 / 1.841 / 0.862
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category or better).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maintained so that some oxygen sensitive species are present in the river (C category).	
									pH	pH levels should be maintained in a C category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

3.1.7.2 Lower Lephalala IUA

Figure 3-3 shows the river resource units within the Lower Lephalala IUA. The priority resource units are shown in red. Table 3-4 provides the RQOs for the RRU-Ri8.

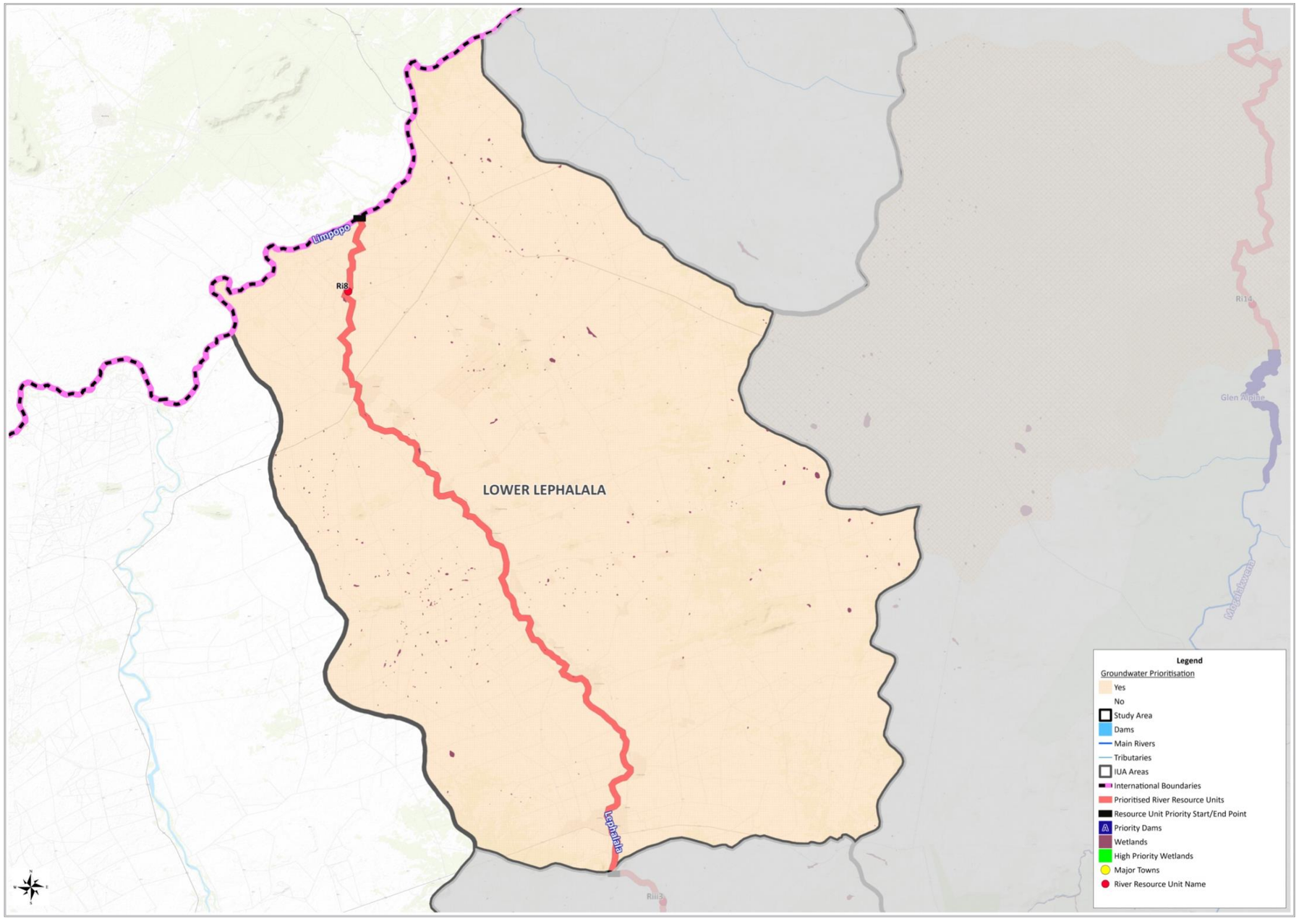

Figure 3-3. River resource units within the Lower Lephalala IUA

Table 3-4. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri8) in the Lower Lephalala IUA (LIMCOM site LEPH-A50H-SEEKO)

IUA	Class	Quaternary catchment	Resource Name	RU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Lower Lephalala IUA	II	A50H	Lephalala	Ri8 - A50H-00110 (EWR site LEPH-A50H-SEEKO)	C	Water quantity		Month		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep	
							Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Lephalala River in a condition equal to or better than a C category. Flows must be met at the confluence with the Limpopo River, i.e. must flow into the Limpopo.	0.568 / 0.644 / 0.726 / 0.911 / 1.277 / 1.104 / 0.980 / 0.844 / 0.807 / 0.727 / 0.661 / 0.577	
							High flows	Maintenance high flows (MCM)		0.612 / 0.632 / 0.612 / 1.758 / 5.756 / 1.758 / 0.632 / 0.000 / 0.000 / 0.000 / 0.000 / 0.000	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 55 mS/m	95 percentile Electrical conductivity greater than 44 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 1.75 mg/l	Median TIN greater than 1.40 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.075 mg/l	Median PO_4-P greater than 0.060 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l	Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5	pH between 6.0 - 6.5 or pH between 8.5 - 9.0
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95th percentile Ammonia (NH_3-N) greater than 35 µg/l 95th percentile Atrazine greater than 39 µg/l 95th percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95th percentile)	95th percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain similar reach type.	GAI score not available as part of IWMI study. Determine and maintain the GAI PES score in a similar or better category.	Reduction in GAI PES score
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of bank length actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain riffle sediment size to include largely gravel	Maintain riffle with mobile sediment in the range of a D50 of 15 mm, D16 of 7 mm and D84 of 25 mm	Riffle dominated by sand or only coarse gravel
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain upstream pool with deep open water	Maintain upstream pool with >60% deep (> 0.5 m) open water	Upstream pool is > 60% filled with sediment and forming largely shallow habitat
								Flood bench	Maintain flood benches along one of the banks	Maintain flood bench of > 10 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 10 m and no signs of recent fine sediment deposition on the benches

IUA	Class	Quaternary catchment	Resource Name	RU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
						Biota	Marginal (bed)	Dominant vegetation	Non-woody vegetation should dominate the channel bed	Non-woody cover >= 40% (aerial cover).	Non-woody cover less than 40%
								Key species	Phragmites mauritianus and Faidherbia albida should be present.	2 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition in the channel bed should maintain desired dominance and non-dominance.	No perennial alien plants	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Prescence of terrestrial woody species
								Reed cover		Reeds <=20%	Reed cover above 20%
							Non-marginal (bank)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 60% (aerial cover).	Woody cover less than 60%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	perennial alien plant species <= 10% (aerial cover).	Cover by alien plants above 10%
							Riparian zone	PES	The PES category should be a C at least	VEGRAI score >= 62%	VEGRAI score < 62%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 14 indigenous species.	Less than 14 indigenous plant species present
							Fish	FRAI score	The Ecological Category should be maintained within a B/C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a B/C category (>77%)	A FRAI score that calculates to a PES category less than B/C for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site.	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (1), Labeo cylindricus (1), Chiloglanis pretoriae (2)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should be maintained within a minimum of a C Category.	To ensure the MIRAI score remains within the range of a C category (>62 - ≤78 %), using the same reference data used in the EWR study.	A MIRAI score of 64% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >100; ASPT value: >6.0.	SASS5 scores less than 105 and ASPT less than 6.1.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Hydropsychidae. To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae. To maintain sufficient quality and quantity of inundated gravel, sand and mud to support the following taxa: Gomphidae Caenidae	Minimum abundance of an A attained for Hydropsychidae, Coenagrionidae, Gomphidae and Caenidae.	If Hydropsychidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Coenagrionidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Gomphidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Caenidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.

IUA	Class	Quaternary catchment	Resource Name	RU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No taxon occurs at a C abundance (>100 individuals).	

3.1.7.3 Kalkpan se Loop IUA

Figure 3-4 shows the river resource units within the Kalkpan se Loop IUA. The priority resource units are shown in red. Table 3-5 provides the RQOs for the RRU-Rvi1.

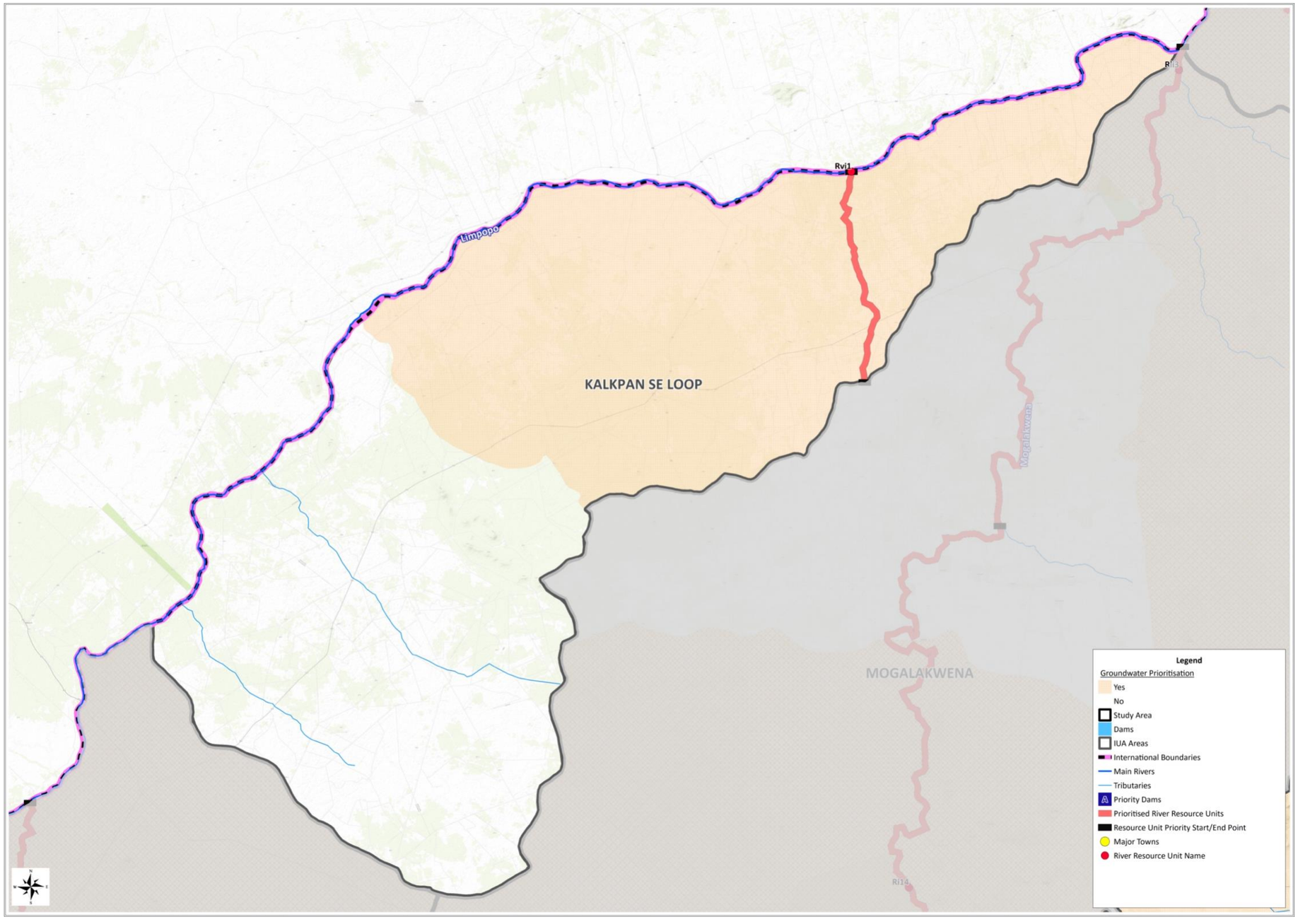

Figure 3-4. River resource units in the Kalkpan se Loop IUA

Table 3-5. Resource Quality Objectives for the prioritised river resource unit (RRU_Rvi1) in the Kalkpan se Loop

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Kalkpan se Loop IUA	I	A63C	Kalkpan Se Loop	Rvi1 - A63C-00033 (EWR site 2_Rietfontein)	B/C	Water quantity		Month		Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep	
							Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Rietfontein River in a condition equal to or better than a B/C category.	0.000 | 0.001 | 0.004 | 0.011 | 0.019 | 0.019 | 0.002 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000	
							High flows	Maintenance high flows (MCM)		0.000 | 0.000 | 0.002 | 0.002 | 0.003 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 260 mS/m	95 percentile Electrical conductivity greater than 208 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 1.75 mg/l	Median TIN greater than 1.40 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.075 mg/l	Median PO_4-P greater than 0.060 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that most oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 7 mg/l	Dissolved oxygen concentrations less than8.4 mg/l
								pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5	pH between 6.5 - 7.0 or pH between 8.0 - 8.5
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band)	Water temperature outside of the reference thermograph (95% band)
							Toxins	Ammonia (NH_3-N)Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95th percentile Ammonia (NH_3-N) greater than 35 µg/l 95th percentile Atrazine greater than 39 µg/l 95th percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95th percentile)	95th percentile E coli / Faecal coliforms greater than 2025 cfu/100ml
						Habitat	Geomorphology	Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of bank length actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length
						Biota	Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 70% (aerial cover).	Non-woody cover less than 70%
								Key species	*Cyperus sexangularis* and *Juncus rigidus* must be present.	2 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 5% (aerial cover).	Woody cover more than 5%
								Non-woody cover		Non-woody cover >= 70% (aerial cover).	Non-woody cover less than 70%
								Reed cover		No reeds.	Presence of reeds

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
							Non-marginal (lower - flood benches)	Dominant vegetation	Non-woody vegetation should dominate the flood features	Non-woody cover >= 50% (aerial cover).	Non-woody cover less than 50%
								Key species	*Cyperus sexangularis* and *Juncus rigidus* must be present.	2 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		Terrestrial woody cover <= 10% (aerial cover).	Terrestrial woody cover above 10%
								Indigenous woody cover		Woody cover <= 50% (aerial cover).	Woody cover more than 5%
								Non-woody cover		Non-woody cover >= 50% (aerial cover).	Non-woody cover less than 50%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 80% (aerial cover).	Woody cover lass than 80%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	No perennial alien plant species.	Presence of perennial alien plants
							Riparian zone	PES	The PES category should be a A/B at least	VEGRAI score >= 88%	VEGRAI score < 88%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 15 indigenous species.	Less than 15 indigenous plant species present
							Fish	FRAI score	Only one species of fish inhabited this site, therefore the PES can be regarded as an A category	PES A; Abundance of juvenile size classes predominantly during the summer breeding season	Lack of juvenile size classes during the summer breeding season; Loss of abundance of individuals at the site for two or more consecutive surveys
								Overall fish health	Maintain overall health of fish	Maintain the overall fish health by limiting bacterial and parasitic infections to <1% of population	Bacterial and/or parasitic infection affecting >1% of the fish population
								Species diversity	Only one species found at the site.	Maintain diversity of age size classes within the population to maintain	
								Key species	*Oreochromis mossambicus*	*Oreochromis mossambicus*	Loss of species from the site
							Macroinvertebrates	MIRAI Category and Score	N/A		
								SASS5 Total Score and ASPT	N/A		
								Key taxa and abundance	To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae	Minimum abundance of an A attained.	Coenagrionidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of Gravel, sand and mud (GSM) habitat to support Gomphidae.	Minimum abundance of an A attained.	Gomphidae missing in two consecutive surveys, or has a single individual present in two consecutive surveys.
								Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No taxon occurs at a C abundance (>100 individuals).	

3.1.7.4 Upper Nyl/Sterk IUA

Figure 3-5 shows the river resource units within the Upper Nyl/Sterk IUA. The priority resource units are shown in red. Table 3-6 to Table 3-10 provides the RQOs for RRU-Ri4, RRU-Ri1, RRU-Ri1-1, RRU-Ri3 and RRU-Ri5, respectively.

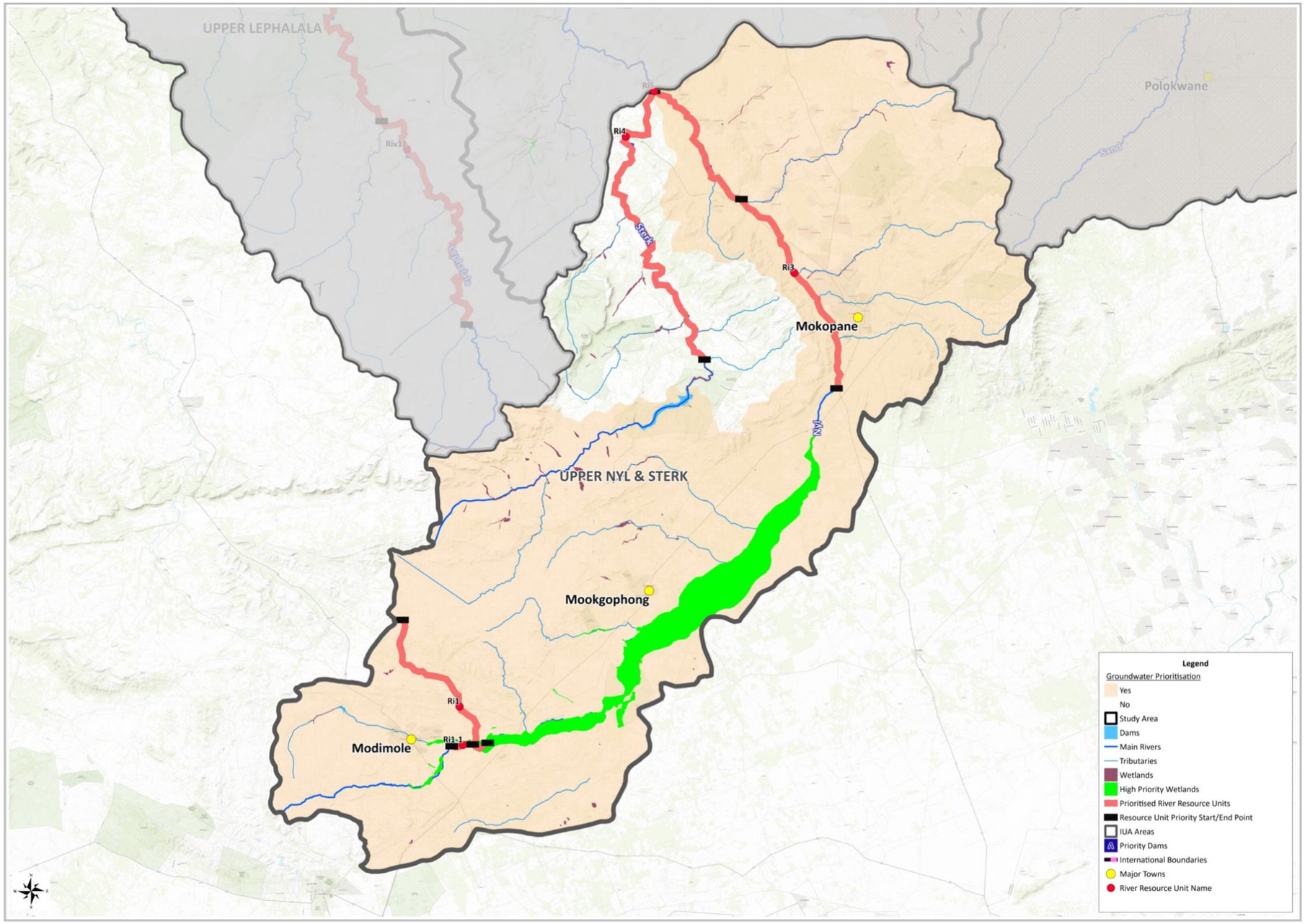

Figure 3-5. River resource units in the Upper Nyl/Sterk IUA

Table 3-6. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri4) in the Upper Nyl/Sterk IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Upper Nyl & Sterk	II	A61J	Sterk	RRU_Ri4 - A61J-00267	Ri4	C		Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a C category	
							Water quantity		Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
								Total flows	MCM	Flows shall be sufficient to maintain the Sterk River in a condition equal to or better than a C category.	0.289 / 0.792 / 2.046 / 3.274 / 7.472 / 2.715 / 1.321 / 0.716 / 0.513 / 0.506 / 0.421 / 0.363
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maintained so that some oxygen sensitive species are present in the river (C category).	
									pH	pH levels should be maintained in a C category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

Table 3-7. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri1) in the Upper Nyl/Sterk IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Upper Nyl/Sterk IUA	II	A61B	Olifantspruit	Ri1- A61B-00489 (EWR site 3_Olifantspruit)	C	Water quantity		Month		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep	
							Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Rietfontein River in a condition equal to or better than a C category.	0.089 / 0.259 / 0.399 / 0.494 / 0.578 / 0.549 / 0.392 / 0.229 / 0.132 / 0.103 / 0.087 / 0.075	
							High flows	Maintenance high flows (MCM)		0.012 / 0.215 / 0.485 / 0.570 / 0.588 / 0.475 / 0.237 / 0.032 / 0.001 / 0.001 / 0.000 / 0.000	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 55 mS/m	95 percentile Electrical conductivity greater than 44 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 1.75 mg/l	Median TIN greater than 1.40 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.075 mg/l	Median PO_4-P greater than 0.060 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l	Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5	pH between 6.0 - 6.5 or pH between 8.5 - 9.0
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)	95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle reach type.	Maintain a GAI PES score of at least a 'C' or > 63%	GAI PES score < 63%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of bank length actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain riffle sediment size to include largely gravel and cobble	Maintain riffle with mobile sediment in the range of a D50 of 27 mm, D16 of 14 mm and D84 of 55 mm	Riffle dominated by sand or only cobble

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for > 60% of pool area	Downstream pool is > 60% filled with sediment and forming largely shallow habitat
								Flood bench	Maintain flood benches along one of the banks	Maintain flood bench of > 2 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 2 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 20% (aerial cover).	Non-woody cover less than 20%
								Key species	*Phragmites australis, Juncus dregeanus* and *Juncus oxycarpus.*	3 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	Perennial alien plant species <= 20% (aerial cover).	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 10% (aerial cover).	Woody cover more than 10%
								Non-woody cover		Non-woody cover >= 20% (aerial cover).	Non-woody cover less than 20%
								Reed cover		Reed cover <= 30% (aerial cover).	Reed cover more than 20%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 40% (aerial cover).	Woody cover less than 40%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	perennial alien plant species <= 50% (aerial cover).	Cover by alien plants more than 50%
							Riparian zone	PES	The PES category should be a D at least	VEGRAI score >= 42%	VEGRAI score < 42%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 20 indigenous species.	Less than 20 indigenous plant species present
								Endemic riparian species	*Combretum erythrophyllum* (southern African endemic) must be present.	1 listed species present.	Absence of 1 or more listed species
							Fish	FRAI score	The Ecological Category should be maintained within a B/C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a B/C category (>77%)	A FRAI score that calculates to a PES category less than B/C for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site.	Presence/absence records. Relative abundance of species (values indicated in parenthesis): *Labeobarbus marequensis (2), Labeo cylindricus (1), Chiloglanis pretoriae (2), Enteromius bifrenatus (2)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a minimum of a B/C Category.	To ensure that the MIRAI score remains within the range of a B/C category (>78 - ≤82 %), using the same reference data used in the EWR study.	A MIRAI score of 80% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >140; ASPT value: >6.1.	SASS5 scores less than 145 and ASPT less than 6.2.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean,	Minimum abundance of an A attained.	If Simuliidae is missing in two consecutive surveys or has a

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
									unembedded surface area (cobbles) to support the following flow-dependent taxa: Simuliidae		single individual present in two consecutive surveys.
									To maintain sufficient quality and quantity of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae	Minimum abundance of an A attained.	Coenagrionidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of Gravel, sand and mud (GSM) habitat to support Gomphidae.	Minimum abundance of an A attained.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

Table 3-8. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri1-1) in the Upper Nyl/Sterk IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Upper Nyl & Sterk	II	A61A	Nyl	RRU_Ri1-1 - A61B-00552	Ri1-1	C		Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a C category	
							Water quantity	Total flows	Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
									MCM	Flows shall be sufficient to maintain the Nyl River in a condition equal to or better than a C category.	0.478 / 1.211 / 1.845 / 2.473 / 3.389 / 2.868 / 2.077 / 1.51 / 1.133 / 0.889 / 0.663 / 0.492
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maintained so that some oxygen sensitive species are present in the river (C category).	
									pH	pH levels should be maintained in a C category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

Table 3-9. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri3) in the Upper Nyl/Sterk IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Upper Nyl & Sterk	II	A61F	Mogalakwena	RRU_Ri3 - A61G-00297	Ri3	C/D		Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a C/D category	
							Water quantity	Total flows	Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
									MCM	Flows shall be sufficient to maintain the Mogalakwena River in a condition equal to or better than a C/D category.	0.604 / 2.405 / 4.519 / 9.415 / 14.208 / 6.496 / 2.89 / 1.312 / 0.892 / 0.822 / 0.735 / 0.681
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C/D category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in a eutrophic state or better (Tolerable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maiintained so that some oxygen sensitive species are present in the river (C/D category).	
									pH	pH levels should be maintained in a C/D category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

Table 3-10. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri5) in the Upper Nyl/Sterk IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical												TPC
								Month		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
						Water quantity	Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Mogalakwena River in a condition equal to or better than a C category.	0.273	0.999	2.503	4.283	6.628	5.248	1.928	1.337	0.935	0.868	0.659	0.458	
							High flows	Maintenance high flows (MCM)		0.154	0.409	1.007	1.135	1.019	0.992	0.697	0.334	0.198	0.157	0.135	0.132	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 85 mS/m												95 percentile Electrical conductivity greater than 68 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 2.24 mg/l												Median TIN greater than 1.79 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.090 mg/l												Median PO_4-P greater than 0.072 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l												Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	5.6 ≤ pH ≤ 9.2												pH between 5.6 - 5.9 or pH between 8.8 - 9.2
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation												Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)												95th percentile Ammonia (NH3-N) greater than 35 µg/l 95th percentile Atrazine greater than 39 µg/l 95th percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95th percentile)												95th percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle reach type.	Maintain a GAI PES score of at least a 'C' or > 63%												GAI PES score < 63%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at <0.5 m difference in elevation from previous cross-sectional surveys												Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length												Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain dominant riffle sediment size to include gravel and cobble	Maintain riffle with mobile sediment in the range of a D50 of 30 mm, D16 of 16 mm and D84 of 65 mm												Riffle dominated by sand or only cobble
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of <25% for riffle sediment												Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water >0.5 m deep for > 60% of pool area												Downstream pool is > 60% filled with sediment and forming largely shallow habitat
								Flood bench	Maintain flood benches along one of the banks	Maintain flood bench of >5 m wide along at least one bank with signs of recent fine sediment deposition												Channel erosion to the extent where there are no benches
Upper Nyl/Sterk IUA	II	A61G	Upper Mogalakwena	Ri5 - A61G-00248 (EWR site 4_Mogalakwena)	C																	

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
											wider than ~ 5 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 70% (aerial cover).	Non-woody cover less than 70%
								Key species	*Juncus lomatophyllus* and *Phragmites australis* must be present.	2 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 10% (aerial cover).	Woody cover more than 10%
								Non-woody cover		Non-woody cover >= 70% (aerial cover).	Non-woody cover less than 70%
								Reed cover		Reed cover <= 20% (aerial cover).	Reed cover more than 20%
							Non-marginal (lower - flood benches)	Dominant vegetation	Non-woody vegetation should dominate the flood features	Non-woody cover >= 60% (aerial cover).	Non-woody cover less than 60%
								Key species	*Flugea virosa*, *Agrostis lachnantha, Phragmites australis* and *Cynodon dactylon* must be present.	4 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	Perennial alien plant species <= 5% (aerial cover).	Perennial alien plant cover more than 5%
								Terrestrial woody cover		Terrestrial woody cover <= 10% (aerial cover).	Terrestrial woody species cover more than 10%
								Indigenous woody cover		Woody cover <= 30% (aerial cover).	Woody cover more than 30%
								Non-woody cover		Non-woody cover >= 60% (aerial cover).	Non-woody cover less than 60%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 70% (aerial cover).	Woody cover less than 70%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	Perennial alien plant species <= 5% (aerial cover).	Perennial alien plant cover more than 5%
							Riparian zone	PES	The PES category should be a C/D at least	VEGRAI score >= 58%	VEGRAI score < 58%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 15 indigenous species.	Less than 15 indigenous plants species present
								Endemic riparian species	*Combretum erythrophyllum* (southern African endemic) must be present.	1 listed species present.	Absence of 1 or more listed species
							Fish	FRAI score	The Ecological Category should be maintained within a B/C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a B/C category (>77%)	A FRAI score that calculates to a PES category less than B/C for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site.	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (1), Labeo cylindricus (1), Chiloglanis pretoriae (2) Micralestes acutidens (1), Enteromius trimaculatus (1)*	The absence of any of the target species for two or more consecutive surveys

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a minimum of a C Category.	To ensure that the MIRAI score remains within the range of a C category (>62 - ≤78 %), using the same reference data used in this EWR study.	A MIRAI score of 64% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >130; ASPT value: >6.3.	SASS5 scores less than 135 and ASPT less than 6.4.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Hydropsychidae >2pp; Simuliidae.	Minimum abundance of an A to be attained for both Hydropsychidae and Simuliidae.	If Hydropsychidae has <2spp present in two consecutive surveys. If Simuliidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae	Minimum abundance of an A attained.	Coenagrionidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of Gravel, sand and mud (GSM) habitat to support Gomphidae.	Minimum abundance of an A attained.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

3.1.7.5 Mogalakwena IUA

Figure 3-6 shows the river resource units within the Mogalakwena IUA. The priority resource units are shown in red. Table 3-11 provides the RQOs for RRU-Ri14 and Table 3-12, the RQOs for RRU_Rii3.

