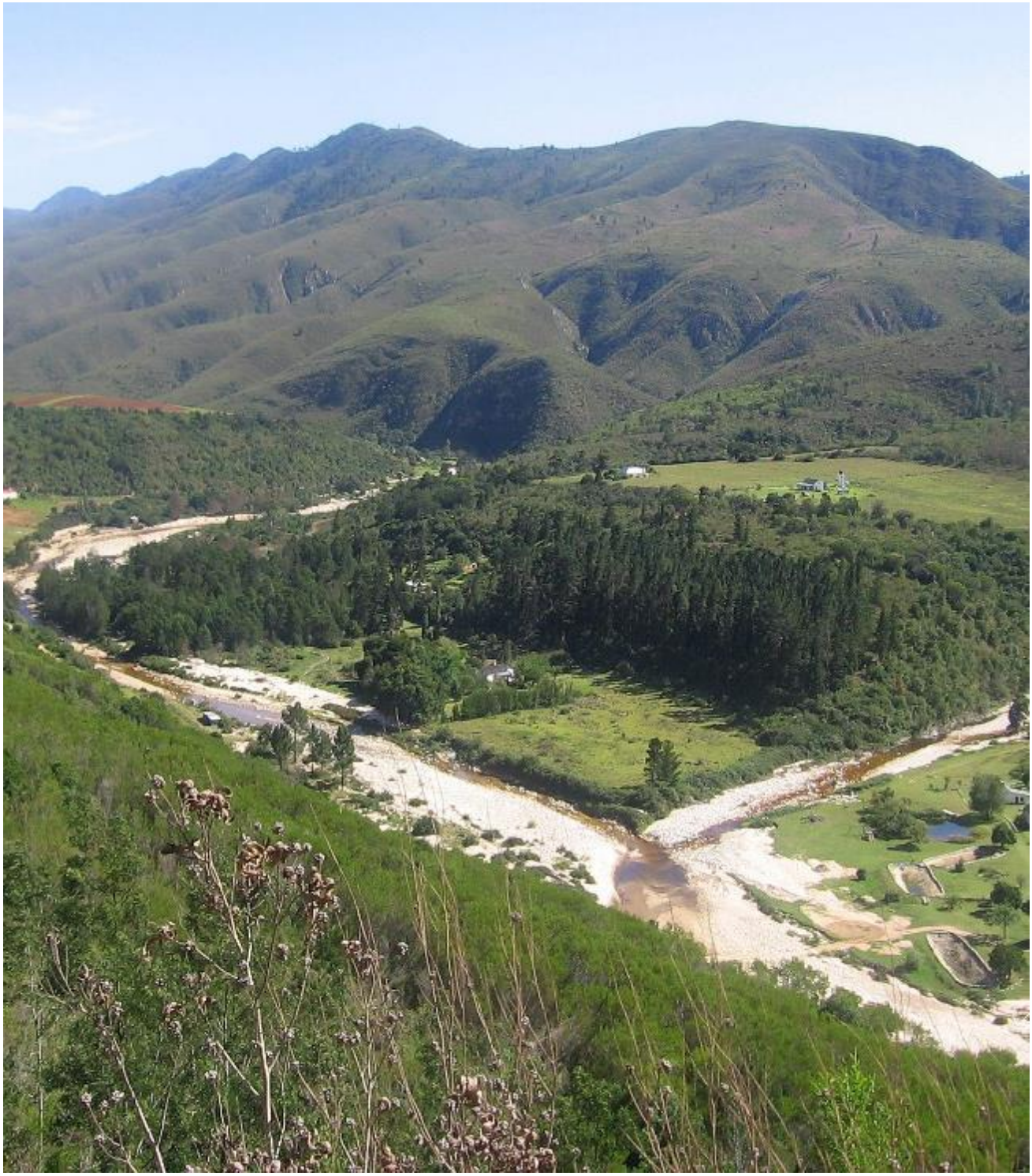

Determination of Water Resources Classes and Resource Quality Objectives in the Breede-Gouritz WMA

July 2018

Revision: Final

Evaluation of Resource Units Report

RDM/WMA8/00/CON/CLA/0617

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Aurecon South Africa (Pty) Ltd in sub-consultancy association with Southern Waters Ecological Research and Consulting, Anchor Environmental and Delta-H Water Systems Modelling

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Document Index

Reports that will be produced as part of this Study are indicated below.

Bold type indicates this Report.

Report Index	Report Number	Report Title
1	RDM/WMA8/00/CON/CLA/0116	Inception
2	RDM/WMA8/00/CON/CLA/0216	Stakeholder Identification and Mapping
3	RDM/WMA8/00/CON/CLA/0316	Water Resources Information and Gap Analysis
4	RDM/WMA8/00/CON/CLA/0416	Resource Unit Delineation and Integrated Units of Analysis
5	RDM/WMA8/00/CON/CLA/0516	Status Quo
6	RDM/WMA8/00/CON/CLA/0117	Linking the Value and Condition of the Water Resource
7	RDM/WMA8/00/CON/CLA/0217	Quantification of the EWR and changes in EGSAs
8	RDM/WMA8/00/CON/CLA/0317	Ecological Base Configuration Scenario
9	RDM/WMA8/00/CON/CLA/0417	Report on Evaluation of Scenarios
10	RDM/WMA8/00/CON/CLA/0517	Resource Unit Prioritisation
11	**RDM/WMA8/00/CON/CLA/0617**	**Evaluation of Resource Units**
12	RDM/WMA8/00/CON/CLA/0717	Outline of Resource Quality Objectives
13	RDM/WMA8/00/CON/CLA/0817	Monitoring Program to Support RQOs Implementation
14	RDM/WMA8/00/CON/CLA/0917	Confidence Assessment of Resource Quality Objectives
15	RDM/WMA8/00/CON/CLA/1017	Water Resource Classes and RQOs Gazette Template
16	RDM/WMA8/00/CON/CLA/0118	Draft Project Report
17	RDM/WMA8/00/CON/CLA/0218	Final Project Report

List of Abbreviations

DWA	*(Previous) Department of Water Affairs*
DWAF	*(Previous) Department of Water Affairs and Forestry*
DWS	*Department of Water and Sanitation*
EC	*Ecological Category (A to E based on Kleynhans et al, 1996)*
EIS	*Ecological Importance and Sensitivity*
EWR	*Ecological Water Requirements*
IUA	*Integrated Unit of Analysis*
NFEPA	*National Freshwater Ecosystem Priority Area*
nMAR	*Natural Mean Annual Runoff*
NWA	*National Water Act*
PES	*Present Ecological Status*
REC	*Recommended Ecological Condition*
RQOs	*Resource Quality Objectives*
RU	*Resource Unit*
WMA	*Water Management Area*
WRC	*Water Resource Classes*
WRCS	*Water Resources Classification System*

Executive Summary

The Chief Directorate: Water Ecosystems of the Department of Water and Sanitation (DWS) has commissioned a study to determine Water Resource Classes (WRC) and associated Resource Quality Objectives (RQOs) for all significant water resources in the Breede-Gouritz Water Management Area (WMA).

The Water Resources Classification procedure have been completed in in the Breede-Gouritz and the determination of the RQOs follows on from this process. The 7-step procedure established by the Department of Water Affairs in 2011 (DWA, 2011) is being applied to determine the Resource Quality Objectives (RQOs) for river, estuary, wetland, dam and groundwater resources in the Breede-Gouritz WMA. These procedural steps to determine RQOs in the Breede-Gouritz WMA include the following:

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

In terms of the RQO determination process, Step 1 (Delineation) and Step 2 (Visioning) have been completed as part of the Classification phase of this study. The Resource Unit Prioritisation Report (DWS, 2018) documents the approach adopted and the outcomes of the implementation of Step 3 of the RQO determination procedure. This report documents the approach adopted and the outcomes of the implementation of Step 4 (Evaluation) of the RQO determination procedure.

A total of 47 sub-components were selected for RQO determination during Step 4 of the RQO determination procedure in the Breede-Gouritz WMA, including:

- 11 sub-components were selected to represent river resources from 37 prioritised RUs.
- 13 sub-components were selected to represent estuaries resources from 34 prioritised RUs.
- 7 sub-components were selected to represent dam resources from 8 prioritised RUs.
- 9 sub-components were selected to represent wetlands resources from 21 prioritised RUs.
- 7 sub-components were selected to represent groundwater resources from 42 prioritised RUs.

Table 0.1 comprises a summary of the selected sub-components on the different significant water resources for the Breede-Gouritz WMA.

Table 0.1 Summary of sub-component prioritisation selection for the Breede-Gouritz WMA

Component	Sub-component	Rivers	Estuaries	Dams	Wetlands	Groundwater
Quantity	Abstraction					x
	Groundwater level					x
	High flows	x	x	x	x	
	Low flows	x	x	x		x
	Discharge					x
	Hydroperiod				x	
Quality	Nutrients	x	x	x	x	x
	Salts	x	x	x		x
	System variables (temperature, oxygen, pH, turbidity	x	x			
	Toxins	x				
	Pathogens	x	x	x		x

Component	Sub-component	Rivers	Estuaries	Dams	Wetlands	Groundwater
Habitat	Geomorphology	x			x	
	Vegetation/Riparian vegetation	x			x	
	Hydrodynamics		x			
	Sediments		x			
Biota	Micro-algae		x			
	Macrophytes		x			
	Invertebrates	x	x		x	
	Fish	x	x	x		
	Birds		x		x	
	Amphibians & reptiles				x	
	Diatoms				x	
	Phytoplankton			x		
	Totals	**11**	**13**	**7**	**9**	**7**

Contents

Figures

Tables

1 Introduction

1.1 Background

Chapter 3 of the National Water Act prescribes a series of measures which are jointly intended to ensure protection of water resources. In accordance with these measures, the Department of Water and Sanitation (DWS), in line with Section 12 of the National Water Act (NWA), established a Water Resources Classification System that is formally prescribed by Regulations 810, dated 17 September 2010.

The Water Resources Classification System (WRCS) (DWAF, 2007a; DWA, 2011) provides guidelines and procedures for determining Water Resource Classes, Reserves and Resource Quality Objectives (RQOs).

Section 13 of the NWA states that "as soon as reasonably practicable after the Minister prescribed a system for classifying water resources, the Minister must, subject to subsection (4), by notice in the Gazette, determine for all or part of every significant water resource-

a) A class in accordance with the prescribed classification system; and

b) Resource quality objectives based on the class determined in terms of paragraph (a)."

In this context, the Chief Directorate: Water Ecosystems has commissioned the current study to determine Water Resource Classes and associated Resource Quality Objectives for all significant water resources in the Breede-Gouritz Water Management Area (WMA). Hitherto, the 7-step Water Resource Classification procedure described in the WRCS Overview Report (DWAF, 2007a) has been completed for the Breede-Gouritz WMA and has resulted in the delineation of 18 integrated units of analysis (IUAs), as well as a recommended Water Resource Class for each IUA or part thereof.

The three Water Resource Classes are defined as:

- *Class I: Minimally used*: The configuration of ecological categories of the water resources within a catchment results in an overall water resource condition that is minimally altered from its pre-development condition.
- *Class II: Moderately used*: The configuration of ecological categories of the water resources within a catchment results in an overall water resource condition that is moderately altered from its pre-development condition.
- *Class III: Heavily used*: The configuration of ecological categories of the water resources within a catchment results in an overall water resource condition that is significantly altered from its pre-development condition.

With the Classification phase of this study completed, the current next phase of the study comprises the 7-step procedure (DWA, 2011) towards determination of RQOs for all significant water resources in the Breede-Gouritz WMA.

Along with the above prescribed methodology, previous RQO determination studies were reviewed to determine an appropriate approach for the current study. Reports of relevant previous studies that are referred to are the RQO determination reports for the Crocodile (West), Marico, Mokolo and Matlabas catchments (DWS, 2015), for the Olifants WMA (DWS, 2014) and the Upper Vaal WMA (DWS, 2014).

1.2 Scope of this phase of the study

The main objective of this study is to determine Resource Quality Objectives (RQOs) for all significant water resources in the Breede-Gouritz WMA that must give effect to the Water Resources Classes that have been determined in the previous phase of the study. To this end the RQOs are the qualifying management factor, not the classification of the IUA and it is the requirements within the RQOs that development has to adhere to. To this end, the 7-step process for determining RQOs, described in DWA (2011) and depicted in Figure 1.1, is being implemented.

Once gazetting has been finalised, implementation, monitoring and review would then follow.

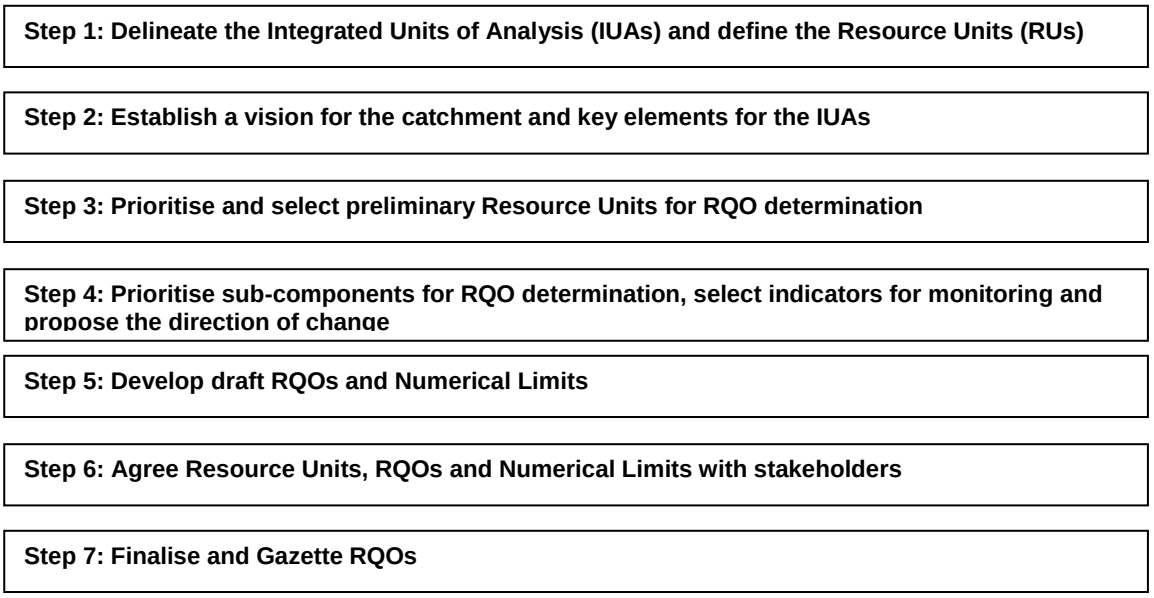

Figure 1.1 The seven-step process for RQO determination (DWA, 2011)

In terms of the RQO process outlined in Figure 1.1, Step 1 (Delineation) and Step 2 (Visioning) have been completed as part of the Classification phase of this study. Step 3 (Prioritisation) involved the iterative process of prioritizing Resource Units using the RU prioritization tool and it is documented in the Resource Units Prioritization Report (DWS, 2018).

This report documents the approach adopted and the outcomes of the implementation of Step 4 (Evaluation) of the RQO determination procedure. Step 4 involves the use of the RU Evaluation Tools to select sub-components for RQO determination, select indicators for monitoring and propose the direction of change. The list of sub-components, indicators selected for monitoring and the rationale for consideration (where applicable) for the rivers, estuaries, dams, wetlands and groundwater in the Breede-Gouritz WMA are documented in this report. This will form the basis for development of RQOs and numerical limits (Step 5).

1.3 Study area

The study area covers all significant water resources of the Breede-Gouritz WMA. The catchments of the Breede River and Gouritz River and their primary tributaries, the Riviersonderend, Groot, Gamka and Olifants rivers, dominate the study area, but it also includes numerous smaller coastal catchments.

During the Classification phase of the study, resource units for rivers, wetlands, dams, groundwater and estuaries as well as a total of 18 Integrated Units of Analysis (IUAs) were delineated in the Breede-Gouritz WMA. The IUAs approximate socio-economic boundaries, delineated to facilitate the integration of ecological and socio-economic aspects required for the evaluation of scenarios during the Classification phase of the study (DWS, 2017). The delineation of the Resource Units and the IUAs is described in the *Resource Unit and Integrated Units of Analysis Delineation Report* (DWS, 2016b).

A visioning exercise for the Breede-Gouritz WMA was undertaken with key stakeholders in the Classification phase of the study. The purpose of the visioning exercise was to articulate the aspirations of the various stakeholders for the future of the WMA. The stakeholders highlighted the key water resource issues relevant to their respective sectors, including issues relating to policy and legislation, resources, administration, capacity/empowerment and technology, and then presented their critical considerations for determining the water resource class.

1.3.1 Breede River Catchment and Overberg Area

Ten IUAs were delineated and a total of 114 biophysical and allocation nodes were identified in the Breede River catchment and Overberg area. The RUs delineated in the Breede River catchment and Overberg area comprise the following: 17 River RUs; 11 Estuary RUs, 6 Dam RUs; 12 Wetland RUs and 27 Groundwater RUs.