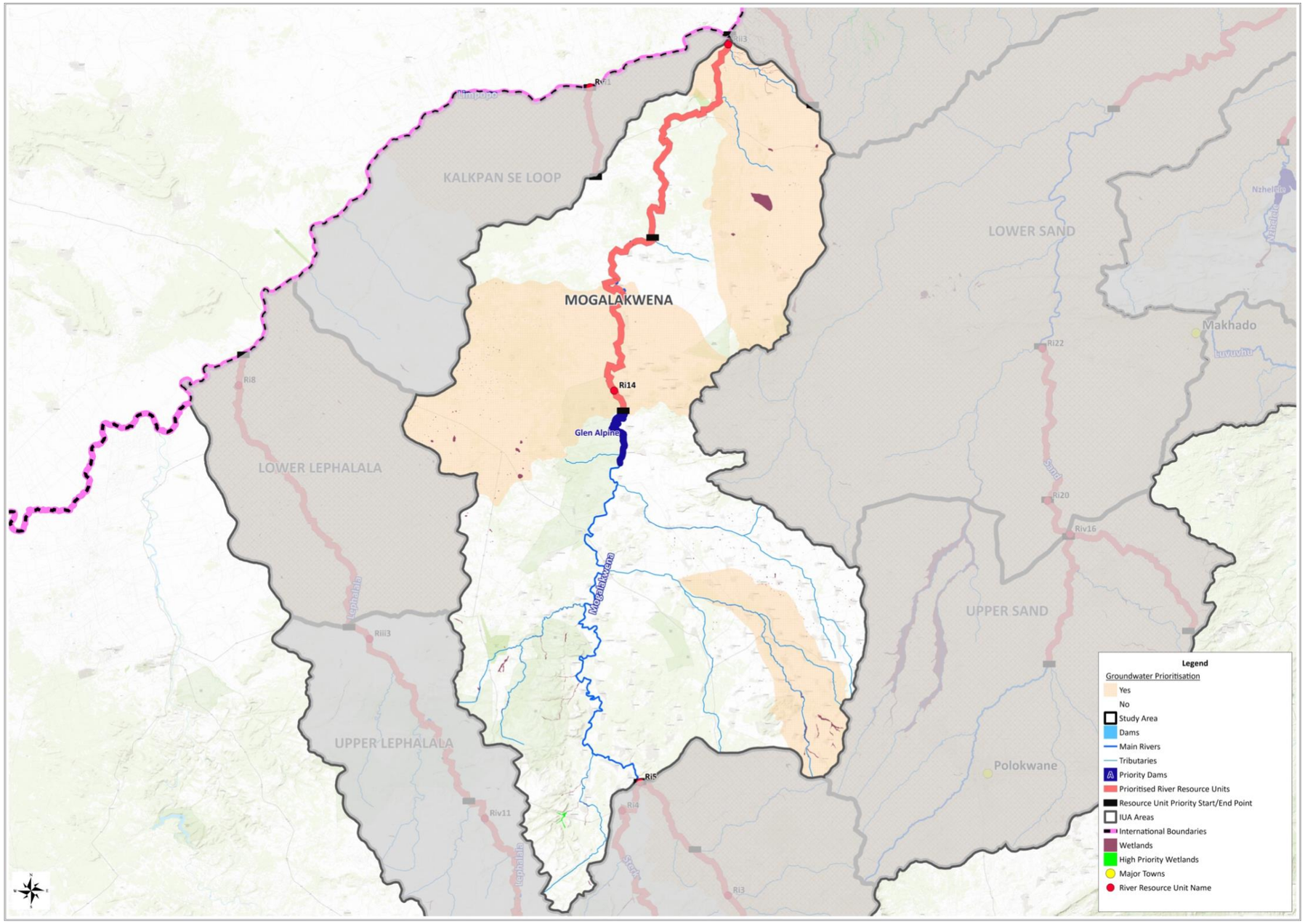

Figure 3-6. River resource units in the Mogalakwena IUA

Table 3-11. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri14) in the Mogalakwena IUA

IUA	Class	Quaternary catchment	Resource Name	TEC	RRU	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Mogalakwena IUA	II	A63A	Middle Mogalakwena	C	Ri14 - A63A-00071 (EWR site 5_Mogalakwena)	Water quantity		Month		Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep	
							Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Mogalakwena River in a condition equal to or better than a C category.	0.487 2.120 2.557 3.906 10.470 9.273 4.486 2.496 1.351 1.104 0.546 0.300	
							High flows	Maintenance high flows (MCM)		0.107 0.135 0.313 0.758 0.495 0.606 0.658 0.629 0.367 0.183 0.057 0.038	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 85 mS/m	95 percentile Electrical conductivity greater than 68 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 2.24 mg/l	Median TIN greater than 1.79 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.090 mg/l	Median PO_4-P greater than 0.072 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l	Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	5.6 ≤ pH ≤ 9.2	pH between 5.6 - 5.9 or pH between 8.8 - 9.2
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)	95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle reach type.	Maintain a GAI PES score of at least a 'C' or > 63%	GAI PES score < 63%

IUA	Class	Quaternary catchment	Resource Name	TEC	RRU	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at <0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain dominant riffle sediment size to include gravel and cobble	Maintain riffle with mobile sediment in the range of a D50 of 35 mm, D16 of 17 mm and D84 of 55 mm	Riffle dominated by sand or only cobble
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for > 60% of pool area	Downstream pool is > 60% filled with sediment and forming largely shallow habitat
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 5 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 5 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 70% (aerial cover).	Non-woody cover less than 70%
								Key species	*Juncus lomatophyllus, Cyperus digitatus, Ischaemum fasciculatum* and *Salix mucronata* must be present.	4 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 10% (aerial cover).	Woody cover more than 10%
								Non-woody cover		Non-woody cover >= 70% (aerial cover).	Non-woody cover less than 70%
								Reed cover		Reed cover <= 20% (aerial cover).	Reed cover more than 20%
							Non-marginal (lower - flood benches)	Dominant vegetation	Non-woody vegetation should dominate the flood features	Non-woody cover >= 80% (aerial cover).	Non-woody cover less than 80%
								Key species	*Cyperus digitatus* and *Gomphocarpus fruticosus* must be present.	2 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition on	Perennial alien plant species <= 20% (aerial cover).	Perennial alien plant cover more than 20%

IUA	Class	Quaternary catchment	Resource Name	TEC	RRU	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Terrestrial woody cover	the flood features should maintain desired dominance and non-dominance.	Terrestrial woody cover <= 30% (aerial cover).	Terrestrial woody species cover more than 30%
								Indigenous woody cover		Woody cover <= 30% (aerial cover).	Woody cover more than 30%
								Non-woody cover		Non-woody cover >= 50% (aerial cover).	Non-woody cover less than 50%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 50% (aerial cover).	Woody cover less than 50%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	No perennial alien plant species.	Presence of perennial alien plants
							Riparian zone	PES	The PES category should be a C at least	VEGRAI score >= 62%	VEGRAI score < 62%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 20 indigenous species.	Less than 20 indigenous plants species present
								Endemic riparian species	*Schotia brachypetala* (southern African endemic) must be present.	1 listed species present.	Absence of 1 or more listed species
								Threatened riparian species	3 nationally protected tree species: Apple Leaf (*Philenoptera violacea*), Leadwood (*Combretum imberbe*) and Camel Thorn (*Vachellia erioloba*) must be present.	3 listed species present.	Absence of 1 or more listed species
							Fish	FRAI score	The Ecological Category should be maintained within a A/B Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a A/B category (>87%)	A FRAI score that calculates to a PES category less than A/B for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site.	Presence/absence records. Relative abundance of species:	The absence of any of the target species for two or more consecutive surveys

IUA	Class	Quaternary catchment	Resource Name	TEC	RRU	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
										Labeobarbus marequensis (2), Labeo cylindricus (2), Chiloglanis pretoriae (2) Micralestes acutidens (1), Enteromius trimaculatus (1), Engrulicypris brevianalis (1)	
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a minimum of a C Category.	To ensure that the MIRAI score remains within the range of a C category (>62 - ≤78 %), using the same reference data used in the EWR study.	A MIRAI score of 64% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >110; ASPT value: >5.2.	SASS5 scores less than 115 and ASPT less than 5.3.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Simuliidae	Minimum abundance of an A attained.	If Simuliidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quality and quantity of inundated vegetation to support vegetation-dwelling Coenagrionidae.	Minimum abundance of an A attained.	Coenagrionidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of Gravel, sand and mud (GSM) habitat to support Gomphidae	Minimum abundance of an A attained.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

Table 3-12. Resource Quality Objectives for the prioritised river resource unit (RRU_Rii3) in the Mogalakwena IUA (LIMCOM Site MOGA-A63D-LIMPK)

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Mogalakwena IUA	II	A63D	Mogalakwena	Rii3- A63D-00034 (EWR site MOGA-A36D-LIMPK)	C	Water quantity		Month		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep	
							Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Mogalakwena River in a condition equal to or better than a C category. Flows must be met at the confluence with the Limpopo River, i.e. must flow into the Limpopo.	1.091 / 1.388 / 1.464 / 1.754 / 2.366 / 1.772 / 1.608 / 1.406 / 1.370 / 1.281 / 1.202 / 1.129	
							High flows	Maintenance high flows (MCM)		0.677 / 2.356 / 0.677 / 2.280 / 10.565 / 0.677 / 0.000 / 0.000 / 0.000 / 0.000 / 0.000 / 0.000	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 85 mS/m	95 percentile Electrical conductivity greater than 68 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 2.24 mg/l	Median TIN greater than 1.79 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.090 mg/l	Median PO_4-P greater than 0.072 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l	Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	5.6 ≤ pH ≤ 9.2	pH between 5.6 - 5.9 or pH between 8.8 - 9.2
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95th percentile Ammonia (NH_3-N) greater than 35 µg/l 95th percentile Atrazine greater than 39 µg/l 95th percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95th percentile)	95th percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain reach type.	GAI score not available as part of IWMI study. Determine and maintain the GAI PES score in a similar or better category	Reduction in GAI PES score
						Habitat	Geomorphology	Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along cross section at < 0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain riffle sediment size to include mainly gravel	Maintain riffle with mobile sediment in the range of a D50 of 17 mm, D16 of 12 mm and D84 of 27 mm	Riffle dominated by sand or only coarse gravel
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for > 60% of pool area	Downstream pool is > 60% filled with sediment and forming largely shallow habitat

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 5 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 5 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal (bed)	Dominant vegetation	A mix of woody and non-woody vegetation should dominate the channel bed	Non-woody cover >= 10%; Woody cover >= 10% (aerial cover).	Non-woody or woody cover less than 10%
								Key species	*Phragmites mauritianus and Ficus capreifolia* should be present.	2 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition in the channel bed should maintain desired dominance and non-dominance.	No perennial alien plants	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Reed cover		Reeds <=10% (aerial cover)	Reed cover more than 10%
							Non-marginal (bank)	Dominant vegetation	A mix of woody and non-woody vegetation should dominate the channel bank	Woody cover >= 40%; non-woody cover >= 20% (aerial cover).	Non-woody cover less than 20% or woody cover less than 40%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	No perennial alien plants	Presence of perennial alien plants
							Riparian zone	PES	The PES category should be a C at least	VEGRAI score >= 62%	VEGRAI score < 62%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 10 indigenous species.	Less than 10 indigenous plant species present
							Fish	FRAI score	A diversity of fish representative of the fish species reference list as per the EWR surveys if sufficient flow and habitat are provided for	PES for fish to remain within a C category (FRAI PES C >62%) after sufficient flow has returned to the river for at least 4 weeks	FRAI PES value <62% for two or more consecutive surveys for the site if sufficient flow and habitat are provided for
								Overall fish health	Fish should be free of bacterial and parasitic infections	<1% of all fish sampled at the site to be affected by bacterial and/or parasitic infections.	>1% of fish assessed at the site affected by bacterial and parasitic infections
								Species diversity	The site should support the diversity and relative abundance of fish as per the reference list used during the EWR studies if sufficient flow and habitat are provided for	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site.	Presence/absence records. Relative abundance of species: *Chiloglanis pretoriae* (2) *Labeobarbus marequensis* (2) *Labeo cylindricus* (2)	The absence of any of these key species if sufficient flow and habitat are provided for
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain at a minimum within a D Category.	To ensure that the MIRAI score remains within the range of a D category (>42 - ≤58 %), using the same reference data used in this EWR study.	A MIRAI score of 60% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >70; ASPT value: >4.8.	SASS5 scores less than 75 and ASPT less than 4.9.
								Key taxa and abundance	To maintain suitable flow velocity (>0.3m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Leptophlebiidae. To maintain sufficient quality and quantity of inundated gravel, sand and mud to support the following taxa: Gomphidae, Caenidae.	Minimum abundance of an A attained.	If Leptophlebiidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Gomphidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Caenidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Dominant taxa	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No taxon occurs at a C abundance (>100 individuals).	

3.1.7.6 Mapungubwe IUA

Figure 3-7 shows the river resource units within the Mapungubwe IUA. The priority resource units are shown in red. Table 3-13 and Table 3-14 provides the RQOs for RRU–Rvi2 and RRU-Riv32, respectively.

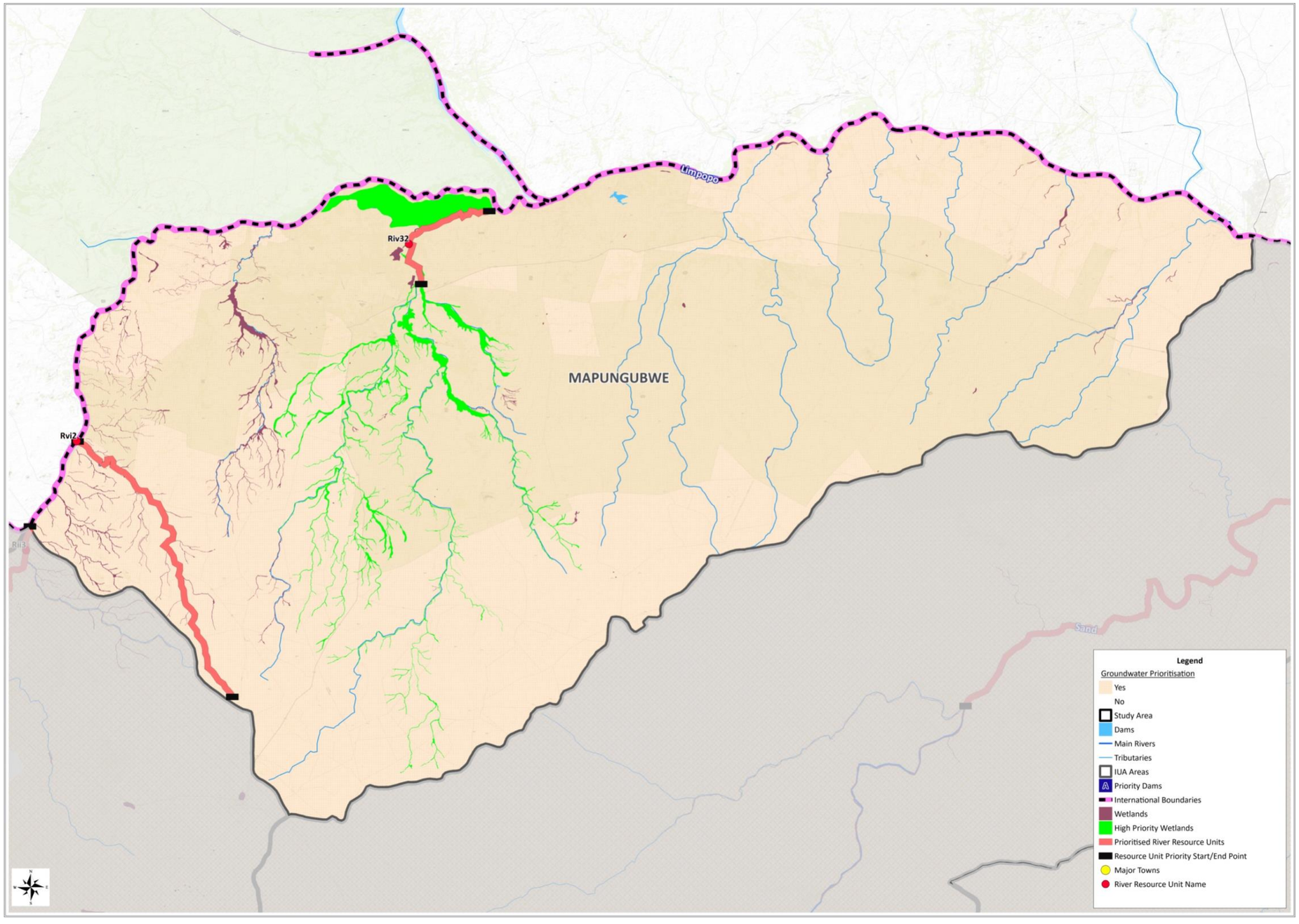

Figure 3-7. River resource units in the Mapungubwe IUA

Table 3-13. Resource Quality Objectives for the prioritised river resource unit (RRU_Rvi2) in the Mapungubwe IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Mapungubwe	II	A63E	Stinkwater	RRU_Rvi2 - A63E-00011	Rvi2	B		Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a B category	
							Water quantity		Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
								Total flows	MCM	Flows shall be sufficient to maintain the Stinkwater River in a condition equal to or better than a B category.	0 / 0 / 0 / 0.014 / 0.078 / 0.039 / 0.006 / 0 / 0 / 0 / 0 / 0
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (B category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in an oligo/mesotrophic state or better (Ideal/Acceptable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maiintained so that most oxygen sensitive species are present in the river (B category).	
									pH	pH levels should be maintained in a B category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data	

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
										and site conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

Table 3-14. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv32) in the Mapungubwe IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical													TPC
								Month		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Mapungubwe IUA	II	A63E	Kolope	Riv32 - A63E-00008 (EWR site 6_Kolope)	C	Water quantity	Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Kolope River in a condition equal to or better than a C category. Flows must be met at the confluence with the Limpopo River, i.e. must flow into the Limpopo.	0.000	0.001	0.008	0.038	0.141	0.143	0.015	0.002	0.000	0.000	0.000	0.000	
							High flows	Maintenance high flows (MCM)		0.000	0.001	0.005	0.004	0.003	0.004	0001	0.000	0.000	0.000	0.000	0.000	
							Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 85 mS/m												95 percentile Electrical conductivity greater than 68 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 2.24 mg/l												Median TIN greater than 1.79 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.090 mg/l												Median PO_4-P greater than 0.072 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l												Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	5.6 ≤ pH ≤ 9.2												pH between 5.6 - 5.9 or pH between 8.8 - 9.2
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation												Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)												95th percentile Ammonia (NH_3-N) greater than 35 µg/l 95th percentile Atrazine greater than 39 µg/l 95th percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli)Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95th percentile)												95th percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain plain bed reach type.	Maintain a GAI PES score of at least a 'D' or > 42%												GAI PES score < 42%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys												Bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderately high proportion of banks actively eroding	Maintain bank erosion below 60% of riverbank length												Bank erosion of more than 60% of riverbank length
						Biota	Non-marginal (lower - flood benches)	Dominant vegetation	Non-woody vegetation should dominate the flood features	Non-woody cover >= 20% (aerial cover).												Non-woody or woody cover less than 20%
								Key species	*Flueggea virosa* and *Croton megalobotrys* must be present.	2 listed species present.												Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	No perennial alien plant species.												Presence of perennial alien plants
								Terrestrial woody cover		Terrestrial woody cover <= 10% (aerial cover).												Woody cover by terrestrial species more than 10%

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 35%	Woody cover less than 35%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	No perennial alien plant species.	Presence of perennial alien plants
							Riparian zone	PES	The PES category should be a C at least	VEGRAI score >= 62%	VEGRAI score < 62%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 20 indigenous species.	Less than 20 indigenous plant species present
								Threatened riparian species	2 nationally protected tree species: Apple Leaf (*Philenoptera violacea*) and Leadwood (*Combretum imberbe*) must be present.	2 listed species present.	Absence of 1 or more listed species
							Fish	FRAI score	A diversity of fish representative of the fish species reference list as per the EWR surveys must be able to recruit to the reach associated with the study site after sufficient flow has been maintained for at least 4 weeks	PES for fish to remain within a C category (FRAI PES C >62%) after sufficient flow has returned to the river for at least 4 weeks	FRAI PES value <62% for two or more consecutive surveys for the site after sufficient flow has occurred within the river for 4 weeks or more.
								Overall fish health	Fish should be free of bacterial and parasitic infections	<1% of all fish sampled at the site to be affected by bacterial and/or parasitic infections.	>1% of fish assessed at the site affected by bacterial and parasitic infections
								Species diversity	The site should support the diversity and relative abundance of fish as per the reference list used during the EWR studies after flow has been restored for at least 4 weeks	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Chiloglanis pretoriae* (1) *Labeobarbus marequensis* (2) *Labeo cylindricus* (1)	The absence of any of these key species after suitable flow has occurred within the river for at least 4 weeks.
							Macroinvertebrates	MIRAI Category and Score	N/A		
								SASS5 Total Score and ASPT	N/A		
								Key taxa and abundance	To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae	To maintain a minimum abundance of an A.	Coenagrionidae missing in two consecutive surveys, or has a single individual present in two consecutive surveys.
								Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No taxon occurs at a C abundance (>100 individuals).	

3.1.7.7 Upper Sand IUA

Figure 3-8 shows the river resource units within the Upper Sand IUA. The priority resource units are shown in red. Table 3-16 provides the RQOs for RRU-Riv16.

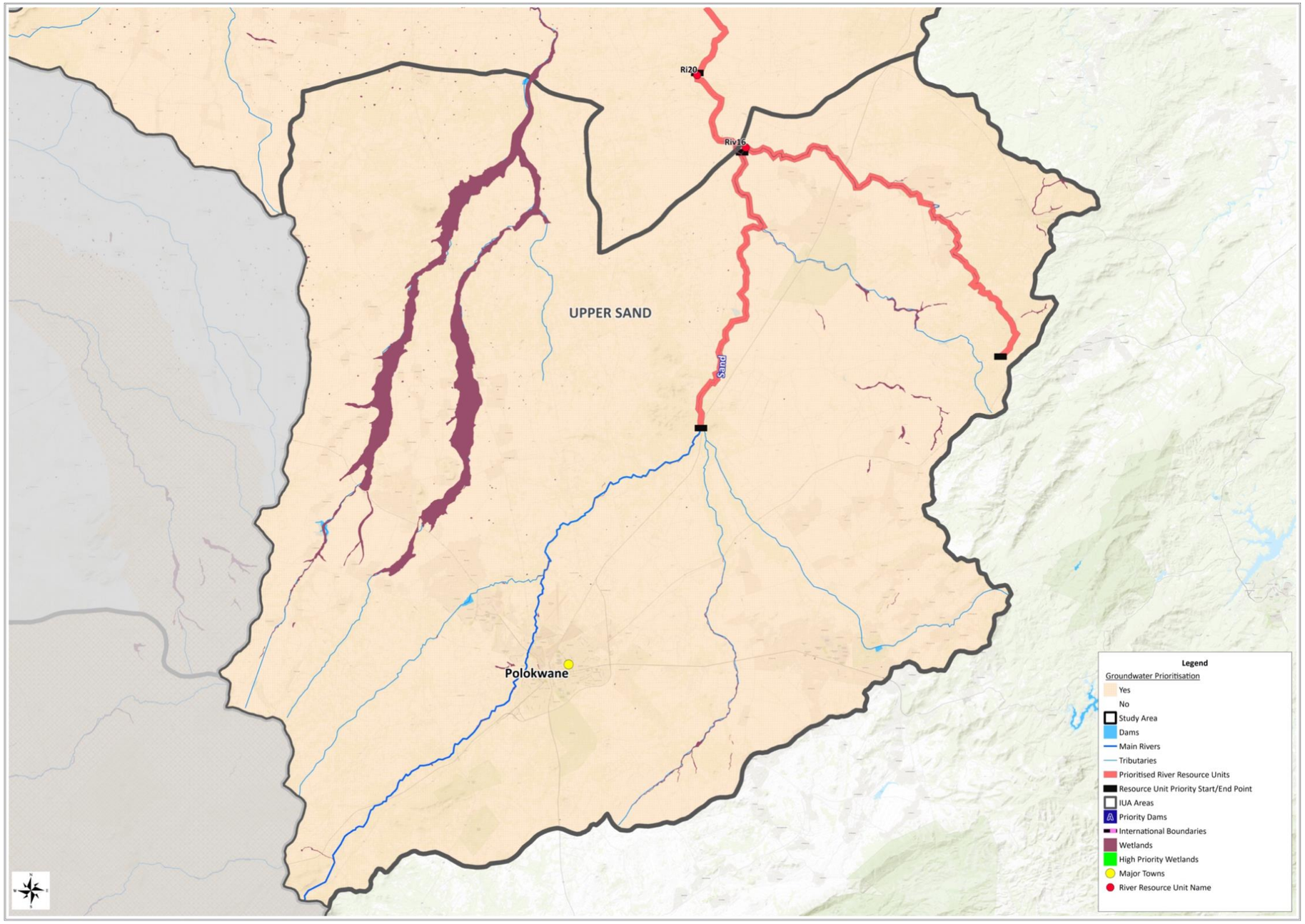

Figure 3-8. River resource units in the Upper Sand IUA

Table 3-15. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv16) in the Upper Sand IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Upper Sand	III	A71F	Dwars	RRU_Riv16 - A71C-00156	Riv16	C		Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a C category	
							Water quantity		Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
								Total flows	MCM	Flows shall be sufficient to maintain the Dwars River in a condition equal to or better than a C category.	0 / 0.005 / 0.016 / 0.322 / 0.776 / 0.297 / 0.001 / 0 / 0 / 0 / 0 / 0
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maintained so that some oxygen sensitive species are present in the river (C category).	
									pH	pH levels should be maintained in a C category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

3.1.7.8 Lower Sand IUA

Figure 3-9 shows the river resource units within the Lower Sand IUA. The priority resource units are shown in red. Table 3-16 to Table 3-18 provides the RQOs for RRU-Ri20, RRU-Ri22 and RRU-Ri25, respectively.

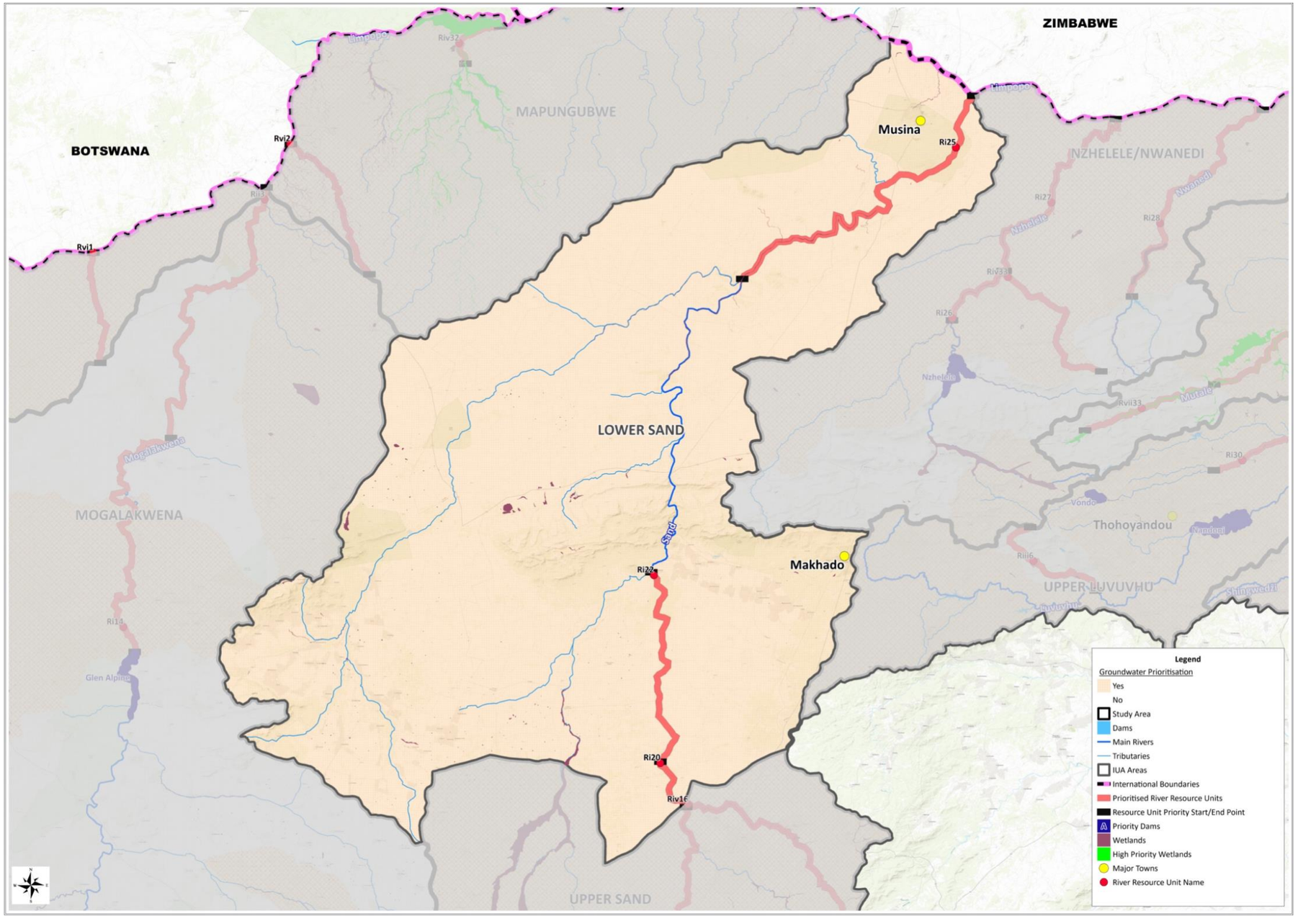

Figure 3-9. River resource units in the Lower Sand IUA

Table 3-16. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri20) in the Upper Sand IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical													TPC
								Month		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Upper Sand IUA	III	A71D	Sand	Ri20 - A71D-00118 (EWR site 7_Sand)	C	Water quantity	Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Sand River in a condition equal to or better than a C category.	0.230	0.212	0.231	0.581	0.669	0.230	0.344	0.315	0.356	0.361	0.317	0.279		
							High flows	Maintenance high flows (MCM)		0.023	0.112	0.226	0.361	0.364	0.173	0.101	0.018	0.004	0.012	0.002	0.023		
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 85 mS/m													95 percentile Electrical conductivity greater than 68 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 2.24 mg/l													Median TIN greater than 1.79 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.090 mg/l													Median PO_4-P greater than 0.072 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l													Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	5.6 ≤ pH ≤ 9.2													pH between 5.6 - 5.9 or pH between 8.8 - 9.2
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation													Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
								Turbidity	A baseline assessment to determine the present state instream turbidity is required.	A 10% variation from background concentration is allowed.													No baseline data available. Monitoring required to determine present state.
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)													95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39-49 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in a Tolerable category for contact recreation	E coli / Faecal coliforms ≤ 84 cfu/100ml (95^{th} percentile)													95^{th} percentile E coli / Faecal coliforms greater than 67 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain plain bed reach type.	Maintain a GAI PES score of at least a 'C' or > 63%													GAI PES score < 63%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.7 m difference in elevation from previous cross-sectional surveys													Riffle bed aggradation or degradation of more than 0.7 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length													Active bank erosion of more than 30% of bank length
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 2 m wide along at least one bank with signs of recent fine sediment deposition													Channel erosion to the extent where there are no benches wider than ~ 2 m and no signs of recent fine sediment deposition on the benches

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Sediment size	Maintain a largely sandy riverbed, with localised gravel deposits	Maintain localised coarse sediment deposits in the range of a D50 of 14 mm, D16 of 8 mm and D84 of 22 mm	Loss of localised gravel deposits along a sandy channel
						Biota	Marginal (Channel bed)	Dominant vegetation	Non-woody vegetation should dominate the channel bed	Non-woody cover >= 5% (aerial cover).	Non-woody cover less than 5%
								Key species	*Cynodon dactylon* must be present.	1 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition on the channel bed should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Reed cover		No reeds.	Presence of reeds
							Non-marginal (lower - flood benches)	Dominant vegetation	Non-woody vegetation should dominate the flood features	Non-woody cover >= 60% (aerial cover).	Non-woody cover less than 60%
								Key species	*Cynodon. dactylon, Sporobolus ioclados* and *Pennisetum macrourum* must be present.	3 listed species present.	Absence of 1 or more listed species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	Perennial alien plant species <= 20% (aerial cover).	Cover by perennial alien plants above 20%
								Terrestrial woody cover		Terrestrial woody cover <= 5% (aerial cover).	Cover by terrestrial woody species more than 5%
								Non-woody cover		Non-woody cover >= 60% (aerial cover).	Non-woody cover less than 60%
							Non-marginal (upper - banks)	Dominant vegetation	Woody and non-woody vegetation should co-dominate the macro-channel banks	Combined cover (Woody and non-woody vegetation) <= 80% or >= 10% (aerial cover).	Combined cover (Woody and non-woody vegetation) > 80% or < 10%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	Perennial alien plant species <= 10% (aerial cover).	Cover by perennial alien plants above 10%
							Riparian zone	PES	The PES category should be a C at least	VEGRAI score >= 62%	VEGRAI score < 62%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 15 indigenous species.	Less than 15 indigenous plant species present
								Endemic riparian species	*Combretum erythrophyllum* (southern African endemic) must be present.	1 listed species present.	Absence of 1 or more listed species
							Fish	FRAI score	A diversity of fish representative of the fish species reference list as per the EWR surveys must be able to recruit to the reach associated with the study site after sufficient flow has been maintained for at least 4 weeks	PES for fish to remain within a C category (FRAI PES C >62%) after sufficient flow has returned to the river for at least 4 weeks	FRAI PES value <62% for two or more consecutive surveys for the site after sufficient flow has occurred within the river for 4 weeks or more
								Overall fish health	Fish should be free of bacterial and parasitic infections	<1% of all fish sampled at the site to be affected by bacterial and/or parasitic infections.	>1% of fish assessed at the site affected by bacterial and parasitic infections
								Species diversity	The site should support the diversity and relative abundance of fish as per the reference list used during the EWR studies after flow has been restored for at least 4 weeks	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions during the summer wet season to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Chiloglanis pretoriae* (1) *Labeobarbus marequensis* (2) *Labeo cylindricus* (2)	The absence of any of these key species after suitable flow has occurred within the river for at least 4 weeks
							Macroinvertebrates	MIRAI Category and Score	N/A		

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								SASS5 Total Score and ASPT	N/A		
								Key taxa and abundance	To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae. To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae, Caenidae	Minimum abundance of an A attained.	If Coenagrionidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Gomphidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Caenidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
								Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No taxon occurs at a C abundance (>100 individuals).	

Table 3-17. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri22) in the Upper Sand IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Lower Sand	II	A71G	Sand	RRU_Ri22 - A71D-00118	Ri22	B/C	Water quantity	Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a B/C category	
								Total flows	Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
									MCM	Flows shall be sufficient to maintain the Sand River in a condition equal to or better than a B/C category.	1.146 / 1.332 / 1.584 / 8.111 / 14.207 / 6.548 / 1.402 / 1.213 / 1.227 / 1.236 / 1.202 / 1.192
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (B/C category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in an oligo/mesotrophic state or better (Ideal/Acceptable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maintained so that most oxygen sensitive species are present in the river (B/C category).	
									pH	pH levels should be maintained in a B/C category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site	

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
										conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

Table 3-18. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri25) in the Lower Sand IUA (LIMCOM Site SAND-A71K-R508B)

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Lower Sand IUA	II	A71K	Sand	Ri25 - A71K-00019 (EWR site SAND-A71K-R508B)	C	Water quantity		Month		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep	
							Low flows	Maintenance low flows	Flows shall be sufficient to maintain the Sand River in a condition equal to or better than a C category. Flows must be met at the confluence with the Limpopo River, i.e. must flow into the Limpopo.	0.104 / 0.163 / 0.188 / 0.372 / 0.720 / 0.320 / 0.195 / 0.141 / 0.119 / 0.099 / 0.086 / 0.078	
							High flows	Maintenance high flows		0.000 / 0.720 / 0.697 / 0.697 / 3.324 / 0.697 / 0.720 / 0.000 / 0.000 / 0.000 / 0.000 / 0.000	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 85 mS/m	95 percentile Electrical conductivity greater than 68 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 2.24 mg/l	Median TIN greater than 1.79 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.090 mg/l	Median PO_4-P greater than 0.072 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l	Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	5.6 ≤ pH ≤ 9.2	pH between 5.6 - 5.9 or pH between 8.8 - 9.2
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
								Turbidity	A baseline assessment to determine the present state instream turbidity is required.	A 10% variation from background concentration is allowed.	No baseline data available. Monitoring required to determine present state.
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)	95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain largely plain bed reach type.	GAI score not available as part of IWMI study. Determine and maintain the GAI PES score in a similar or better category	Reduction in GAI PES score
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain largely sandy bed with localised gravel component	Maintain largely sandy bed with localised gravel deposits with range of a D50 of 20 mm, D16 of 9 mm and D84 of 46 mm	Loss of a largely sandy bed with localised gravel deposits
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 5 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where the flood benches are <

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
											5m wide along both banks and no signs of recent fine sediment deposition on the benches
						Biota	Marginal (bed)	Dominant vegetation	Non-woody vegetation should dominate the channel bed	Non-woody cover >= 10% (aerial cover).	Non-woody cover less than 10%
								Alien plant species	The riparian vegetation structure and composition in the channel bed should maintain desired dominance and non-dominance.	No perennial alien plants	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Reed cover		Reeds <=5%	Reed cover more than 5%
							Non-marginal (bank)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 60% (aerial cover).	Woody cover less than 60%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	No perennial alien plants	Presence of perennial alien plants
							Riparian zone	PES	The PES category should be a B/C at least	VEGRAI score >= 78%	VEGRAI score < 78%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 10 indigenous species.	Less than 10 indigenous plant species present
							Fish	FRAI score	A diversity of fish representative of the fish species reference list as per the LIMCOM surveys must be able to recruit to the reach associated with the study site after sufficient flow has been maintained for at least 4 weeks	PES for fish to remain within a C category (FRAI PES C >62%) after sufficient flow has returned to the river for at least 4 weeks	FRAI PES value <62% for two or more consecutive surveys for the site after sufficient flow has occurred within the river for 4 weeks or more
								Overall fish health	Fish should be free of bacterial and parasitic infections	<1% of all fish sampled at the site to be affected by bacterial and/or parasitic infections.	>1% of fish assessed at the site affected by bacterial and parasitic infections
								Species diversity	The site should support the diversity and relative abundance of fish as per the reference list used during the EWR studies after flow has been restored for at least 4 weeks	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions during the summer wet season to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Chiloglanis pretoriae* (2) *Labeobarbus marequensis* (2) *Labeo cylindricus* (1)	The absence of any of these key species after suitable flow has been restored to the site for at least 4 weeks.
							Macroinvertebrates	MIRAI Category and Score	N/A		
								SASS5 Total Score and ASPT	N/A		
								Key taxa and abundance	To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae. To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae, Caenidae	Minimum abundance of an A attained.	If Coenagrionidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Gomphidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Caenidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
								Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No taxon occurs at a C abundance (>100 individuals).	

3.1.7.9 Nzhelele/Nwanedi IUA

Figure 3-10 shows the river resource units within the Lower Sand IUA. The priority resource units are shown in red. Table 3-19 to Table 3-22 provides the RQOs for RRU-Ri26, RRU-Riv33, RRU-Ri27 and RRU-Ri28.

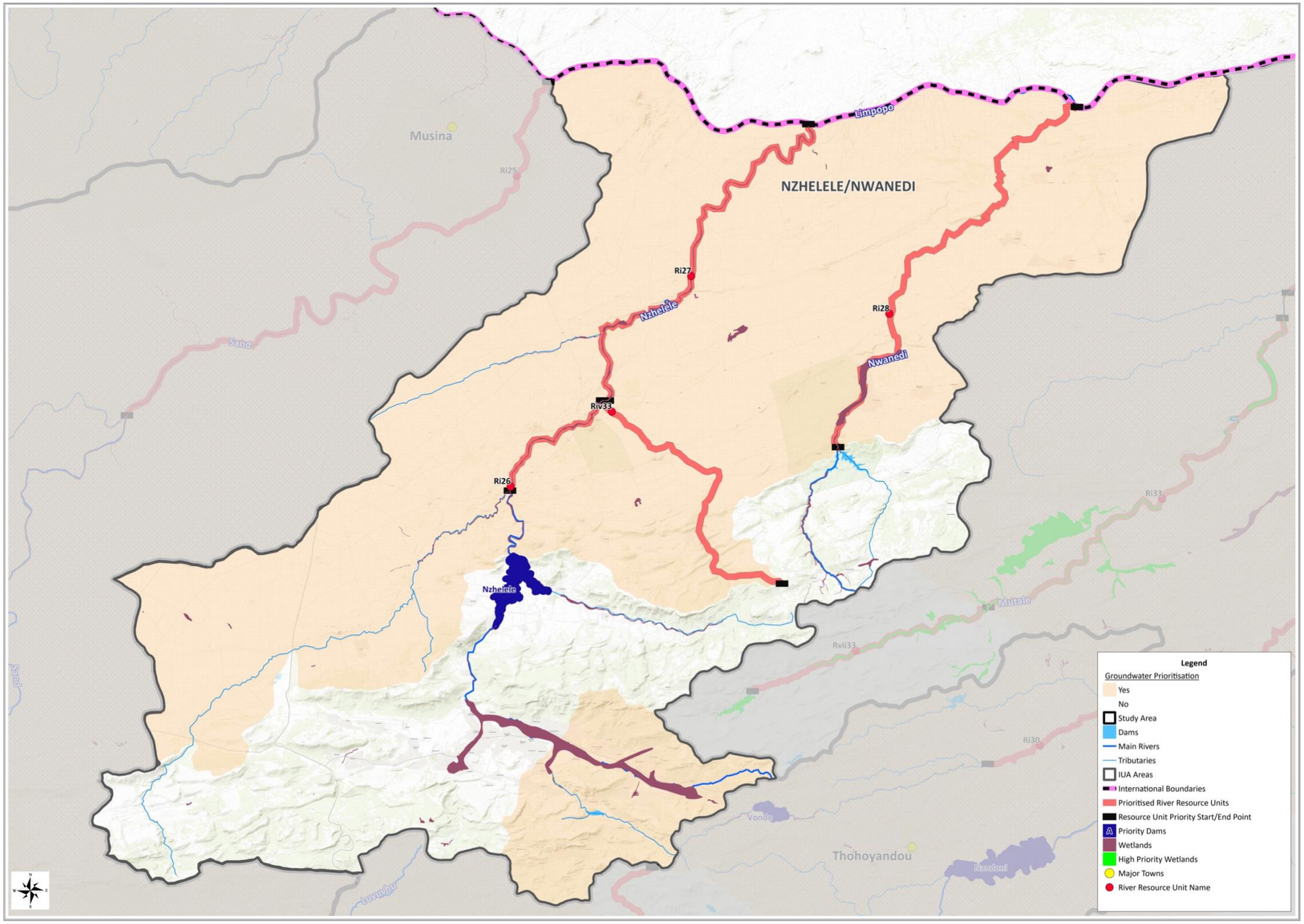

Figure 3-10. River resource units in the Nzhelele/Nwanedi IUA

Table 3-19. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri26) in the Nzhelele/Nwanedi IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Nzhelele/Nwanedi	II	A80F	Nzhelele	RRU_Ri26 - A80G-00053	Ri26	C		Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a C category	
							Water quantity	Total flows	Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
									MCM	Flows shall be sufficient to maintain the Nzhelele River in a condition equal to or better than a C category.	0.857 / 0.703 / 1.123 / 7.225 / 16.87 / 11.878 / 6.959 / 3.568 / 2.549 / 2.089 / 1.336 / 0.918
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maintained so that some oxygen sensitive species are present in the river (C category).	
									pH	pH levels should be maintained in a C category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site conditions (to be determined when monitoring commences)	

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

Table 3-20. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv33) in the Nzhelele/Nwanedi IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Nzhelele/Nwanedi	II	A80G	Tshishiru	RRU_Riv33 - A80G-00054	Riv33	C		Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a C category	
							Water quantity	Total flows	Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
									MCM	Flows shall be sufficient to maintain the Tshishiru River in a condition equal to or better than a C category.	0.009 / 0.002 / 0.005 / 0.22 / 0.36 / 0.122 / 0.008 / 0 / 0 / 0 / 0 / 0
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maiintained so that some oxygen sensitive species are present in the river (C category).	
									pH	pH levels should be maintained in a C category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

Table 3-21. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri27) in the Nzhelele/Nwanedi IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical													TPC
								Month		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Nzhelele and Nwanedi IUA	II	A80G	Nzhelele	Ri27 - A80G-00026 (EWR site 7_Nzhelele)	C	Water quantity	Low flows (MCM)	Maintenance low flows	Flows shall be sufficient to maintain the Nzhelele River in a condition equal to or better than a C category. Flows must be met at the confluence with the Limpopo River, i.e. must flow into the Limpopo.	1.212	1.023	1.252	3.229	6.116	7.159	6.174	4.635	3.641	3.012	2.381	1.762	
							High flows (MCM)	Maintenance high flows		0.328	0.455	0.788	1.080	1.220	1.476	1.453	0.490	0.481	0.345	0.201	0.345	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 85 mS/m													95 percentile Electrical conductivity greater than 68 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 2.24 mg/l													Median TIN greater than 1.79 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.090 mg/l													Median PO_4-P greater than 0.072 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l													Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	5.6 ≤ pH ≤ 9.2													pH between 5.6 - 5.9 or pH between 8.8 - 9.2
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation													Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)													95^{th} percentile Ammonia (NH_3-N) greater than 35 - 44 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)													95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle reach type.	Maintain a GAI PES score of at least a 'D' or > 42%													GAI PES score < 42%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys													Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderately-high proportion of banks actively eroding	Maintain active bank erosion below 60% of riverbank length													Bank erosion of more than 60% of bank length
								Bed sediment size	Maintain dominant riffle sediment size to include gravel and cobble	Maintain riffle with mobile sediment in the range of a D50 of 27 mm, D16 of 11 mm and D84 of 82 mm													Riffle dominated by sand or only cobble
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment													Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for > 60% of pool area													Downstream pool is > 60% filled with sediment and forming largely shallow habitat

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 2 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 2 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 20% (aerial cover).	Non-woody cover less than 20%
								Key species	*Juncus oxycarpus, Cyperus sexangularis, Phragmites mauritianus* and *Pluchea bojeri* must be present.	4 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Non-woody cover		Woody cover <= 5% (aerial cover).	Woody cover more than 5%
								Reed cover		Reed cover <= 10% (aerial cover).	Reed cover more than 10%
							Non-marginal (lower - flood benches)	Dominant vegetation	Non-woody vegetation should dominate the flood features	Non-woody cover >= 10% (aerial cover).	Non-woody cover less than 10%
								Key species	*Pluchea bojeri* must be present.	1 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	Perennial alien plant species <= 5% (aerial cover).	Cover by perennial alien plants more than 5%
								Terrestrial woody cover		Terrestrial woody cover <= 10% (aerial cover).	Cover by terrestrial woody species more than 10%
								Non-woody cover		Non-woody cover >= 10% (aerial cover).	Non-woody cover less than 10%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 60% (aerial cover).	Woody cover less than 60%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	Perennial alien plant species <= 5% (aerial cover).	Cover by perennial alien plants more than 5%
							Riparian zone	PES	The PES category should be a B/C at least	VEGRAI score >= 78%	VEGRAI score < 78%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 25 indigenous species.	Less than 25 indigenous plant species present
								Threatened riparian species	1 nationally protected tree species: Apple Leaf (*Philenoptera violacea*) must be present.	1 listed species present.	Absence of 1 or more listed key species
							Fish	FRAI score	The Ecological Category should be maintained within an B Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a B category (>82%)	A FRAI score that calculates to a PES category less than B for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (2), Labeo cylindricus (2), Labeo molybdinus (1), Chiloglanis pretoriae (2), Engraulicypris brevianalis (1)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a C Category.	To ensure that the MIRAI score remains within the range of a C category (>62 - ≤78 %), using the same reference data used in the EWR study.	A MIRAI score of 64% or less.

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >130; ASPT value: >6.0.	SASS5 scores less than 135 and ASPT less than 6.1.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Hydropsychidae >2pp; Simuliidae	Minimum abundance of an A attained for the Hydropsychidae, Simuliidae.	If Simuliidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Hydropsychidae has <2spp present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae.	Minimum abundance of an A attained for Coenagrionidae.	Coenagrionidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae.	Minimum abundance of an A attained for Gomphidae.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

Table 3-22. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri28) in the Nzhelele/Nwanedi IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical													TPC
										Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Nzhelele and Nwanedi IUA	II	A80J	Ṅwaneḍi	Ri28 - A80J-00028 (EWR site 8_ Ṅwaneḍi)	C	Water quantity		Month															
							Low flows (MCM)	Maintenance low flows	Flows shall be sufficient to maintain the Ṅwaneḍi River in a condition equal to or better than a C category. Flows must be met at the confluence with the Limpopo River, i.e. must flow into the Limpopo.	0.437	0.517	0.763	1.307	1.877	1.830	1.344	1.063	0.860	0.730	0.630	0.515	
							High flows (MCM)	Maintenance high flows		0.195	0.314	0.513	0.829	0.998	0.866	0.468	0.117	0.043	0.024	0.017	0.036	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 85 mS/m													95 percentile Electrical conductivity greater than 68 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 2.24 mg/l													Median TIN greater than 1.79 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.090 mg/l													Median PO_4-P greater than 0.072 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l													Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	5.6 ≤ pH ≤ 9.2													pH between 5.6 - 5.9 or pH between 8.8 - 9.2
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation													Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
								Turbidity	A baseline assessment to determine the present state instream turbidity is required.	A 10% variation from background concentration is allowed.													No baseline data available. Monitoring required to determine present state.
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)													95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)													95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle reach type.	Maintain a GAI PES score of at least a 'D' or > 42%													GAI PES score < 42%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along cross section at < 0.5 m difference in elevation from previous cross-sectional surveys													Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderately-high proportion of banks actively eroding	Maintain bank erosion below 50% of riverbank length													Bank erosion of more than 50% of riverbank length
								Bed sediment size	Maintain dominant riffle sediment size to include gravel	Maintain riffle with mobile sediment in the range of a D50 of 32 mm, D16 of 14 mm and D84 of 59 mm													Riffle dominated by sand or only coarse gravel
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment													Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for > 60% of pool area													Downstream pool is > 60% filled with sediment and forming largely shallow habitat

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 1 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 1 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 10% (aerial cover).	Non-woody cover less than 0%
								Key species	*Commelina diffusa* must be present.	1 listed species present in the wet season	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Reed cover		No reeds.	Presence of reeds
							Non-marginal (lower - flood benches)	Dominant vegetation	Non-woody vegetation should dominate the flood features	Non-woody cover >= 70% (aerial cover).	Non-woody cover less than 70%
								Key species	*Ficus sycomorus, Breonaria salicina, Combretum erythrophyllum* and *Faidherbia albida* must be present.	4 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	Perennial alien plant species <= 10% (aerial cover).	Cover by perennial alien plants more than 10%
								Terrestrial woody cover		Terrestrial woody cover <= 10% (aerial cover).	Cover by terrestrial woody species more than 10%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 80% (aerial cover).	Woody cover less than 80%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	Perennial alien plant species <= 10% (aerial cover).	Cover by perennial alien plants more than 10%
							Riparian zone	PES	The PES category should be a C at least	VEGRAI score >= 62%	VEGRAI score < 62%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 20 indigenous species.	Less than 20 indigenous plant species present
								Endemic riparian species	*Buxus macowanii (*SA endemic*)* and *Schotia brachypetala (*southern African endemic*)* must be present.	2 listed species present.	Absence of 1 or more listed endemic species
								Threatened riparian species	1 nationally protected tree species: Matumi (*Breonadia salicina* must be present.	1 listed species present.	Absence of 1 or more listed protected species
							Fish	FRAI score	The Ecological Category should be maintained within a B/C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a B/C category (>77%)	A FRAI score that calculates to a PES category less than B/C for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (1), Labeo cylindricus (1), Chiloglanis pretoriae (2)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a C Category.	To ensure that the MIRAI score remains within the range of a C category (>62 - ≤78 %), using the same reference data used in the EWR study.	A MIRAI score of 64% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >110; ASPT value: >6.1.	SASS5 scores less than 115 and ASPT less than 6.2.

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Hydropsychidae.	Minimum abundance of an A attained.	Hydropsychidae is missing in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae	Minimum abundance of an A attained.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

3.1.7.10 Upper Luvuvhu IUA

Figure 3-11 shows the river resource units within the Upper Luvuvhu IUA. The priority resource units are shown in red. Table 3-23 and Table 3-24 provides the RQOs for RRU-Riii6 and RRU-Ri30, respectively.

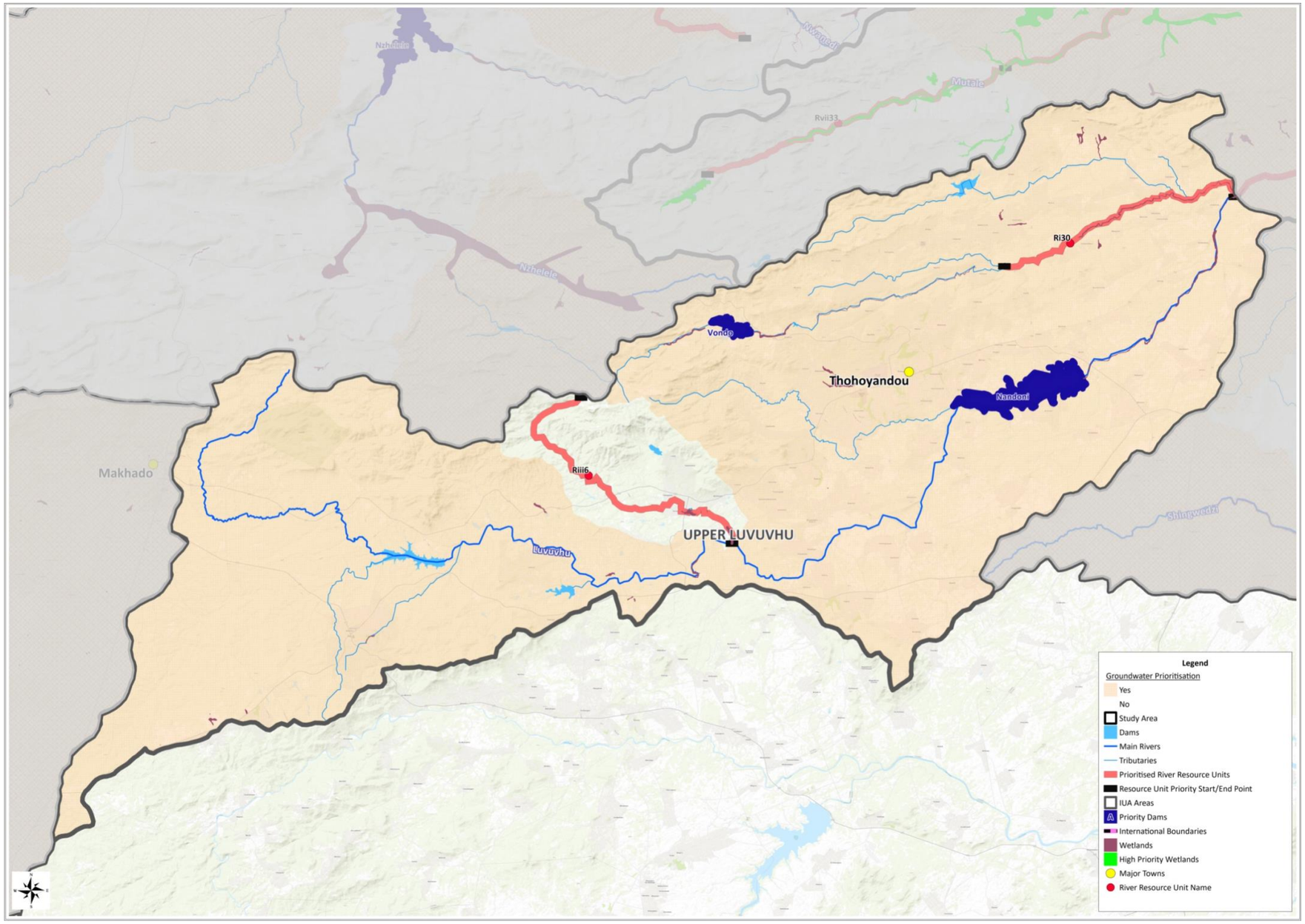

Figure 3-11. River resource units in the Upper Luvuvhu IUA

Table 3-23. Resource Quality Objectives for the prioritised river resource unit (RRU_Riii6) in the Upper Luvuvhu IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical														TPC
								Month		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
						Water quantity	Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Latonyanda River in a condition equal to or better than a C category.	0.384	0.431	0.690	1.504	2.259	2.645	1.989	1.206	0.862	0.674	0.535	0.419	
							High flows	Maintenance high flows (MCM)		0.035	0.127	0.344	0.722	0.769	0.616	0.444	0.060	0.026	0.017	0.010	0.018	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 55 mS/m													95 percentile Electrical conductivity greater than 44 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 1.75 mg/l													Median TIN greater than 1.40 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.075 mg/l														Median PO_4-P greater than 0.060 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l													Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5														pH between 6.0 - 6.5 or pH between 8.5 - 9.0
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation														Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
								Turbidity	A baseline assessment to determine the present state instream turbidity is required.	A 10% variation from background concentration is allowed.														No baseline data available. Monitoring required to determine present state.
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)														95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)														95^{th} percentile E coli / Faecal coliforms greater than 20-25 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle/rapid reach type.	Maintain a GAI PES score of at least a 'C' or > 63%														GAI PES score < 63%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys														Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length														Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain dominant riffle sediment size to include gravel and cobble	Maintain riffle with mobile sediment in the range of a D50 of 14 mm, D16 of 7 mm and D84 of 56 mm														Riffle dominated by sand or only cobble
Upper Luvuvhu IUA	II	A91D	Latonyanda	Riii6 - A91D-00108 (EWR site 10_Latonyanda)	C																			

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for > 60% of pool area	Downstream pool is > 60% filled with sediment and forming largely shallow habitat
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 2 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 2 m and no signs of recent fine sediment deposition on the benches
						Biota	Channel	Dominant vegetation	Non-woody vegetation should dominate the channel	Non-woody cover >= 30% (aerial cover).	Non-woody cover less than 30%
								Key species	*Cyclosorus interruptus, Commelina diffusa* and *Isolepis cernua* must be present.	3 listed species present in the wet season	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition in the channel should maintain desired dominance and non-dominance.	Perennial alien plant species <= 10% (aerial cover).	Cover by perennial alien plants more than 10%
								Terrestrial woody cover		Terrestrial woody cover <= 10% (aerial cover).	Cover by terrestrial woody species more than 10%
								Reed cover		No reeds.	Presence of reeds
							MCB	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 70% (aerial cover).	Woody cover less than 70%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	Perennial alien plant species <= 10% (aerial cover).	Cover by perennial alien plants more than 10%
							Riparian zone	PES	The PES category should be a C/D at least	VEGRAI score >= 58%	VEGRAI score < 58%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 15 indigenous species.	Less than 15 indigenous plant species present
								Endemic riparian species	*Combretum erythrophyllum* (southern African endemic) must be present.	1 listed species present.	Absence of *Combretum erythrophyllum*
							Fish	FRAI score	The Ecological Category should be maintained within a B/C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a B/C category (>77%)	A FRAI score that calculates to a PES category less than B/C for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (2), Labeo cylindricus (1), Chiloglanis pretoriae (1), Anoplopterus "southern stargazer sp" (2)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a B/C Category.	To ensure that the MIRAI score remains within the range of a B/C category (>78 - ≤82 %), using the same reference data used in this EWR study.	A MIRAI score of 80% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >175; ASPT value: >7.2.	SASS5 scores less than 180 and ASPT less than 7.3.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa:	Minimum abundance of an A attained.	If Heptageniidae or Simuliidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
									Heptageniidae Simuliidae		
									To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Atyidae	Minimum abundance of an A attained.	Atyidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae	Minimum abundance of an A attained.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

Table 3-24. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri30) in the Upper Luvuvhu IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Upper Luvuvhu IUA	II	A91G	Mutshindudi	Ri30 - A91G-00091 (EWR site 11_Mutshindudi)	C	Water quantity		Month		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep	
							Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Mutshindudi River in a condition equal to or better than a C category.	0.664 / 0.967 / 2.094 / 3.638 / 4.140 / 4.494 / 2.662 / 1.633 / 1.213 / 1.035 / 0.853 / 0.714	
							High flows	Maintenance high flows (MCM)		0.078 / 0.436 / 1.827 / 3.433 / 4.931 / 3.825 / 1.711 / 0.324 / 0.082 / 0.015 / 0.016 / 0.025	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 55 mS/m	95 percentile Electrical conductivity greater than 44 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 1.75 mg/l	Median TIN greater than 1.40 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.075 mg/l	Median PO_4-P greater than 0.060 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l	Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5	pH between 6.0 - 6.5 or pH between 8.5 - 9.0
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95th percentile Ammonia (NH_3-N) greater than 35 µg/l 95th percentile Atrazine greater than 39 µg/l 95th percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95th percentile)	95th percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle/rapid reach type.	Maintain a GAI PES score of at least a 'C' or > 63%	GAI PES score < 63%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional survey	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of riverbank length
								Bed sediment size	Maintain dominant riffle sediment size to include gravel, cobble and bedrock	Maintain riffle with mobile sediment in the range of a D50 of 25 mm, D16 of 13 mm and D84 of 50 mm	Riffle dominated by sand or only cobble
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for 60% of pool area	Downstream pool is > 60% filled with sediment and forming largely shallow habitat

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 5 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 5 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal zone	Dominant vegetation	Woody and non-woody vegetation should co-dominate the marginal zone	A mix of woody and non-woody plants.	Cover (Woody and non-woody combined) less than 10%
								Key species	*Breonadia salicina, Cyclosorus interruptus, Phragmites mauritianus, Salix mucronata, Cyperus alopecuroides, Cyperus eragrostis* and *Juncus lomatophyllus* must be present.	7 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 20% (aerial cover).	Woody cover more than 20%
								Non-woody cover		Non-woody cover >= 30% (aerial cover).	Non-woody cover less than 30%
								Reed cover		Reed cover <= 25% (aerial cover).	Cover by reeds more than 25%
							Non-marginal (lower - flood benches)	Dominant vegetation	Woody and non-woody vegetation should co-dominate the flood features	Non-woody cover >= 15% (aerial cover), Woody cover >= 5% (aerial cover).	Non-woody cover less than 15% or woody cover less than 5%
								Key species	*Breonadia salicina, Phragmites mauritianus, Salix mucronata,* and *Ficus sycomorus* must be present.	4 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	Perennial alien plant species <= 10% (aerial cover).	Cover by perennial alien plants more than 10%
								Terrestrial woody cover		Terrestrial woody cover <= 10% (aerial cover).	Cover by terrestrial woody species more than 10%
								Indigenous woody cover		Woody cover >= 5% (aerial cover).	Woody cover less than 5%
								Non-woody cover		Non-woody cover >= 15% (aerial cover).	Non-woody cover less than 15%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 20% (aerial cover).	Woody cover less than 20%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	Perennial alien plant species <= 20% (aerial cover).	Cover by perennial alien plants more than 20%
							Riparian zone	PES	The PES category should be a C at least	VEGRAI score >= 62%	VEGRAI score < 62%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 25 indigenous species.	Less than 25 indigenous plant species present
								Threatened riparian species	2 nationally protected tree species: Apple Leaf (*Philenoptera violacea*) and Matumi (*Breonadia salicina*) must be present.	2 listed species present.	Absence of either listed protected species
							Fish	FRAI score	The Ecological Category should be maintained within a B/C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a C category (>62%)	A FRAI score that calculates to a PES category less than C for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site.	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (2), Labeo cylindricus (2), Chiloglanis pretoriae (2), Anoplopterus "southern stargazer sp" (1), Enteromius trimaculatus (2)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a C Category.	To ensure that the MIRAI score remains within the range of a C category (>62 - ≤78 %), using the same reference data used in the EWR study.	A MIRAI score of 64% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >160; ASPT value: >6.8.	SASS5 scores less than 165 and ASPT less than 7.0.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Heptageniidae Simuliidae	Minimum abundance of an A attained.	If Heptageniidae or Simuliidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Atyidae	Minimum abundance of an A attained.	Atyidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae	Minimum abundance of an A attained.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

3.1.7.11 Lower Luvuvhu/Mutale IUA

Figure 3-12 shows the river resource units within the Lower Luvuvhu/Mutale IUA. The priority resource units are shown in red. Table 3-25, Table 3-26, Table 3-27, Table 3-28 and Table 3-29 provides the RQOs for RRU-Ri32, RRU-Rvi33, RRU-Ri33, RRU-Ri34 and RRU-Ri36, respectively.