1.3.2 Gouritz River Catchment and Coastal Area

Eight IUAs were delineated and a total of 148 biophysical and allocation nodes were identified in the Gouritz River catchment and Coastal area. The RUs delineated in the Gouritz River catchment and Coastal area comprise the following: 20 River RUs; 23 Estuary RUs; 2 Dam RUs; 9 Wetland RUs; and 14 Groundwater RUs.

1.4 Prioritisation of RUs outcomes

A summary of the priority RUs for rivers, estuaries, dams, wetlands and groundwater resource units are presented below. These represent the list of proposed RUs for which RQOs should be developed.

The prioritized RUs for determining RQOs have been identified using the following criteria:

- The top 17 river priority RUs in the Breede and Overberg IUAs and the top 20 river priority RUs in the Gouritz and Coastal IUAs
- Estuaries with a priority weighting of ≥ 0.5
- Dams determined from prioritisation process with a priority weighting of > 0.5
- Wetlands RUs as determined from the prioritisation process
- Groundwater RUs with a priority level of 3.

The resource units listed in Table 1.1 and

Table 1.2 and mapped in Figure 1.1 and Figure 1.3 are the preliminary RU prioritised during the previous step (Step 3) of the RQO process.

Table 1.1 Summary of results of the prioritisation process for the Breede and Overberg IUAs

IUA	Prioritised Resource Units (RUs)				
	River	Estuary	Dam	Wetland	Groundwater
A1 Upper Breede Tributaries	nviii1 Breede nvii2 Molenaars		Ceres Koekedouw	Strategic Water Source wetlands	BB-1 (H10A) BB-1 (H10B) BB-1 (H10C) BB-3 (H10F) BB-3 (H10J) BB-2 (H20B) BB-2 (H20C)
A2 Breede Working Tributaries	nvii7 Hex		Greater Brandvlei	East Coast Shale Renosterveld Channelled Floodplain (Papenkuils)	BB-3 (H10G) BB-3 (H10H) BB-3 (H10L) BB-2 (H20A) BB-2 (H20F) BB-5 (H20H) BB-6 (H30B) BB-4 (H40B) BB-5 (H40C) BB-7 (H40J)
A3 Middle Breede Renosterveld	nvii8 Breede ni2 Breede			East Coast Shale Renosterveld Floodplain (Breede)	BB-7 (H40K)
B4 Riviersonderend Theewaters	nvii10 Du Toits nv7 Riviersonderend niv28 Baviaans nv9 Riviersonderend		Theewaterskloof	Strategic Water Source wetlands	BR-1 (H60A) BR-1 (H60B) BR-1 (H60C)
F9 Lower Riviersonderend	ni3 Riviersonderend				
B5 Overberg West	piii1 Palmiet piii2 Palmiet piii3 Palmiet	Palmiet	Eikenhof Kogelberg Arieskraal No.2	Strategic Water Source wetlands (Palmiet)	BO-1 (G40C) BO-1 (G40D)
H16 Overberg West Coastal		Buffels Rooiels Bot Onrus		Southwest Sand Fynbos Channelled Valley Bottom (Kleinmond) Strategic Water Source	BO-2 (G40H)

IUA	Prioritised Resource Units (RUs)				
	River	Estuary	Dam	Wetland	Groundwater
				wetlands	
F10 Overberg East Renosterveld	nv23 Klein			Southwest Ferricrete Fynbos Floodplain (Kars)	BO-3 (G50D)
H17 Overberg East Fynbos	ni4 Nuwejaar nv24 Kars	Klein Uilkraals Ratel Heuningnes Klipdrifsfontein		Southwest Ferricrete Fynbos Floodplain, Flat, Depression (Agulhas) East Coast Shale Renosterveld Floodplain (De Hoop Vlei) South Strandveld Western Strandveld Flat/Seep (Heuningnes)	BO-3 (G50B) BO-3 (G50E)
F11 Lower Breede Renosterveld	niii4 Breede	Breede		East Coast Shale Renosterveld Floodplain (Breede)	
TOTALS	**17**	**11**	**6**	**12**	**27**

Table 1.2 Summary of results of the prioritisation process for the Gouritz and Coastal IUAs

IUA	Prioritised Resource Units (RUs)				
	River	Estuary	Dam	Wetland	Groundwater
C6 Gamka Buffels				Upper Nama Karoo Depression Lower Nama Karoo Depression	GGr-3 (J11E) GGa-2a, 2b and 2c (J21A) GGa-2a, 2b and 2c (J21B) GGa-2a, 2b and 2c (J23A) GGa-1 (J24B)
E8 Touws	gviii1 Doring gv5 Touws gv4 Buffels gv6 Groot gii3 Groot			Strategic Water Source Wetlands	GGr-1 (J12C) GGr-1 (J12D)
D7 Gouritz-Olifants	giv20 Gamka giii2 Olifants gv36 Kammanassie		Stompdrift		GO-4 (J35B)
F13 Lower Gouritz	gi4 Gouritz	Gouritz		Albany Thicket Floodplain (Gouritz)	GGo-1 (J40C) GGo-1 (J40D)
F12 Duiwenhoks	giii8 Duiwenhoks	Duiwenhoks		East Coast Shale Renosterveld Channelled Valley Bottom (Goukou) East Coast Shale Renosterveld Channelled Valley Bottom (Duiwenhoks)	
I18 Hessequa	giii7 Goukou	Goukou			GGo-2A and 2B (H90E)
G14 Groot-Brak	gviii2 Groot-Brak	Klein Brak Groot Brak Blinde Tweekuilen Gericke Hartenbos	Wolwedans		GC-1 (K20A)

IUA	Prioritised Resource Units (RUs)				
	River	Estuary	Dam	Wetland	Groundwater
G15 Coastal	gvii9 Malgas gvii11 Kaaimans giii10 Diep gvii13 Karatara gviii9 Goukamma gvii14 Knysna gviii11 Gouna giv6 Keurbooms	Maalgate Gwaing Kaaimans Wilderness Swartvlei Goukamma Knysna Noetsie Piesang Keurbooms Matjies Sout (Oos) Groot (Wes) Bloukrans		Freshwater Lake (Groenvlei) Freshwater Lake (Wilderness Lakes) Strategic Water Source wetlands	GC-2 (K40D) GC-3 (K70A)
TOTALS	**20**	**23**	**2**	**9**	**14**

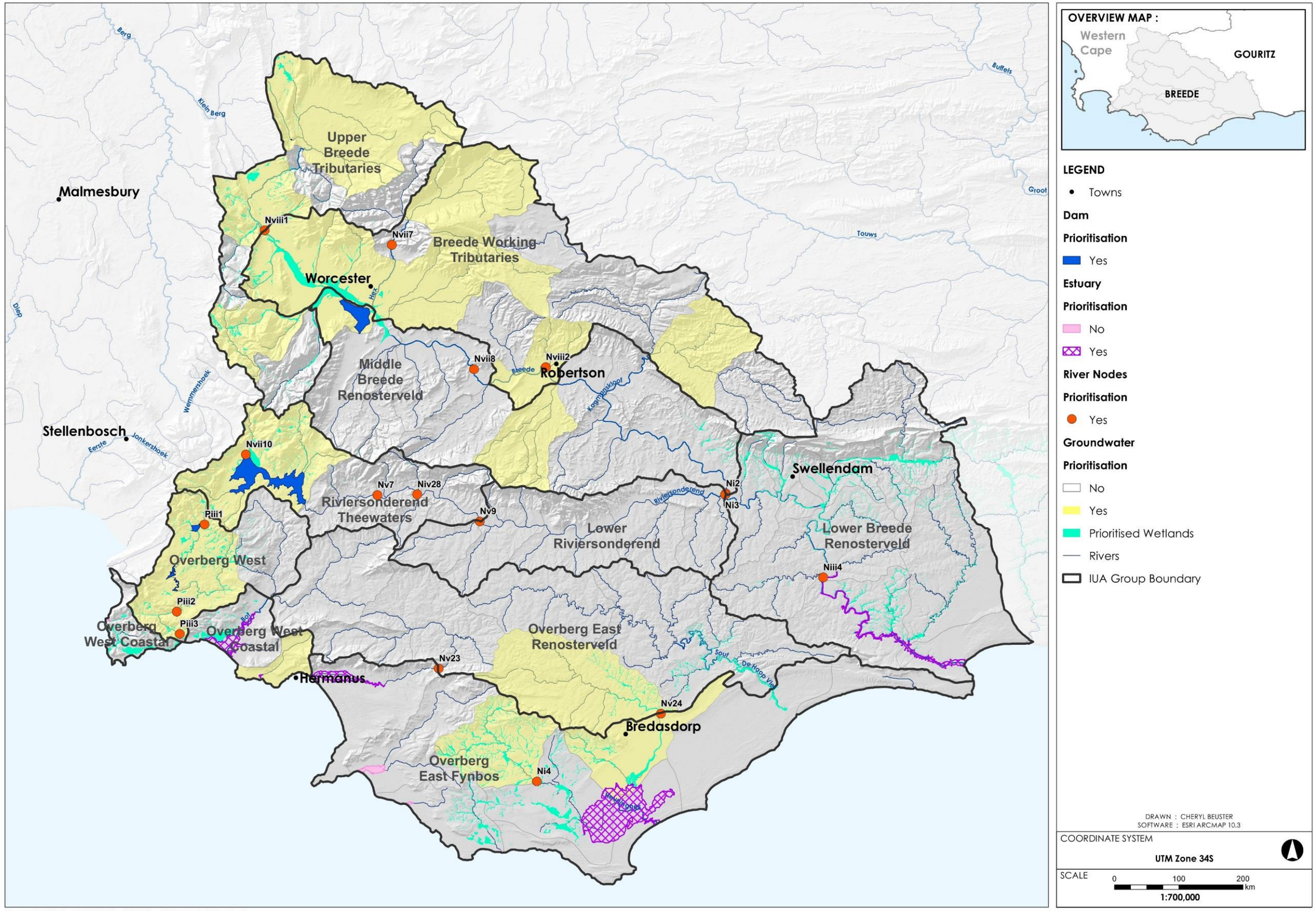

Figure 1.2 Summary of results of the prioritisation process for the Breede and Overberg IUAs

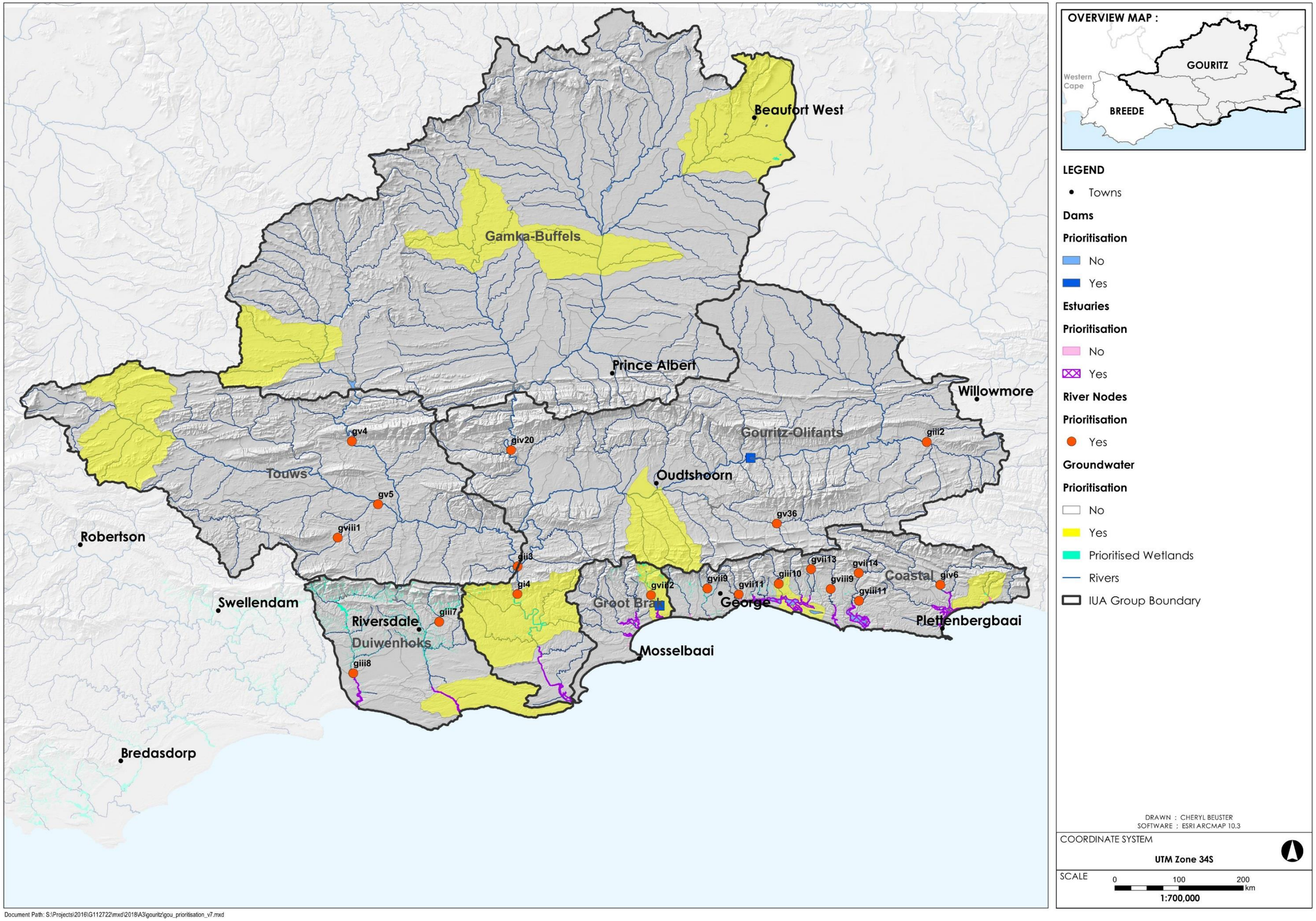

Figure 1.3 Summary of results of the prioritisation process for the Gouritz and Coastal IUAs

2 Approach

2.1 Resource Quality Objectives process overview

For the determination and implementation of RQOs, a seven-step procedure was established (DWA, 2011). This process is interlinked with the Water Resources Classification System and forms part of an Adaptive Management Cycle that is used as an improved water resources management practice. Overall the Adaptive Management Cycle process consists of delineating the resource units (RU), setting a vision for the catchment, prioritise, select and evaluate RUs for RQOs, drafting RQOs and numerical limits, and agreeing these with the stakeholders to finalise and Gazette the RQOs, and finally moving to implementing, monitoring and reviewing before restarting the process for corrections and improvements.

Due to the large number of Resource Units within the Breede-Gouritz WMA, it is necessary to prioritise the most useful Resource Units for RQO determination. In terms of the seven-step RQO determination process, Step 1 (Delineation) and Step 2 (Visioning) have been explained and completed as part of the Classification phase of this study (Figure 2.1). The purpose of Step 3 of the Procedure to Determine and Implement Resource Quality Objectives (DWA, 2011) is to select and prioritise preliminary Resource Units using the RU prioritisation tool for RQO determination. The evaluation of the RU priority ratings for selection are then done (Step 4), and the RQOs and numerical limits are drafted (Step 5). These will then be discussed and agreed at the stakeholder engagement workshops (Step 6). This process will allow for the selection of at least one RU to represent each IUA that will then be monitored after the gazetting of the RQOs (Step 7).

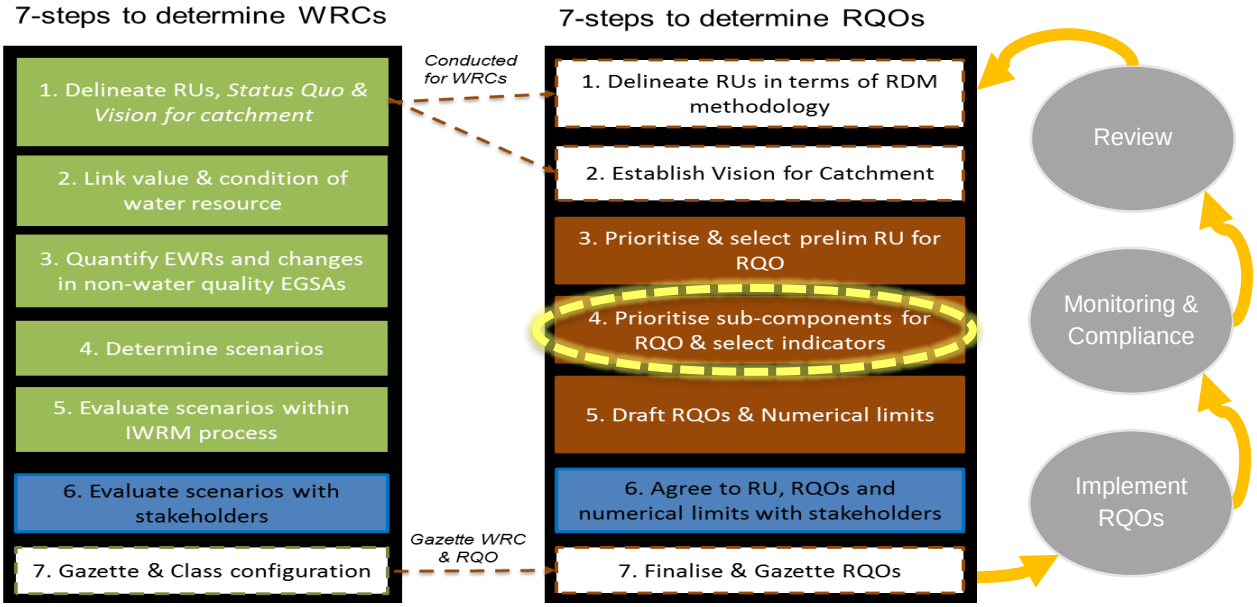

Figure 2.1 Integration of the seven-step processes for WRC determination and the RQO determination (DWA, 2011), incorporating the three additional steps to implement the Adaptive Management Cycle

Management, monitoring and compliance are the three additional steps of the Adaptive Management Cycle to be implemented after the seven-step RQO process. This introduces a continual learning and improvement procedure which allows for changes to align the RQOs with the vision for the resource. The changes, if needed, will indicate that the measures that are in place to protect the water resource are not sufficient to comply with the RQOs set, or alternatively that the RQOs that have been set are not realistic, and the process will need to be revisited to correct these issues.

2.2 Sub-component prioritisation and indicator selection overview

Step 4 (Prioritise sub-components for RQO determination, select indicators for monitoring and propose the direction of change) of the RQOs process comprises of two main objectives: firstly, the identification and prioritisation of sub-components that may be important to either users of the environment; and secondly, the selection of those sub-components and associated indicators for which RQOs and Numerical Limits should be developed. In order to complete the activities of Step 4 of the RQOs process, specialist workshops are held wherein the Resource Evaluation Tool is used for the selection of sub-components for RQO determination, and indicators for RUs in the study area. The Resource Evaluation tool is a decision support tool for the prioritisation process, which serves two main functions:

i. Determine the level of threat posed to each of the sub-components by impacting activities in the catchment

ii. Identify which sub-components should be protected in order to support water resource dependent activities and/or maintain the integrity and ecological functioning of the water resource (DWS< 2011:57)

The information from the resource Evaluation Tool is then used to prioritise sub-components.

The sub-steps that form the activities of Step 4 include:

1. Identify and assess the impact of current and anticipated future use on water resource components
2. Assess the importance of activities in driving resource change
3. Determine the anticipated level of impact on each sub-component
4. Determine the anticipated consequences of the impacting activities on each sub-component

The specific approaches used to prioritise sub-components and select indicators for estuaries, dams, wetlands and groundwater RUs within the Breede-Gouritz WMA are discussed below.

2.2.1 River sub-component prioritisation and indicator selection

The RU evaluation tool for river was used to prioritise sub-components that may be important to users and the environment and to select indicators for which RQOs and Numerical Limits should be developed by following the guidelines provided:

- Identify and assess the impact of current and anticipated future use on water resource components
    - Assess the importance of activities in driving resource change
    - Determine the anticipated level of impact on each sub-component
    - Determine the cumulative level of impact on each sub-component
    - Determine the anticipated consequences of the impacting activities on each sub-component
- Identify requirements of important user groups\
    - Identify important user groups within the ‘protection of the water resource’ and ‘water resource dependent activity’ user group types
    - Rate the importance of sub-components for the ‘protection of the water resource’ and ‘water resource dependent activities’
    - Summarise the aspirations of each important user group
    - Review the present state information
    - Propose the desired direction and magnitude of change for each sub-component for important user-groups
- Selection of sub-components for RQO determination
    - Review the ecosystem and user prioritisation ratings
    - Select sub-components and associated indicators for RQO determination
- Establish the desired direction of change for selected sub-components

- Where applicable, understand the trade-offs that have been made between user groups in the Water Resource Classification
- Propose an acceptable direction of change for each selected sub-component
- Align the outcomes of each RU assessment across the catchment
- Complete the information sheet for the Resource Unit Evaluation Tool

The content of the RQOs will be formatted to be the same as much as possible, within the limits of the data. The studies used to source the data for the high priority RUs have been written at different times in the past and so the content is not the same between studies. Cognisance is also given to the fact that RQOs need to be meaningful but also implementable by the Department, who are all trained in assessing river condition using the Ecostatus modules developed by Neels Kleynhans, amongst other things. For this reason, condition scores for different river attributes calculated using the Ecostatus modules are also included as RQOs. With this in mind Table 2.1 below summarises the indicators for each RU and describes the reasons for their choice, Table 2.2 indicates what kinds of RQOs will be written for each RU in the Breede River basin and the Overberg area and Table 2.3 indicates what kinds of RQOs will be written for each RU in the Gouritz River basin and Coastal area.

Table 2.1 Reasons for selecting the river RQO indicators and some examples of the indicators

Component	Sub-component	Reason for selection	Example of indicator
Quantity	Low flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Flow RQOs given are a monthly average volumes (MCM) that include maintenance low and high flows combined i.e. they include the inter-annual floods with a return period greater than 1:2 years
	High flows		
Quality	Nutrients	Nutrients affects primary productivity and the growth of attached (periphyton) or free-floating algae (phytoplankton). Algae is a food source for biota, both aquatic invertebrates and vertebrates such as fish. High nutrient concentrations promote excessive algal growth which causes taste and odour problems in drinking water, and cause obstructions in irrigation equipment.	Water quality fitness-for-use categories, ranging from Ideal, Acceptable, and Tolerable. If currently in an Unacceptable category the quality should be improved to at least a Tolerable category or better. Limits based on the South African Water Quality Guidelines are specified for the different categories, for different uses.
	Salts	Salts affect the osmoregulation of aquatic organisms. High salt concentrations reduce the yield of irrigated crops, cause corrosion of household appliances, and cause taste problems in drinking water.	
	System variables	pH, temperature, and dissolved oxygen are important for the maintenance of ecosystem health. pH describes the acidity or alkalinity of water which in turn affects the solubility of metals and distribution of aquatic organisms. It also affects corrosion or scaling in household appliances. Temperature affects the distribution of biota and migration/breeding signals. All biota is dependent on dissolved oxygen; some species are more sensitive to low DO than more tolerant species. Dissolved oxygen saturation is affected by water temperature. Anoxic conditions affect the solubility of metals.	
	Toxins	The presence of toxic substances can have a chronic or acute impact on aquatic biota. Some toxins can bioaccumulate in fish. In humans, toxic substances can be carcinogenic.	Conservative approach is followed, no agrochemicals should be present in water.
	Pathogens	Pathogens cause waterborne diseases such as diarrhoea, cholera, dysentery, etc in human users. Although human pathogens in general don't affect aquatic biota they are often associated with high organic loads (related to untreated or partially treated sewage) which affects the dissolved oxygen concentration of the water.	Fitness for use categories for treated domestic water supply and contact recreation.

Component	Sub-component	Reason for selection	Example of indicator
Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	Index of Habitat Integrity Provides an overall score for ecological condition. PAI Provides a score for the water quality condition. (1) GAI provides a score for the geomorphology condition. (1)
	Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI provides a score for the vegetation condition. (1) % cover of indigenous and riparian plant species.
Biota	Fish	Indigenous fish are of conservation importance.	FRAI provides a score for the fish condition. (1) Catch per Unit Effort (CPUE) of fish species present. Frequency of occurrence (FROC) of key fish species.
	Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI Provides a score for the macroinvertebrate condition. (1) SASS and ASPT scores from SASS. The number of macroinvertebrate families present. Presence of key families.

(1) Scores are ranked as: A natural; B near natural; C moderately modified with natural functions still in place; D moderately modified with a loss of natural functions; E severely modified, F critical modified with a total loss of biota and function

Table 2.2 RQO components and sub-components for each Prioritised Resource Unit in the Breede River basin and the Overberg area

IUA	RU priority	Quat #	Node code	River	Quantity	Quality					Habitat		Biota	
					Low flows & high flows	Nutrients	Salts	System variables	Toxins	Pathogens	Geomorphology	Riparian vegetation	Fish	Invertebrates
A1 Upper Breede Tributaries	**4**	**H10F**	**nviii1**	**Breede**	x	x	x	x	x	x	x	x	x	x
	4	**H10J**	**nvii2**	**Molenaars**	x	x	x	x	x	x	x	x	x	
A2 Breede Working Tributaries	**3**	**H20G**	**nvii7**	**Hex**	x	x	x	x	x	x	x	x	x	x
A3 Middle Breede Renosterveld	**3**	**H40F**	**nvii8**	**Breede**	x	x	x	x	x	x	x	x	x	x
	4	**H50B**	**ni2**	**Breede**	x	x	x	x	x	x				
B4 Riviersonderend Theewaterskloof	**3**	**H60B**	**nvii10**	**Du Toits**	x	x	x	x	x	x				
	3	**H60D**	**nv7**	**Riviersonderend**	x	x	x	x	x	x				
	3	**H60E**	**niv28**	**Baviaans**	x	x	x	x		x	x	x	x	x
	4	**H60F**	**nv9**	**Riviersonderend**	x	x	x	x	x	x	x	x	x	x
F9 Lower Riviersonderend	**4**	**H60L**	**ni3**	**Riviersonderend**	x	x	x	x	x	x				
B5 Overberg West	**3**	**G40C**	**piii1**	**Palmiet**	x	x	x	x	x	x	x	x	x	x
	3	**G40D**	**piii2**	**Palmiet**	x	x	x	x	x	x	x	x	x	x
	4	**G40D**	**piii3**	**Palmiet**	x	x	x	x	x	x	x	x	x	x
H16 Overberg West Coastal	**4**	**G40K**	**nv23**	**Klein**	x	x	x	x	x	x	x	x	x	x
H17 Overberg East Fynbos	**4**	**G50B**	**ni4**	**Nuwejaar**	x	x	x	x		x	x	x	x	x
	4	**G50D**	**nv24**	**Kars**	x	x	x	x	x	x	x	x	x	x
F11 Lower Breede Renosterveld	**3**	**H70G**	**niii4**	**Breede**	x	x	x	x	x	x	x	x	x	x

Table 2.3 RQO components and sub-components for each Resource Unit in the Gouritz River basin and Coastal area

IUA	RU priority	Quat #	Node code	River	Quantity	Quality					Habitat		Biota	
					Low flows & high flows	Nutrients	Salts	System variables	Toxins	Pathogens	Geomorphology	Riparian vegetation	Fish	Invertebrates
E8 Touws	3	J12L	gviii1	Doring	x	x	x	x		x	x	x	x	x
	3	J12L	gv5	Touws	x	x	x	x		x	x	x	x	x
	3	J11H	gv4	Buffels	x	x	x	x		x	x	x	x	x
	3	J11J	gv6	Groot	x	x	x	x	x					
	3	J13C	gii3	Groot	x	x	x	x						
D7 Gouritz-Olifants	3	J25A	giv20	Gamka	x	x	x	x		x	x	x	x	x
	4	J31C	giii2	Olifants	x	x	x	x		x	x	x		x
	4	J34C	gv36	Kammanassie	x	x	x	x		x		x	x	x
F13 Lower Gouritz	4	J40B	gi4	Gouritz	x	x	x	x		x	x	x	x	x
F12 Duiwenhoks	4	H80D	giii8	Duiwenhoks	x	x	x	x		x	x	x	x	x
I18 Hessequa	3	H90A	giii7	Goukou	x	x	x	x	x	x	x	x	x	x
G14 Groot-Brak	4	K20A	gviii2	Groot-Brak	x	x	x	x		x	x	x	x	x
G15 Coastal	3	K30B	gvii9	Malgas	x	x	x	x	x	x	x	x	x	x
	4	K30C	gvii11	Kaaimans	x	x	x	x		x	x	x	x	x
	4	K40A	giii10	Diep	x	x	x	x		x	x	x	x	x
	4	K40C	gvii13	Karatara	x	x	x	x		x	x	x	x	x
	4	K40E	gvii9	Goukamma	x	x	x	x		x	x	x	x	x
	3	K50A	gvii14	Knysna	x	x	x	x		x	x	x	x	x
	4	K50B	gviii11	Gouna	x	x	x	x		x	x	x	x	x
	4	K60C	giv6	Keurbooms	x	x	x	x		x	x	x	x	x

2.2.2 Estuary sub-component prioritisation and indicator selection

The RU evaluation tool for estuaries was used to prioritise estuaries that may be important to users and the environment and to select indicators for which RQOs and Numerical Limits should be developed by following the same guidelines provided in the as for river nodes. A total of 34 estuaries were evaluated in this manner.

The content of the RQOs will be formatted to be the same as much as possible, within the limits of the data. Reserve determination studies used as the main source of data for these high priority estuaries were prepared different times in the past (between 2008 and 2017) and so the content is not the same between studies. Cognisance is also given to the fact that RQOs need to be meaningful but also implementable by the Department. For this reason, condition scores for different river attributes calculated using the Ecostatus modules are also included as RQOs. With this in mind Table 2.4 below summarises the indicators for each RU and describes the reasons for their choice.

Table 2.4 Reasons for selecting the river RQO indicators and some examples of the indicators

Component	Sub-component	Reason for selection	Example of indicator
Quantity	Low flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Flow RQOs given are a monthly average volumes (MCM) that include maintenance low and high flows combined i.e. they include the inter-annual floods with a return period greater than 1:2 years
	High flows		
Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	Specifications for maximum and minimum level for key properties of and contaminants in water
	Salinity		
	System variables (temperature, oxygen, pH, turbidity)		
	Pathogens		

Component	Sub-component	Reason for selection	Example of indicator
Habitat	Hydrodynamics	Provides a score for the water quality condition.	Specifications for the state of the mouth
	Sediments	Provides an overall score for ecological condition.	Narrative account of the flow and/or tidal regime required to maintain sedimentary processes and habitat integrity at a specified level
Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Chlorophyll a
	Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	% cover of indigenous aquatic macrophytes
	Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Community composition and abundance of benthic invertebrates and/or zooplankton
	Fish	Estuaries are important as nursery areas for marine fish.	Community composition and abundance of fish
	Birds	Estuaries are important feeding, roosting and breeding areas for birds	Community composition and abundance

2.2.3 Dam sub-component prioritisation and indicator selection

To determine the subcomponents to be included per priority dam for which Resource Quality Objectives should be determined, the 'Resource Unit Evaluation' tool for dams was used. Minor improvements to the tool was made, mainly to improve clarity with respect to evaluation criteria.

Evaluation criteria were included for quantity, quality, habitat and biotic requirements associated with dams. The specific indicators for each of these include:

- Quantity – low flows or maintenance flows and high flows, including freshets and 1:2-year floods. Note that this includes releases of water to the downstream river, for the ecology and for other users, as well as inflows.
- Quality – nutrients, salts, system variables, toxics, pathogens
- Habitat – riparian and in-dam habitats
- Biota – fish, aquatic and riparian plants, mammals, birds, amphibians, phytoplankton and aquatic invertebrates/zooplankton

The evaluation criteria for each of the above indicators are:

i) *Cumulative level of impact* - This is the anticipated level of impact of current and future use/activities in the upstream catchments on the inflows to the dam and the quality, habitat and biota in the dam. The 'impact rating' can be Very High: -1; High: -0.75; Moderate: -0.5; Low: -0.25; None: 0. Positive scores can be used where a positive impact on the resource quality is expected.
ii) *Trajectory of change* – These are indicated by arrows to show a positive (↑), negative (↓) or stable (→**)** trajectory.
iii) Confidence in the scoring indicated as 'very low' to 'high'.
iv) *Protection of the Resource*: Rating of importance of components for the protection of the water resource, i.e. importance to releases of water for downstream EWRs. Scores given are Very High: 1; High: 0.75; Moderate: 0.5; Low: 0.25; Not important: 0.
v) *Water Resource Dependent Activities*: Rating of importance of components for protection of the water resource for in-dam activities and releases of water for downstream use (irrigation, domestic/rural supply, etc.). Scores given are Very High: 1; High: 0.75; Moderate: 0.5; Low: 0.25; Not important: 0.
vi) Components with importance scores of 0.5 and higher for the 'importance for protection' or 'importance for other water use' are then selected to be included as an EcoSpec and/or UserSpec and will form part of the final set of RQOs for that specific dam.

A total number of seven dams were prioritised based on the criteria for selection in Step 3 of the RQO process, five of which is in the Breede-Overberg area and two of which is in the Gouritz-Coastal area of the WMA Table 2.5 includes some information on the selected dams.