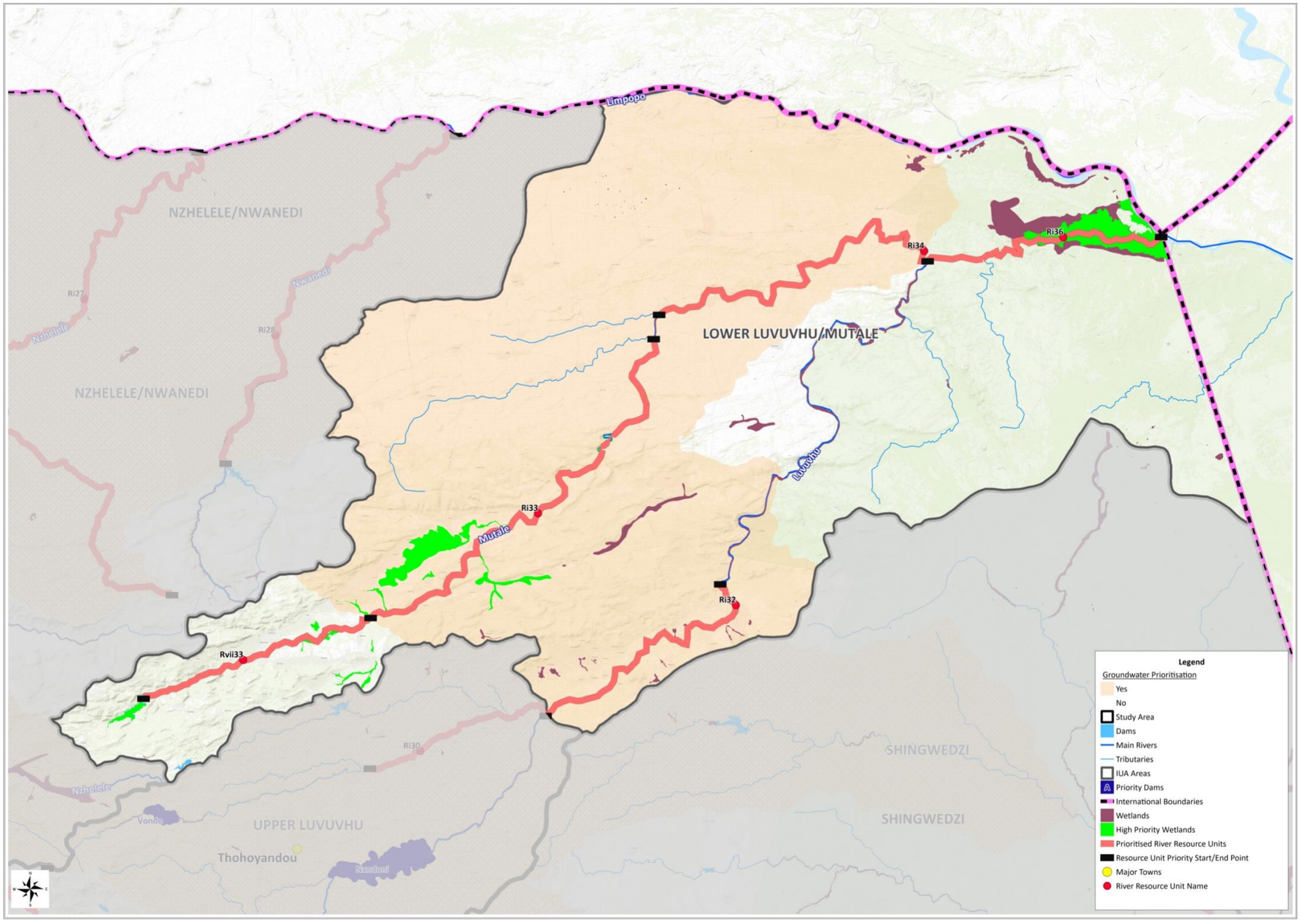

Figure 3-12. River resource units in the Lower Luvuvhu/Mutale IUA

Table 3-25. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri32) in the Lower Luvuvhu/Mutale IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical													TPC
								Month		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Lower Luvuvhu / Mutale IUA	II	A91H	Luvuvhu	Ri32 - A91H-00045 (EWR site 12_Luvuvhu)	C	Water quantity	Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Luvuvhu River in a condition equal to or better than a C category.	1.441	2.622	7.833	15.474	25.241	28.602	16.085	6.640	3.964	2.787	1.938	1.520		
							High flows	Maintenance high flows (MCM)		0.169	1.095	4.808	7.867	9.055	8.316	5.574	0.732	0.090	0.038	0.007	0.023		
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 55 mS/m														95 percentile Electrical conductivity greater than 44 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 1.75 mg/l													Median TIN greater than 1.40 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.075 mg/l													Median PO_4-P 0.060 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l													Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5													pH between 6.0 - 6.5 or pH between 8.5 - 9.0
								Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation													Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)													95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)													95^{th} percentile E coli / Faecal coliforms 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle reach type.	Maintain a GAI PES score of at least a 'D' or > 42%													GAI PES score < 42%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional survey													Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 40% of riverbank length													Active bank erosion of more than 40% of riverbank length
								Bed sediment size	Maintain dominant riffle sediment size to include gravel and cobble	Maintain riffle with mobile sediment in the range of a D50 of 35 mm, D16 of 19 mm and D84 of 59 mm													Riffle dominated by sand or only cobble
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment													Embeddedness levels of > 25% for 25% of riffle area/sampling points

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Pool depth	Maintain upstream pool with deep open water	Maintain upstream pool with water > 0.5 m deep for > 60% of pool area	Upstream pool is > 60% filled with sediment and forming largely shallow habitat
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 5 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 5 m and no signs of recent fine sediment deposition on the benches
							Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 60% (aerial cover).	Non-woody cover less than 60%
								Key species	*Phragmites mauritianus*, Breonadia *salicina* and *Ficus caprefolia* must be present.	3 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 25% (aerial cover).	Woody cover more than 25%
								Non-woody cover		Non-woody cover >= 60% (aerial cover).	Non-woody cover less than 60%
								Reed cover		Reed cover >= 30% (aerial cover).	Cover by reeds less than 35%
							Non-marginal (lower - flood benches)	Dominant vegetation	Woody and non-woody vegetation should co-dominate the flood features	A mix of woody and non-woody plants.	Non-woody cover less than 15% or woody cover less than 5%
								Key species	*Phragmites mauritianus, Ludwigia octovalvis, Pluchea dioscoridis, Phyllanthus reticulatus, Flueggea virosa, Ficus sycomorus* and *Combretum erythrophyllum* must be present.	7 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	Perennial alien plant species <= 10% (aerial cover).	Cover by perennial alien plants more than 10%
								Terrestrial woody cover		Terrestrial woody cover <= 10% (aerial cover).	Cover by terrestrial woody species more than 10%
								Indigenous woody cover		Woody cover <= 15% (aerial cover).	Woody cover more than 15%
								Non-woody cover		Non-woody cover >= 15% (aerial cover).	Non-woody cover less than 15%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 60% (aerial cover).	Woody cover less than 60%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	Perennial alien plant species <= 10% (aerial cover).	Cover by perennial alien plants more than 10%
							Riparian zone	PES	The PES category should be a C at least	VEGRAI score >= 62%	VEGRAI score < 62%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 35 indigenous species.	Less than 35 indigenous plant species present
								Endemic riparian species	*Combretum erythrophyllum* (southern African endemic) must be present.	1 listed species present.	Absence of 1 or more listed endemic species
								Threatened riparian species	2 nationally protected tree species: Apple Leaf (*Philenoptera violacea*) and Matumi (*Breonadia salicina*) must be present.	2 listed species present.	Absence of 1 or more listed protected species
						Biota	Fish	FRAI score	The Ecological Category should be maintained within a B/C	FRAI to be maintained within the range of a C category (>62%)	A FRAI score that calculates to a PES category less than

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
									Category, using reference data used for the EWR studies		C for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (2), Labeo cylindricus (2), Anoplopterus "southern stargazer sp" (1), Anguilla marmorata (1), Glossogobius callidus (1), Chiloglanis pretoriae (2), Enteromius trimaculatus (1)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a C Category.	To ensure that the MIRAI score remains within the range of a C category (>62 - ≤78 %), using the same reference data used in the EWR study.	A MIRAI score of 64% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 score and ASPT values are in the following range: SASS5 score: >170; ASPT value: >6.1.	SASS5 scores less than 175 and ASPT less than 6.2.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Perlidae Simuliidae	Minimum abundance of an A attained for both Perlidae and Simuliidae.	If Perlidae or Simuliidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Atyidae	Minimum abundance of an A attained.	Atyidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae	Minimum abundance of an A attained.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

Table 3-26. Resource Quality Objectives for the prioritised river resource unit (RRU_Rvii33) in the Lower Luvuvhu/Mutale IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Lower Luvuvhu/Mutale	II	A92A	Mutale	RRU_Rvii33 - A92B-00051	Rvii33	C		Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a C category	
							Water quantity		Month*		Oct / Nov / Dec / Jan / Feb / Mar / Apr / May / Jun / Jul / Aug / Sep
								Total flows	MCM	Flows shall be sufficient to maintain the Mutale River in a condition equal to or better than a C category.	1.408 / 2.828 / 5.683 / 11.565 / 15.937 / 13.589 / 7.055 / 2.337 / 1.105 / 0.975 / 0.718 / 0.753
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category or better).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maiintained so that some oxygen sensitive species are present in the river (C category).	
									pH	pH levels should be maintained in a C category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (B category or better).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category or better to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

Table 3-27. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri33) in the Lower Luvuvhu/Mutale IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Lower Luvuvhu / Mutale IUA	II	A92B	Middle Mutale	Ri33 - A92B-00051 (EWR site 13_Mutale1)	C	Water quantity		Month		Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep	
							Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Mutale River in a condition equal to or better than a C category.	1.828 | 3.207 | 5.888 | 9.399 | 10.421 | 10.140 | 6.325 | 3.143 | 1.720 | 1.608 | 1.258 | 1.173	
							High flows	Maintenance high flows (MCM)		0.415 | 1.472 | 4.181 | 5.897 | 7.925 | 7.593 | 3.299 | 0.360 | 0.061 | 0.104 | 0.043 | 0.137	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 55 mS/m	95 percentile Electrical conductivity greater than 44 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 1.75 mg/l	Median TIN greater than 1.40 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.075 mg/l	Median PO_4-P greater than 0.060 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l	Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5	pH between 6.0 - 6.5 or pH between 8.5 - 9.0
								Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
								Turbidity	A baseline assessment to determine the present state instream turbidity is required.	A 10% variation from background concentration is allowed.	No baseline data available. Monitoring required to determine present state.
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)	95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle/rapid reach type.	Maintain a GAI PES score of at least a 'C' or > 63%	GAI PES score < 63%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Bed sediment size	Maintain dominant riffle sediment size to include gravel, cobble and bedrock	Maintain riffle with mobile sediment in the range of a D50 of 32 mm, D16 of 18 mm and D84 of 53 mm	Riffle dominated by sand or only cobble
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain upstream pool with deep open water	Maintain upstream pool with water > 0.5 m deep for 60% of pool area	Upstream pool is > 60% filled with sediment and forming largely shallow habitat
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 5 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 5 m and no signs of recent fine sediment deposition on the benches
						Biota	Aquatic zone	Key species	*Potamogeton schweinfurthii, Stuckenia pectinatus* and *Nymphoides thunbergiana* must be present.	3 listed species present in the wet season	Absence of 1 or more key species
							Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 80% (aerial cover).	Non-woody cover less than 80%
								Key species	*Ischaemum fasciculatum, Juncus lomatophyllus, Phragmites mauritianus, Breonadia salicina* and *Gomphostigma virgatum* must be present.	5 listed species present in the wet season	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 5% (aerial cover).	Woody cover more than 5%
								Non-woody cover		Non-woody cover >= 80% (aerial cover).	Non-woody cover less than 80%
								Reed cover		Reed cover <= 30% (aerial cover).	Cover by reeds more than 30%
							Non-marginal (lower - flood benches)	Dominant vegetation	Woody and non-woody vegetation should co-dominate the flood features	Non-woody cover >= 50% (aerial cover).	Non-woody cover less than 50%
								Key species	*Syzygium cordatum, Syzygium guineense, Combretum erythrophyllum, Miscanthus junceus, Juncus lomatophyllus, Juncus oxycarpus, Schoenoplectus brachyceras* and *Ischaemum fasciculatum* must be present.	8 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	Perennial alien plant species <= 10% (aerial cover). Maintain absence of *Mimosa pigra*.	Cover by perennial alien plants more than 10%
								Terrestrial woody cover		Terrestrial woody cover <= 5% (aerial cover).	Cover by terrestrial woody species more than 5%
								Indigenous woody cover		Woody cover <= 20% (aerial cover).	Woody cover more than 20%
								Non-woody cover		Non-woody cover >= 50% (aerial cover).	Non-woody cover less than 50%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 60% (aerial cover).	Woody cover less than 60%

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	Perennial alien plant species <= 5% (aerial cover).	Cover by perennial alien plants more than 5%
							Riparian zone	PES	The PES category should be a B/C at least	VEGRAI score >= 78%	VEGRAI score < 78%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 35 indigenous species.	Less than 35 indigenous plant species present
								Endemic riparian species	*Combretum erythrophyllum* and *Miscanthus junceus* (southern African endemics) must be present.	2 listed species present.	Absence of 1 or more listed endemic species
							Fish	FRAI score	The Ecological Category should be maintained within a C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a C category (>62%)	A FRAI score that calculates to a PES category less than C for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (2), Labeo cylindricus (2), Chiloglanis pretoriae (2), Anoplopterus "southern stargazer sp" (formerly Amphilius uranoscopus) (1), Glossogobius callidus (1), Petrocephalus wesselsi (2), Marcusenius macrolepidotus (2)* and *Anguilla marmorata (1)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a C Category.	To ensure that the MIRAI score remains within the range of a C category (>62 - ≤78 %), using the same reference data used in the EWR study.	A MIRAI score of 64% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >120; ASPT value: >6.1.	SASS5 scores less than 125 and ASPT less than 6.2.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Heptageniidae	Minimum of an A abundance attained.	If Heptageniidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae	Minimum of an A abundance obtained.	Coenagrionidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
								Dominant taxa	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No taxon occurs at a C abundance (>100 individuals).	

Table 3-28. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri34) in the Lower Luvuvhu/Mutale IUA

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Lower Luvuvhu / Mutale IUA	II	A92D	Lower Mutale	Ri34 - A92D-00030 (EWR site 14_Mutale2)	B/C	Water quantity		Month		Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep	
							Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Mutale River in a condition equal to or better than a C category.	2.001 3.347 6.257 10.677 13.442 13.943 7.119 3.467 2.035 1.903 1.467 1.404	
							High flows	Maintenance high flows (MCM)		0.501 1.662 5.061 7.505 9.146 8.277 3.763 0.483 0.051 0.083 0.059 0.111	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (B/C category).	95 percentile EC ≤ 42.5 mS/m	95 percentile Electrical conductivity greater than 34 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Ideal/Acceptable or B/C category).	Median TIN ≤ 1.23 mg/l	Median TIN greater than 0.98 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.050 mg/l	Median PO_4-P greater than 0.040 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that most oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6.5 mg/l	Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH values should be maintained at in a B/C category to protect aquatic ecosystems.	6.5 ≤ pH ≤ 8.5	pH between 6.0 - 6.5 or pH between 8.5 - 9.0
								Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)	95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)	95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle/rapid reach type.	Maintain a GAI PES score of at least a 'C' or > 63%	GAI PES score < 63%
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain dominant riffle sediment size to include gravel and cobble	Maintain riffle with mobile sediment in the range of a D50 of 24 mm, D16 of 15 mm and D84 of 50 mm	Riffle dominated by sand or only cobble

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for 60% of pool area	Downstream pool is > 60% filled with sediment
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 5 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 5 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 60% (aerial cover).	Non-woody cover less than 60%
								Key species	*Phragmites mauritianus* and *Breonadia salicina* must be present.	2 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	No perennial alien plant species.	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Indigenous woody cover		Woody cover <= 5% (aerial cover).	Woody cover more than 5%
								Non-woody cover		Non-woody cover >= 60% (aerial cover).	Non-woody cover less than 60%
							Non-marginal (lower - flood benches)	Dominant vegetation	Woody and non-woody vegetation should co-dominate the flood features	Dominance by either woody or non-woody plants.	Non-woody or woody cover less than 10%
								Key species	*Faidherbia albida, Phragmites mauritianus and Pluchea bojeri* must be present.	3 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition on the flood features should maintain desired dominance and non-dominance.	Perennial alien plant species <= 5% (aerial cover).	Cover by perennial alien plants more than 5%
								Terrestrial woody cover		Terrestrial woody cover <= 5% (aerial cover).	Cover by terrestrial woody species more than 5%
								Indigenous woody cover		Woody cover <= 20% (aerial cover).	Woody cover more than 20%
								Non-woody cover		20% >= Non-woody cover <= 60%.	Non-woody cover less than 20% or more than 60%
							Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 60% (aerial cover).	Woody cover less than 60%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	No perennial alien plant species.	Presence of perennial alien plants
							Riparian zone	PES	The PES category should be a B at least	VEGRAI score >= 82%	VEGRAI score < 82%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 35 indigenous species.	Less than 35 indigenous plant species present
								Threatened riparian species	3 nationally protected tree species: Apple Leaf (*Philenoptera violacea*) Leadwood (*Combretum imberbe*) and Matumi (*Breonadia salicina*) must be present.	3 listed species present.	Absence of 1 or more listed protected species
							Fish	FRAI score	The Ecological Category should be maintained within a C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a C category (>62%)	A FRAI score that calculates to a PES category less than C for two or more consecutive surveys

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (2), Labeo cylindricus (2) (2), Chiloglanis pretoriae, Anoplopterus "southern stargazer sp" (formerly Amphilius uranoscopus) (1), Glossogobius callidus (1), Micralestes acutidens (2)* and *Anguilla marmorata (1)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a B/C Category.	To ensure that the MIRAI score remains within the range of a B/C category (>78 - ≤82 %), using the same reference data used in the EWR study.	A MIRAI score of 80% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >160; ASPT value: >6.0.	SASS5 scores less than 165 and ASPT less than 6.1.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Perlidae Heptageniidae	Minimum abundance of an A attained for Perlidae and Heptageniidae.	If Perlidae or Heptageniidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon: Coenagrionidae	Minimum of an A abundance attained.	Coenagrionidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
									To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae	Minimum of an A abundance attained.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

Table 3-29. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri36) in the Lower Luvuvhu/Mutale IUA (LIMCOM Site LUVU-A91K-OUTPO)

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical														TPC
								Month		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
						Water quantity	Low flows	Maintenance low flows	Flows shall be sufficient to maintain the Luvuvhu River in a condition equal to or better than a C category. Flows must be met at the confluence with the Limpopo River, i.e. must flow into the Limpopo.	3.070	3.363	3.786	5.018	7.075	6.315	5.113	4.042	3.837	3.492	3.257	3.184	
							High flows	Maintenance high flows		3.948	1.540	3.948	5.439	12.866	5.439	1.540	0.000	0.000	0.000	0.000	0.000	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (B/C category).	95 percentile EC ≤ 42.5 mS/m													95 percentile Electrical conductivity greater than 34 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable/BC category).	Median TIN ≤ 1.23 mg/l													Median TIN greater than 0.98 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.050 mg/l														Median PO_4-P greater than 0.040 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that most oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6.5 mg/l													Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5														pH between 6.0 - 6.5 or pH between 8.5 - 9.0
								Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation													Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
								Turbidity	A baseline assessment to determine the present state instream turbidity is required.	A 10% variation from background concentration is allowed.													No baseline data available. Monitoring required to determine present state.
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)													95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)													95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle/rapid reach type.	GAI score not available as part of IWMI study. Determine and maintain the GAI PES score in a similar or better PES category													Reduction in GAI PES
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys													Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length													Maintain active bank erosion below 30% of riverbank length
								Bed sediment size	Maintain cobble as dominant riffle sediment	Maintain riffle with mobile sediment in the range of a D50 of 145 mm, D16 of 78 mm and D84 of 242 mm													Riffle dominated by sand or only cobble
Lower Luvuvhu / Mutale IUA	II	A91K	Luvuvhu	Ri36 - A91K-00035 (EWR site LUVU-A91K-OUTPO)	B/C																			

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for > 60% of pool area	Downstream pool is > 60% filled with sediment and forming shallow habitat
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 2 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 2 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal (bed)	Dominant vegetation	A mix of woody and non-woody vegetation should dominate the channel bed	Non-woody cover >= 10%; Woody cover >= 5% (aerial cover).	Non-woody cover less than 10% or woody cover less than 5%
								Key species	*Breonadia salicina and Ficus capreifolia should be* present.	2 listed species present.	Absence of 1 or more listed key species
								Alien plant species	The riparian vegetation structure and composition in the channel bed should maintain desired dominance and non-dominance.	No perennial alien plants	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Reed cover		Reeds <=10%	Reed cover more than 10%
							Non-marginal (bank)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 60% (aerial cover).	Woody cover less than 60%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	No perennial alien plants	Presence of perennial alien plants
							Riparian zone	PES	The PES category should be a B at least	VEGRAI score >= 82%	VEGRAI score < 82%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 12 indigenous species.	Less than 12 indigenous plant species present
							Fish	FRAI score	The Ecological Category should be maintained within a B/C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a B/C category (>77%)	A FRAI score that calculates to a PES category less than B/C for two or more consecutive surveys
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site.	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (2), Labeo cylindricus (2), Chiloglanis pretoriae (3), Anoplopterus "southern stargazer sp" (formerly Amphilius uranoscopus) (3), Glossogobius callidus (2), Micralestes acutidens (2)* and *Anguilla marmorata (2)*	The absence of any of the target species for two or more consecutive surveys
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a B/C Category.	To ensure that the MIRAI score remains within the range of a C category (>78 - ≤82 %), using the same reference data used in the EWR study.	A MIRAI score of 80% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >170; ASPT value: >6.5.	SASS5 scores less than 175 and ASPT less than 6.6.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-	Minimum abundance of an A attained for Perlidae, Hydropschidae >2spp, Atyidae, Coenagrionidae, Gomphidae and Caenidae.	If Perlidae is missing in two consecutive surveys or has a single individual present

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
									dependent taxa: Perlidae and Hydropsychidae>2spp. To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxa: Atyidae Coenagrionidae To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae, Caenidae		in two consecutive surveys. If Hydropsychidae has <2spp present in two consecutive surveys. If Atyidae or Coenagrionidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Gomphidae or Caenidae is missing in two consecutive surveys, or has a single, individual present in two consecutive surveys.
								Dominant taxa	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No taxon occurs at a C abundance (>100 individuals).	

3.1.7.12 Shingwedzi IUA

Figure 3-13 shows the river resource units within the Lower Sand IUA. The priority resource units are shown in red. Table 3-30 and Table 3-31 provides the RQOs for RRU-Riv28 and RRU-Ri37, respectively.