Table 2.5 Prioritised dams considered in this sub-component and indicator phase of the RQO determination procedure

IUA	Name of dam	Quaternary Drainage Area	Completion date	River	Capacity (1000 m^3)	Purpose / use	Owner
B4 Riviersonderend Theewaterskloof	Theewaterskloof	H60D	1980	Riviersonderend	480 406 (includes inflow from Banhoek + Wolwekloof)	Municipal and industrial (WCWSS) *(City of Cape Town, Stellenbosch LM, Drakenstein LM, Overberg Water [Caledon])* and irrigation *(agricultural users direct from dam and indirect from downstream releases in the Theewaterskloof and Berg rivers: 3 x WUAs, 4 x IBs plus individual farmers riparian to the dam)*	DWS
A2 Breede Working Tributaries	Greater Brandvlei	H10L	1983	Breede Tributary	456 000	Irrigation and domestic supply	DWS
A1 Upper Breede Tributaries	Ceres Koekedouw	H10C	2001	Koekedouw	17 200	Irrigation (Koekedouw WUA), municipal and industrial (Ceres)	Witzenberg Local Municipality
B5 Overberg West	Eikenhof	G40C	1977, raised 1998	Palmiet	29 000	Irrigation (Groenland WUA), municipal (Grabouw)	Groenland WUA
B5 Overberg West	Kogelberg	G40D	1986	Palmiet	19 300	Industrial (hydropower) and urban transfer to WCWSS	DWS
B5 Overberg West	Arieskraal	G40D	1967	Palmiet River	5 500	Irrigation	Henderson D.A.
D7 Gouritz-Olifants	Stompdrift	J33B	1965, raised 2014	Olifants River	55 300	Irrigation (Stompdrift-Kammanassie WUA)	DWS
G15 Coastal	Wolwedans	K20A	1990	Groot Brak	25 530	Municipal and industrial	DWS

2.2.4 Wetland sub-component prioritisation and indicator selection

As discussed in the Resource Unit Prioritisation Report, the use of the Wetland Resource Unit Prioritisation Tool (WRPT) is considered problematic for wetland resources, due to the unrealistic input data requirements and the cumbersome and time-consuming process involved in using the tool (INR, 2017). An updated methodology was used to determine high priority wetland resource units, according to ecological importance and provision of ecosystem services. These wetland resource units were considered per wetland region in order to allow for representation across the WMA. Although these priority wetland resource units are still to be workshopped with stakeholders, particular wetlands considered important were assessed in this report in terms of the wetland sub-component prioritisation and indicator selection. These were wetlands considered in Reserve Determination as well as all other wetlands identified in the Resource Unit Prioritisation Report. For Wetlands considered in Reserve Determination the outputs were reviewed and appropriate user and ecological specifications were identified. For all other prioritised wetlands the overall land use impact and ecological categories were identified. From these processes relevant indicators and numerical values were then extracted, the outcome being a set of measurable indicators for individual priority wetlands and groups of wetlands.

The priority wetlands which have had Reserve studies are:

- **A2 Middle Breede Renosterveld**
    - Papenkuils Wetland System
- **F12 Duiwenhoks**
    - Duiwenhoks Wetland System (Gouritz)
- **G15 Coastal**
    - Maalgate wetlands (Coastal)
    - Groenvlei wetland (Coastal)
    - Bitou Wetland System (Gouritz)

The priority wetlands which have been worked on by the Working for Wetlands Program are:

- **H17 Overberg East Fynbos**
    - Boesmans River Wetland (Agulhas wetland)
    - Upper Ratel River Wetland (Agulhas wetland)
    - Pietersiekloof Wetland (Agulhas wetland)
    - Bergplaas Wetland (Agulhas wetland)
- **F12 Duiwenhoks**
    - Duiwenhoks East Wetland (moderate priority)
    - Grootbosberg Wetland
    - Lower Tierkloof
    - Upper Gaffie

The priority wetlands which were worked on by Malan et al.

- **A2 Breede Working Tributaries and A3 Middle Breede Renosterveld**
    - Papenkuils and Platdrif
- **H16 Overberg East Coastal**
    - Groot Rondevlei (moderate priority)
    - Groot Witvlei (moderate priority)
    - Malkopsvlei (moderate priority)

- **H17 Overberg East Fynbos**
    - Salmonsdam A
    - Nuwejaars River (Agulhas wetlands)
    - Groot Hagelkraal River (Agulhas wetlands)
    - Agulhas wetlands
- **F12 Duiwenhoks**
    - Goukou wetland

Ecological Reserve monitoring is a process whereby the following is required:

1. Determining the Present Ecological Status (PES) of the resource
2. Formulating the Recommended Ecological Category (REC)
3. Specifying the Resource Quality Objective (RQO)
4. Specifying the ecological attributes that would indicate the attainment of the REC.

These steps are reliant on measuring a trend of how the resource is changing over time, with change being measured against a baseline or reference condition for driver and response components.

In most cases wetland RQOs are based on moderate confidence data measured over a short temporal scale, with limited long-term monitoring. Wetlands do not have the same level of data available in which to make appropriate recommendations, as opposed to the relatively well understood dynamics of other water resources. It is therefore critical that the first step in the development of a monitoring program for wetlands is the development of a reference condition with a higher level of confidence.

Through this study HIGH priority wetlands have been defined according to Ecological importance and provision of important Ecosystem Services. Wetlands defined as important through this process may have a poor level of data associated with them (i.e. Nama Karoo Depression Wetlands) and even where relatively large amounts of data are available they may be inherently complex systems (i.e. Goukou Wetland System). It is therefore difficult to design a "one size fits all" monitoring program for wetlands due to the limited conceptual understanding there is for these varied systems.

Note: Although HIGH priority wetlands have been identified, these may be considered a representative sample of wetlands in the study area. All wetlands are still to be considered under the National Water Act for triggering activities, and will need to be assessed fully. The benefit of identifying HIGH priority wetlands is to identify a representative sample of wetlands whereby further information is required, or where information is available to ensure that monitoring occurs.

It is proposed that the first step in monitoring is to develop a conceptual understanding of the HIGH priority wetland system, then to apply the WET-Health assessment methodology (Hydrology/Geomorphology/Vegetation: Macfarlane et al. 2008) in order to get an understanding of the baseline condition of the wetland system before monitoring commences. Strictly speaking the responder component (i.e. vegetation or biota) of an ecosystem should be easier to rehabilitate than the underlying driver conditions (i.e. hydrology, water quality and geomorphology) due in part to drivers being able to mitigate change over a longer time period.

Drivers and Responders: The drivers of a wetland are primarily responsible for the presence and maintenance of the system, whilst responders may react to short term fluctuations.

In all wetland types the most important driver is hydrology, followed by geomorphology and water quality. Vegetation is both driver and responder, with other ecosystem responses coming after. This allows for an understanding of the important components and sub-components of wetland systems, in order for effective indicators to be developed (Table 2.6). Indicator selection relates to the prioritisation process, which means that an indicator may be related to monitoring an important ecological characteristic, threat or provision of an important ecosystem service of the wetland.

Table 2.6 A representation of the important drivers of different wetland types

Wetland HGM type	Driver				Driver/ Responder	Responder				
	QUANTITY		HABITAT	QUALITY	HABITAT	BIOTA				
	Flow	Hydroperiod	Geomorphology	Water Quality	Vegetation	Diatoms*	Invertebrates#	Fish	Birds	Frogs
Floodplain	xx	xx	xx	x	x	x	x	x	x	x
Channelled Valley-Bottom		xx	xx	x	x	x	x	x	x	x
Unchanneled Valley-Bottom		xx	xx	x	x	x	x		x	x
Seep		xx	xx	x	x	x	x		x	x
Depression		xx	xx	x	x	xx	xx		x	x
Flat		xx		x	xx	xx	xx		x	x

* Diatoms are a responder to water quality but are considered a reliable water quality indicator; # the presence of certain invertebrates provides a first approximation of hydroperiod and water chemistry; xx indicates relative importance is higher; x indicates relative importance is lower

Wetland Water Quality: Wetland biota are well-adapted to widely varying water quality conditions because of the stagnant, low-oxygen conditions that naturally exist in wetland environments. In the Western Cape wetland systems are exposed to increased nutrient loads and other water quality related impacts, pushing some wetland systems beyond a threshold.

As defined above the most important consideration for wetland monitoring is the development of a conceptual model of wetland hydrological and geomorphological functioning in order to determine the most relevant indicator to select for monitoring. Although in some cases, the most important indicator may be related to Biota (i.e. RAMSAR sites) it is still considered important to understand the functioning of the wetland system.

The steps for evaluation were as follows (with steps 2-3 being conducted as part of developing a baseline):

1. Develop a conceptual model of:
    a. Wetland hydrological functioning and geomorphology
    b. Wetland water quality
    c. Wetland vegetation
    d. Wetland biota
2. Validation and site selection (Required as part of monitoring):
    a. Visit the wetland in the field to determine if the defined wetland type and delineation is correct
    b. Site selection should focus on the representability, access to site, reliability of hydrology and hydraulics (if applicable), and diversity of ecological cues.
    c. Set a monitoring point relevant for particular RQO for particular wetland resource unit
3. Monitoring should take account of the relevant RQO and if required develop a baseline of:
    a. Wetland hydrology (WET-Hydrology module: Macfarlane et al. 2008)
    b. Wetland geomorphology (WET-Geomorphology module: Macfarlane et al. 2008)
    c. Wetland vegetation (WET-Vegetation module: Macfarlane et al. 2008)

Wetland hydrological functioning and geomorphology

As the classification of wetlands relies on defining wetland type, this was used as the precursor to understanding the hydrological and geomorphological functioning of the wetland resource units. This can be defined for flow and water distribution and retention patterns (i.e. baseflow/surrounding runoff) (Table 2.7), which in turn can be related to potential threats through surface water/groundwater usage and indirect land management impacts. Consideration of water distribution and retention patterns (i.e. hydroperiod) relates to the seasonal inundation of different types of wetlands (i.e. temporary, seasonal and permanently waterlogged zones of a wetland: Figure 2.2). The key drivers and threats of different wetland types are provided in Figures 2.3 to Figure 2.8.

Table 2.7 A conceptualisation of hydrological impacts for different wetland types

Wetland HGM type	Floods	Hydroperiod		
	High flows	Baseflow	Surrounding runoff	Standing water
Floodplain	x	x	x	
Channelled Valley-Bottom	x	x	x	
Unchanneled Valley-Bottom		x	x	
Seep		x	x	
Depression		x	x	
Flat		x	x	x

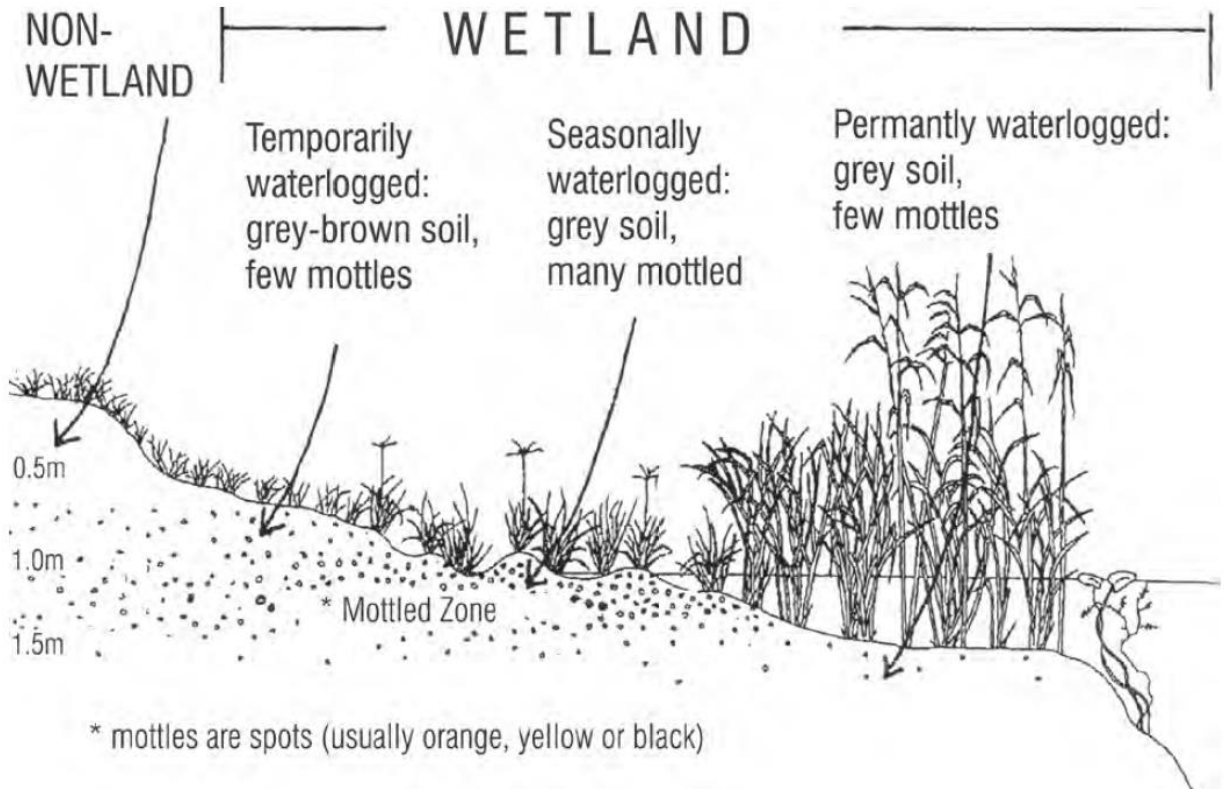

Figure 2.2 Conceptualisation of the water retention patterns within a wetland (DWAF, 2009)

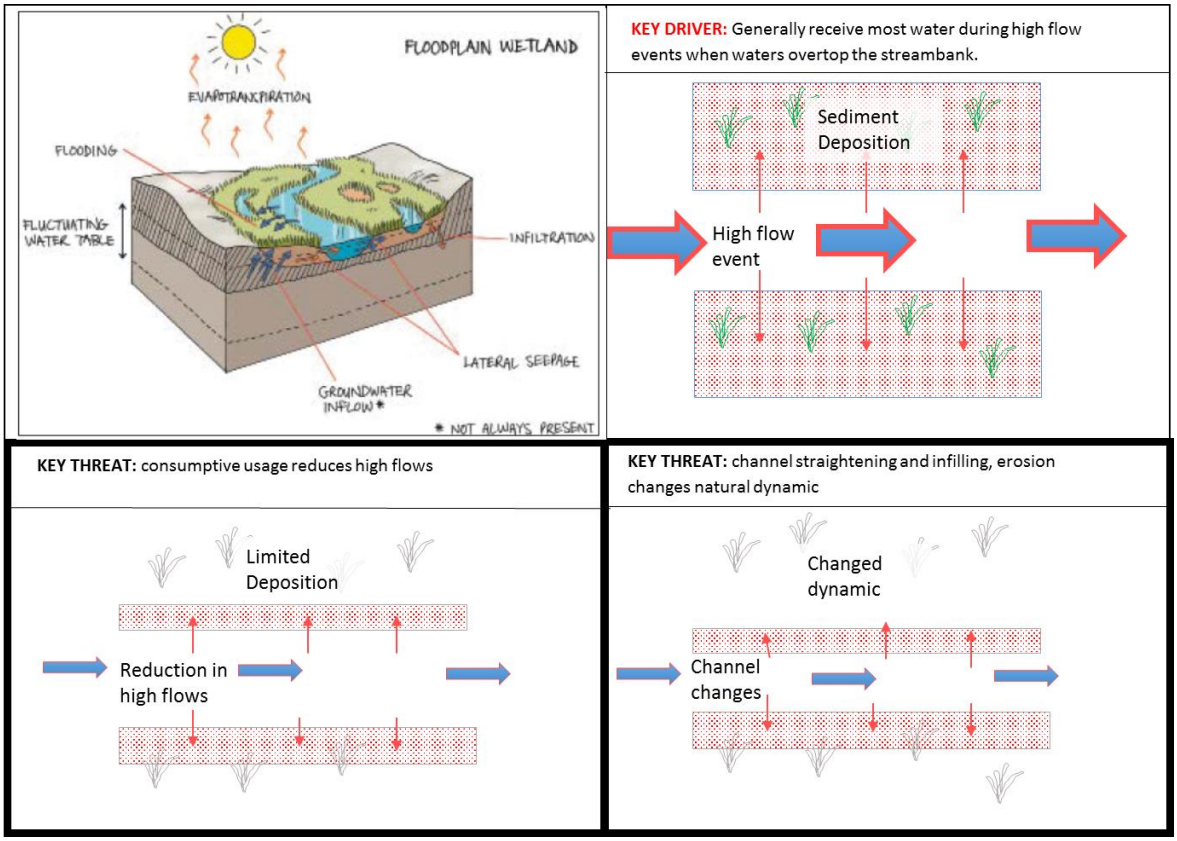

Figure 2.3 Conceptualisation of the key drivers and threats to floodplain wetlands

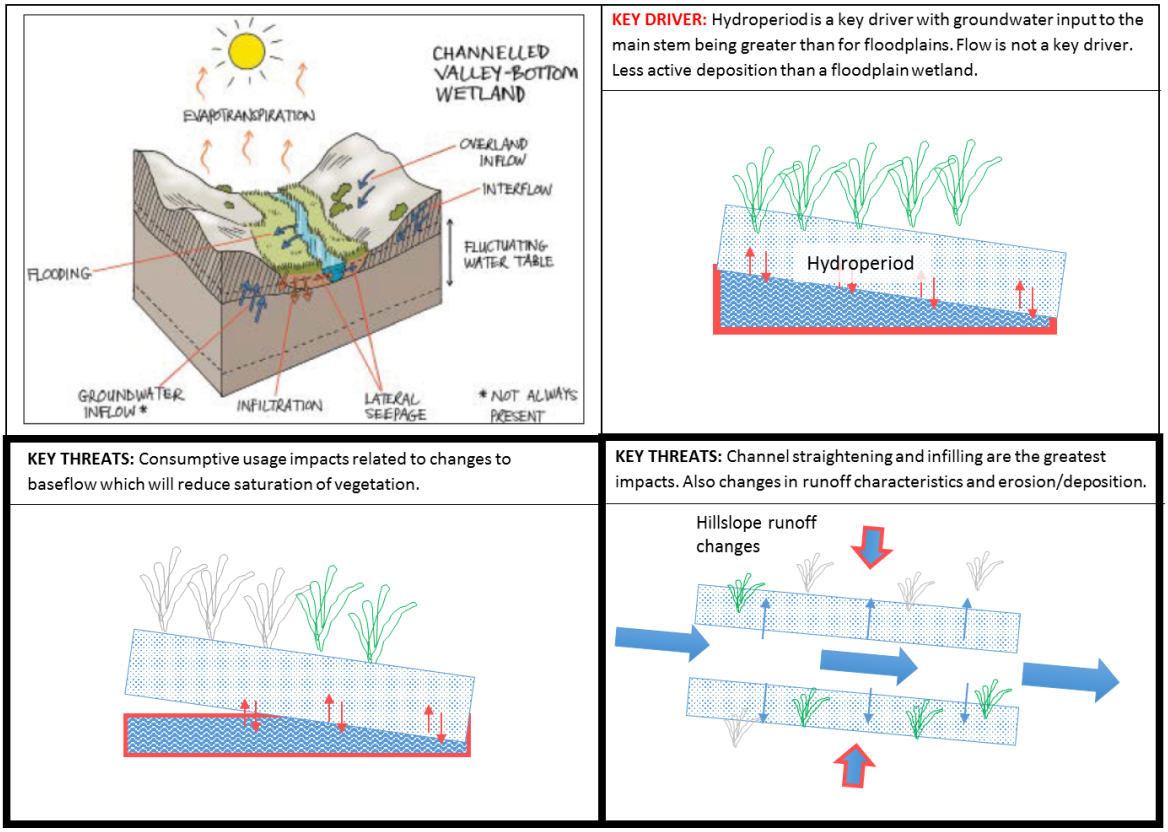

Figure 2.4 Conceptualisation of the key drivers and threats to channelled valley-bottom wetlands

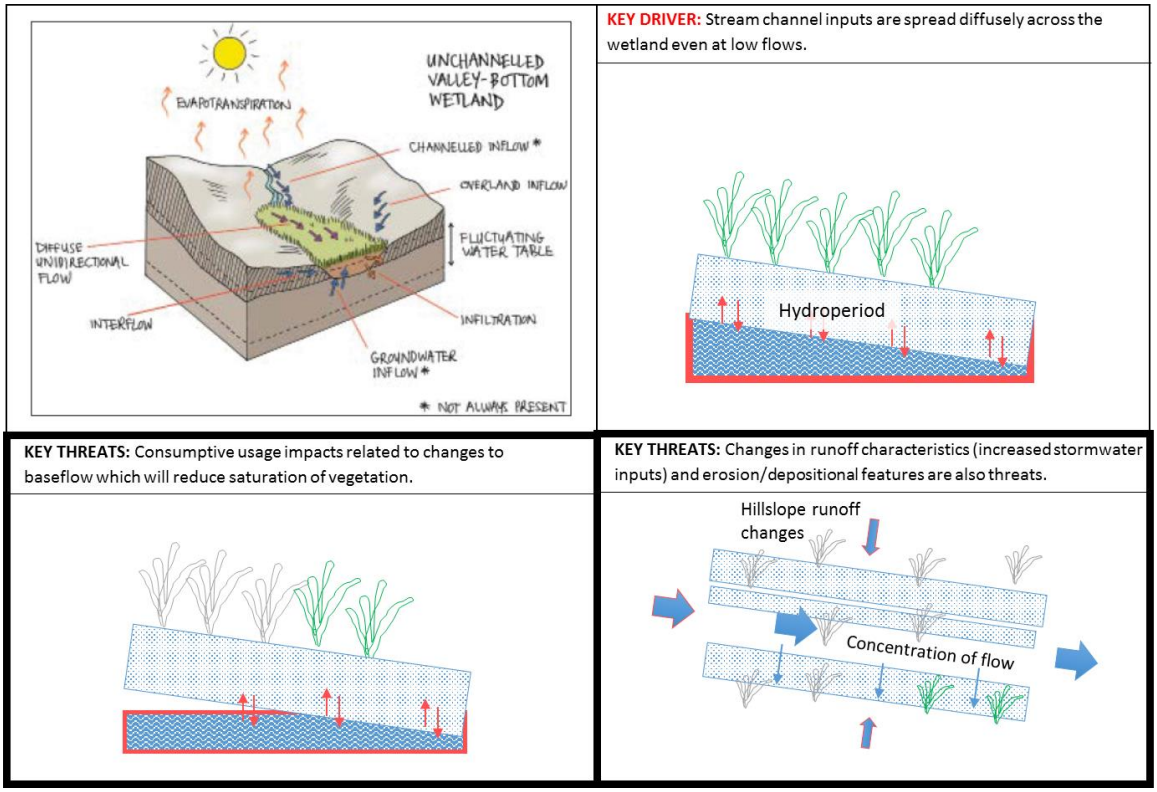

Figure 2.5 Conceptualisation of the key drivers and threats to unchanneled valley-bottom wetlands

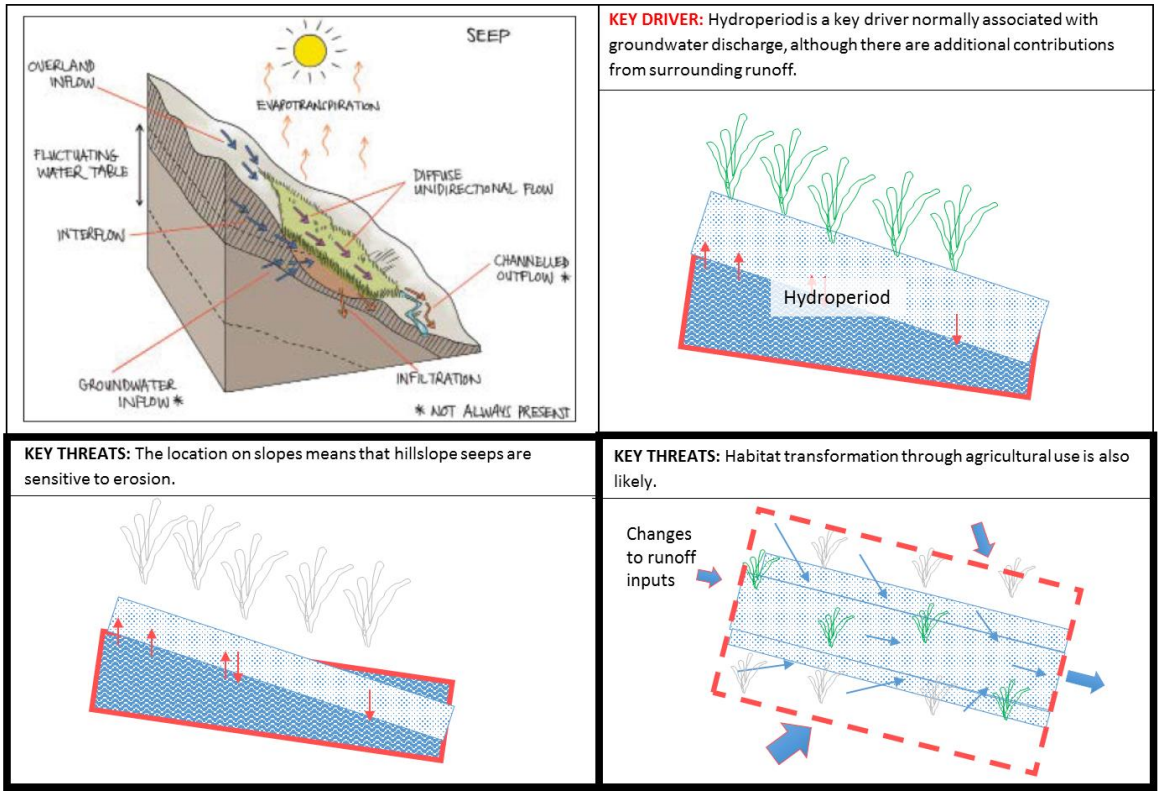

Figure 2.6 Conceptualisation of the key drivers and threats to seep wetlands

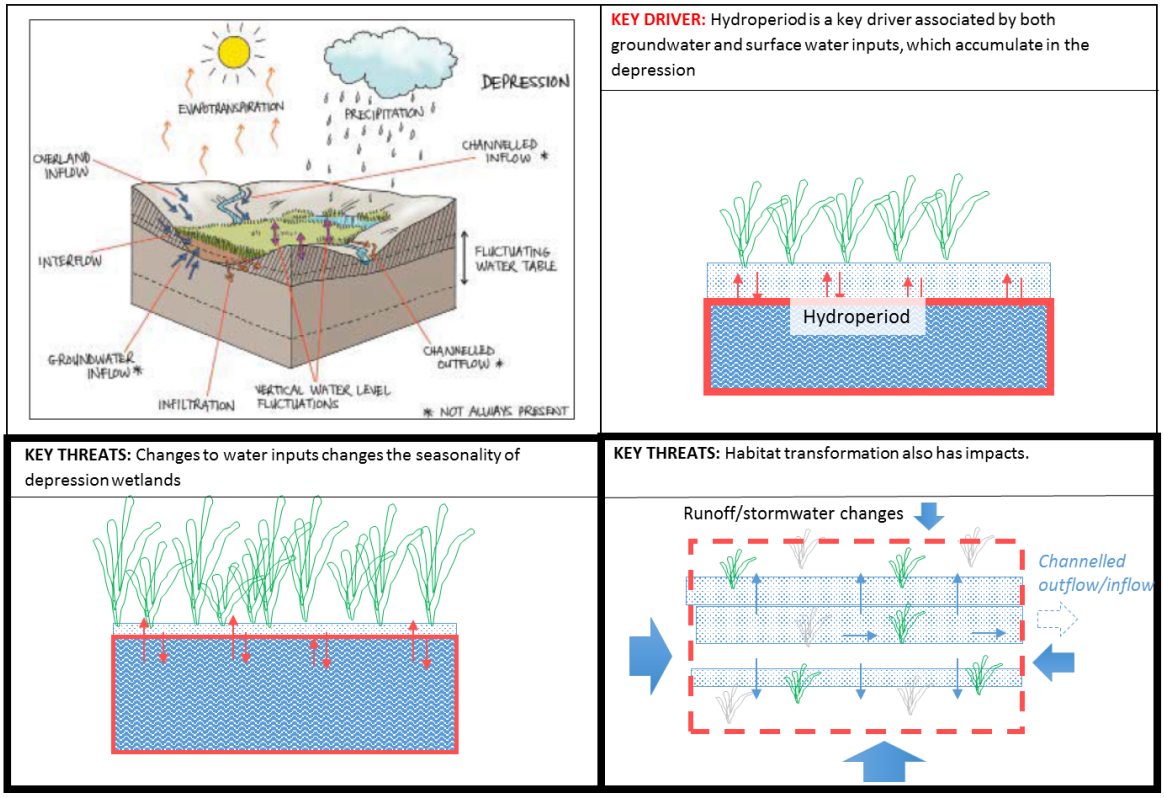

Figure 2.7 Conceptualisation of the key drivers and threats to depression wetlands

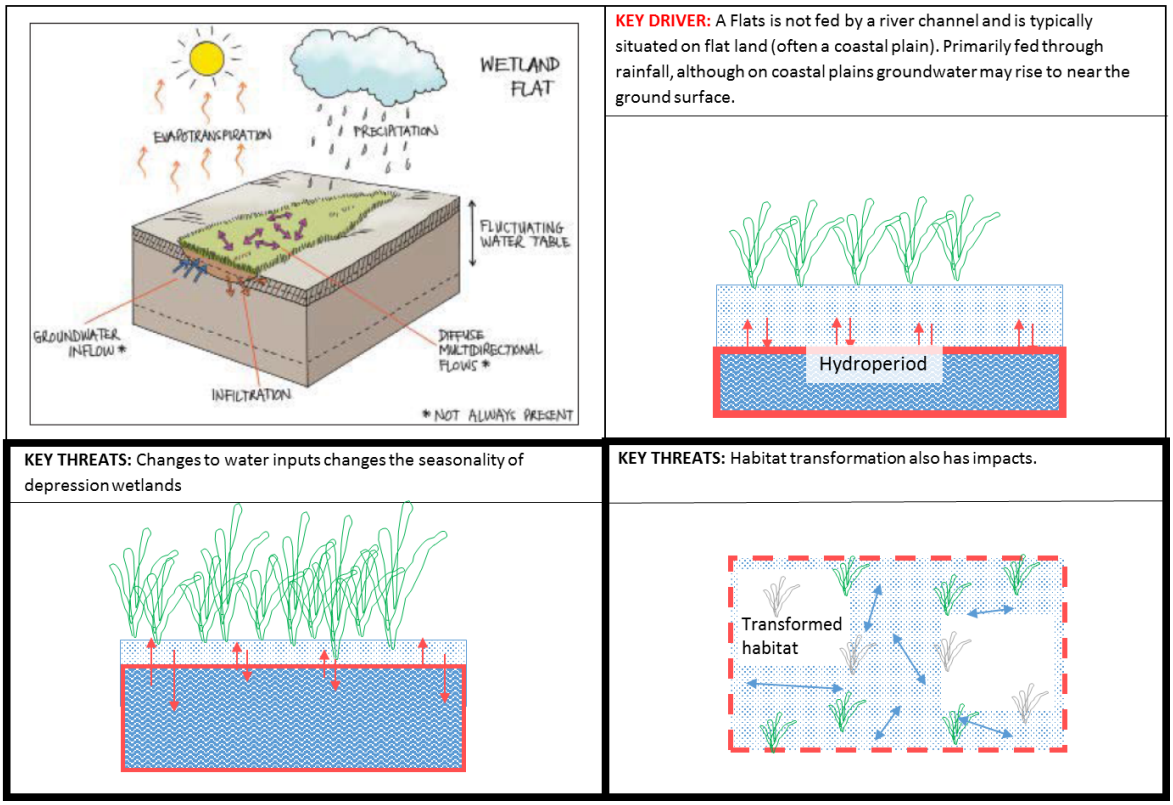

Figure 2.8 Conceptualisation of the key drivers and threats to wetland flats

2.2.5 Groundwater sub-component prioritisation and indicator selection

The Resource Unit Evaluation Tool addresses the prioritisation of sub-components that may be important to users and the environment and assists in the selection of indicators for which RQOs and Numerical Limits should be developed. The RU Evaluation Tool is however focussed on river, estuary, and wetland RUs, and there is no standard tool for the selection of indicators for groundwater RUs.

Therefore, the Resource Unit Evaluation Tool was used only as a guideline. The components routinely considered for rivers (quality, quantity) are equally applicable to groundwater. Relevant sub-components were selected based on the tool and also following recent examples from other catchments, specifically the Olifants-Doorn (DWS, 2014), and the Inkomati-Usuthu (DWS, 2015).

3 Results

3.1 Selected user sub-components and indicators for rivers

The RU evaluation tool for river was used to prioritise sub-components that may be important to users and the environment and to select indicators for which RQOs and Numerical Limits should be developed.

Two different levels of numerical and descriptive RQOs will be written. Hydrological and ecological condition RQOs will be written for all RUs. In addition to this, water quality, geomorphology, riparian vegetation, macroinvertebrates and fish RQOs will be written for the high priority RQOs. No RWOs will be written for RUs with a zero-ranked score.

The 17 high priority RUs in the Breede River basin and Overberg area where detailed RQOs for hydrology, water quality, geomorphology, riparian vegetation, macroinvertebrates and fish will be written are shown in Table 3.1.

Table 3.1 RUs selected for evaluation in the Breede River basin and Overberg area

RU priority	Quat #	Node code	River	REC	PES	%nMAR	Comprehensive EWR sites	Rapid III EWR sites
4	H10F	Nviii1	Breede	D	D/E	55.19	x	
4	H10J	Nvii2	Molenaars	B	B	89.88	x	
3	H20G	Nvii7	Hex	C	C	79.43		x
3	H40F	Nvii8	Breede	C/D	C/D	50.52	x	
4	H50B	Ni2	Breede		D	49.09		
3	H60B	Nvii10	Du Toits		B	90.12		
3	H60D	Nv7	Riviersonderend		D	53.58		
3	H60E	Niv28	Baviaans	B	B	84.98	x	
4	H60F	Nv9	Riviersonderend	D	D	56.66	x	
4	H60L	Ni3	Riviersonderend		D	52.67		
3	H70G	Niii4	Breede	B/C	C	53.4	x	
3	G40C	Piii1	Palmiet	B	C	87.4		x
3	G40D	Piii2	Palmiet	B/C	B/C	49.11		x
4	G40D	Piii3	Palmiet	B	B	57.99		x
4	G50B	Ni4	Nuwejaar	D	D	45.46		x
4	G50D	Nv24	Kars	B	B/C	89.16		x
4	G40K	Nv23	Klein	C	C/D	84.71		x

Where: Quat = quaternary catchment, REC = Recommended Ecological Category, PES = Present Ecological Status, %nMAR = current day flow as a percentage of Mean Annual Runoff, EWR = Ecological Water Requirements

The 20 high priority RUs in the Gouritz River basin and Coastal area where detailed RQOs for hydrology, water quality, geomorphology, riparian vegetation, macroinvertebrates and fish will be written are shown in Table 3.2.