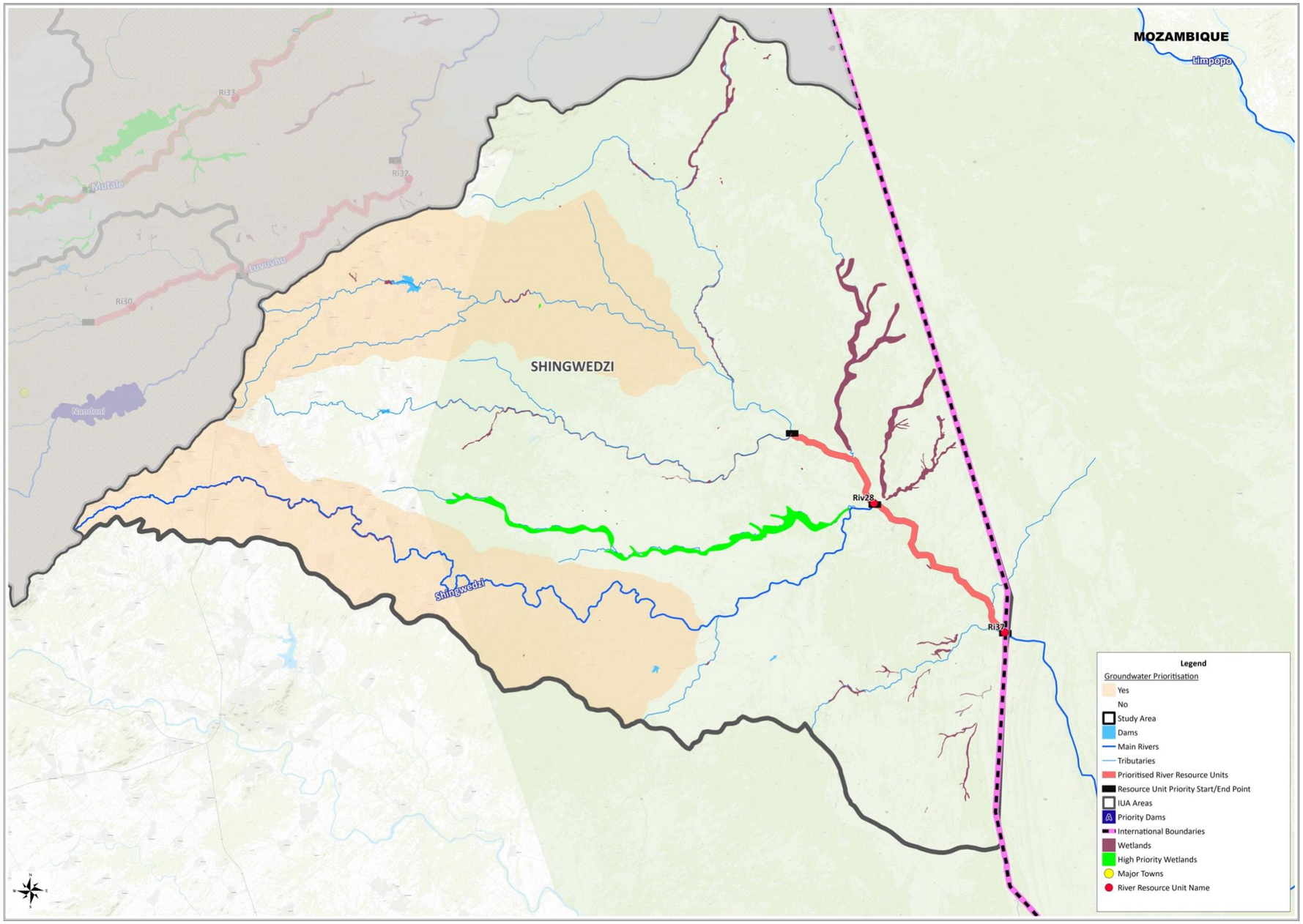

Figure 3-13. River resource units in the Shingwedzi IUA

Table 3-30. Resource Quality Objectives for the prioritised river resource unit (RRU_Riv28) in the Shingwedzi IUA

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
Shingwedzi	II	B90H	Mphongolo	RRU_Riv28 - B90H-00113	Riv28	A		Overall Ecological Category	Target Ecological Category	To maintain the Ecological Category of the resource unit in a A category	
							Water quantity	Total flows	Month*		Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep
									MCM	Flows shall be sufficient to maintain the Mphongolo River in a condition equal to or better than an A category.	0.414 | 1.525 | 5.23 | 11.921 | 13.2 | 5.712 | 1.127 | 0.409 | 0.39 | 0.393 | 0.39 | 0.397
							Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (A category).	
								Nutrients	Total Inorganic nitrogen (TIN), Orthophosphate (PO4-P)	River nutrient concentrations should be maintained in an oligotrophic state or better (Ideal category).	
								System variables	Dissolved oxygen	Dissolved oxygen concentrations should be maintained so that all oxygen sensitive species are present in the river (A category).	
									pH	pH levels should be maintained in a A category to protect aquatic organisms.	
									Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	
								Toxins/Biocides	Ammonia (NH_3-N), Atrazine, Endosulfan	Toxic substances should be maintained at concentrations that does not pose a threat to river aquatic ecosystems (A category).	
								Pathogens	Escherichia coli (E coli), Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Ideal category to safeguard contact recreational water users.	
							Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Determine and maintain reach type.	GAI score not available. Determine and maintain the GAI PES score in a similar or better category
									Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain bank erosion below 30% of riverbank length
									Bed sediment size	Determine and maintain dominant riffle sediment size	Maintain riffle with mobile sediment in baseline size range
									Embeddedness	Maintain low embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment
									Pool depth	Maintain pools with deep open water	Maintain pool with water > 0.5 m deep for > 60% of pool area
									Flood bench	Maintain flood benches along at least one of the banks	Maintain flood benches along at least one bank with signs of recent fine sediment deposition
							Biota	Riparian vegetation	PES	Maintain or improve the current PES (VEGRAI score to be determined when monitoring commences)	
									Species richness	Maintain the number of indigenous plant species within the riparian zone (to be determined when monitoring commences)	
									Alien invasive plant species cover (% aerial)	Maintain the absence of alien plant species cover, or maintain a low cover percentage	
								Fish	PES	Maintain or improve the current PES (FRAI score to be determined when monitoring commences)	

IUA	Class	Quaternary catchment	Resource Name	RU	Biophysical Node	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical
									Species richness	Maintain the number of indigenous fish species within the river reach according to reference data and site conditions (to be determined when monitoring commences)	
									Alien invasive species	Maintain alien fish abundance at <5% of total abundance within the river reach.	
								Macroinvertebrates	PES	Maintain or improve the current PES (MIRAI Ecological Category (EC) to be determined when monitoring commences)	
									SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the MIRAI EC (to be determined when monitoring commences).	
									Taxon dominance	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	

Table 3-31. Resource Quality Objectives for the prioritised river resource unit (RRU_Ri37) in the Shingwedzi IUA (LIMCOM Site SHIN-B90H-POACH)

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical												TPC
								Month		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Shingwedzi River IUA	II	B90H	Shingwedzi	Ri37 - B90H-00145 (EWR site SHIN-B90H-POACH)	C	Water quantity	Low flows	Maintenance low flows (MCM)	Flows shall be sufficient to maintain the Shingwedzi River in a condition equal to or better than a B/C category. Flows must be met at the confluence with the Limpopo River, i.e. must flow into the Limpopo.	0.229	0.255	0.366	0.797	1.079	0.779	0.412	0.274	0.273	0.257	0.246	0.241	
							High flows	Maintenance high flows (MCM)		0.000	0.000	0.000	1.510	2.507	1.150	0.000	0.000	0.000	0.000	0.000	0.000	
						Water quality	Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95 percentile EC ≤ 85 mS/m												95 percentile Electrical conductivity greater than 68 mS/m
							Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 2.24 mg/l												Median TIN greater than 1.79 mg/l
								Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.090 mg/l												Median PO4-P greater than 0.072 mg/l
							System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5% percentile Dissolved oxygen concentration ≥ 6 mg/l												Dissolved oxygen concentrations less than 7.2 mg/l
								pH	pH affects aquatic organisms and solubility of metals	5.6 ≤ pH ≤ 9.2												pH between 5.6 - 5.9 or pH between 8.8 - 9.2
								Water temperature	Water temperatures (°C) should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation												Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
								Turbidity	A baseline assessment to determine the present state instream turbidity is required.	A 10% variation from background concentration is allowed.												No baseline data available. Monitoring required to determine present state.
							Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95% percentile) Atrazine ≤ 49 µg/l (95% percentile) Endosulfan ≤ 0.075 µg/l (95% percentile)												95^{th} percentile Ammonia (NH_3-N) greater than 35 µg/l 95^{th} percentile Atrazine greater than 39 µg/l 95^{th} percentile Endosulfan greater than 0.06 µg/l
							Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95^{th} percentile)												95^{th} percentile E coli / Faecal coliforms greater than 20 cfu/100ml
						Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle/plain bed reach type.	GAI score not available as part of IWMI study. Determine and maintain the GAI PES score in a similar or better category												Reduction in GAI PES category
								Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys												Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
								Bank erosion	Maintain low to moderate proportion of banks actively eroding	Maintain active bank erosion below 30% of riverbank length												Active bank erosion of more than 30% of bank length
								Bed sediment size	Maintain gravel as dominant riffle sediment	Maintain riffle with mobile sediment in the range of a D50 of 27 mm, D16 of 17 mm and D84 of 53 mm												Riffle dominated by sand or only coarse gravel

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
								Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
								Pool depth	Maintain pool downstream of bridge with deep open water	Maintain pool downstream of bridge with water > 0.5 m deep for > 60% of pool area	Pool downstream of bridge is > 60% filled with sediment and forming shallow habitat
								Flood bench	Maintain flood benches along at least one of the banks	Maintain flood bench of > 2 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 2 m and no signs of recent fine sediment deposition on the benches
						Biota	Marginal (bed)	Dominant vegetation	Non-woody vegetation should dominate the channel bed	Non-woody cover >= 10% (aerial cover).	Non-woody cover less than 10%
								Alien plant species	The riparian vegetation structure and composition in the channel bed should maintain desired dominance and non-dominance.	No perennial alien plants	Presence of perennial alien plants
								Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
								Reed cover		Reeds <=10%	Reed cover more than 10%
							Non-marginal (bank)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 60% (aerial cover).	Woody cover less than 60%
								Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	No perennial alien plants	Presence of perennial alien plants
							Riparian Zone	PES	The PES category should be a B at least	VEGRAI score >= 82%	VEGRAI score < 82%
								Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 10 indigenous species.	Less than 10 indigenous plant species present
							Fish	FRAI score	The Ecological Category should be maintained within a C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a C category (>62%)	A FRAI score that calculates to a PES category less than C for two or more consecutive surveys if suitable flow and habitat are present
								Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
								Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
								Key species	To maintain suitable flow conditions to support the key species identified at the site	Presence/absence records. Relative abundance of species: *Labeobarbus marequensis (2), Labeo cylindricus (2), Chiloglanis pretoriae (1)* if suitable flow and habitat are present	The absence of any of the target species for two or more consecutive surveys if suitable flow and habitat are present
							Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a C Category.	To ensure that the MIRAI score remains within the range of a C category (>62 - ≤78 %), using the same reference data used in the EWR study.	A MIRAI score of 64% or less.
								SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >130; ASPT value: >5.0.	SASS5 scores less than 135 and ASPT less than 5.1.
								Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa: Simuliidae To maintain sufficient quantity and quality of inundated vegetation to support the following vegetation-dwelling taxon:	Minimum A abundance attained.	If Simuliidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys. If Coenagrionidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.

IUA	Class	Quaternary catchment	Resource Name	RRU	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
									Coenagrionidae To maintain sufficient quantity and quality of inundated gravel, sand and mud to support the following taxa: Gomphidae, Caenidae		If Gomphidae or Caenidae is missing in two consecutive surveys, or has a single, individual present in two consecutive surveys.
								Dominant taxa	To ensure that no group consistently dominates the fauna, over more than two consecutive surveys.	No taxon occurs at a C abundance (>100 individuals).	

3.2 Dam Resource Quality Objectives and numerical limits

3.2.1 Dams in the Upper Nyl/Sterk and Mogalakwena IUAs

Three dams were prioritised for implementation of RQOs in the Mogalakwena IUA, namely Donkerpoort Dam in the Upper Nyl River, Doorndraai Dam in the Sterk River and Glen Alpine Dam in the Mogalakwane River. The three dams will need to be operated as a system to meet the maintenance low and high flows downstream of each of the dams. The flows that will be required to be released from each dam will depend on the percentage storage of the dam on the 1st of April of each year when the decision is made on whether curtailment is required on the water users dependent on the dam, which includes the monthly maintenance flows of the EWR to meet the recommended EC.

Currently the priority classification for the Mogalakwena IUA does not include the EWR. Although preliminary monthly rule curves for Doorndraai and Glen Alpine Dams were determined for the 2011 annual operating analysis, these were not implemented. To ensure the implementation of the maintenance low and high flows that have been determined for the Mogalakwena system, Table 3-32 provides a proposal for the priority classification of the flows for the EWRs. It is recommended that 80% of the monthly quantities have a 99% risk interval and 20% of the monthly flows have a 90% risk interval.

Table 3-32. Proposed priority classification of water users including EWRs in the Mogalakwena System

Category /Water User	Priority Classification				Total
	Low	Medium Low	Medium	High	
	90% Assurance	95% Assurance	98% Assurance	99% Assurance	
	(1 in 10 years)	(1 in 20 years)	(1 in 50 years)	(1 in 100 years)	
Domestic & Urban	10%	30%	0%	60%	100%
Irrigation	10%	30%	30%	30%	100%
Mining, Industries & Power Generation	10%	10%	0%	80%	100%
EWR	20%	0%	0%	80%	100%
Return Flows					0%
Curtailment Level	**0**	**1**	**2**	**3**	**4**

The numerical limits on the quantity required to be released is provided in the monthly rule curves determined for a site immediately downstream of the dam. These are provided for the dams in the Mogalakwena system.

3.2.1.1 Donkerpoort Dam

The Donkerpoort dam is situated on the little Nyl River, a tributary of the Upper Nyl River. The EWR site to which the Donkerpoort Dam should contribute is on the Nyl River, however it is difficult to operate the Dam to meet the EWR, as the site is also dependent on the unregulated upstream flows of the Nyl River. The Donkerpoort Dam is owned and operated by the Modimolle Local Municipality, and it will be challenging to integrate into the annual operating rules of the Mogalakwena IUA.

It is recommended that no Numerical Limits for water quantity are set for the Donkerpoort Dam. However, the wastewater treatment works is located downstream of the dam and the return flows will contribute to the downstream EWR maintenance flows.

3.2.1.2 Doorndraai Dam

The recommended EC for the EWR site immediately downstream of Doorndraai Dam is a category D. An estimate of the ecological water requirements of the site is presented in Table 3-33. The table should be used to operate Doorndraai Dam for the EWR based on the starting storage of the dam at each decision date of the hydrological year.

Table 3-33. Monthly flow requirements of Doorndraai Dam

	10	20	30	40	50	60	70	80	90	99
Oct	1.023	0.932	0.787	0.694	0.612	0.491	0.414	0.338	0.285	0.278
Nov	5.365	1.494	0.804	0.686	0.602	0.497	0.402	0.333	0.332	0.332
Dec	6.616	3.084	1.849	0.759	0.631	0.514	0.416	0.347	0.3	0.265
Jan	9.232	4.167	2.216	1.92	0.729	0.531	0.426	0.351	0.304	0.275
Feb	7.72	3.405	2.1	1.108	0.603	0.461	0.374	0.319	0.283	0.261
Mar	3.745	2.479	1.29	0.855	0.669	0.52	0.427	0.354	0.339	0.338
Apr	1.957	1.255	0.936	0.753	0.624	0.498	0.411	0.341	0.328	0.328
May	1.378	1.074	0.839	0.717	0.626	0.514	0.416	0.352	0.302	0.271
Jun	1.071	0.939	0.78	0.686	0.603	0.497	0.402	0.339	0.292	0.256
Jul	1.051	0.946	0.803	0.705	0.623	0.514	0.416	0.351	0.302	0.26
Aug	1.025	0.936	0.794	0.701	0.621	0.513	0.416	0.346	0.295	0.253
Sep	0.986	0.904	0.758	0.67	0.598	0.495	0.4	0.327	0.265	0.22
Total	**41.169**	**21.615**	**13.956**	**10.254**	**7.541**	**6.045**	**4.92**	**4.098**	**3.627**	**3.337**

3.2.1.3 Glen Alpine Dam

The high confidence monthly flows required to meet the recommended EC of C is presented in Table 3-34. The EWR should be included in the priority classification of the water users dependent on Glen Alpine Dam, as recommended in Table 3-32 above.

The annual operating analysis of the Mogalakwena system was last done in 2021, however the preliminary EWR maintenance flows were not implemented. The AOA will need to be updated once the EWRs have been gazetted. This will include updating the short-term characteristics curves (STCC) over a 5-year period and the proposed priority classification, including the EWR as a user, accepted by the system operating forum (SOF) of the Mogalakwena system.

Table 3-34. Monthly Flow Requirements from Glen Alpine Dam

nMAR	188.946	MCM			
S.Dev.	15.804				
CV	0.084				
Q75	0.2848				
Ecological Category	**C**				
	MCM	% nMAR	Excludes floods with return period ≥1:2 years.		
Total EWR	43.439	22.99			
Maint. Lowflows	39.096	20.692			
Drought Lowflows	26.707	14.135			
Maint. Highflows	4.343	2.299			
Monthly Distributions (MCM)					
	Natural	Modified Flows (EWR)			
		Low flows		High flows	Total EWR
Month	Mean	Maint.	Drought	Maint.	Maint.
Oct	3.417	0.487	0.741	0.107	0.594
Nov	13.305	2.12	1.02	0.135	2.255
Dec	18.652	2.557	1.951	0.313	2.87
Jan	31.569	3.906	3.485	0.758	4.663
Feb	52.951	10.47	4.785	0.495	10.965
Mar	26.374	9.273	4.619	0.606	9.879
Apr	15.229	4.486	2.522	0.658	5.143
May	8.955	2.496	2.082	0.629	3.125
Jun	5.898	1.351	1.632	0.367	1.717
Jul	4.964	1.104	1.552	0.183	1.287
Aug	4.168	0.546	1.266	0.057	0.603
Sep	3.464	0.3	1.054	0.038	0.338
Total	**188.95**	**39.1**	**26.71**	**4.34**	**43.44**

3.2.2 Dams in the Nzhelele/Nwanedi IUA

There is no operating rule for Nzhelele Dam that has been developed to date. The dam is operated based on the weekly orders provided to the dam operators for releases. The dam does not currently make releases for the EWR.

The EWR at 8_Nzhelele is based on the natural flow contribution from the total upstream catchment. This includes Nzhelele Dam as well as the contributions from the unregulated tributaries of the Mutamba and Tshishiru Rivers, upstream of the EWR site. The high confidence monthly flows required to meet the recommended EC of C is presented in Table 3-35. The EWR should be included in the priority classification of the water users dependent on Nzhelele Dam, where it is recommended that 80% of the monthly EWR flows have a 99% risk interval and 20% of the monthly flows have a 90% risk interval, for the contribution of the EWR flows from the Nzhelele Dam.

There is no annual operating analysis of the Nzhelele system. The AOA needs to be developed once the EWRs have been gazetted. This will include developing the short-term characteristics curves (STCC) of Nzhelele Dam over a 5-year period and the priority classification, including the EWR as a user accepted by the system operating forum (SOF) of the Nzhelele system.

Table 3-35. Monthly Flow Requirements from Nzhelele Dam

nMAR	98.42	MCM			
S.Dev.	7.494				
CV	0.076				
Q75	0.2467				
Ecological Category	**C**				
	MCM	% nMAR	Excludes floods with return period ≥1:2 years.		
Total EWR	50.257	51.063			
Maint. Low flows	41.595	42.263			
Drought Low flows	22.504	22.865			
Maint. High flows	8.662	8.801			
Monthly Distributions (MCM)					
	Natural	Modified Flows (EWR)			
		Low flows		High flows	Total EWR
Month	Mean	Maint.	Drought	Maint.	Maint.
Oct	1.719	1.212	0.626	0.328	1.539
Nov	2.083	1.023	0.603	0.455	1.478
Dec	4.001	1.252	0.998	0.788	2.039
Jan	14.739	3.229	2.323	1.08	4.309
Feb	25.98	6.116	3.542	1.22	7.336
Mar	18.102	7.159	3.919	1.476	8.635
Apr	10.976	6.174	3.048	1.453	7.627
May	6.986	4.635	2.387	0.49	5.124
Jun	5.158	3.641	1.779	0.481	4.122
Jul	3.835	3.012	1.395	0.345	3.358
Aug	2.794	2.381	1.076	0.201	2.582
Sep	2.047	1.762	0.809	0.345	2.107
Total	98.42	41.59	22.5	8.66	50.26

3.2.3 Dams in the Upper Luvuvhu IUA

Four dams were prioritised for implementation of the RQOs namely Albasini Dam in the Upper Luvuvhu River; Vondo Dam in the Mutshindudi River, a tributary of the Luvuvhu; Mvuwe Dam in the Mbwedi River which is also a tributary of the Luvuvhu; and Nandoni Dam in the Luvuvhu River. The four dams will be operated as a system to meet the maintenance flows of the EWR downstream of the dams. The flows that will be required to be released from each dam will depend on the percentage storage of the dam on the 1st of April when the decision is made on the amount of allocation to water users dependent on the dam, including the EWR based on the priority classification of the Luvuvhu River system.

The priority classification for the Luvuvhu River system is provided in able 3-36, which includes releases for the EWR maintenance flows of 74.34 million m^3/a. It also recommends that 80% of the monthly flows have a 99% risk interval and 20% of the monthly flows have a 90% risk interval. The AOA of the Luvuvhu system needs to be updated once the EWRs have been gazetted.

Table 3-36. Proposed priority classification of water user including EWRs in the Luvuvhu System

Category /Water User	Priority Classification				Total
	Low	Medium Low	Medium	High	
	90% Assurance	95% Assurance	98% Assurance	99% Assurance	
	(1 in 10 years)	(1 in 20 years)	(1 in 50 years)	(1 in 100 years)	
Domestic & Urban	15%	15%	40%	30%	100%
Irrigation	100%	0%	0%	0%	100%
Mining, Industries & Power Generation	10%	10%	0%	80%	100%
EWR	20%	0%	0%	80%	100%
Losses	25%	25%	25%	25%	100%
Curtailment Level	**0**	**1**	**2**	**3**	**4**

3.2.3.1 Albasini Dam

The recommended EC for the EWR site immediately downstream of Albasini Dam is a category B. The estimated EWR at node Riii5 is presented in Table 3-37. The table will be used to operate Albasini Dam based on the starting storage of the dam at each decision date of the hydrological year. The total annual maintenance flow to achieve the EC B is 29.98 million m^3/a. This will be released monthly as illustrated in Table 3-37. In the event of a drought, the monthly drought flows will be used to make monthly releases over the hydrological year.

Table 3-37. Monthly Flow Requirements from Albasini Dam

	10	20	30	40	50	60	70	80	90	99
Oct	2.434	2.074	1.749	1.484	1.253	1.158	1.076	1.012	0.958	0.937
Nov	2.302	1.973	1.647	1.391	1.228	1.114	1.032	0.971	0.927	0.898
Dec	2.409	2.124	1.824	1.541	1.3	1.169	1.071	0.969	0.968	0.966
Jan	3.934	2.61	2.147	1.641	1.367	1.204	1.109	1.026	0.97	0.938
Feb	6.281	2.762	2.021	1.594	1.288	1.108	1.008	0.938	0.893	0.859
Mar	5.508	3.76	2.473	1.835	1.463	1.241	1.119	1.042	0.991	0.96
Apr	4.569	3.312	2.595	1.857	1.512	1.303	1.135	1.028	1.018	0.972
May	4.663	3.418	2.738	2.015	1.629	1.376	1.236	1.071	1.012	0.991
Jun	4.16	3.215	2.592	1.981	1.542	1.221	1.201	1.032	0.99	0.947
Jul	3.785	3.09	2.565	1.923	1.506	1.253	1.168	1.043	1.036	0.98
Aug	3.323	2.842	2.388	1.797	1.429	1.231	1.117	1.039	0.992	0.977
Sep	2.711	2.316	1.924	1.569	1.293	1.155	1.064	0.996	0.951	0.921
Total	**46.079**	**33.496**	**26.663**	**20.628**	**16.81**	**14.533**	**13.336**	**12.167**	**11.706**	**11.346**

3.2.3.2 Vondo Dam

The high confidence monthly EWR flows required to meet the recommended EC of C in the Mutshindudi River is presented in Table 3-38.

This EWR must be included in the priority classification of the water users dependent on dams in the Luvuvhu River system.

The annual operating analysis of the Luvuvhu system was last done in 2021, however the preliminary EWR for releases downstream of Vondo Dam were not included. The AOA needs to be updated once the EWRs have been gazetted. This will include updating the short-term characteristics curves (STCC) over a period of 5-year period and the proposed priority classification, which includes the EWR as a user, accepted by the system operating forum (SOF) of the Luvuvhu system.

It is important to note that the EWR releases into the Mutshindudi River will also contribute to the EWR downstream of the confluence with the Luvuvhu River, as the flows are required to meet the ecological functioning of the river in the Kruger National Park.

Table 3-38. Monthly Flow Requirements from Vondo Dam

nMAR	56.42	MCM			
S.Dev.	3.444				
CV	0.061				
Q75	0.135				
Ecological Category	C				
	MCM	% MAR	Excludes floods with return period ≥1:2 years.		
Total EWR	40.811	72.335			
Maint. Lowflows	24.108	42.73			
Drought Lowflows	11.736	20.802			
Maint. Highflows	16.703	29.605			
Monthly Distributions (MCM)					
	Natural	Modified Flows (EWR)			
		Low flows		High Flows	Total EWR
Month	Mean	Maint.	Drought	Maint.	Maint.
Oct	1.154	0.664	0.421	0.078	0.742
Nov	2.528	0.967	0.688	0.436	1.403
Dec	6.135	2.094	1.267	1.827	3.921
Jan	9.959	3.638	1.847	3.433	7.07
Feb	13.104	4.14	1.803	4.931	9.071
Mar	10.55	4.494	1.897	3.825	8.32
Apr	5.171	2.662	1.178	1.711	4.373
May	2.593	1.633	0.776	0.324	1.958
Jun	1.707	1.213	0.569	0.082	1.295
Jul	1.374	1.035	0.491	0.015	1.05
Aug	1.125	0.853	0.413	0.016	0.87
Sep	1.02	0.714	0.387	0.025	0.739
Total	56.42	24.11	11.74	16.7	40.81

3.2.3.3 Nandoni Dam

There is no high confidence monthly EWR flows that were determined for the site (node Rvii24) immediately downstream of the Nandoni Dam. To determine the monthly flows immediately downstream of Nandoni Dam, the monthly EWR flows for the Mutshindudi River (11_Mutshindudi) were subtracted from the high confidence monthly flows of a site on the Luvuvhu River (12_Luvuvhu) downstream of the confluence with the Mutshindudi River. This is presented in Table 3-39. The monthly EWR for the site (node Rvii24) provided in Table 3-39 together with the curtailment level at the starting storage will be used to determine releases for the maintenance low and high flows. In the event of a drought, the monthly drought flows in Table 3-39 will be used to make monthly releases over the hydrological year.

The AOA of the Luvuvhu River system needs to be updated once the EWRs have been gazetted. This will include updating the short-term characteristics curves (STCC) of the prioritised dams in the Luvuvhu River system over a 5-year period and the proposed priority classification which includes the EWR as a user, accepted by the system operating forum (SOF) of the Luvuvhu system.

Table 3-39. Amended Monthly Flow Requirements from Nandoni Dam

nMAR	388.014	MCM			
S.Dev.	22.81				
CV	0.059				
Q75	0.905				
Ecological Category	C				
	MCM		% nMAR		Excludes floods with return period ≥1:2 years.
Total EWR	111.111		28.64%		
Maint. Lowflows	90.04		23.21%		
Drought Lowflows	80.379		20.72%		
Maint. Highflows	21.071		5.43%		
Monthly Distributions (MCM)					
	Natural	Modified Flows (EWR)			
		Low flows		High flows	Total EWR
Month	Mean	Maint.	Drought	Maint.	Maint.
Oct	8.099	0.777	3.204	0.091	0.868
Nov	11.927	1.655	3.731	0.659	2.314
Dec	24.511	5.739	6.156	2.981	8.72
Jan	50.438	11.836	8.993	4.434	16.27
Feb	79.083	21.101	11.928	4.124	25.225
Mar	64.405	24.108	13.935	4.491	28.599
Apr	32.452	13.423	9.574	3.863	17.286
May	18.145	5.007	6.337	0.408	5.415
Jun	13.614	2.751	5.018	0.008	2.759
Jul	11.352	1.752	4.332	0.023	1.775
Aug	9.526	1.085	3.782	-0.009	1.076
Sep	8.043	0.806	3.389	-0.002	0.804
Total	**331.595**	**90.04**	**80.379**	**21.071**	**111.111**

3.2.3.4 Mvuwe Dam

There is no EWR site or hydrological node identified in the Mbwedi River where the Mvuwe Dam is located. Without an EWR site in the Mbwedi River, it is recommended that RQOs for water quantity not be set for Mvuwe Dam.

3.2.4 Resource Quality Objectives for water quality and biota in Dams

Water quality in Dams

Pathogens - The numerical limits for E coli were based on the updated recreational water quality guidelines (Genthe, Claassen and Steyn, 2020) Tier 1 guideline values. In the absence of observed E coli data for the dams, a conservative approach was followed and the RQOs were set to maintain the water quality in an Acceptable category in all the dams. This objective can be reviewed once the National

Microbial Monitoring Programme becomes operational in dams in the study area, and actual recreational activities are obtained.

Alien aquatic plants

The impact of alien aquatic plants is well known in South Africa with Hartebeespoort Dam an infamous example. Invasive aquatic species include *Pontederia crassipes* (Water Hyacinth), *Pistia stratiotes (*Water Lettuce), *Salvinia molesta* (Kariba Weed), *Myriophyllum aquaticum* (Parrot's Feather), and *Azolla filiculoides* (Water Fern). These species are all invasive and thrive particularly well in eutrophic conditions, choking waterways and covering water bodies and stream habitats, at times resulting in fish kills. They do particularly well in quiet water environments such as dams, so RQOs for dams that include alien aquatic plants was included as indicators using overall (combined species) aerial extent (% of dam covered by aliens) and water quality, due to the strong link between nutrients and alien aquatic plant vigour and extent.

Fish community structures in dams

The flowing water habitat (lotic) that is typical of a riverine system is transformed to a habitat type characterised by no flow (lentic habitat) when an impoundment is established. Rheophilic (flow-dwelling) fish species tend to be displaced from the inundated reach of the river impacted by the impoundment shortly after the habitat transformation takes place. Some of the more generalist species are adaptable to a certain degree and, although breeding within the impoundment is limited, still sustain a population within the lentic environment. Species such as *Labeo molybdinus,* although known to inhabit and breed within lotic environments, tend to also thrive in lentic habitats, but habitat specialists such as *Chiloglanis* spp are completely displaced and move along the watercourse to seek suitable alternative habitat. Similarly, species commonly encountered within the lotic habitats throughout the catchment area such as *Labeo cylindricus* and, to a lesser extent, Labeo marequensis, would also be displaced from the inundation zone of the impacted river reach. Rheophilic specialist species can only seek alternative habitat if suitable habitat is located upstream of the inundation zone as downstream accessibility to alternative habitat is very often inhibited by the impoundment structure (the dam wall). Individuals that move to alternative habitat upstream will also increase the competition for resources amongst individuals that already inhabit those river reaches. The establishment of an impoundment therefore tends to decrease the species diversity and abundance of rheophilic species in general, both through alteration of the physical habitat and the changes to the physicochemical properties of the water that many of the fish cannot adapt to.

There are fish species that thrive in lentic environments. Noteworthy species that will tend to dominate within a lentic environment will include *Clarias gariepinus*, which is a particularly resilient generalist species that becomes dominant. Other indigenous species from the catchment area that also thrive in lentic environments include those of the Cichlidae family, such as *Oreochromis mossambicus*, *Tilapia sparrmanii* and *Pseudocrenilabrus philander*. Smaller barb species that also do well in lentic environments include *Enteromius paludinosus*. Furthermore, alien fish species also thrive in lentic environments, with *Cyprinus carpio* being particularly adapted to the transformed habitat and which quickly dominate the population. The community structure as described above would be typical of any impoundment within the catchment area.

3.2.4.1 RQOs for water quality and biota in the Donkerpoort Dam

The RQOs for water quality, fish and alien vegetation for the Donkerpoort Dam is provided in Table 3-40.

Table 3-40. Resource Quality Objectives for water quality and biota in the Donkerpoort Dam

IUA	Dam Name	Component	Sub-component	Indicator/Measure	RQO Narrative	RQO Numerical	TPC
Nyl/Sterk	Donkerpoort Dam	Quality	Nutrients	Total Phosphates (mg/l) Chlorophyll a (µg/l)	Maintain Donkerpoort Dam in a mesotrophic state or better (intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems) in order to protect bulk water provision for domestic water supply and mitigate drinking water treatment costs.	Median annual Total Phosphates ≤ 0.047 mg/l Median annual Chlorophyll a ≤ 20 µg/l	Median annual Total Phosphates greater than 0.038 mg/l Median annual Chlorophyll a greater than 16 µg/l
			Salts	Electrical Conductivity (EC) (mS/m) Total dissolved salts (TDS) (mg/l)	Salt concentrations must be maintained at a level that is not harmful to aquatic ecosystems in the dam and is in an Acceptable fitness for use state for domestic and industrial water supply, and for irrigation water supply.	95%tile EC ≤ 90 mS/m 95%tile TDS ≤ 585 mg/l	95%tile EC greater than 72 mS/m 95%tile TDS greater than 468 mg/l
			Pathogens	Escherichia coli, Faecal coliforms	Donkerpoort Dam must be maintained in an Acceptable microbiological state that is safe for contact recreational user.	95%tile E coli / Faecal coliforms ≤ 25 cfu/100ml	
		Biota	Fish	Maintenance of fish species diversity	Maintain fish abundance at a level that fulfils ecosystem services roles of recreational angling and subsistence harvesting	Balanced relative abundance and diversity between Cichlidae, Cyprinidae and Clariidae	A notable dominance of one family of fish over two or more consecutive assessments

IUA	Dam Name	Component	Sub-component	Indicator/Measure	RQO Narrative	RQO Numerical	TPC
				Fish health	Fish health to be maintained in a state that is safe for consumption and suitable for recreational angling	Ulcers, bacterial infections and parasite burdens limited to <1% of fish population	>1% of the catch being impacted by bacterial infections or overburden of parasites
				Fish abundance	Maintaining fish abundance to support subsistence and recreational fishing	Maintain a stable catch per unit effort relative to previous surveys	A notable decline in fish population abundance over more than two assessments
			Alien aquatic plant species	Water Quality (Nutrients)	Maintain Donkerpoort Dam in a mesotrophic state or better	Median annual Total Phosphates ≤ 0.047 mg/l	Median annual Total Phosphates greater than 0.038 mg/l
						Median annual Chlorophyll a ≤ 20 µg/l	Median annual Chlorophyll a greater than 16 µg/l
				Aerial extent	Maintain low % aerial cover of AIP (Water Hyacinth, Water Lettuce, Water Fern, Kariba Weed, Parrot's Feather) on dam surface and fringe	Maintain aerial cover of AIP on dam surface below 10%	The presence of AIP species on the dam surface or along the fringe

3.2.4.2 RQOs for water quality and biota in the Doorndraai Dam

The RQOs for water quality, fish and alien vegetation for the Doorndraai Dam is provided in Table 3-41.

Table 3-41 Resource Quality Objectives for water quality and biota in the Doorndraai Dam

IUA	Dam Name	Component	Sub-component	Indicator/Measure	RQO Narrative	RQO Numerical	TPC
Nyl/Sterk	Doorndraai Dam	Quality	Nutrients	Total Phosphates (mg/l) Chlorophyll a (µg/l)	Maintain Doorndraai Dam in a mesotrophic state or better (intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems) in order to protect bulk water provision (municipal and industrial water supply) and mitigate drinking water treatment costs.	Median annual Total Phosphates ≤ 0.047 mg/l Median annual Chlorophyll a ≤ 20 µg/l	Median annual Total Phosphates greater than 0.038 mg/l Median annual Chlorophyll a greater than 16 µg/l
			Salts	Electrical Conductivity (EC) (mS/m) Total dissolved salts (TDS) (mg/l)	Salt concentrations must be maintained at a level that is not harmful to aquatic ecosystems in the dam and is in an Acceptable fitness for use state for domestic and industrial water supply, and for irrigation water supply.	95%tile EC ≤ 90 mS/m 95%tile TDS ≤ 585 mg/l	95%tile EC greater than 72 mS/m 95%tile TDS greater than 468 mg/l
			Pathogens	Escherichia coli, Faecal coliforms	Doorndraai Dam must be maintained in an Acceptable microbiological state that is safe for contact recreational user.	95%tile E coli / Faecal coliforms ≤ 15 cfu/100ml	95%tile E coli / Faecal coliforms greater than 20 cfu/100ml
		Biota	Fish	Maintenance of fish species diversity	Maintain fish abundance at a level that fulfils ecosystem services roles of recreational angling and subsistence harvesting	Balanced relative abundance and diversity between Cichlidae, Cyprinidae and Clariidae	A notable dominance of one family of fish over two or more consecutive assessments
				Fish health	Fish health to be maintained in a state that is safe for	Ulcers, bacterial infections and	>1% of the catch being impacted by

IUA	Dam Name	Component	Sub-component	Indicator/Measure	RQO Narrative	RQO Numerical	TPC
					consumption and suitable for recreational angling	parasite burdens limited to <1% of fish population	bacterial infections or overburden of parasites
				Fish abundance	Maintaining fish abundance to support subsistence and recreational fishing	Maintain a stable catch per unit effort relative to previous surveys	A notable decline in fish population abundance over more than two assessments
			Alien aquatic plant species	Water Quality (Nutrients)	Maintain Doorndraai Dam in a mesotrophic state or better	Median annual Total Phosphates ≤ 0.047 mg/l	Median annual Total Phosphates greater than 0.038 mg/l
						Median annual Chlorophyll a ≤ 20 µg/l	Median annual Chlorophyll a greater than 16 µg/l
				Aerial extent	Maintain low % aerial cover of AIP (Water Hyacinth, Water Lettuce, Water Fern, Kariba Weed, Parrot's Feather) on dam surface and fringe	Maintain aerial cover of AIP on dam surface below 10%	The presence of AIP species on the dam surface or along the fringe

3.2.4.3 RQOs for water quality and biota in the Glen Alpine Dam

The RQOs for water quality, fish and alien vegetation for the Glen Alpine Dam is provided in Table 3-42.

Table 3-42 Resource Quality Objectives for water quality and biota in the Glen Alpine Dam

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
Mogalakwena	Glen Alpine Dam	Quality	Nutrients	Total Phosphates (mg/l) Chlorophyll a (µg/l)	Maintain Glen Alpine Dam in a mesotrophic state or better (intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems) in order to protect irrigation water supply to downstream users and rural domestic water users.	Median annual Total Phosphates ≤ 0.047 mg/l Median annual Chlorophyll a ≤ 20 µg/l	Median annual Total Phosphates greater than 0.038 mg/l Median annual Chlorophyll a greater than 16 µg/l
			Salts	Electrical Conductivity (EC) (mS/m) Total dissolved salts (TDS) (mg/l)	Salt concentrations must be maintained at a level that is not harmful to aquatic ecosystems in the dam and is in an Acceptable fitness for use state for domestic and industrial water supply, and for irrigation water supply.	95%tile EC ≤ 90 mS/m 95%tile TDS ≤ 585 mg/l	95%tile EC greater than 72 mS/m 95%tile TDS greater than 468 mg/l
			Pathogens	Escherichia coli, Faecal coliforms	Glen Alpine Dam must be maintained in an Acceptable microbiological state that is safe for contact recreational user.	95%tile E coli / Faecal coliforms ≤ 25 cfu/100ml	95%tile E coli / Faecal coliforms greater than 20 cfu/100ml
		Biota	Fish	Maintenance of fish species diversity	Maintain fish abundance at a level that fulfils ecosystem services roles of recreational angling and subsistence harvesting	Balanced relative abundance and diversity between Cichlidae, Cyprinidae and Clariidae	A notable dominance of one family of fish over two or more consecutive assessments
				Fish health	Fish health to be maintained in a state that is safe for consumption and	Ulcers, bacterial infections and parasite burdens limited to <1% of fish population	>1% of the catch being impacted by bacterial infections or

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
					suitable for recreational angling		overburden of parasites
				Fish abundance	Maintaining fish abundance to support subsistence and recreational fishing	Maintain a stable catch per unit effort relative to previous surveys	A notable decline in fish population abundance over more than two assessments
			Alien aquatic plant species	Water Quality (Nutrients)	Maintain Glen Alpine Dam in a mesotrophic state or better	Median annual Total Phosphates ≤ 0.047 mg/l	Median annual Total Phosphates greater than 0.038 mg/l
						Median annual Chlorophyll a ≤ 20 µg/l	Median annual Chlorophyll a greater than 16 µg/l
				Aerial extent	Maintain low % aerial cover of AIP (Water Hyacinth, Water Lettuce, Water Fern, Kariba Weed, Parrot's Feather) on dam surface and fringe	Maintain aerial cover of AIP on dam surface below 10%	The presence of AIP species on the dam surface or along the fringe

3.2.4.4 RQOs for water quality and biota in the Nzhelele Dam

The RQOs for water quality, fish and alien vegetation for the Nzhelele Dam is provided in Table 3-43.

Table 3-43 Resource Quality Objectives for water quality and biota in the Nzhelele Dam

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
Nzhelele/Nwanedi	Nzhelele Dam	Quality	Nutrients	Total Phosphates (mg/l) Chlorophyll a (µg/l)	Maintain Nzhelele Dam in a mesotrophic state or better (intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems) in order to protect irrigation water supply to downstream users and rural domestic water users.	Median annual Total Phosphates ≤ 0.047 mg/l Median annual Chlorophyll a ≤ 20 µg/l	Median annual Total Phosphates greater than 0.038 mg/l Median annual Chlorophyll a greater than 16 µg/l
			Salts	Electrical Conductivity (EC) (mS/m) Total dissolved salts (TDS) (mg/l)	Salt concentrations must be maintained at a level that is not harmful to aquatic ecosystems in the dam and is in an Acceptable fitness for use state for domestic and industrial water supply, and for irrigation water supply.	95%tile EC ≤ 90 mS/m 95%tile TDS ≤ 585 mg/l	95%tile EC greater than 72 mS/m 95%tile TDS greater than 468 mg/l
			Pathogens	Escherichia coli, Faecal coliforms	Glen Alpine Dam must be maintained in an Acceptable microbiological state that is safe for contact recreational user.	95%tile E coli / Faecal coliforms ≤ 25 cfu/100ml	95%tile E coli / Faecal coliforms greater than 20 cfu/100ml
		Biota	Fish	Maintenance of fish species diversity	Maintain fish abundance at a level that fulfils ecosystem services roles of recreational angling and subsistence harvesting	Balanced relative abundance and diversity between Cichlidae, Cyprinidae and Clariidae	A notable dominance of one family of fish over two or more consecutive assessments
				Fish health	Fish health to be maintained in a state that is safe for consumption and	Ulcers, bacterial infections and parasite burdens	>1% of the catch being impacted by bacterial infections

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
					suitable for recreational angling	limited to <1% of fish population	or overburden of parasites
				Fish abundance	Maintaining fish abundance to support subsistence and recreational fishing	Maintain a stable catch per unit effort relative to previous surveys	A notable decline in fish population abundance over more than two assessments
			Alien aquatic plant species	Water Quality (Nutrients)	Maintain Nzhelele Dam in a mesotrophic state or better	Median annual Total Phosphates ≤ 0.047 mg/l	Median annual Total Phosphates greater than 0.038 mg/l
						Median annual Chlorophyll a ≤ 20 µg/l	Median annual Chlorophyll a greater than 16 µg/l
				Aerial extent	Maintain low % aerial cover of AIP (Water Hyacinth, Water Lettuce, Water Fern, Kariba Weed, Parrot's Feather) on dam surface and fringe	Maintain aerial cover of AIP on dam surface below 10%	The presence of AIP species on the dam surface or along the fringe

3.2.4.5 RQOs for water quality and biota in the Vondo Dam

The RQOs for water quality, fish and alien vegetation for the Vondo Dam is provided in Table 3-44.

Table 3-44 Resource Quality Objectives for water quality and biota in the Vondo Dam

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
Upper Luvuvhu	Vondo Dam	Quality	Nutrients	Total Phosphates (mg/l) Chlorophyll a (µg/l)	Maintain Vondo Dam in a mesotrophic state or better (intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems) in order to protect irrigation water supply to downstream users and rural domestic water users.	Median annual Total Phosphates ≤ 0.047 mg/l Median annual Chlorophyll a ≤ 20 µg/l	Median annual Total Phosphates greater than 0.038 mg/l Median annual Chlorophyll a greater than 16 µg/l
			Salts	Electrical Conductivity (EC) (mS/m) Total dissolved salts (TDS) (mg/l)	Salt concentrations must be maintained at a level that is not harmful to aquatic ecosystems in the dam and is in an Acceptable fitness for use state for domestic and industrial water supply, and for irrigation water supply.	95%tile EC ≤ 90 mS/m 95%tile TDS ≤ 585 mg/l	95%tile EC greater than 72 mS/m 95%tile TDS greater than 468 mg/l
			Pathogens	Escherichia coli, Faecal coliforms	Vondo Dam must be maintained in an Acceptable microbiological state that is safe for contact recreational user.	95%tile E coli / Faecal coliforms ≤ 25 cfu/100ml	95%tile E coli / Faecal coliforms greater than 20 cfu/100ml
		Biota	Fish	Maintenance of fish species diversity	Maintain fish abundance at a level that fulfils ecosystem services roles of recreational angling and subsistence harvesting	Balanced relative abundance and diversity between Cichlidae, Cyprinidae and Clariidae	A notable dominance of one family of fish over two or more consecutive assessments
				Fish health	Fish health to be maintained in a state that	Ulcers, bacterial infections and	>1% of the catch being impacted by

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
					is safe for consumption and suitable for recreational angling	parasite burdens limited to <1% of fish population	bacterial infections or overburden of parasites
				Fish abundance	Maintaining fish abundance to support subsistence and recreational fishing	Maintain a stable catch per unit effort relative to previous surveys	A notable decline in fish population abundance over more than two assessments
			Alien aquatic plant species	Water Quality (Nutrients)	Maintain Vondo Dam in a mesotrophic state or better	Median annual Total Phosphates ≤ 0.047 mg/l	Median annual Total Phosphates greater than 0.038 mg/l
						Median annual Chlorophyll a ≤ 20 µg/l	Median annual Chlorophyll a greater than 16 µg/l
				Aerial extent	Maintain low % aerial cover of AIP (Water Hyacinth, Water Lettuce, Water Fern, Kariba Weed, Parrot's Feather) on dam surface and fringe	Maintain aerial cover of AIP on dam surface below 10%	The presence of AIP species on the dam surface or along the fringe

3.2.4.6 RQOs for water quality and biota in the Nandoni Dam

The RQOs for water quality, fish and alien vegetation for the Nandoni Dam is provided in Table 3-45.

Table 3-45 Resource Quality Objectives for water quality and biota in the Nandoni Dam

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
Upper Luvuvhu	Nandoni Dam	Quality	Nutrients	Total Phosphates (mg/l) Chlorophyll a (µg/l)	Maintain Nandoni Dam in a mesotrophic state or better (intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems) in order to protect irrigation water supply to downstream users and rural domestic water users.	Median annual Total Phosphates ≤ 0.047 mg/l Median annual Chlorophyll a ≤ 20 µg/l	Median annual Total Phosphates greater than 0.038 mg/l Median annual Chlorophyll a greater than 16 µg/l
			Salts	Electrical Conductivity (EC) (mS/m) Total dissolved salts (TDS) (mg/l)	Salt concentrations must be maintained at a level that is not harmful to aquatic ecosystems in the dam and is in an Acceptable fitness for use state for domestic and industrial water supply, and for irrigation water supply.	95%tile EC ≤ 90 mS/m 95%tile TDS ≤ 585 mg/l	95%tile EC greater than 72 mS/m 95%tile TDS greater than 468 mg/l
			Pathogens	Escherichia coli, Faecal coliforms	Nandoni Dam must be maintained in an Acceptable microbiological state that is safe for contact recreational user.	95%tile E coli / Faecal coliforms ≤ 25 cfu/100ml	95%tile E coli / Faecal coliforms greater than 20 cfu/100ml
		Biota	Fish	Maintenance of fish species diversity	Maintain fish abundance at a level that fulfils ecosystem services roles of	Balanced relative abundance and diversity between Cichlidae,	A notable dominance of one family of fish over two or more

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
					recreational angling and subsistence harvesting	Cyprinidae and Clariidae	consecutive assessments
				Fish health	Fish health to be maintained in a state that is safe for consumption and suitable for recreational angling	Ulcers, bacterial infections and parasite burdens limited to <1% of fish population	>1% of the catch being impacted by bacterial infections or overburden of parasites
				Fish abundance	Maintaining fish abundance to support subsistence and recreational fishing	Maintain a stable catch per unit effort relative to previous surveys	A notable decline in fish population abundance over more than two assessments
			Alien aquatic plant species	Water Quality (Nutrients)	Maintain Nandoni Dam in a mesotrophic state or better	Median annual Total Phosphates ≤ 0.047 mg/l	Median annual Total Phosphates greater than 0.038 mg/l
						Median annual Chlorophyll a ≤ 20 µg/l	Median annual Chlorophyll a greater than 16 µg/l
				Aerial extent	Maintain low % aerial cover of AIP (Water Hyacinth, Water Lettuce, Water Fern, Kariba Weed, Parrot's Feather) on dam surface and fringe	Maintain aerial cover of AIP on dam surface below 10%	The presence of AIP species on the dam surface or along the fringe

3.2.4.7 RQOs for water quality and biota in the Albasini Dam

The RQOs for water quality, fish and alien vegetation for the Albasini Dam is provided in Table 3-46.

Table 3-46 Resource Quality Objectives for water quality and biota in the Albasini Dam

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
Upper Luvuvhu	Albasini Dam	Quality	Nutrients	Total Phosphates (mg/l) Chlorophyll a (µg/l)	Maintain Albasini Dam in a mesotrophic state or better (intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems) in order to protect bulk domestic water supply and irrigation water supply.	Median annual Total Phosphates ≤ 0.047 mg/l Median annual Chlorophyll a ≤ 20 µg/l	Median annual Total Phosphates greater than 0.038 mg/l Median annual Chlorophyll a greater than 16 µg/l
			Salts	Electrical Conductivity (EC) (mS/m) Total dissolved salts (TDS) (mg/l)	Salt concentrations must be maintained at a level that is not harmful to aquatic ecosystems in the dam and is in an Acceptable fitness for use state for domestic and industrial water supply, and for irrigation water supply.	95%tile EC ≤ 90 mS/m 95%tile TDS ≤ 585 mg/l	95%tile EC greater than 72 mS/m 95%tile TDS greater than 468 mg/l
			Pathogens	Escherichia coli, Faecal coliforms	Albasini Dam must be maintained in an Acceptable microbiological state that is safe for contact recreational user.	95%tile E coli / Faecal coliforms ≤ 25 cfu/100ml	95%tile E coli / Faecal coliforms greater than 20 cfu/100ml
		Biota	Fish	Maintenance of fish species diversity	Maintain fish abundance at a level that fulfils ecosystem services roles of recreational angling and subsistence harvesting	Balanced relative abundance and diversity between Cichlidae, Cyprinidae and Clariidae	A notable dominance of one family of fish over two or more consecutive assessments
				Fish health	Fish health to be maintained in a state	Ulcers, bacterial infections and	>1% of the catch being impacted by

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
					that is safe for consumption and suitable for recreational angling	parasite burdens limited to <1% of fish population	bacterial infections or overburden of parasites
				Fish abundance	Maintaining fish abundance to support subsistence and recreational fishing	Maintain a stable catch per unit effort relative to previous surveys	A notable decline in fish population abundance over more than two assessments
			Alien aquatic plant species	Water Quality (Nutrients)	Maintain Albasini Dam in a mesotrophic state or better	Median annual Total Phosphates ≤ 0.047 mg/l	Median annual Total Phosphates greater than 0.038 mg/l
						Median annual Chlorophyll a ≤ 20 µg/l	Median annual Chlorophyll a greater than 16 µg/l
				Aerial extent	Maintain low % aerial cover of AIP (Water Hyacinth, Water Lettuce, Water Fern, Kariba Weed, Parrot's Feather) on dam surface and fringe	Maintain aerial cover of AIP on dam surface below 10%	The presence of AIP species on the dam surface or along the fringe

3.2.4.8 RQOs for water quality and biota in the Mvuwe Dam

The RQOs for water quality, fish and alien vegetation for the Mvuwe Dam is provided in Table 3-47.

Table 3-47 Resource Quality Objectives for water quality and biota in the Mvuwe Dam

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
Upper Luvuvhu	Mvuwe Dam	Quality	Nutrients	Total Phosphates (mg/l) Chlorophyll a (µg/l)	Maintain Mvuwe Dam in a mesotrophic state or better (intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems) in order to protect irrigation water supply to downstream users and rural domestic water users.	Median annual Total Phosphates ≤ 0.047 mg/l Median annual Chlorophyll a ≤ 20 µg/l	Median annual Total Phosphates greater than 0.038 mg/l Median annual Chlorophyll a greater than 16 µg/l
			Salts	Electrical Conductivity (EC) (mS/m) Total dissolved salts (TDS) (mg/l)	Salt concentrations must be maintained at a level that is not harmful to aquatic ecosystems in the dam and is in an Acceptable fitness for use state for domestic and industrial water supply, and for irrigation water supply.	95%tile EC ≤ 90 mS/m 95%tile TDS ≤ 585 mg/l	95%tile EC greater than 72 mS/m 95%tile TDS greater than 468 mg/l
			Pathogens	Escherichia coli, Faecal coliforms	Mvuwe Dam must be maintained in an Acceptable microbiological state that is safe for contact recreational user.	95%tile E coli / Faecal coliforms ≤ 25 cfu/100ml	95%tile E coli / Faecal coliforms greater than 20 cfu/100ml
		Biota	Fish	Maintenance of fish species diversity	Maintain fish abundance at a level that fulfils ecosystem services roles of recreational angling and subsistence harvesting	Balanced relative abundance and diversity between Cichlidae, Cyprinidae and Clariidae	A notable dominance of one family of fish over two or more consecutive assessments
				Fish health	Fish health to be maintained in a state that is safe for consumption and suitable for recreational angling	Ulcers, bacterial infections and parasite burdens limited to <1% of fish population	>1% of the catch being impacted by bacterial infections or overburden of parasites

IUA	Dam Name	Component	Sub-component	Indicator/ Measure	RQO Narrative	RQO Numerical	TPC
				Fish abundance	Maintaining fish abundance to support subsistence and recreational fishing	Maintain a stable catch per unit effort relative to previous surveys	A notable decline in fish population abundance over more than two assessments
			Alien aquatic plant species	Water Quality (Nutrients)	Maintain Mvuwe Dam in a mesotrophic state or better	Median annual Total Phosphates ≤ 0.047 mg/l	Median annual Total Phosphates greater than 0.038 mg/l
						Median annual Chlorophyll a ≤ 20 µg/l	Median annual Chlorophyll a greater than 16 µg/l
				Aerial extent	Maintain low % aerial cover of AIP (Water Hyacinth, Water Lettuce, Water Fern, Kariba Weed, Parrot's Feather) on dam surface and fringe	Maintain aerial cover of AIP on dam surface below 10%	The presence of AIP species on the dam surface or along the fringe

3.3 Wetland Resource Quality Objectives and numerical limits

The objective of the wetland component was to specify RQOs for high priority wetlands. Following the recommendations and method guidelines by DWS (2016) and more recently by Bredin *et al* (2019), specific RQOs were set for priority wetlands of high or very high importance. The overall, integrated process of determining RQOs for wetlands is outlined below as a 5-step process (Bredin *et al.,* 2019):

- Identify potentially significant wetland resources.
- Identify, verify, and prioritize wetland resources to inform the delineation of Resource Units.
- Desktop delineation, Present Ecological State and Importance and Sensitivity of Priority Wetland Resources to determine the Recommended Ecological Category and to inform the delineation of Resource Units.
- Determine sub-components and indicators; and
- Set Resource Quality Objectives, and numerical criteria, and provide implementation information.

Wetland information / data used to determine RQOs included field verification and assessments, the quantification or qualification of impacts for which SANCL (2022) was used within National Wetland Map 5 (NBA, 2018) delineations, PES, EI, ES, HGM typing and delineated extent. These aspects of each wetland lend themselves to the definition of both narrative and numeric RQOs**.** Numeric RQOs rely heavily on species counts from past studies and extents (expressed in Ha) calculated from land cover data (SANLC, 2022).

Table 3-48. Wetland Resource Quality Objectives for priority wetland resource units

<table>
<tr><th>IUA / RU</th><th>Component</th><th>Subcomponent</th><th>Indicator</th><th colspan="11">RQO</th><th>TPC</th></tr>
<tr><th></th><th></th><th></th><th></th><th colspan="2">Narrative</th><th colspan="9">Numerical</th><th></th></tr>
<tr><td colspan="15">The RQOs outlined below for the Luvuvhu Floodplain (Makuleke) - river & floodplain complex with pans, are to maintain a B category (TEC), with a percentage score of at least 82%, and the EI should remain Very High and the ES High.</td></tr>
<tr><td rowspan="20">Lower Luvuvhu / Mutale (RU15)</td><td rowspan="16">Water quantity</td><td rowspan="14">Water Inputs</td><td rowspan="14">Hydrology (EWR)</td><td colspan="2" rowspan="14">Maintenance of perenniality, seasonality and wet and dry season baseflows is required to provide the necessary wetting regime required for supporting wetland components. The quantity and timing of inputs, depth to groundwater. and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function.</td><td colspan="9">The EWR determined for the upstream Luvuvhu River site should be implemented (not shown here) i.e. main channel must remain perennial, and the EWR for the floodplain component (floods) is shown below.</td><td>Failure to implement the EWR determined for the upstream Luvuvhu River site OR loss of perenniality of the main channel</td></tr>
<tr><td colspan="9">Floods. Flood can occur in the month before or after the month indicated</td><td rowspan="14">Flood peaks beyond the specified range OR reduced return interval of occurrence for specified floods</td></tr>
<tr><td></td><td colspan="4">Within year floods</td><td colspan="4">Inter annual floods</td></tr>
<tr><td></td><td colspan="4"><1:2 years</td><td colspan="4">>=1:2 years</td></tr>
<tr><td>Flood Class</td><td>Class1</td><td>Class2</td><td>Class3</td><td>Class4</td><td>1:2 year</td><td>1:5 year</td><td>1:10 year</td><td>1:20 year</td></tr>
<tr><td>Ave peak discharge (m^3/s)</td><td>11.1</td><td>23.4</td><td>50.4</td><td>88.7</td><td>200</td><td>593</td><td>1029</td><td>1660</td></tr>
<tr><td>Ave duration (days)</td><td>4</td><td>6</td><td>8</td><td>10</td><td>10</td><td>15</td><td>20</td><td>34</td></tr>
<tr><td>Number</td><td>2</td><td>2</td><td>2</td><td>1</td><td colspan="4">As per return period</td></tr>
<tr><td>Oct</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Nov</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dec</td><td>1</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jan</td><td></td><td>1</td><td>1</td><td></td><td rowspan="4">1</td><td rowspan="4">1</td><td rowspan="4">1</td><td rowspan="4">1</td></tr>
<tr><td>Feb</td><td></td><td></td><td></td><td>1</td></tr>
<tr><td>Mar</td><td></td><td></td><td>1</td><td></td></tr>
<tr><td>Apr</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>May</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jun</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jul</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Aug</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Sep</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Vol (10^6m^3)</td><td>8.66</td><td>14.49</td><td>32.78</td><td>28.72</td><td>74.55</td><td>208.14</td><td>420.84</td><td>787.78</td></tr>
<tr><td>% PES (2022) MAR</td><td>1.81</td><td>3.04</td><td>6.87</td><td>6.02</td><td>15.62</td><td>43.61</td><td>88.19</td><td>165.08</td></tr>
<tr><td>Depth to ground water on the floodplain</td><td>The average depth to groundwater across the floodplain should remain shallow to support phreatophytic vegetation communities and pan levels.</td><td colspan="9">The average depth to groundwater should range between 2.5m and 4.5m and should only extent to 6.5m during natural droughts.</td><td>The average depth to groundwater > 4.5m</td></tr>
<tr><td rowspan="2">Water distribution and retention patterns</td><td>Flooding by damming with the wetland</td><td>Maintain the absence of artificial damming within the wetland complex (excludes pans).</td><td colspan="9">Artificial damming within the delineated wetland area shall not exceed 0Ha (excludes pans).</td><td>Artificial damming within the delineated wetland area > 0Ha (excludes pans)</td></tr>
<tr><td>Pan water level regime</td><td>Pan water level regimes are dependent on flooding regimes and rainfall for infilling. The return period for floods required by different pans should be adhered to as far as possible according to the EWR determined for pans.</td><td colspan="9">The EWR determined for the floodplain component including pans should be implemented (See above).</td><td>Failure to implement the EWR determined for the floodplain component including pans</td></tr>
<tr><td rowspan="4">Habitat</td><td rowspan="2">Wetland vegetation structure / composition</td><td>Extent of natural wooded land within the wetland complex (land cover classes 1-4, 2020)</td><td>The extent of natural wooded land within the wetland complex should remain a dominant component of overall vegetation</td><td colspan="9">The extent of natural wooded land within the wetland complex should not decline below 2600Ha.</td><td>The extent of natural wooded land within the wetland complex < 2600Ha</td></tr>
<tr><td>Extent of herbaceous wetlands (land cover classes 22-23, 2020)</td><td>The extent of herbaceous wetlands should not decline.</td><td colspan="9">The extent of herbaceous wetlands should not decline below 49.6Ha.</td><td>The extent of herbaceous wetlands < 49.6Ha</td></tr>
<tr><td rowspan="2">Habitat fragmentation with the wetland delineation</td><td>Extent of alien invasive plants within the wetland / complex</td><td>Dense patches of alien invasive plant species should be prevented from establishing within the wetland complex.</td><td colspan="9">Dense patches of alien invasive plant species should not exceed 2% of the wetland area.</td><td>Dense patches of alien invasive plant species > 2% of the wetland area</td></tr>
<tr><td>Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching , SANLC classes 47-67)</td><td>Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex.*</td><td colspan="9">The aerial extent of developments within the delineated wetland area shall not exceed 0Ha.</td><td>The aerial extent of developments within the delineated wetland area > 0Ha</td></tr>
</table>