Table 3.2 RUs selected for evaluation in the Gouritz River basin and Coastal area

RU priority	Quat #	Node code	River	REC	PES	%nMAR	Comprehensive EWR sites	Rapid III EWR sites
3	J12L	gviii1	Doring	C/D	C/D	43.79		x
3	J12L	gv5	Touws	B/C	B/C	43.01	x	
3	J11H	gv4	Buffels	C	C	66.36	x	
3	J11J	gv6	Groot		D	44.48		
3	J13C	gii3	Groot		B	42.01		
3	J25A	giv20	Gamka	C	C/D	51.49		x
4	J31C	giii2	Olifants	C	C	84.08		x
4	J34C	gv36	Kammanassie	C/D	C/D	71.93		x
4	J40B	gi4	Gouritz	C	C	54.89	x	
4	H80D	giii8	Duiwenhoks	D	D	93.51		x
3	H90A	giii7	Goukou	C/D	C/D	87.04		x
4	K20A	gviii2	Groot-Brak	B/C	B/C	93.62	x	
3	K30B	gvii9	Malgas	C	C	95.29	x	

RU priority	Quat #	Node code	River	REC	PES	%nMAR	Comprehensive EWR sites	Rapid III EWR sites
4	K30C	gvii11	Kaaimans	B	B	94.03	x	
4	K40A	giii10	Diep	A/B	B	96.64	x	
4	K40C	gvii13	Karatara	A/B	B	94.21	x	
4	K40E	gviii9	Goukamma	B/C	B/C	87.31	x	
3	K50A	gvii14	Knysna	B	B	95.54	x	
4	K50B	gviii11	Gouna	A/B	A/B	92.12	x	
4	K60C	giv6	Keurbooms	B/C	C	84.09	x	

Where: Quat = quaternary catchment, REC = Recommended Ecological Category, PES = Present Ecological Status, %nMAR = current day flow as a percentage of Mean Annual Runoff, EWR = Ecological Water Requirements

Table 3.3 Sub-component and indicator selection for prioritized rivers in the Upper Breede Tributaries IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
A1 Upper Breede Tributaries	II	A1-R01	Breede River	nviii1	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Risk of nutrient enrichment from agricultural sources and WWTW discharges. Nutrients should be maintained in mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained.	Electrical conductivity
						System variables	pH should be maintained in desirable state, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Intensive grape and fruit growing area and concerns about agrochemical residues. No data to assess current state. Agrochemicals should be maintained to minimize impacts of aquatic biota.	Ammonia Atrazine & Endosulfan
						Pathogens	Water-borne diseases pose a risk to recreational users and anglers in this river reach. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
A1 Upper Breede Tributaries	II	A1-R02	Molenaars River	nvii2	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Largely natural stream with low risk of nutrient enrichment Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in current state.	Electrical conductivity
						System variables	pH should be maintained in natural state (acidic western cape stream), no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Some concerns about elevated ammonia concentrations from upstream fish farming activities. No concerns about agrochemicals.	Ammonia
						Pathogens	Water-borne diseases pose a risk to recreational users and anglers in this river reach. River should be maintained in a low risk state.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species

Table 3.4 Sub-component and indicator selection for prioritized rivers in the Breede Working Tributaries IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
A2 Breede Working Tributaries	III	A2-R03	Hex River	nvii7	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Risk of nutrient enrichment from agricultural sources and wastewater discharges. Nutrients should be maintained in mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in present to meet ecosystem requirements.	Electrical conductivity
						System variables	pH should be maintained in desirable state, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Intensive grape and fruit growing area and concerns about agrochemical residues. No data to assess current state. Agrochemicals should be maintained to minimize impacts of aquatic biota.	Ammonia Atrazine & Endosulfan
						Pathogens	Water-borne diseases pose a risk to recreational users and anglers in this river reach. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

Table 3.5 Sub-component and indicator selection for prioritized rivers in the Middle Breede Renosterveld IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
A3 Middle Breede Renosterveld	III	A3-R04	Breede River	nvii8	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Risk of nutrient enrichment from agricultural sources and WWTW discharges. Nutrients should be maintained in mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained.	Electrical conductivity
						System variables	pH should be maintained in desirable state, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Intensive grape growing area and concerns about agrochemical residues. No data to assess current state. Agrochemicals should be maintained to minimize impacts of aquatic biota.	Ammonia Atrazine & Endosulfan
						Pathogens	Water-borne diseases pose a risk to recreational users and anglers in this river reach. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
A3 Middle Breede Renosterveld	III	A3-R05	Breede River	ni2	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Risk of nutrient enrichment from agricultural sources and WWTW discharges at Robertson and Bonnievale. Nutrients should be maintained in mesotrophic state or better.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are elevated due to saline irrigation return flows. Salt concentrations should not deteriorate beyond current day conditions.	Electrical conductivity
						System variables	pH should be maintained in desirable state, no concerns raised about unnatural water temperature although low flows result in unnatural elevated temperatures. No concerns about low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration Water temperature
						Toxins	Intensive grape and fruit growing area and concerns about agrochemical residues. No data to assess current state. Agrochemicals should be maintained to minimize impacts of aquatic biota.	n/a
						Pathogens	Water-borne diseases pose a risk to recreational users and anglers in this river reach. River should be maintained in a low risk.	Escherichia coli

Table 3.6 Sub-component and indicator selection for prioritized rivers in the Riviersonderend Theewaterskloof IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
B4 Riviersonderend Theewaterskloof	III	B4-R06	Du Toits River	nvii10	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Natural stream with low risk of nutrient enrichment Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in current state.	Electrical conductivity
						System variables	pH should be maintained in natural state (acidic western cape stream), no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen
						Toxins	Natural catchment area; no concerns about toxins. River should be maintained in a low risk.	Atrazine & Endosulfan
						Pathogens	Natural catchment area; no concerns about microbial pollution. River should be maintained in a low risk.	Escherichia coli
B4 Riviersonderend Theewaterskloof	III	B4-R07	Riviersonderend River	nv7	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Situated downstream of Theewaterskloof Dam there is a low risk of nutrient enrichment; most are trapped in the dam. Nutrients should be maintained in mesotrophic state or better.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in that state to meet ecosystem requirements.	Electrical conductivity
						System variables	pH is slightly acidic and should be maintained in desirable state, concerns about low water temperatures resulting from bottom releases, some concerns about low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Some concerns about elevated iron and manganese in the released water. River should be maintained in a low risk.	Atrazine & Endosulfan
						Pathogens	Water-borne diseases pose a risk to recreational users and anglers in this river reach. River should be maintained in a low risk.	Escherichia coli

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
B4 Riviersonderend Theewaterskloof	III	B4-R08	Baviaans River	niv28	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Natural stream with low risk of nutrient enrichment. Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in current state.	Electrical conductivity
						System variables	pH should be maintained in natural state (acidic western cape stream), no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	Natural catchment area; no concerns about microbial pollution. River should be maintained in a low risk for contact recreation.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
B4 Riviersonderend Theewaterskloof	III	B4-R09	Riviersonderend River	nv9	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Some risk of nutrient enrichment from irrigation next to the river. Nutrients should be maintained in mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained to meet ecosystem requirements.	Electrical conductivity
						System variables	pH is typical of Western Cape acidic streams and should be maintained as such, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Irrigation next to the river raises concerns about agrochemical residues. No data to assess current state. Agrochemicals should be maintained to minimize impacts of aquatic biota.	Atrazine & Endosulfan
						Pathogens	No significant sources of microbial pollution. River should be maintained in a low risk.	Escherichia coli or Faecal coliforms
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

Table 3.7 Sub-component and indicator selection for prioritized rivers in the Lower Riviersonderend IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
F9 Lower Riviersonderend	III	F9-R10	Riviersonderend River	ni3	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Some risk of nutrient enrichment from irrigation next to the river. Nutrients should be maintained in mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are elevated and should not deteriorate beyond present day conditions.	Electrical conductivity
						System variables	pH should be maintained in desirable state, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Water temperature Dissolved oxygen concentration
						Toxins	Irrigation next to the river raises concerns about agrochemical residues. No data to assess current state. Agrochemicals should be maintained to minimize impacts of aquatic biota.	Atrazine & Endosulfan
						Pathogens	No significant sources of microbial pollution. River should be maintained in a low risk.	Escherichia coli

Table 3.8 Sub-component and indicator selection for prioritized rivers in the Overberg West IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
B5 Overberg West	II	B5-R11	Palmiet River	piii1	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Largely natural stream with low risk of nutrient enrichment Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in current state.	Electrical conductivity
						System variables	pH should be maintained in natural state (acidic western cape stream), no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen
						Toxins	No concerns about agrochemicals yet. River should be maintained in a low risk for aquatic ecosystems.	Atrazine & Endosulfan
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk for contact recreation.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
B5 Overberg West	II	B5-R12	Palmiet River	piii2	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Some risk of nutrient enrichment from agricultural sources and WWTW discharges at Grabouw. Nutrients should be maintained in mesotrophic state or better.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained to meet ecosystem requirements.	Electrical conductivity
						System variables	pH is slightly acidic (naturally) and should be maintained in that state. No concerns about unnatural water temperature. No concerns about low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Intensive apple and fruit growing area in the middle reaches of the Palmiet therefore some concerns about agrochemical residues. No data to assess current state. Agrochemicals should be maintained to minimize impacts of aquatic biota.	Atrazine & Endosulfan Iron (Mn) Manganese (Mn)
						Pathogens	Water-borne diseases pose a risk to recreational hikers in this river reach. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
B5 Overberg West	II	B5-R13	Palmiet River	piii3	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low nutrient enrichment. Nutrients should be maintained in mesotrophic state or better.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained to meet ecosystem requirements.	Electrical conductivity
						System variables	pH is slightly acidic (naturally) and should be maintained in that state. No concerns about unnatural water temperature. No concerns about low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	No concerns about agrochemicals yet. River should be maintained in a low risk to protect aquatic ecosystems.	Atrazine & Endosulfan
						Pathogens	Water-borne diseases pose a risk to recreational hikers in this river reach. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

Table 3.9 Sub-component and indicator selection for prioritized rivers in the Overberg East Renosterveld IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
F10 Overberg East Renosterveld	II	F10-R14	Klein River	nv23	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally elevated and should be maintained in current state.	Electrical conductivity
						System variables	pH should be maintained in natural, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Some concerns about agrochemicals.	Atrazine & Endosulfan
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk for contact recreation.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score

Table 3.10 Sub-component and indicator selection for prioritized rivers in the Overberg East Fynbos IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
H17 Overberg East Fynbos	II	H17-R15	Nuwejaar River	ni4	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	No data, probably low risk of nutrient enrichment Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are probably naturally elevated. Maintain in current state.	Electrical conductivity
						System variables	pH should be maintained in natural state. no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk for contact recreation.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
H17 Overberg East Fynbos	II	H17-R16	Kars River	nv24	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Monitoring stopped in 1987. Probably low risk of nutrient enrichment Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally elevated and should be maintained in current state.	Electrical conductivity
						System variables	pH should be maintained in natural, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	No concerns about agrochemicals yet. River should be maintained in a low risk.	Ammonia Atrazine & Endosulfan
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score

Table 3.11 Sub-component and indicator selection for prioritized rivers in the Lower Breede Renosterveld IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
F11 Lower Breede Renosterveld	II	F11-R17	Breede River	niii4	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Some risk of nutrient enrichment from agricultural sources and WWTW discharges at Grabouw. Nutrients should be maintained in mesotrophic state or better.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained to meet ecosystem requirements.	Electrical conductivity
						System variables	pH is slightly acidic (naturally) and should be maintained in that state. No concerns about unnatural water temperature. No concerns about low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Intensive apple and fruit growing area in the middle reaches of the Palmiet therefore some concerns about agrochemical residues. No data to assess current state. Agrochemicals should be maintained to minimize impacts of aquatic biota.	Ammonia Atrazine & Endosulfan
						Pathogens	Water-borne diseases pose a risk to recreational hikers in this river reach. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

Table 3.12 Sub-component and indicator selection for prioritized rivers in the Touws IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
E8 Touws	III	E8-R18	Doring River	gviii1	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally saline and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in natural, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
E8 Touws	III	E8-R19	Touws River	gv5	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally saline and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in natural, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
E8 Touws	III	E8-R20	Buffels River	gv4	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally saline and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in natural, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
E8 Touws	III	E8-R21	Groot River	gv6	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally saline and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in natural, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	No concerns about agrochemicals yet. River should be maintained in a low risk to protect aquatic ecosystems.	Atrazine & Endosulfan
E8 Touws	III	E8-R22	Groot River	gii3	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally saline and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in natural, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration

Table 3.13 Sub-component and indicator selection for prioritized rivers in the Gouritz-Olifants IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
D7 Gouritz-Olifants	III	D7-R23	Gamka River	giv20	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment. Nutrients should be maintained in a mesotrophic state or better.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally moderately saline and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in the recommended range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect human recreational users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
D7 Gouritz-Olifants	III	D7-R24	Olifants River	giii2	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	No data, monitoring stopped in 1995. Probably low risk of nutrient enrichment. Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally saline and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in recommended range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect human users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score
D7 Gouritz-Olifants	III	D7-R25	Kammanassie River	gv36	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment. Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained to meet ecosystem requirements.	Electrical conductivity
						System variables	pH should be maintained in the recommended range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to human users.	Escherichia coli

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
					Habitat	Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

Table 3.14 Sub-component and indicator selection for prioritized rivers in the Lower Gouritz IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
F13 Lower Gouritz	II	F13-R26	Gouritz River	gi4	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment. Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally saline and should be maintained in its current state.	Electrical conductivity
						System variables	pH is elevated but still in the recommended range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect human users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

Table 3.15 Sub-component and indicator selection for prioritized rivers in the Duiwenhoks IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
F12 Duiwenhoks	III	F12-R27	Duiwenhoks River	giii8	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Low risk of nutrient enrichment (mostly dryland agriculture). Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally moderately elevated and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in natural range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect human recreational users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

Table 3.16 Sub-component and indicator selection for prioritized rivers in the Hessequa IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator
I18 Hessequa	III	I18-R28	Goukou River	giii7	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Some risk of nutrient enrichment from upstream irrigation agriculture. Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are moderately elevated and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in natural range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	No concerns about agrochemicals yet. River should be maintained in a low risk to protect aquatic ecosystems.	Atrazine & Endosulfan
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect human users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

Table 3.17 Sub-component and indicator selection for prioritized rivers in the Groot-Brak IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G14 Groot-Brak	III	G14-R29	Groot-Brak River	gviii2	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Largely natural catchment with low risk of nutrient enrichment. Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are naturally saline and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in natural range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect human users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score Sediment particle size
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

Table 3.18 Sub-component and indicator selection for prioritized rivers in the Coastal IUA

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-R30	Malgas River	gvii9	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Urban stream with some risk of nutrient enrichment from urban runoff. Nutrients should be maintained in a mesotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in its current state.	Electrical conductivity
						System variables	pH should be maintained in natural range for naturally acidic rivers, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Toxins	Some concerns about agrochemicals from urban area. River should be maintained in a low risk to protect ecosystems.	Ammonia Atrazine & Endosulfan
						Pathogens	Some concerns about microbial pollution from urban runoff. River should not pose a risk to urban recreation users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score Sediment particle size
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-R31	Kaaimans River	gvii11	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Largely natural catchment with low risk of nutrient enrichment. Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in an ideal state for aquatic ecosystems.	Electrical conductivity
						System variables	pH is naturally acidic and it should be maintained in its natural range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect recreational users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score Sediment particle size
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-R32	Diep River	giii10	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Largely natural catchment with low risk of nutrient enrichment. Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in an ideal state for aquatic ecosystems.	Electrical conductivity
						System variables	pH is naturally acidic and it should be maintained in its natural range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect the health of human users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score Sediment particle size
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-R33	Karatara River	gvii13	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Largely natural catchment with low risk of nutrient enrichment. Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in an ideal state for aquatic ecosystems.	Electrical conductivity
						System variables	pH is naturally acidic and it should be maintained in its natural range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect human users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score Sediment particle size
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-R34	Goukamma River	gvii9	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Largely natural catchment with probably a low risk of nutrient enrichment. No water quality monitoring data available on this river. Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are probably low and should be maintained in an ideal state for aquatic ecosystems.	Electrical conductivity
						System variables	pH is probably naturally acidic and it should be maintained in its natural range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect recreational users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score Sediment particle size
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-R35	Knysna River	gvii14	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Largely natural catchment with low risk of nutrient enrichment. Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in an ideal state for aquatic ecosystems.	Electrical conductivity
						System variables	pH is naturally acidic and it should be maintained within its natural range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk to protect recreational users.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score Sediment particle size
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-R36	Gouna River	gviii11	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	Largely natural catchment with low risk of nutrient enrichment. Nutrients should be maintained in an oligotrophic state.	Nutrient concentrations (phosphate and total inorganic nitrogen)
						Salts	Salt concentrations are low and should be maintained in an ideal state for aquatic ecosystems.	Electrical conductivity
						System variables	pH is naturally acidic and it should be maintained in its natural range, no concerns raised about unnatural water temperature or low dissolved oxygen concentrations. Current state should be maintained to meet ecosystem requirements.	pH range Dissolved oxygen concentration
						Pathogens	No concerns about microbial pollution yet. River should be maintained in a low risk.	Escherichia coli
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score Sediment particle size
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

IUA	Class	RU	River	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-R37	Keurbooms River	giv6	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	Maintenance low flows Drought flows Maintenance high flows
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users. Excessive nutrients stimulate undesirable algal blooms in dams, and periphyton and macrophyte growth in rivers.	Specifications for maximum and minimum level for key properties of and contaminants in water
						Salts	High salt concentrations affect crops yields, unpalatable drinking water, and interferes with the osmoregulation of aquatic organisms.	Electrical conductivity
						System variables	System variables such as pH, water temperature, suspended sediment, affect aquatic biota and uses.	pH range Dissolved oxygen concentration
						Toxins	Agrochemicals (pesticide & herbicides residues) can have chronic or acute impacts on aquatic biota.	Conservative approach followed, no agrochemicals present in water.
						Pathogens	Water-borne diseases negatively affect domestic water supplies.	Fitness for use categories for domestic water supply and contact recreation.
					Habitat	Geomorphology	Instream habitat influences aquatic biota. Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms.	GAI score Sediment particle size
						Riparian vegetation	Riparian habitat influences river channel structure and also protects agricultural land from erosion and provides habitat to riparian organisms	VEGRAI score % cover of indigenous and riparian plant species
					Biota	Fish	Indigenous fish are of conservation importance.	FRAI score Catch per Unit Effort (CPUE) of fish species present Frequency of occurrence (FROC) of key fish species
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	MIRAI score SASS and ASPT scores from SASS The number of macroinvertebrate families present Presence of key families

3.2 Selected user sub-components and indicators for estuaries

The RU evaluation tool for estuaries was used to prioritise sub-components that may be important to users and the environment and to select indicators for which RQOs and Numerical Limits should be developed.