IUA / RU	Component	Subcomponent	Indicator	RQO		TPC
				Narrative	Numerical	
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted within the wetland complex.	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 0Ha.	The aerial extent of agricultural activities and croplands within the delineated wetland area > 0Ha
	Habitat / Biota	Protection	Protected areas / Conservation	The wetland complex should remain under the national protection of conservation.	100% of the delineated wetland complex should remain protected by conservation, such that it also remains a Ramsar site and IBA.	< 100% of the delineated wetland complex protected by conservation
			Ramsar wetland	The wetland complex should retain qualities to uphold its Ramsar status as a wetland of international importance.		
			Important birding area	The wetland complex should remain an IBA (Important Birding Area).		
	Biota	Birds	Threatened bird species (water / wetland / riparian-dependent)	Populations of Pels Fishing Owl (*Scotopelia peli*) White Crowned Lapwing (*Vanellus albiceps*) Black Stork (*Ciconia nigra)*, Yellow billed Stork (*Mycteria ibis*), Open billed stork (Anastomus lamelligerus), Saddle-billed Stork (*Ephippiorhynchus senegalensis*), Great White Pelican (*Pelecanus onocrotalus*), Greater Painted-Snipe *(Rostratula benghalensis)* and Pygmy Goose (*Nettapus auritus*) should be maintained within the wetland complex.	9 listed species should occur during the wet season	< 9 listed species during the wet season
			Bird species diversity within the wetland complex	The number of bird species (includes residents and migrants) that utilise the Luvuvhu River and its floodplain and pans should be maintained.	The number of bird species that utilise the Luvuvhu River and its floodplain and pans should be at least 450 species.	The number of bird species that utilise the Luvuvhu River and its floodplain and pans < 450 species
		Mammals	Elephant abundance	The abundance of elephants within the wetland complex should be strategically and adaptively managed to promote conservation targets for all species, and overall vegetation health.	N/A	
			Hippo abundance (VU)	The main Luvuvhu River and perennial and near-perennial pans within the floodplain should continue to supports pods of Hippopotamus (Hippopotamus amphibius, VU). The Luvuvhu main channel should remain perennial to maintain critical hippo habitats, especially during the dry season.	N/A	
		Reptiles	Crocodile abundance (VU)	The main Luvuvhu River and perennial and near-perennial pans within the floodplain should continue to supports Nile Crocodiles (Crocodylus niloticus, VU). The Luvuvhu main channel should remain perennial to maintain critical crocodile habitats, especially during the dry season.	N/A	
			Threatened reptile species (water-dependent)	The Nile crocodile (Crocodylus niloticus, CITES App. II; SA Red Data: Vulnerable) and African python (*Python sebae*, CITES App. II; SA Red Data: Vulnerable), should both remain an integral part of the wetland complex.	2 listed species should remain present within the wetland complex	< 2 listed species remain present within the wetland complex
		Fish	Species diversity in the Luvuvhu River and perennial pans	The number of fish species that occur in the Luvuvhu River and perennial pans should be maintained, and alien fish species should be kept as low as possible (especially Tilapia niloticus)	The number of fish species that occur in the Luvuvhu River and perennial pans should be at least 26 indigenous species in the wet season.	The number of fish species that occur in the Luvuvhu River and perennial pans < 26 indigenous species in the wet season
		Amphibians	Frogs and toads (species diversity)	The number of amphibian species that occur along the Luvuvhu River and within its floodplain and pans should be maintained.	The number of amphibian species that occur along the Luvuvhu River and within its floodplain and pans should be at least 30 species in the wet season.	The number of amphibian species that occur along the Luvuvhu River and within its floodplain and pans < 30 species in the wet season
		Vegetation	Alian invasive plants	The wetland complex should be maintained by removal of perennial alien plant species, especially *Mimosa pigra*.	There should be zero occurrence of *Mimosa pigra* within the wetland complex.	Presence of *Mimosa pigra* within the wetland complex
			Plant species diversity within the wetland complex	The number of plant species that occur along the Luvuvhu River and within its floodplain and pans should be maintained.	The number of plant species that occur along the Luvuvhu River and within its floodplain and pans should be at least 250 species.	The number of plant species that occur along the Luvuvhu River and within its floodplain and pans < 250 species
	Water quality	Salts	Electrical conductivity (mS/m)	Water quality in the main Luvuvhu River channel should maintain the TEC (B/C).	95th percentile EC < 70 mS/m	95th percentile EC > 70 mS/m
		System Variables	pH		5.75 >= pH <= 9.0	pH < 5.75 or pH > 9.0
		Nutrients	Total inorganic nitrogen (TIN) (mg/l)		Median TIN < 1.90 mg/l	Median TIN > 1.90 mg/l

IUA / RU	Component	Subcomponent	Indicator	RQO		TPC
				Narrative	Numerical	
			Orthophosphate (mg/l)		Median PO_4-P < 0.075 mg/l	Median PO_4-P > 0.075 mg/l
			Ammonia (NH_3-N) (mg/l)		Median NH_3-N < 0.044 mg/l	Median NH_3-N > 0.044 mg/l
The RQOs outlined below for the Mutale Wetlands (Seeps, Valley bottom with and without channel) are to maintain a C category (TEC), with a percentage score of at least 62%, and the EI should remain Very High and the ES High.						
Lower Luvuvhu / Mutale (RU15)	Water quantity	Water Inputs	Hydrology (EWR)	Maintenance of perenniality and wet and dry season baseflows is required. to provide the necessary wetting regime required for supporting other wetland components. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function.	The EWR determined for the downstream Mutale River site (Ri33) should be implemented	Failure to implement the EWR determined for the downstream Mutale River site (Ri33)
		Water distribution and retention patterns	Flooding by damming within the wetland	The current extent of damming within the wetland complex should not be permitted to increase.	The extent of damming within the delineated wetland area shall not exceed 6Ha.	The extent of damming within the delineated wetland area > 6Ha
	Habitat	Wetland vegetation structure / composition	Extent of natural grassland within the wetland complex (land cover classes 12-13; SANLC, 2020)	The extent of natural grassland within the wetland complex should not decline.	The extent of natural grassland within the wetland complex should not decline below 3.7Ha.	The extent of natural grassland within the wetland complex < 3.7Ha
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; SANLC, 2020)	The extent of natural wooded land within the wetland complex should not decline.*	The extent of natural wooded land within the wetland complex should not decline below 2935Ha.*	The extent of natural wooded land within the wetland complex < 2935Ha*
			Extent of herbaceous wetlands (land cover classes 22-23; SANLC, 2020)	The extent of herbaceous wetlands should not decline.	The extent of herbaceous wetlands should not decline below 49.6Ha.	The extent of herbaceous wetlands < 49.6Ha
		Habitat fragmentation within the wetland complex delineation	Extent of alien invasive plants within the wetland complex	Dense patches of alien invasive plant species should be prevented from establishing within the wetland complex.	Dense patches of alien invasive plant species should not exceed 5% of the wetland area.	Dense patches of alien invasive plant species > 5% of the wetland area
			Extent of planted forest within the wetland complex (land cover classes 5-7; SANLC, 2020)	The current extent of planted forest within the wetland complex should not increase.*	The current extent of planted forest within the wetland complex should not exceed 6.8Ha.*	The extent of planted forest within the wetland complex > 6.8Ha*
			Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching, SANLC classes 47-67)	Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex.*	The aerial extent of developments within the delineated wetland area shall not exceed 34.6Ha.*	The aerial extent of developments within the delineated wetland area > 34.6Ha*
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73; SANLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex. *	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 98Ha.*	The aerial extent of agricultural activities and croplands within the delineated wetland area > 98Ha*
	Biota	Taxon richness	Number of wetland-dependent plant species	The number of wetland-dependent plant species that occur within the wetland complex should be maintained.	The number of wetland-dependent plant species that occur within the wetland complex should be 20 at least (see Table # for list).	The number of wetland-dependent plant species that occur within the wetland < 20
	Water quality	Salts	Electrical conductivity (mS/m)	Water quality river RQOs from the upper Mutale river site (Ri33) apply. Water quality is sufficient to maintain the TEC.	95th percentile EC < 70 mS/m	95th percentile EC > 70 mS/m
		System Variables	pH		5.75 >= pH <= 9.0	pH < 5.75 or pH > 9.0
		Nutrients	Total inorganic nitrogen (TIN) (mg/l)		Median TIN < 1.90 mg/l	Median TIN > 1.90 mg/l
			Orthophosphate (mg/l)		Median PO_4-P < 0.075 mg/l	Median PO_4-P > 0.075 mg/l
			Ammonia (NH_3-N) (mg/l)		Median NH_3-N < 0.044 mg/l	Median NH_3-N > 0.044 mg/l
The RQOs outlined below for Lake Fundudzi with valley bottom wetlands are to maintain a B category (TEC), with a percentage score of at least 82%, and the EI should remain Very High and the ES High.						
Lower Luvuvhu / Mutale (RU15)	Water quantity	Water distribution and retention patterns	Lake water level regime	Lake water level regime should be maintained within its natural fluctuation range.	N/A	
	Habitat	Wetland extent	Delineated wetland area (Ha)	The extent of valley bottom wetlands upstream of the lake should be maintained.	The extent of valley bottom wetlands upstream of the lake should be maintained at a minimum of 40Ha.	The extent of valley bottom wetlands upstream of the lake < 40Ha
		Wetland vegetation structure / composition	Extent of natural grassland and non-woody vegetation within the wetland complex, including herbaceous wetlands.	The extent of natural grassland and non-woody vegetation including herbaceous wetlands within the wetland complex should be maintained.	The extent of natural grassland and non-woody vegetation, including herbaceous wetlands, within the wetland complex should remain at about 170Ha.	The extent of natural grassland and non-woody vegetation, including herbaceous wetlands, within the wetland complex < 170Ha

IUA / RU	Component	Subcomponent	Indicator	RQO		TPC
				Narrative	Numerical	
			Extent of natural wooded land within the wetland complex.	The extent of natural wooded land within the wetland complex should not increase*	The extent of natural wooded land within the wetland delineation should not become more 248Ha.*	The extent of natural wooded land within the wetland delineation > 248Ha*
		Habitat fragmentation within the wetland delineation	Extent of alien invasive plants within the wetland / complex	Dense patches of alien invasive plant species should be prevented from establishing within the wetland complex.	Dense patches of alien invasive plant species should not exceed 5% of the wetland area.	Dense patches of alien invasive plant species > 5% of the wetland area
			Extent of planted forest within the wetland complex (land cover classes 5-7; SANLC, 2020)	Wetland habitat loss or fragmentation due to forestry should not be permitted within the wetland complex.*	The aerial extent of forestry within the delineated wetland area shall not exceed 0Ha.*	The aerial extent of forestry within the delineated wetland area > 0Ha*
			Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching , SANLC classes 47-67)	Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex.*	The aerial extent of developments within the delineated wetland area shall not exceed 0Ha.*	The aerial extent of developments within the delineated wetland area > 0Ha*
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73; SANLC, 2020)	Wetland habitat loss due to direct agricultural activities, including croplands should not be permitted within the wetland complex*	The aerial extent of agricultural activities, including croplands within the delineated wetland area shall not exceed 0Ha.*	The aerial extent of agricultural activities, including croplands within the delineated wetland area > 0Ha*
	Habitat / Biota	Protection	Rehabilitation structures	WfW rehabilitation structures in valley-bottom wetlands upstream of the Lake should be maintained.	N/A	
			Cultural importance	Lake Fundudzi should remain a water body of cultural importance as a sacred site to the surrounding people.	100% of Lake Fundudzi and its surrounding wetlands should remain a water body of cultural importance as a sacred site to the surrounding people.	
	Biota	Taxon richness	Number of wetland-dependent plant species	The number of wetland-dependent plant species that occur within the wetland complex should be maintained.	The number of wetland-dependent plant species that occur within the wetland complex should be 10 at least.	The number of wetland-dependent plant species that occur within the wetland complex < 10
	Water quality	Sediments	Sediment supply from the catchment	The Lake Fundudzi catchment is steep and has gravel roads which erode during rain events. Sediment supply from the catchment in these denuded areas should be managed before entering the valley bottom wetlands or Lake.	Zero supply of catchment sediments to the valley bottom wetlands	Measurable supply of catchment sediments to the valley bottom wetlands
		Salts	Electrical conductivity (mS/m)	Water quality in the main Mutale River channel should maintain the TEC (B/C).	95th percentile EC < 70 mS/m	95th percentile EC > 70 mS/m
		System Variables	pH		5.75 >= pH <= 9.0	pH < 5.75 or pH > 9.0
		Nutrients	Total inorganic nitrogen (TIN) (mg/l)		Median TIN < 1.90 mg/l	Median TIN > 1.90 mg/l
			Orthophosphate (mg/l)		Median PO4-P < 0.075 mg/l	Median PO_4-P > 0.075 mg/l
			Ammonia (NH_3-N) (mg/l)		Median NH_3-N < 0.044 mg/l	Median NH_3-N > 0.044 mg/l
The RQOs outlined below for the Kolope riverine wetlands are to maintain a A/B category (TEC), with a percentage score of at least 88%, and the EI should remain Very High and the ES at least Low.						
Mapungubwe (RU 8)	Water quantity	Water Inputs	Hydrology (EWR)	These riverine wetlands are intermittent to ephemeral with a high degree of flashiness during rainfall events, but also with a myriad of small pans both off-channel and within the broader channel that have high levels of clay and clearly hold water for some time (a few weeks at most). This is a difficult flow regime to maintain, nevertheless an EWR was determined for the downstream Kolope River site, which should be implemented.	The EWR determined for the downstream Kolope River site (Riv32) should be implemented	Failure to implement the EWR determined for the downstream Kolope River site (Riv32)
		Water distribution and retention patterns	Flooding by damming within the wetland	The current extent of damming within the wetland complex should not be permitted to increase (excludes water holding facilities at Venetia mine).	The extent of damming within the delineated wetland area should not exceed 1Ha.	The extent of damming within the delineated wetland area > 1Ha
	Habitat	Wetland vegetation structure / composition	Extent of natural grassland within the wetland complex (land cover classes 12-13; SANLC, 2020)	The overall extent of natural grassland should be maintained within the wetland complex, but should not become the dominant cover type.	The overall extent of natural grassland should be maintained at around 30% of the wetland extent.	The overall extent of natural grassland < 30% of the wetland extent
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; SANLC, 2020)	The overall extent of open and dense woodland within the wetland complex should be maintained as the dominant cover type.	The overall extent of woodland should be maintained at around 60% of the wetland extent.	The overall extent of woodland < 60% of the wetland extent
		Habitat fragmentation within the wetland delineation	Extent of alien invasive plants within the wetland / complex	Dense patches of alien invasive plant species should be prevented from establishing within conserved portion of the wetland complex.	Dense patches of alien invasive plant species should not exceed 0% of the wetland area within the conserved portion.	Dense patches of alien invasive plant species > 0% of the wetland area within the conserved portion

IUA / RU	Component	Subcomponent	Indicator	RQO		TPC
				Narrative	Numerical	
			Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching , SANLC classes 47-67)	Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex.*	The aerial extent of developments within the delineated wetland area shall not exceed 15Ha.*	The aerial extent of developments within the delineated wetland area > 15Ha*
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73; SANLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase within the wetland complex. *	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 180Ha.*	The aerial extent of agricultural activities and croplands within the delineated wetland area > 180Ha*
	Habitat / Biota	Protection	Protected areas / Conservation	The wetland complex should remain under the national and private protection of conservation.	100% of the delineated wetland complex within Mapungubwe National Park and De Beers Venetia Nature Reserve should remain protected by conservation, and WfW rehabilitation structures at Leeuwpan should be maintained.	< 100% of the delineated wetland complex within Mapungubwe National Park and De Beers Venetia Nature Reserve is protected by conservation
The RQOs outlined below for the Maloutswa Floodplain with depressional wetlands (pans) are to maintain a C category (TEC), with a percentage score of at least 62%, and the EI should remain Very High and the ES High						
Mapungubwe (RU 8)	Water quantity	Water Inputs	Hydrology (EWR)	Floods from the Limpopo, Maloutswa and Kolope rivers are necessary to inundate this complex floodplain thereby providing the wetting regime required for supporting the floodplain vegetation and dependent biota. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function. The EWR determined for the upstream Kolope River should be implemented, but environmental flows in the Limpopo River will also need to be maintained.	The EWR determined for the upstream Kolope River site (Riv32) should be implemented	Failure to implement the EWR determined for the upstream Kolope River site (Riv32)
		Water distribution and retention patterns	Flooding by damming within the wetland	The current extent of damming within the wetland complex should not be permitted to increase.	The extent of damming within the delineated wetland area should not exceed 40Ha.	The extent of damming within the delineated wetland area > 40Ha
	Habitat	Wetland vegetation structure / composition	Extent of natural grassland within the wetland complex (land cover classes 12-13; SANLC, 2020) combined with the extent of herbaceous wetlands (land cover classes 22-23; SANLC, 2020)	The combined extent of natural grassland and herbaceous wetlands should be maintained within the wetland complex and not allowed to decrease.	The combined extent of natural grassland and herbaceous wetlands should not decline below 1338Ha.	The combined extent of natural grassland and herbaceous wetlands should < 1338Ha
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; SANLC, 2020)	The extent of open and dense woodland should not be allowed to increase within the wetland complex*	The extent of open and dense woodland should not increase above 1300Ha.*	The extent of open and dense woodland > 1300Ha*
		Habitat fragmentation within the wetland delineation	Extent of alien invasive plants within the wetland / complex	Dense patches of alien invasive plant species should be prevented from establishing within conserved portion of the wetland complex.	Dense patches of alien invasive plant species should not exceed 0% of the wetland area within the conserved portion.	Dense patches of alien invasive plant species > 0% of the wetland area within the conserved portion
			Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching , SANLC classes 47-67)	Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex.*	The aerial extent of developments within the delineated wetland area shall not exceed 12Ha.*	The aerial extent of developments within the delineated wetland area > 12Ha*
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73; SANLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not increase within the wetland complex. *	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 800Ha.*	The aerial extent of agricultural activities and croplands within the delineated wetland area > 800Ha*
	Habitat / Biota	Protection	Protected areas / Conservation	The wetland complex should remain under the national protection of conservation.	100% of the delineated wetland complex should remain protected by conservation, allowing for current agreements that cater for existing agriculture.	< 100% of the delineated wetland complex protected by conservation
	Biota	Waterbirds	Wetland / floodplain birds (species diversity)	The number of wetland-dependent bird species that utilise the floodplain should be maintained.	The number of wetland-dependent bird species that utilise the floodplain should be at least 37.	The number of wetland-dependent bird species that utilise the floodplain < 37

IUA / RU	Component	Subcomponent	Indicator	RQO		TPC
				Narrative	Numerical	
		Amphibians	Amphibian species diversity	The number of amphibian species that utilise the floodplain and wetland features should be maintained.	The number of amphibian species that utilise the floodplain and wetland features should at least 4.	The number of amphibian species that utilise the floodplain and wetland features < 4
		Wetland plants	Number of wetland-dependent plant species	The number of wetland-dependent plant species should be maintained.	The number of wetland-dependent plant species should be at least 15.	The number of wetland-dependent plant species < 15
	Water quality	Salts	Electrical conductivity (mS/m)	Water quality parameters for the upstream Kolope River site are given since these flows will feed the floodplain, but water quality in the Limpopo River will also be important during flooding.	95th percentile EC < 85 mS/m	95th percentile EC > 85 mS/m
		System Variables	pH		5.6 >=pH<= 9.2	pH >9.2 or pH < 5.6
		Nutrients	Total inorganic nitrogen (TIN) (mg/l)		Median TIN < 2.24 mg/l	Median TIN > 2.24 mg/l
			Orthophosphate (mg/l)		Median PO_4-P < 0.09 mg/l	Median PO_4-P > 0.09 mg/l
			Ammonia (NH_3-N) (mg/l)		Median NH_3-N < 0.073 mg/l	Median NH_3-N > 0.073 mg/l
The RQOs outlined below for the Peat domes in KNP - Malahlapanga (with thermal springs), are to maintain a B/C category (TEC), with a percentage score of at least 78%, and the EI should remain Very High and the ES at least Moderate.						
Shingwedzi (RU 16)	Water quantity	Water Inputs	Flow rates from natural springs	Water flowing from springs should not be impeded so as to cause drying of peats	N/A	
	Habitat	Wetland vegetation structure / composition	Extent of woody vegetation within the wetland complex	Woody vegetation should not be permitted to encroach into the wetland complex	N/A	
			Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020) together with the extent of herbaceous wetlands (land cover classes 22-23, 2020)	The current extent of natural grassland together with herbaceous wetland should not decline.	The current extent of natural grassland together with herbaceous wetland should not decline below 8Ha.	The current extent of natural grassland together with herbaceous wetland < 8Ha
		Habitat fragmentation within the wetland delineation	Extent of alien invasive plants within the wetland / complex	Dense patches of alien invasive plant species should be prevented from establishing within the wetland complex.	Dense patches of alien invasive plant species should not exceed 0% of the wetland area.	Dense patches of alien invasive plant species > 0% of the wetland area
			Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching , SANLC classes 47-67)	Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex.*	The aerial extent of developments within the delineated wetland area shall not exceed 0Ha.*	The aerial extent of developments within the delineated wetland area > 0Ha*
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73; SANLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted within the wetland complex. *	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 0Ha.*	The aerial extent of agricultural activities and croplands within the delineated wetland area > 0Ha*
			Grazing and trampling pressure	The abundance of megaherbivores (mainly elephants and buffalos) within the wetland complex should be strategically and adaptively managed to promote conservation targets for all species, and integrity of peat domes.	N/A	
	Habitat / Biota	Protection	Protected areas / Conservation	The wetland complex should remain under the national protection of conservation.	100% of the delineated wetland complex should remain protected by conservation.	< 100% of the delineated wetland complex protected by conservation
			Rehabilitation structures	WfW rehabilitation structures. mainly earthen berms, to promote pooling and wetland vegetation recovery, should be maintained where necessary.	N/A	
	Biota	Taxon richness	Number of wetland-dependent plant species	The number of wetland-dependent plant species that occur within the wetland complex should be maintained.	The number of wetland-dependent plant species that occur within the wetland complex should be 6 at least.	The number of wetland-dependent plant species that occur within the wetland complex < 6
The RQOs outlined below for the Bububu riverine wetlands with sodic sites (tributary of the Shingwedzi), are to maintain a A category (TEC), with a percentage score of at least 92%, and the EI should remain Very High and the ES at least Moderate.						
Shingwedzi (RU 16)	Habitat	Wetland vegetation structure / composition	Extent of natural grassland within the wetland complex (land cover classes 12-13; SANLC, 2020)	The wetland complex should retain a non-dominant natural grassland component	The wetland complex should comprise 10-25% natural grassland.	The wetland complex comprises < 10-25% natural grassland
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; SANLC, 2020)	The wetland complex should remain dominated by natural wooded land (dense and open woodland)	The wetland complex should comprise 60-85% natural wooded land (dense and open woodland)	The wetland complex comprises < 60-85% natural wooded land (dense and open woodland)

IUA / RU	Component	Subcomponent	Indicator	RQO		TPC
				Narrative	Numerical	
		Habitat fragmentation within the wetland delineation	Extent of alien invasive plants within the wetland / complex	Dense patches of alien invasive plant species should be prevented from establishing within the wetland complex.	Dense patches of alien invasive plant species should not exceed 0% of the wetland area.	Dense patches of alien invasive plant species > 0% of the wetland area
			Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching , SANLC classes 47-67)	Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex.*	The aerial extent of developments within the delineated wetland area shall not exceed 0Ha.*	The aerial extent of developments within the delineated wetland area > 0Ha*
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73; SANLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted within the wetland complex. *	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 0Ha.*	The aerial extent of agricultural activities and croplands within the delineated wetland area > 0Ha*
	Habitat / Biota	Protection	Protected areas / Conservation	The wetland complex should remain under the national protection of conservation.	100% of the delineated wetland complex should remain protected by conservation.	< 100% of the delineated wetland complex protected by conservation
The RQOs outlined below for the Nyl River floodplain (including Nylsvley), are to maintain a B/C category (TEC), with a percentage score of at least 78%, and the EI should remain Very High and the ES High.						
Upper Nyl & Sterk (RU1)	Water quantity	Water Inputs	Hydrology (EWR)	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation and dependent biota. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function. The EWR determined for the floodplain should be implemented.	The EWR determined for the floodplain should be implemented: The flood requirements are: · an annual flood of 3 - 5 m3/s · a 1:2 year flood of 16 - 20 m3/s with a duration of 3 to 4 months · a 1:3 year flood of 28 - 30 m3/s with a duration of 50 to 90 days · a 1:5 year flood of 45 - 50 m3/s with a duration of 90 to -150 days.	Flood peaks beyond the specified range OR reduced return interval of occurrence for specified floods
		Water distribution and retention patterns	Flooding by damming with the wetland	The current extent of damming within the wetland complex should not be permitted to increase.	The extent of damming within the delineated wetland area should not exceed 23Ha.	The extent of damming within the delineated wetland area > 23Ha
	Habitat	Wetland vegetation structure / composition	Extent of woody vegetation on the floodplain	Woody vegetation should not be permitted to encroach onto the floodplain	N/A	
			Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020) together with the extent of herbaceous wetlands (land cover classes 22-23, 2020)	The current extent of natural grassland together with herbaceous wetland should not decline.	The current extent of natural grassland together with herbaceous wetland should not decline below 4070Ha.	The combined extent of natural grassland and herbaceous wetlands < 4070Ha (excluding water bodies)
		Habitat fragmentation with the wetland delineation	Extent of alien invasive plants within the wetland / complex	Dense patches of alien invasive plant species should be prevented from establishing within the wetland complex.	Dense patches of alien invasive plant species should not exceed 5% of the wetland area.	Dense patches of alien invasive plant species > 5% of the wetland area
				Dense patches of alien invasive plant species should be prevented from establishing within the Ramsar site (Nylsvley Nature Reserve).	Dense patches of alien invasive plant species should not exceed 0% of the wetland area within the Ramsar site (Nylsvley Nature Reserve).	Dense patches of alien invasive plant species > 0% of the wetland area within the Ramsar site (Nylsvley Nature Reserve)
			Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching , SANLC classes 47-67)	Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex*	The aerial extent of developments within the delineated wetland area shall not exceed 0Ha*	The aerial extent of developments within the delineated wetland area > 0Ha*
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73, 2020)	Wetland habitat loss due to direct agricultural activities, including grazing, and croplands should not be permitted to increase in extent within the wetland complex. *	The aerial extent of agricultural activities, including grazing, and croplands within the delineated wetland area shall not exceed 3430Ha. *	The aerial extent of agricultural activities, including croplands within the delineated wetland area > 390Ha*
	Habitat / Biota	Protection	Protected areas / Conservation	Nylsvley Nature Reserve (a portion of the floodplain) should remain under the provincial protection of conservation.	100% of the Nylsvley Nature Reserve (a portion of the floodplain) should remain protected by conservation, such that it also remains a Ramsar site and IBA.	< 100% of the Nylsvley Nature Reserve protected by conservation
			Ramsar wetland	Nylsvley Nature Reserve (a portion of the floodplain) should retain qualities to uphold its Ramsar status as a wetland of international importance.		
			Important birding area	Nylsvley Nature Reserve (a portion of the floodplain) should remain an IBA (Important Birding Area).		