Two different levels of numerical and descriptive RQOs will be provided. Hydrological and ecological condition RQOs will be written for all estuaries (including micro-estuaries but excluding river outlets) while more detailed RQOs including those for sedimentary processes, mouth condition, water quality, microalgae, macrophyte, invertebrate, fish and avifauna for the high priority estuaries.

The priority estuaries where detailed RQOs for hydrology, water quality, microalgae, macrophyte, invertebrate, fish and avifauna will be prepared are shown in Table 3.19 and Table 3.20.

Table 3.19 Priority estuaries in the Breede and Overberg portion of the WMA for which RQOs will be provided.

Estuary	Type	Area (ha) incl. floodplain	Channel area	Catchment size (km^2)	Present day MAR Mm^3	Reserve (Scenarios)	PES	REC
Palmiet	Closed	28.53	26	470	177.94	Yes 7	C	B
Buffels (Oos)	Micro	4.73	1.3	23	12.70	-	B	B
Rooiels	Closed	16.03	1.9	21	9.44	Yes 4	B	B
Bot/Kleinmond	Lake	2 039.01	1229.2	887	77.67	Yes 3	C	B
Onrus	Closed	15.13	3.5	58	4.74	Yes 5	E	D
Klein	Lake	1 802.33	113.6	896	51.21	Yes 7	C	B
Uilkraals	Closed	702.31	55.7	377	6.82	Yes 4	D	C
Ratel	Micro	8.63	1.5	95	3.42	-	C	C
Heuningnes	Open	13 125.81	1451.5	3578	29.53	In Prog 5	C	A
Klipdrifsfontein	Micro	2.23	0.8	27	0.75	-	A	A
Breede	Open	2 079.43	1147.6	12 496	1140.69	Yes 5	B	B

Table 3.20 Priority estuaries in the Gouritz portion of the WMA.

Estuary	Type	Area (ha) incl. floodplain	Channel area	Catchment size (km^2)	Present day MAR Mm^3	Reserve (Scenarios)	PES	REC
Gouritz	Open	1 049.41	319	45 544	397.85	Yes 5	C	B
Duiwenhoks	Open	419.33	108.3	1207	81.62	Yes 5	B	A
Goukou	Open	372.33	122.4	1438	89.94	Yes 5	C	B
Klein Brak	Closed	976.93	89.4	556	35.54	Yes 5	C	C
Groot Brak	Closed	205.13	65.6	162	0.92	Yes 10	D	C
Blinde	Micro	4.13	2.1	28	1.01	-	B	B
Tweekuilen	Micro	9.82	1.6	35	1.25	-	D	D
Gericke	Micro	3.62	0.9	12	0.39	-	D	D
Hartenbos	Closed	236.93	30.5	169	3.74	-	D	C
Maalgate	Closed	22.23	17	185	35.72	-	B	B
Gwaing	Closed	10.63	4.2	121	51.16	Yes 5	B	C
Kaaimans	Open	20.63	9	132	26.88	-	B	B
Wilderness	Lake	1 091.73	501.8	173	29.01	Yes 5	B	A
Swartvlei	Lake	2 037.9[1]	114.5	419	92.49	Yes 8	B	B
Goukamma	Closed	213.13	45.3	252	46.25	Yes 8	B	A
Knysna	Bay	2 284.11	1691.7	419	84.32	Yes 10	B	B
Noetsie	Closed	14.83	8	39	5.11	-	B	A
Piesang	Closed	59.53	4.9	48	6.41	-	C	B
Keurbooms	Open	1 523.41	398.2	1123	104.2	Yes 5	A	A
Matjies	Micro	2.53	0.5	25	3.22	Yes 5	B	B
Sout (Oos)	Micro	13.83	1.7	33	3.45	Yes 5	A	A
Groot (Wes)	Closed	64.43	30.2	82	10.88	-	B	A
Bloukrans	River mouth	4.21	2.3	88	31.38	-	A	A

Table 3.21 Sub-component and indicator selection for prioritized estuaries in the Overberg West IUA

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
B5 Overberg West	II	B5-E01	Palmiet Estuary	pxi1	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Temperature pH Dissolved oxygen Secchi depth
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

Table 3.22 Sub-component and indicator selection for prioritized estuaries in the Overberg West Coastal IUA

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
H16 Overberg West Coastal	II	H16-E02	Buffels Estuary	bxi1	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						System variables		Dissolved oxygen
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
H16 Overberg West Coastal	II	H16-E03	Rooiels Estuary	bxi2	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						System variables		Dissolved oxygen
						Pathogens		Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
H16 Overberg West Coastal	II	H16-E04	Bot Estuary	nxi6	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		pH Dissolved oxygen
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
H16 Overberg West Coastal	II	H16-E05	Onrus Estuary	nxi8	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts	WQ influences habitat quality for organisms and also fitness for use for users	Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness

Table 3.23 Sub-component and indicator selection for prioritized estuaries in the Overberg East Fynbos IUA

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
H17 Overberg East Fynbos	II	H17-E06	Klein Estuary	nxi7	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
H17 Overberg East Fynbos	II	H17-E07	Uilkraals Estuary	nxi5	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
H17 Overberg East Fynbos	II	H17-E08	Ratel Estuary	nxi3	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
H17 Overberg East Fynbos	II	H17-E09	Heuningnes Estuary	nxi1	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen pH
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
H17 Overberg East Fynbos	II	H17-E10	Klipdrifsfontein Estuary	bxi3	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness

Table 3.24 Sub-component and indicator selection for prioritized estuaries in the Lower Breede Renosterveld IUA

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
F11 Lower Breede Renosterveld	II	F11-E11	Breede Estuary	nxi2	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

Table 3.25 Sub-component and indicator selection for prioritized estuaries in the Lower Gouritz IUA

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
F13 Lower Gouritz	II	F13-E12	Gouritz Estuary	gxi1	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

Table 3.26 Sub-component and indicator selection for prioritized estuaries in the Duiwenhoks IUA

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
F12 Duiwenhoks	III	F12-E13	Duiwenhoks Estuary	gxi2	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

Table 3.27 Sub-component and indicator selection for prioritized estuaries in the Hessequa IUA

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
I18 Hessequa	III	I18-E14	Goukou Estuary	gxi3	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen pH
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

Table 3.28 Sub-component and indicator selection for prioritized estuaries in the Groot-Brak IUA

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G14 Groot-Brak	III	G14-E15	Klein-Brak Estuary	gxi4	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen TSS pH
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G14 Groot-Brak	III	G14-E16	Groot-Brak Estuary	gxi5	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen pH
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G14 Groot-Brak	III	G14-E17	Blinde Estuary	gxi19	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G14 Groot-Brak	III	G14-E18	Tweekuilen Estuary	gxi20	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G14 Groot-Brak	III	G14-E19	Gericke Estuary	gxi21	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G14 Groot-Brak	III	G14-E20	Hartenbos Estuary	gxi22	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity Secchi depth
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

Table 3.29 Sub-component and indicator selection for prioritized estuaries in the Coastal IUA

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-E21	Maalgate Estuary	gxi6	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E22	Gwaing Estuary	gxi7	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E23	Kaaimans Estuary	gxi8	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E24	Wilderness Estuary	gxi9	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity pH

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E25	Swartvlei Estuary	gxi10	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity pH
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-E26	Goukamma Estuary	gxi11	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E27	Knysna Estuary	gxi12	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E28	Noetsie Estuary	gxi13	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E29	Piesang Estuary	gxi14	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E30	Keurbooms Estuary	gxi15	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	II	G15-E31	Matjies Estuary	gxi16	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E32	Sout (Oos) Estuary	gxi17	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E33	Groot (Wes) Estuary	gxi23	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness
G15 Coastal	II	G15-E34	Bloukrans Estuary	gxi18	Quantity	Low flows High flows	Component selected as part of original Reserve baseline information and standard for measuring all other ecosystem responses	MMR/MAR (% Nat)
					Quality	Nutrients	WQ influences habitat quality for organisms and also fitness for use for users	DIN DIP
						Salts		Salinity
						System variables		Dissolved oxygen Turbidity
						Pathogens		Enterococci Escherichia coli

IUA	Class	RU	Estuary	Node	Component	Sub-component	Rationale for sub-component choice	Indicator selection
					Habitat	Hydrodynamics	Provides a score for the water quality condition.	Mouth state Tidal variation
						Sediments	Provides an overall score for ecological condition.	Sediment characteristics Channel shape/size
					Biota	Micro-algae	Benthic microalgae and phytoplankton provide a useful indicator of water quality and are also an important source of food for other estuarine biota	Biomass and community composition of phytoplankton and benthic microalgae community
						Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	Extent, distribution and richness of macrophytes
						Invertebrates	Invertebrates provide a useful measure of aquatic biodiversity and also are indicators of water quality.	Macrofauna community composition, abundance and richness
						Fish	Estuaries are important as nursery areas for marine fish.	Fish community composition, abundance and richness
						Birds	Estuaries are important feeding, roosting and breeding areas for birds	Avifauna community composition, abundance and richness

3.3 Selected user sub-components and indicators for dams

The following tables provide a summary of the findings for each of the priority dams for which numerical limits will be determined during step 6 of the RQO determination process:

- Prioritised dams in the Breede River basin and Overberg area, including Theewaterskloof Dam, Greater Brandvlei Dam, Eikenhof Dam, Kogelberg Dam, Arieskraal Dam and Ceres Koekedouw Dam presented in Table 3.30 to Table 3.33.
- Prioritised dams in the Gouritz River basin and Coastal area, including Stompdrift Dam and Wolwedans Dam presented in Table 3.34 and in Table 3.35.

Although most of the dams could attempt to meet high EWR flows, high flows have only been specified at two dams as an indicator, because of the lack of adequately sized dam outlet structures to make flood releases. Releases from dams is therefore mainly to maintain dam levels for the release of water for irrigation, rural and domestic purposes. The only dams for which high flow release requirements for ecological purposes have been specified because it is desirable, despite their existing restrictive outlet structures are:

- Theewaterskloof Dam
- Wolwedans Dam

Table 3.30 Sub-component and indicator selection for prioritized dams in the Upper Breede Tributaries IUA

IUA	RU	Dam name	Component	Sub-component	Rationale for sub-component choice	Indicator selection
A1 Upper Breede Tributaries	A1-D01	Ceres Koekedouw	Quantity	Low flows	Dam levels must remain sufficient to provide for releases for irrigation and urban use as well as releases for ecosystem function downstream.	Dam levels, agreed ecological releases
			Quality	Nutrients	The system must be maintained in a mesotrophic state or better.	Ortho-phosphate, nitrogen, ammonium
				Salts	Salt levels must be maintained at concentrations where they do not impact negatively on the ecosystem and are acceptable for municipal treatment	Electrical conductivity
			Biota	Fish	The wellbeing of the fish community of this artificial ecosystem must be maintained in a suitable condition to contribute to regional biodiversity and to support the local recreational angling industry. Consumption of fish must not pose a health risk to local communities.	Implementation of the Index of Reservoir Habitat Impairment (IRHI) by Miranda and Hunt (2011), fish health evaluation Populations of indigenous fish

Table 3.31 Sub-component and indicator selection for prioritized dams in the Breede Working Tributaries IUA

IUA	RU	Dam name	Component	Sub-component	Rationale for sub-component choice	Indicator selection
A2 Breede Working Tributaries	A2-D01	Greater Brandvlei Dam	Quantity	Low flows	Dam levels must remain sufficient to make releases for irrigation. Freshening releases should only be made when considered essential.	Dam levels
			Quality	Nutrients	The system must be maintained in an oligotrophic state.	Ortho-phosphate, nitrogen, ammonium
				Salts	Salt levels must be maintained at concentrations where they do not impact negatively on the ecosystem.	Electrical conductivity
			Biota	Fish	The wellbeing of the fish community of this artificial ecosystem must be maintained in a suitable condition to contribute to regional biodiversity and to support local recreational angling industry. The re-infestation of alien species from the dam should be prevented. Consumption of fish must not pose a health risk.	Implementation of the Index of Reservoir Habitat Impairment (IRHI) by Miranda and Hunt (2011), fish health evaluation Populations of indigenous fish

Table 3.32 Sub-component and indicator selection for prioritized dams in the Riviersonderend Theewaterskloof IUA

IUA	RU	Dam name	Component	Sub-component	Rationale for sub-component choice	Indicator selection
B4 Riviersonderend Theewaterskloof	B4-D01	Theewaterskloof Dam	Quantity	Low flows	Dam levels must remain sufficient to provide for transfers and releases for irrigation, urban, industrial and rural water use, as well as ecosystem function downstream.	Dam levels, EWR
				High flows	Aspirational ecological releases for ecosystem function downstream, within the constraints of the limiting capacity of the outlet works. During the dry season (summer) irrigation releases significantly exceed dry-season EWR flows due to releases made for irrigation.	EWR
				Nutrients	The system must be maintained in a mesotrophic state or better.	Ortho-phosphate, nitrogen, ammonium
				Salts	Salt levels must be maintained at concentrations where they do not impact negatively on the ecosystem and are acceptable for municipal treatment and rural use.	Electrical conductivity
			Biota	Fish	The wellbeing of the fish community of this artificial ecosystem must be maintained in a suitable condition to contribute to regional biodiversity and to support local recreational angling industry. The re-infestation of alien species from the dam should be prevented. Consumption of fish must not pose a health risk.	Implementation of the Index of Reservoir Habitat Impairment (IRHI) by Miranda and Hunt (2011), fish health evaluation Populations of indigenous fish
				Phytoplankton	The system must be maintained in a mesotrophic state or better.	Chlorophyll a

Table 3.33 Sub-component and indicator selection for prioritized dams in the Overberg West IUA

IUA	RU	Dam name	Component	Sub-component	Rationale for sub-component choice	Indicator selection
B5 Overberg West	B5-D01	Eikenhof Dam	Quantity	Low flows	Dam levels must remain sufficient to make releases for irrigation, as well as releases for ecosystem function downstream.	Dam levels
			Quality	Nutrients	The system must be maintained in an oligotrophic state.	Ortho-phosphate, nitrogen, ammonium
				Salts	Salt levels must be maintained at concentrations where they do not impact negatively on the ecosystem.	Electrical conductivity
			Biota	Fish	The wellbeing of the fish community of this artificial ecosystem must be maintained in a suitable condition to contribute to regional biodiversity and to support the local recreational angling industry. Consumption of fish must not pose a health risk.	Implementation of the Index of Reservoir Habitat Impairment (IRHI) by Miranda and Hunt (2011), fish health evaluation Populations of indigenous fish
	B5-D02	Kogelberg Dam	Quantity	Low flows	Dam levels must remain sufficient for hydro-electric generation, and to provide for the transfer of water for urban and industrial use.	Dam levels
			Quality	Nutrients	The system must be maintained in a mesotrophic state or better.	Ortho-phosphate, nitrogen, ammonium
				Pathogens	The system must be maintained in a state that is safe for contact recreation.	E coli and/or Faecal coliforms
			Biota	Fish	The wellbeing of the fish community of this artificial ecosystem must be maintained in a suitable condition to contribute to regional biodiversity. Consumption of fish must not pose a health risk.	Implementation of the Index of Reservoir Habitat Impairment (IRHI) by Miranda and Hunt (2011), fish health evaluation Populations of indigenous fish
	B5-D03	Arieskraal n. 2 Dam	Quantity	Low flows	Dam levels must remain sufficient to provide for irrigation surrounding the dam, as well as releases for ecosystem function downstream.	Dam levels, EWR
				High flows	During the wet season the dam levels must be maintained such that they are able to support releases for ecosystem function, mainly through spills, due to the limiting outlet works capacity.	Dam levels, EWR
			Quality	Nutrients	The system must be maintained in a mesotrophic state or better.	Ortho-phosphate, nitrogen, ammonium
				Pathogens	The system must be maintained in a state that is safe for contact recreation.	E coli and/or Faecal coliforms
			Biota	Fish	The wellbeing of the fish community of this artificial ecosystem must be maintained in a suitable condition to contribute to regional biodiversity. Consumption of fish must not pose a health risk.	Implementation of the Index of Reservoir Habitat Impairment (IRHI) by Miranda and Hunt (2011), fish health evaluation Populations of indigenous fish

Table 3.34 Sub-component and indicator selection for prioritized dams in the Gouritz-Olifants IUA

IUA	RU	Dam name	Component	Sub-component	Rationale for sub-component choice	Indicator selection
D7 Gouritz-Olifants	D7-D01	Stompdrift Dam	Quantity	Low flows	Dam levels must remain sufficient to provide for industrial use.	Dam levels
			Quality	Salts	Salt levels must be maintained at concentrations where they do not impact negatively on the ecosystem.	Electrical conductivity

Table 3.35 Sub-component and indicator selection for prioritized dams in the Coastal IUA

IUA	RU	Dam name	Component	Sub-component	Rationale for sub-component choice	Indicator selection
G15 Coastal	G15-D01	Wolwedans Dam	Quantity	Low flows	Dam levels must remain sufficient to provide for municipal and industrial use, as well as releases for ecosystem function of the downstream estuary.	Dam levels, EWR
				High flows	During the wet season the dam levels must be maintained such that they are able to support releases for ecosystem function, mainly through spills, due to the limiting outlet works capacity.	Dam levels, EWR
			Quality	Nutrients	The system must be maintained in a mesotrophic state.	ortho-phosphate, nitrogen, ammonium
				Salts	Salt levels must be maintained at concentrations where they do not impact negatively on the ecosystem and are acceptable for industrial use by PetroSA and for municipal treatment.	Electrical conductivity

3.4 Selected user sub-components and indicators for wetlands

The conceptual understanding of priority wetland resource units was used to define indicators for each Wetland Resource Unit and describes the reasons for their choice.