IUA / RU	Component	Subcomponent	Indicator	RQO		TPC
				Narrative	Numerical	
	Biota	Birds	Threatened bird species (water / wetland-dependent)	Breeding populations of threatened species should be maintained. These include Rufous bellied Heron (*Butroides rufiventris*), Little Bittern (Ixob*rychus minutus*), Dwarf Bittern (*Ixobychus sturmiz*), Bittern (*Botaurus stellaris*), Pygmy Goose (*Nettapus auritus*), Baillon's Crake (*Porzana pusilla*), Striped Crake (*Aenigmatolimnas marginalis*) and Black Stork (*Ciconia nigra*) .	The number of threatened bird species that use the floodplain for breeding during the flood season should be at least 8	The number of threatened bird species that use the floodplain for breeding during the flood season < 8
			Waterbird species diversity	The number of bird species (includes residents and migrants) that utilise the floodplain should be maintained.	The number of bird species that utilise the floodplain should be at least 102 species.	The number of bird species that utilise the floodplain should < 102 species
		Fish	Species diversity in the floodplain during flooding	The number of fish species that occur on the floodplain during flooding should be maintained.	The number of fish species that occur in the floodplain during floods should be at least 10 species.	The number of fish species that occur in the floodplain during floods < 10 species
		Amphibians	Amphibian species diversity	The number of amphibian species that utilise the floodplain should be maintained.	The number of amphibian species that utilise the floodplain in the wet season should be at least 11.	The number of amphibian species that utilise the floodplain in the wet season < 11
		Vegetation	Alian invasive plants	The wetland complex should be maintained by removal of perennial alien plant species.	Dense patches of alien invasive plant species should not exceed 5% of the wetland area.	Dense patches of alien invasive plant species > 5% of the wetland area
			Threatened plants species	The floodplain is the only location in South Africa where wild rice (*Oryza longistaminata*; VU) grows and provides an important breeding ground for frogs and toads after rain and during floods. As such, Wild Rice populations should be maintained within the floodplain.	The aerial extent of *Oryza longistaminata* on the floodplain should correspond to the flooding regime:	Reduced aerial extent of Oryza longistaminata flooding as follows:
					· 50-59 % (area) of floodplain grasses inundated during an annual flood of 3 - 5 m3/s (at Nylsvley - central region)	· < 50-59 % (area) of floodplain grasses inundated during an annual flood of 3 - 5 m3/s (at Nylsvley - central region)
					· 80-89 % (area) of floodplain grasses inundated during a 1:2 year flood of 16 - 20 m3/s with a duration of 3 to 4 months (at Nylsvely - central region)	·< 80-89 % (area) of floodplain grasses inundated during a 1:2 year flood of 16 - 20 m3/s with a duration of 3 to 4 months (at Nylsvely - central region)
					· 80-89 % (area) of floodplain grasses inundated during a 1:3 year flood of 28 - 30 m3/s with a duration of 50 to 90 days (at Nylsvely - central region)	· < 80-89 % (area) of floodplain grasses inundated during a 1:3 year flood of 28 - 30 m3/s with a duration of 50 to 90 days (at Nylsvely - central region)
					· 90-99 % (area) of floodplain grasses inundated during a 1:5 year flood of 45 - 50 m3/s with a duration of 90 to -150 days (at Nylsvely - central region)	· < 90-99 % (area) of floodplain grasses inundated during a 1:5 year flood of 45 - 50 m3/s with a duration of 90 to -150 days (at Nylsvely - central region)
			Plant species diversity within the wetland complex	The number of plant species that occur within the floodplain and are water or wetland-dependent should be maintained.	The number of plant species that occur within the floodplain and are water or wetland-dependent should be at least 35.	The number of plant species that occur within the floodplain and are water or wetland-dependent < 35
		Salts	Electrical conductivity (mS/m)	Water quality in the Nyl River and the tributaries that feed the floodplain should maintain the TEC (C).	95th percentile EC < 85 mS/m	95th percentile EC > 85 mS/m
	Water quality	System variables	pH		5.6 >=pH<= 9.2	pH >9.2 or pH < 5.6
		Nutrients	Total inorganic nitrogen (TIN) (mg/l)		Median TIN < 2.24 mg/l	Median TIN > 2.24 mg/l
			Orthophosphate (mg/l)		Median PO_4-P < 0.09 mg/l	Median PO_4-P > 0.09 mg/l
			Ammonia (NH_3-N) (mg/l)		Median NH_3-N < 0.073 mg/l	Median NH_3-N > 0.073 mg/l
The RQOs outlined below for the Nyl Pans (valley bottom with a channel with depressional wetlands / lakes), are to maintain a C/D category (TEC), with a percentage score of at least 58%, and the EI should remain High and the ES High.						
Upper Nyl & Sterk (RU2)	Water quantity	Water Inputs	Hydrology (EWR)	Flows are necessary to replenish these large depressional lakes and flood the wetland between them, thereby providing the wetting regime required for supporting the wetland and lake vegetation and dependent biota. The quantity and timing	The EWR determined for the floodplain should be implemented: The flood requirements are:	Flood peaks beyond the specified range OR reduced return interval of occurrence for specified floods
					· an annual flood of 3 - 5 m3/s	
					· a 1:2 year flood of 16 - 20 m3/s with a duration of 3 to 4 months	

IUA / RU	Component	Subcomponent	Indicator	RQO		TPC
				Narrative	Numerical	
				of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function. The EWR determined for the upstream Nyl floodplain should be implemented, and will service these downstream wetlands.	· a 1:3 year flood of 28 - 30 m3/s with a duration of 50 to 90 days · a 1:5 year flood of 45 - 50 m3/s with a duration of 90 to -150 days.	
	Habitat	Wetland vegetation structure / composition	Extent of natural grassland within the wetland complex (land cover classes 12-13; SANLC, 2020) combined with the extent of herbaceous wetlands (land cover classes 22-23; SANLC, 2020)	The combined extent of natural grassland and herbaceous wetlands should be maintained within the wetland complex and not allowed to decrease.	The combined extent of natural grassland and herbaceous wetlands should not decline below 340Ha (excluding water bodies).	The combined extent of natural grassland and herbaceous wetlands < 340Ha (excluding water bodies)
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; SANLC, 2020)	The extent of open and dense woodland should not be allowed to increase within the wetland complex*	The extent of open and dense woodland should not increase above 1080Ha.*	The extent of open and dense woodland > 1080Ha*
		Habitat fragmentation within the wetland delineation	Extent of alien invasive plants within the wetland / complex	Dense patches of alien invasive plant species should be prevented from establishing within the wetland complex.	Dense patches of alien invasive plant species should not exceed 5% of the wetland area.	Dense patches of alien invasive plant species > 5% of the wetland area
			Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching , SANLC classes 47-67)	Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex.*	The aerial extent of developments within the delineated wetland area shall not exceed 78Ha.*	The aerial extent of developments within the delineated wetland area > 78Ha*
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73; SANLC, 2020)	Wetland habitat loss due to direct agricultural activities, including croplands should not be permitted to increase in extent within the wetland complex. *	The aerial extent of agricultural activities, including croplands within the delineated wetland area shall not exceed 390Ha.*	The aerial extent of agricultural activities, including croplands within the delineated wetland area > 390Ha*
			Grazing and trampling pressure	The grazing and trampling pressure within the wetland should be managed so as not to cause any denudation within the wetland	Extent of bare soil within the wetland to be 0Ha	Extent of bare soil within the wetland > 0Ha
		Lake area	Extent of natural open water	The extent of natural open water bodies should be maintained (given seasonal fluctuations).	The extent of natural open water bodies should be maintained (given seasonal fluctuations) at about 200Ha.	The extent of natural open water bodies (given seasonal fluctuations) < 200Ha
	Biota	Wetland plants	Number of wetland-dependent species	The number of wetland-dependent plant species should be maintained.	The number of wetland-dependent plant species should be at least 15.	The number of wetland-dependent plant species < 15
	Water Quality	Effluent	Water chemistry	Water chemistry (effluent) to comply with effluent standards.	Water quality (effluent) to comply with standards outlined in DWS notice 169 of 2013	Non-compliance with effluent standards outlined in DWS notice 169 of 2013
		Salts	Electrical conductivity (mS/m)	Water quality in the Nyl River and the tributaries that feed the floodplain should maintain the TEC (C/D).	95th percentile EC < 85 mS/m	95th percentile EC > 85 mS/m
		System variables	pH		5.6 >=pH<= 9.2	pH >9.2 or pH < 5.6
		Nutrients	Total inorganic nitrogen (TIN) (mg/l)		Median TIN < 2.24 mg/l	Median TIN > 2.24 mg/l
			Orthophosphate (mg/l)		Median PO_4-P < 0.09 mg/l	Median PO_4-P > 0.09 mg/l
			Ammonia (NH3-N) (mg/l)		Median NH3-N < 0.073 mg/l	Median NH3-N > 0.073 mg/l
The RQOs outlined below for Wonderkrater depressional wetland & spring with peat, are to maintain a B category (TEC), with a percentage score of at least 82%, and the EI should remain Very High and the ES at least Moderate.						
Upper Nyl & Sterk (RU1)	Water quantity	Water Inputs	Flow rates from natural spring	Water flowing from springs should not be impeded so as to cause drying of peats	N/A	
	Habitat	Wetland vegetation structure / composition	Extent of natural grassland and non-woody vegetation within the wetland complex.	The extent of natural grassland and non-woody vegetation within the wetland complex should be maintained, or increase.	The extent of natural grassland and non-woody vegetation within the wetland complex should remain at about 50% of the wetland or more.	The extent of natural grassland and non-woody vegetation within the wetland complex < 50% of the wetland
			Extent of natural wooded land within the wetland complex.	The extent of natural wooded land within the wetland complex should not increase	The extent of natural wooded land within the wetland complex should not become more than 50% of the wetland extent.	The extent of natural wooded land within the wetland complex > 50% of the wetland extent
		Habitat fragmentation within	Extent of alien invasive plants within the wetland / complex	Dense patches of alien invasive plant species should be prevented from establishing within the wetland complex.	Dense patches of alien invasive plant species should not exceed 5% of the wetland area.	Dense patches of alien invasive plant species > 5% of the wetland area

IUA / RU	Component	Subcomponent	Indicator	RQO		TPC
				Narrative	Numerical	
		the wetland delineation	Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73; SANLC, 2020)	Wetland habitat loss due to direct agricultural activities, including croplands should not be permitted within the wetland complex.	The aerial extent of agricultural activities, including croplands within the delineated wetland area shall not exceed 0Ha.	The aerial extent of agricultural activities, including croplands within the delineated wetland area > 0Ha
			Erosion / incision	Existing WfW rehabilitation structures should be protected and maintained so as not to promote erosion or incision within the wetland	N/A	
			Grazing and trampling pressure	The grazing and trampling pressure within the wetland should be managed so as not to cause any denudation within the wetland	N/A	
	Habitat / Biota	Protection	Protected areas / Conservation	The wetland complex should remain under protection	100% of the wetland complex should remain under protection	< 100% of the wetland complex protected
	Biota	Taxon richness	Number of wetland-dependent plant species	The number of wetland-dependent plant species should be maintained	The number of wetland-dependent plant species should be at least 10.	The number of wetland-dependent plant species < 10
The RQOs outlined below for the Mokamole wetlands (tributary of the Mogalakwena; Valley bottom with a channel), are to maintain a B/C category (TEC), with a percentage score of at least 78%, and the EI should remain High and the ES High.						
Mogalakwena (RU 4)	Water quantity	Water distribution and retention patterns	Flooding by damming within the wetland	The current extent of damming within the wetland complex, or upstream from it, should not be permitted to increase.	The extent of damming within the delineated wetland, or upstream from it, should not exceed 0Ha.	The extent of damming within the delineated wetland > 0Ha
	Habitat	Wetland vegetation structure / composition	Extent of natural grassland within the wetland complex (land cover classes 12-13; SANLC, 2020) combined with the extent of herbaceous wetlands (land cover classes 22-23; SANLC, 2020)	The combined extent of natural grassland and herbaceous wetlands should be maintained within the wetland complex and not allowed to decrease.	The combined extent of natural grassland and herbaceous wetlands should not decline below 100Ha.	The combined extent of natural grassland and herbaceous wetlands < 100Ha
			Extent of natural wooded land within the wetland complex (land cover classes 1-4; SANLC, 2020)	The extent of open and dense woodland should not be allowed to increase within the wetland complex	The extent of open and dense woodland should not increase above 5Ha.	The extent of open and dense woodland > 5Ha
		Habitat fragmentation within the wetland delineation	Extent of alien invasive plants within the wetland / complex	Dense patches of alien invasive plant species should be prevented from establishing within the wetland complex.	Dense patches of alien invasive plant species should not exceed 0% of the wetland area	Dense patches of alien invasive plant species > 0% of the wetland area
			Extent of planted forest within the wetland complex (land cover classes 5-7; SANLC, 2020)	Wetland habitat loss or fragmentation due to forestry should not be permitted within the wetland complex.*	The aerial extent of forestry within the delineated wetland area shall not exceed 0Ha.*	The aerial extent of forestry within the delineated wetland area > 0Ha*
			Developments within the wetland complex (includes mines and quarries, SANLC classes 68-72, built-up areas, infrastructure, canals, furrows and trenching , SANLC classes 47-67)	Wetland habitat loss or fragmentation due to developments should not be permitted within the wetland complex.*	The aerial extent of developments within the delineated wetland area shall not exceed 1Ha.*	The aerial extent of developments within the delineated wetland area > 1Ha*
			Land cover classes denoted to cultivated areas within the wetland complex (classes 32-46 & 73; SANLC, 2020)	Wetland habitat loss due to direct agricultural activities and croplands should not be permitted to increase in extent within the wetland complex. *	The aerial extent of agricultural activities and croplands within the delineated wetland area shall not exceed 10Ha.*	The aerial extent of agricultural activities and croplands within the delineated wetland area > 10Ha*
	Biota	Taxon richness	Number of wetland-dependent plant species	The number of wetland-dependent plant species that occur within the wetland complex should be maintained.	The number of wetland-dependent plant species that occur within the wetland complex should be 10 at least.	The number of wetland-dependent plant species that occur within the wetland complex should be 10 at least.

* - includes a 200m buffer

N/A - Not Available (a numerical limit could not be defined)

3.4 Groundwater Resource Quality Objectives and numerical limits

Whilst groundwater resource units have been defined, the preferred scale for application of RQOs is at quaternary catchment scale. Therefore, prioritisation was completed at quaternary catchment level. The prioritised groundwater resource units, for which draft RQOs are enveloped, were provided in (Evaluation of Resource Unit Report, 2025). This included the selected components, sub-components and indicators to be assessed in each prioritised resource unit.

Water quantity related RQOs (i.e. abstraction, water level and baseflow) are aimed at ensuring sufficient yield for all users, and to maintain groundwater discharge to support low flow river requirements. The setting of water quality related RQOs is aimed at maintaining the groundwater quality in relation to its background/present level.

In all cases the setting of RQO's has considered the aquifer-specific conditions such as interaction with surface water, and differing water quality. The setting of RQOs is therefore based on an understanding of the behaviour of the various aquifers within each catchment.

The outcomes of the RQO determination for a prioritised groundwater resource units for the study area is provided in Table 3-49 to Table 3-67.

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Table 3-49. Groundwater Resource Quality Objectives for GRU A50-2 in the Lower Lephalala

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Lower Lephalala	A50-2	A50G	Gabrro-Anorthotsie (weathered and fractured aquifer, i.e., secondary) aquifers overlain by a weathered horizon of variable thickness)	Low to Moderate groundwater use to support rural water supply and groundwater schemes.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 4.5 m.
					Groundwater Quality:	NO_3 (as N) EC F	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 20 mg/l < 150 mS/m <1.5 mg/l

Table 3-50. Groundwater Resource Quality Objectives for the GRU A50-3 in the Lower Lephalala

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Lower Lephalala	A50-3	A50H	Limpopo River alluvial aquifer and the Beitbridge Complex intergranular/weathered and fractured aquifer	Moderate groundwater use to support economic activities (agriculture), rural water supply and groundwater schemes.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 4.0 m. Medium to long-term water trends should show recovery.
					Groundwater Quality:	NO_3 (as N) EC F	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 150 mS/m <1.5 mg/l

Table 3-51. Groundwater Resource Quality Objectives for the GRU A50-4 in the Kalkpan se Loop

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Kalkpan se Loop	A50-4	A63C	Limpopo River alluvial aquifer and the Beitbridge Complex weathered and fractured aquifer	Low to Moderate groundwater use to rural water supply. GW could play a role in supporting spring seepages.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 4.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (incl. springs) (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river/spring towards wellfield in a 250 m zone along main stem/spring not allowed.
					Low flow in river	Compliance with the low flow requirements in the river (as per riverine RQO)	Maintain the low flow requirements in the river	Refer to RRU_Rvi1 RQO

Table 3-52. Groundwater Resource Quality Objectives for GRU A61-1 for the Nyl River Valley

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Nyl River Valley	A61-1	A61A	Waterberg Group, comprising of sedimentary and metamorphic rocks weathered and fractured aquifer	High groundwater use to support groundwater schemes and Modimolle wellfield. GW play a moderate role in supporting baseflow.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 7 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
		A61B		Low to Moderate groundwater use to support rural water supply. GW play a moderate role in supporting baseflow (and wetlands).	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	n/a (Add (Hydstra mon. borehole to catchment)
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient (river towards wellfield in a 250 m zone along main stem not allowed.

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
					Low flow in river	Compliance with the low flow requirements in the river (as per riverine RQO)	Maintain the low flow requirements in the river	Refer to Ri1 (Olifantspruit RQO)
		A61C		Low to Moderate groundwater use to support rural water supply. GW play a moderate role in supporting baseflow (and Nylsvlei).	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 6.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface (incl. springs) water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river/spring towards wellfield in a 250 m zone along main stem (and Nylsvlei) not allowed.
		A61D	Upper Nyl River Valley alluvial aquifers and Karoo weathered aquifer	Low to Moderate groundwater use to support groundwater schemes and Mookgophong wellfield. GW play a moderate role in supporting baseflow (and wetlands).	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 8.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem (and

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
								wetland) not allowed.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 1 mg/l < 100 mS/m
						E.coli Total Coliform	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	0 counts / 100ml <10 counts / 100ml
		A61E	Lower Nyl River Valley alluvial aquifers and Karoo weathered aquifer Gabbro-Norite (weathered and fractured aquifer, i.e., secondary) aquifers overlain by a weathered horizon of variable thickness)	Moderate groundwater use to support groundwater schemes/wellfields and rural water supply. GW play a moderate role in supporting baseflow (and wetlands).	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 4.5 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem (and wetland) not allowed.

Table 3-53. Groundwater Resource Quality Objectives for GRU A61-2 in the Sterk area

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Sterk	A61-2	A61H	Waterberg Group, comprising of sedimentary and metamorphic rocks weathered and fractured aquifer	Low to Moderate groundwater use to support groundwater schemes/wellfields and rural water supply. GW could play a moderate role in supporting baseflow (and wetlands).	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 4.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (incl. springs) (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem (and wetland) not allowed.

Table 3-54. Groundwater Resource Quality Objectives for GRU A61-3 in the Upper Mogalakwena

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Upper Mogalakwena	A61-3	A61F	Gabbro-Norite (weathered and fractured aquifer, i.e., secondary) aquifers overlain by a weathered horizon of variable thickness) Dorps River dolomite aquifer	Low to Moderate groundwater use to support groundwater schemes/Mokopane wellfields and rural water supply. GW play a role in supporting baseflow.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 8.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
					Groundwater Quality:	NO_3 (as N) EC Mg	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 20 mg/l < 150 mS/m < 70 mg/l
						E.coli Total Coliform	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	0 counts / 100ml <10 counts / 100ml

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
		A61G	Gabbro-Norite (weathered and fractured aquifer, i.e., secondary) aquifers overlain by a weathered horizon of variable thickness)	Moderate groundwater use to support groundwater schemes, Mogalakwena Mine wellfields and rural water supply. GW play a moderate role in supporting baseflow.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 8.5 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
					Groundwater Quality:	NO_3 (as N) EC Mg	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 150 mS/m < 70 mg/l

Table 3-55. Groundwater Resource Quality Objectives for GRU A62-2 in the Matlala

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Matlala	A62-2	A62E	Hout River Gneiss weathered and fractured aquifer Matlala Granite fractured aquifers	Low to Moderate groundwater use to support economic activities (agriculture) and rural water supply. GW could play a role in supporting baseflow (and wetlands).	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 3.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem (and wetland) not allowed.

Table 3-56. Groundwater Resource Quality Objectives for GRU A63-1 in the Lower Mogalakwena

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Lower Mogalakwena	A63-1	A63A	Beitbridge Complex weathered and fractured aquifer	High groundwater use to support economic activities (agriculture).	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 4.5 m. Medium to long-term water trends should show recovery.
					Groundwater Quality:	NO_3 (as N) EC Mg Ca Cl	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 200 mS/m < 70 mg/l < 70 mg/l < 200 mg/l
		A63D	Beitbridge Complex and Letaba Formation weathered and fractured aquifer	Moderate groundwater use to support economic activities (agriculture) (Alldays) and groundwater schemes and rural water supply.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 5.0 m.
					Groundwater Quality:	NO_3 (as N) EC Mg Ca Cl	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 150 mS/m < 70 mg/l < 70 mg/l < 100 mg/l

Table 3-57. Groundwater Resource Quality Objectives for GRU A63/71-3 for the Limpopo Tributaries/Mapungubwe

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Limpopo Tributaries/ Mapungubwe,	A63/71-3	A63E	Limpopo River alluvial aquifer and the Beitbridge Complex intergranular/weathered and fractured aquifer Limpopo River alluvial aquifer and the Beitbridge Complex intergranular/weathered and fractured aquifer	High groundwater use to support economic activities (agriculture). Hosts Mapungubwe and Venetia Mine. GW could play a role in supporting wetlands.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 4.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (incl. springs) (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river/spring towards wellfield in a 250 m zone along main stem (and wetland) not allowed.
					Groundwater Quality:	NO_3 (as N) EC Mg Cl	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 6 mg/l < 200 mS/m < 70 mg/l < 200 mg/l
		A71L		High groundwater use to support economic activities (mining). Schroda/Greefswald	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact	Groundwater use should be sustainable for all	Water level fluctuations should not exceed long-

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
				Wellfields. Hosts Mapungubwe.		during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	users and the environment	term averages of 4.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (incl. springs) (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river/spring towards wellfield in a 250 m zone along main stem (and wetland) not allowed.
					Groundwater Quality:	NO_3 (as N) EC Mg Cl Na	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 6 mg/l < 200 mS/m < 70 mg/l < 200 mg/l < 200 mg/l

Table 3-58. Groundwater Resource Quality Objectives for GRU A71-1 in the Upper Sand IUA

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Upper Sand	A71-1	A71A	Turfloop Granite fractured aquifers Hout River Gneiss and weathered and fractured aquifer Alluvial aquifers	High groundwater use to support economic activities. Hosts Polokwane (i.e. Sand River) wellfields.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 6.5 m. Medium to long-term water trends should show recovery.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 150 mS/m
						E.coli Total Coliform	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	0 counts / 100ml <10 counts / 100ml
		A71B	Turfloop Granite fractured aquifers Hout River Gneiss and weathered and fractured aquifer Alluvial aquifers	High groundwater use to support economic activities (Several wellfields, groundwater schemes and rural water supply).	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 3.5 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
								towards wellfield in a 250 m zone along main stem not allowed.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 200 mS/m
						E.coli Total Coliform	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	0 counts / 100ml <10 counts / 100ml

Table 3-59. Groundwater Resource Quality Objectives for GRU A71-2 in the Middle Sand

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Middle Sand	A71-2	A71C	Matlala Granite fractured aquifers Hout River Gneiss and weathered and fractured aquifer	High groundwater use to support economic activities (agriculture), rural water supply and groundwater schemes.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 3.5 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
					Groundwater Quality:	NO_3 (as N) EC Na	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 200 mS/m < 200 mg/l
		A71D	Matlala Granite and Bandelierkop fractured aquifers Hout River Gneiss and weathered and fractured aquifer	High groundwater use to support groundwater schemes and rural water supply.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 4.0 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
								zone along main stem not allowed.
		A71H	Bandelierkop fractured aquifers Hout River Gneiss and weathered and fractured aquifer	Moderate groundwater use to support groundwater schemes	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	n/a (Add (Hydstra mon.borehole to catchment)
					Groundwater Quality:	NO_3 (as N) EC Na	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 200 mS/m < 200 m/l

Table 3-60. Groundwater Resource Quality Objectives for GRU A71-3 in the Hout

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Hout	A71-3	A71E	Hout River Gneiss and weathered and fractured aquifer Alluvial aquifers	High groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting wetlands.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 3.5 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem (and wetland) not allowed.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 150 mS/m
		A71F	Hout River Gneiss and weathered and fractured aquifer	High groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting wetlands.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	n/a (Add (Hydstra mon.borehole to catchment)
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
								towards wellfield in a 250 m zone along main stem (and wetland) not allowed.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 75 mS/m
		A71G	Matlala Granite and Bandelierkop fractured aquifers Hout River Gneiss and weathered and fractured aquifer Alluvial aquifers	High groundwater use to support economic activities (agriculture), groundwater schemes and rural water supply.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 3.5 m. Medium to long-term water trends should show recovery.
					Groundwater Quality:	NO^3 (as N) EC Mg Na	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 100 mS/m < 70 mg/l < 200 mg/l
		A72A	Bandelierkop fractured aquifers Hout River Gneiss and weathered and fractured aquifer Alluvial aquifers	High groundwater use to support economic activities (agriculture), groundwater schemes and rural water supply.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 4.0 m. Medium to long-term water trends should show recovery.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after	< 10 mg/l < 100 mS/m

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
						Mg Na Cl	treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 70 mg/l < 200 mg/l < 200 mg/l

Table 3-61. Groundwater Resource Quality Objectives for GRU A71-4 and A71-5 in the Sandbrak/Lower Sand

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Sandbrak/ Lower Sand	A71-4	A71J	Beitbridge Complex weathered and fractured aquifer Karoo aquifers	High groundwater use to support economic activities (agriculture) and rural water supply. GW could play a role in supporting wetlands.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 7.0 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (incl. springs) (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river/spring towards wellfield in a 250 m zone along main stem not allowed.
		A72B	Beitbridge Complex weathered and fractured aquifer Karoo aquifers	Moderate groundwater use to support economic activities (agriculture), groundwater schemes and rural water supply.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 6.0 m.
	A71-5	A71K	Limpopo River alluvial aquifer and the Beitbridge Complex weathered and fractured aquifer	High groundwater use to support groundwater schemes, rural water supply and Musina (i.e., Limpopo River) wellfield.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 3.5 m. Medium to long-term water trends should show recovery.

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
					Groundwater Quality:	NO_3 (as N) EC Sulphate Mg	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 200 mS/m < 200 mg/l < 70 mg/l
						E.coli Total Coliform	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	0 counts / 100ml <10 counts / 100ml

Table 3-62. Groundwater Resource Quality Objectives for GRU A80-1 in the Upper Nzhelele

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Upper Nzhelele	A80-1	A80A	Soutpansberg Basalts weathered and fractured aquifer Alluvial aquifers	Low to moderate groundwater use to support groundwater schemes and rural water supply. GW play a role in supporting wetlands and spring seepages.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 3.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (incl. springs) (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river/spring towards wellfield in a 250 m zone along main stem (and wetland) not allowed.
		A80F	Soutpansberg Basalts weathered and fractured aquifer Beitbridge Complex weathered and fractured aquifer	Moderate groundwater use to support economic activities (agriculture) and rural water supply. GW could play a role in supporting wetlands. Potential coal mining development.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 3.0 m.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 150 mS/m

Table 3-63. Groundwater Resource Quality Objectives for GRU A80-2 in the Lower Nzhelele

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Lower Nzhelele	A80-2	A80G	Soutpansberg Basalts weathered and fractured aquifer Beitbridge Complex weathered and fractured aquifer	Moderate groundwater use to support economic activities (agriculture) and rural water supply. GW could play a role in supporting baseflow and spring seepages.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 3.5 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (incl. springs) (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river/spring towards wellfield in a 250 m zone along main stem not allowed.
					Low flow in river	Compliance with the low flow requirements in the river (as per riverine RQO)	Maintain the low flow requirements in the river	Refer to Ri27

Table 3-64. Groundwater Resource Quality Objectives for GRU A80-3 in the Nwanedi

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Nwanedi	A80-3	A80J	Soutpansberg Basalts weathered and fractured aquifer Beitbridge Complex weathered and fractured aquifer	Moderate groundwater use to support economic activities (agriculture), groundwater schemes and rural water supply. GW could play a role in supporting wetlands.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 5.5 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem (and wetland) not allowed.
					Low flow in river	Compliance with the low flow requirements in the river (as per riverine RQO)	Maintain the low flow requirements in the river	Refer to Ri28

Table 3-65. Groundwater Resource Quality Objectives for GRU A91-1 in the Upper Luvuvhu

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Upper Luvuvhu	A91-1	A91A	Soutpansberg Basalts weathered and fractured aquifer Hout River Gneiss weathered and fractured aquifer	High groundwater use (Makhado) to support groundwater schemes and rural water supply. GW could play a role in supporting baseflow.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 6.0 m. Medium to long-term water trends should show recovery.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
		A91B	Hout River Gneiss weathered and fractured aquifer	Moderate groundwater use to support economic activities (agriculture), groundwater schemes and rural water supply. GW could play a role in supporting baseflow.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 7.0 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a	< 10 mg/l < 100 mS/m

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
							deteriorating trend from natural background	
		A91C	Hout River Gneiss weathered and fractured aquifer Soutpansberg Basalts weathered and fractured aquifer		Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 7.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 100 mS/m
		A91E	Hout River Gneiss weathered and fractured aquifer Soutpansberg Basalts weathered and fractured aquifer	Low groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting baseflow.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	n/a (Add (Hydstra mon.borehole to catchment)
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
								zone along main stem not allowed.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 100 mS/m
		A91F	Hout River Gneiss weathered and fractured aquifer Soutpansberg Basalts weathered and fractured aquifer	Low groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting baseflow.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 8.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
					Groundwater Quality:	NO_3 (as N) EC Mg	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 100 mS/m < 70 mg/l
		A91G	Hout River Gneiss weathered and fractured aquifer Soutpansberg Basalts	Low groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting baseflow and wetlands.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises	Groundwater use should be sustainable for all users and the environment	n/a

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
			weathered and fractured aquifer Alluvial aquifer			under consideration of aquifer response time.		
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem (and wetland) not allowed.
					Groundwater Quality:	NO_3 (as N) EC	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	< 10 mg/l < 100 mS/m
					Low flow in river	Compliance with the low flow requirements in the river (as per riverine RQO)	Maintain the low flow requirements in the river	Refer to Ri28 (Mutshindudi)

Table 3-66. Groundwater Resource Quality Objectives for GRU A91-2 in the Mutale/Luvuvhu

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Mutale/Luvuvhu	A91-2	A91H	Soutpansberg Basalts weathered and fractured aquifer Alluvial aquifer	Low groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting baseflow.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 5.0 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
					Low flow in river	Compliance with the low flow requirements in the river (as per riverine RQO)	Maintain the low flow requirements in the river	Refer to Ri32
		A92B	Soutpansberg Basalts weathered and fractured aquifer Alluvial aquifer	Low to Moderate groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting baseflow and wetlands	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 7.0 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem (and wetland) not allowed.

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
					Low flow in river	Compliance with the low flow requirements in the river (as per riverine RQO)	Maintain the low flow requirements in the river	Refer to Ri33
		A92C	Soutpansberg Basalts weathered and fractured aquifer Karoo aquifer	Low to Moderate groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting baseflow and spring seepages.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed seasonal averages of 6.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (incl. springs) (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.
		A92D	Soutpansberg Basalts weathered and fractured aquifer Karoo aquifer Beitbridge Complex weathered and fractured aquifer	Low to Moderate groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting baseflow and wetlands.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 8.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (incl. springs) (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem (and wetland) not allowed.
					Low flow in river	Compliance with the low flow requirements in the river (as per riverine RQO)	Maintain the low flow requirements in the river	Refer to Ri34

Table 3-67. Groundwater Resource Quality Objectives for GRU B90-1 in the Shingwedzi

Area/IUA	GRU	Quat	Aquifer	Description (of prioritised resource units)	Component and sub-component	Indicator	RQO Narrative	RQO Numerical
Shingwedzi	B90-1	B90B	Soutpansberg Basalts weathered and fractured aquifer Hout River Gneiss weathered and fractured aquifer Hout River Gneiss weathered and fractured aquifer	Low to Moderate groundwater use to support groundwater schemes and rural water supply.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 6.0 m.
		B90F		Low to Moderate groundwater use to support groundwater schemes and rural water supply. GW could play a role in supporting wetlands.	Abstraction (Available Yield)	Groundwater Levels: (Seasonal abstraction) water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. (Permanent abstraction) water level decline stabilises under consideration of aquifer response time.	Groundwater use should be sustainable for all users and the environment	Water level fluctuations should not exceed long-term averages of 5.5 m.
					Discharge	Groundwater Levels: Relative water levels between groundwater and surface water (in mamsl)	The natural gradient between groundwater and surface water should be maintained	Reverse groundwater gradient river towards wellfield in a 250 m zone along main stem not allowed.

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