Table 3.36 Sub-component and indicator selection for prioritized rivers in the Breede-Gouritz WMA

Component	Sub-component	Reason for selection	Example of indicator
QUANTITY	High flows	Floodplain wetlands require high flow events in order to overtop banks.	River flow RQOs are given as monthly average volumes (MCM) that include maintenance low and high flows combined.
	Hydroperiod	In certain wetlands channelized flow is not as important as the retention of water. In order to maintain wetland functioning water needs to be retained and distributed, often with seasonal fluctuations.	Wetlands have a dynamic hydrology varying daily, seasonally and annually. Due to this dynamic nature it is difficult to define the frequency and duration of water retention and distribution. An approach to define prolonged saturation up to the temporary zone relies on defining the wetland plants and wetland soils. The hydrological regime (Hydroperiod) describes the behaviour of water within the system and, for wetlands, in the underlying soil. For wetlands and inland water bodies the hydrological regime may be classified according to the period of inundation and saturation, as well as inundation depth class for permanently inundated waterbodies.
QUALITY	Nutrients	Nutrients affects primary productivity and the growth of free-floating algae (phytoplankton). Algae is a food source for biota, both aquatic invertebrates and vertebrates such as fish.	Phosphate (PO_4-P), Total Inorganic Nitrogen (TIN-N)
HABITAT	Geomorphology	The relationship of water and sediment creates a stable equilibrium for a wetland. Any change to this equilibrium will push a wetland into a vulnerable state of either aggradation (sediment deposition) or degradation (sediment removal).	Sediment accumulation
	Vegetation	Wetland vegetation is an important indicator of a wetland boundary. Alien invasive vegetation encroachment into a wetland may result in reduction of water distribution and push the wetland into a vulnerable state geomorphically.	Wetland vegetation and alien invasive vegetation
BIOTA	Invertebrates	Invertebrates have relatively short life spans and many are confined to a narrow range of environmental conditions. They are therefore useful bio-indicators particularly of water chemistry. Presence of certain taxa will indicate whether the water is perennial, saline, acidic and in some cases if the wetland is in a good condition.	Invertebrate presence
	Birds	Water birds use wetlands as important aquatic habitats. The overall number of water birds and the specific numbers of each species give strong indications to the health of a wetland.	Bird count using CWAC procedure
	Amphibians & reptiles	Frogs require wetland habitats as important stepping stones. A decline in frog populations may be an indicator of a decline in wetland water quality.	Frog presence through counting calls
	Diatoms	Diatoms are a reliable indicator of water quality. Diatom monitoring is also a cheap, reliable surrogate for water quality in much the same way that aquatic invertebrates are used to indicate water quality in rivers.	Diatoms presence

Table 3.37 Summary of subcomponents and indicators selected for prioritized wetlands in the Breede-Overberg Region of the WMA

IUA	Class	RU	Wetland name	Wetland Region	Component	Sub-component	Rationale for sub-component choice	Indicator selection	Priority		
									Ecological Importance	Ecosystem services	
										Supply	Demand
A1 Breede Tributaries	II	A1-W01	Strategic Water Source Wetlands	WR1 Western Folded	Quantity	Hydroperiod	Important hillslope seeps contribute to water supply of downstream rivers.	Wetland extent.		x	x
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
A2 Breede Working Tributaries (A2)	III	A2-W02	East Coast Shale Renosterveld Floodplain (Papenkuils)	WR1 Western Folded	Quantity	Flow	Floodplain requires overbank flooding in order to inundate endangered floodplain vegetation.	High flow		x	
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
A3 Middle Breede Tributaries	III	A3-W03	East Coast Shale Renosterveld Floodplain (Breede)	WR8 Southern Folded	Quantity	Flow	Floodplain requires overbank flooding in order to inundate critically endangered floodplain vegetation.	High flow	x	x	x
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
B4 Riviersonderend Theewaters	III	B4-W04	Strategic Water Source Wetlands	WR1 Western Folded and WR3 Southern Coastal	Quantity	Hydroperiod	Important hillslope seeps contribute to water supply of downstream rivers.	Wetland extent.	x	x	x
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
B5 Overberg West	II	B5-W05	Strategic Water Source Wetlands	WR2 Coastal Southern Folded	Quantity	Hydroperiod	Important hillslope seeps contribute to water supply of downstream rivers.	Wetland extent.		x	x
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
H16 Overberg West Coastal	II	H16-W06	Southwest Sand Fynbos Channelled Valley Bottom (Kleinmond)	WR2 Coastal Southern Folded	Quantity	Hydroperiod	Channelled valley-bottom requires seasonal inundation in order to maintain endangered wetland vegetation and provide habitat for birds under Ramsar conditions.	Wetland extent.	x		x
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
					Biota	Birds		Bird abundance			
H16 Overberg West Coastal	II	H16-W07	Strategic Water Source Wetlands	WR2 Coastal Southern Folded	Quantity	Hydroperiod	Important hillslope seeps contribute to water supply of downstream rivers.	Wetland extent.		x	x
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
F10 Overberg East Renosterveld	II	F10-W08	Southwest Ferricrete Fynbos Floodplain (Kars)	WR8 Southern Coastal	Quantity	Flow	Floodplain requires overbank flooding in order to inundate floodplain vegetation which provides important habitat for NFEPA frogs. Wetland also provides important sediment retention services.	High flow	x	x	
					Habitat	Geomorphology		Sediment accumulation			
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
					Biota	Amphibians & reptiles		Frog presence			

IUA	Class	RU	Wetland name	Wetland Region	Component	Sub-component	Rationale for sub-component choice	Indicator selection	Priority		
									Ecological Importance	Ecosystem services	
										Supply	Demand
H17 Overberg East Fynbos	II	H17-W09	Southwest Ferricrete Fynbos Floodplain (Agulhas)	WR2 Coastal Southern Folded and WR4 Coastal Sediments	Quantity	Flow	Floodplain requires overbank flooding in order to inundate critically endangered floodplain vegetation which provides important habitat for NFEPA frogs.	High flow	x	x	x
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
H17 Overberg East Fynbos	II	H17-W09	Southwest Ferricrete Fynbos Flat (Agulhas)	WR2 Coastal Southern Folded and WR4 Coastal Sediments	Quantity	Hydroperiod	Flat requires seasonal inundation of critically endangered vegetation which provides important habitat for NFEPA frogs. Biota sensitive to changes in water chemistry.	Wetland extent			
					Quality	Nutrients		PO4-P, TIN-N			
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
					Biota	Amphibians & reptiles		Frog presence			
					Biota	Invertebrates		Invertebrates presence			
H17 Overberg East Fynbos	II	H17-W09	Southwest Ferricrete Fynbos Depression (Agulhas)	WR4 Coastal Sediments	Quantity	Hydroperiod	Depression requires seasonal inundation of critically endangered vegetation which provides important habitat for NFEPA frogs. Biota sensitive to changes in water chemistry.	Wetland extent			
					Quality	Nutrients		PO4-P, TIN-N			
					Habitat	Vegetation		Wetland vegetation			
					Biota	Amphibians & reptiles		Frog presence			
					Biota	Invertebrates		Invertebrates presence			
H17 Overberg East Fynbos	II	H17-W10	East Coast Shale Renosterveld Floodplain (De Hoop Vlei)	WR4 Coastal Sediments	Quantity	Flow	Floodplain requires overbank flooding in order to inundate critically endangered floodplain vegetation which provides important habitat for NFEPA frogs.	High flow	x		
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
					Biota	Birds		Bird abundance			
H17 Overberg East Fynbos	II	H17-W11	South Strandveld Western Strandveld Flat/Seep (Heuningnes)	WR4 Coastal Sediments	Quantity	Hydroperiod	Flat/seep requires seasonal inundation to maintain vegetation habitat for birds according to Ramsar conditions.	Wetland extent.	x		
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
					Biota	Birds		Bird abundance			
F11 Lower Breede Renosterveld	II	F11-W12	East Coast Shale Renosterveld Floodplain (Breede)	WR3 Southern Coastal	Quantity	Flow	Floodplain requires overbank flooding in order to inundate critically endangered floodplain vegetation. Water quality amelioration service to be maintained.	High flow		x	
					Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			

Table 3.38 Summary of subcomponents and indicators selected for prioritized wetlands in the Gouritz-Coastal Region of the WMA

IUA	Class	Wetland name	Wetland Region	Component	Sub-component	Rationale for sub-component choice	Indicator selection	Priority		
								Ecological Importance	Ecosystem services	
									Supply	Demand
C6 Gamka Buffels	II	Upper Nama Karoo Depression	WR5 Nama Karoo	Quantity	Hydroperiod	Depression requires seasonal inundation to maintain wetland habitat and to function as a NFEPA cluster.	Wetland extent	x		
				Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
				Biota	Diatoms		Diatom presence			
				Biota	Invertebrates		Invertebrate presence			
C6 Gamka Buffels	II	Lower Nama Karoo Depression	WR6 Great Karoo	Quantity	Hydroperiod	Depression requires seasonal inundation to maintain wetland habitat and to function as a NFEPA cluster.	Wetland extent	x	x	
				Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
				Biota	Diatoms		Diatom presence			
				Biota	Invertebrates		Invertebrate presence			
E8 Touws	III	Strategic Water Source Wetlands	WR7 Cape Fold Swartberg	Quantity	Hydroperiod	Important hillslope seeps contribute to water supply of downstream rivers.	Wetland extent		x	x
				Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
F13 Lower Gouritz	II	Albany Thicket Floodplain (Gouritz)	WR3 Southern Coastal	Quantity	Flow	Floodplain requires overbank flooding in order to inundate critically endangered floodplain vegetation. Water quality amelioration service to be maintained.	High flow	x		
				Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
F12 Duiwenhoks	III	East Coast Shale Renosterveld Channelled Valley Bottom (Goukou)	WR3 Southern Coastal	Quantity	Hydroperiod	Channelled valley-bottom requires seasonal inundation in order to maintain critically endangered vegetation. Erosion and alien invasive plant encroachment threatens water retention.	Wetland extent	x	x	x
				Habitat	Geomorphology		Erosion features			
				Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
F12 Duiwenhoks	III	East Coast Shale Renosterveld Channelled Valley Bottom (Duiwenhoks)	WR3 Southern Coastal	Quantity	Hydroperiod	Channelled valley-bottom requires seasonal inundation in order to maintain critically endangered vegetation. Erosion and alien invasive plant encroachment threatens water retention.	Wetland extent	x	x	x
				Habitat	Geomorphology		Erosion features			
					Vegetation		Natural vegetation versus alien invasive vegetation			

IUA	Class	Wetland name	Wetland Region	Component	Sub-component	Rationale for sub-component choice	Indicator selection	Priority		
								Ecological Importance	Ecosystem services	
									Supply	Demand
G15 Coastal	II	Freshwater Lake (Groenvlei)	WR11 Sedimentary Coastal Lakes	Quantity	Hydroperiod	Groenvlei requires seasonal inundation in order to maintain water levels and vegetation. Acts as a sink for nutrients and sediments.	Wetted extent related to groundwater inputs.	x		
				Habitat	Vegetation		Natural vegetation versus alien invasive vegetation			
G15 Coastal	II	Freshwater Lake (Wilderness)	WR10 South East Coastal	Quantity	Hydroperiod	Wilderness Lakes require seasonal inundation in order to maintain water levels and vegetation. Acts as a sink for nutrients and sediments.	Wetland extent	x		
				Habitat	Vegetation		Wetland vegetation and wetted perimeter.			
				Biota	Birds		Bird abundance			
G15 Coastal	II	Strategic Water Source Wetlands	WR10 South East Coastal	Quantity	Hydroperiod	Important hillslope seeps contribute to water supply of downstream rivers.	Wetland extent		x	x
				Habitat	Vegetation		Wetland vegetation and wetted perimeter.			

3.5 Selected user sub-components and indicators for groundwater

The selected components, sub-components and indicators are listed in Table 3.39. These sub-components will be assessed in each prioritised resource unit. For each indicator, an RQO description will be developed, along with a numerical value where possible (i.e. for those that are numeric).

Table 3.39 Selected user sub-components and indicators for groundwater

Component	Sub-Component	Indicator
Quantity	Abstraction (available yield)	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.
	Saline intrusion (available yield)	Groundwater level
	Discharge	Relative water levels between groundwater and surface water
	Discharge	Buffer zone around rivers and FEPAs
	Discharge	Compliance with the low flow requirements in the river
Quality	Nutrients	NO_3 (as N)
	Salts	EC, SO_4
	Pathogens	E-coli, Total Coliform

Table 3.40 Sub-component and indicator selection for prioritized groundwater resource units

IUA	RU	Quat	Component	Sub-component	Rationale for sub-component choice	Indicator selection
B5 Overberg West	BO-1	G40A, G40C, G40D	Quantity	Abstraction (Available Yield)	Whilst exploiting groundwater storage is acceptable for managing drought, and could be acceptable for short periods to bridge the transition to other bulk water supplies (i.e. 5-10 years desalination/ re-use), over the long-term, groundwater use should be sustainable for all users and the environment. The RQO essentially implies that groundwater mining is considered unacceptable in the long-term. Implementation of this RQO requires the authority to isolate the cause of groundwater level decline, and identify over-abstraction (unacceptable) from transition to new dynamic equilibrium (unavoidable), drought and climate change (unavoidable).	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.
H16 Overberg West Coastal	BO-2	G40H				
F10 Overberg East Renosterveld / H17 Overberg East Fynbos	BO-3	G50B, G50D, G50E				
A1 Upper Breede Tributaries	BB-1	H10A, H10B, H10C				
A1 Upper Breede Tributaries / A3 Breede Working Tributaries	BB-3	H10L, H10F, H10G, H10J				
A1 Upper Breede Tributaries / A3 Breede Working Tributaries	BB-2	H20A, H20B, H20C, H20F				
A3 Breede Working Tributaries	BB-4	H40B				
A3 Breede Working Tributaries	BB-5	H20H, H10H, H40C				
A3 Breede Working Tributaries	BB-6	H30B				
B4 Riviersonderend Theewaters	BR-1	H60A, H60B, H60C				
A3 Breede Working Tributaries / A2 Middle Breede Renosterveld	BB-7	H40J, H40K				
E8 Touws	GGr-1	J12C, J12D				
C6 Gamka-Buffels	GGr-3	J11E				
C6 Gamka-Buffels	GGa-1	J24B				
C6 Gamka-Buffels	GGa-2a, 2b and 2c	J21A, J21B, J23A				
D7 Gouritz-Olifants	GO-4	J35B				
F13 Lower Gouritz	GGo-1	J40C, J40D				
I18 Hessequa	GGo-2	H90E				
G15 Coastal	GC-2	K40D				
H16 Overberg West Coastal	BO-2	G40H	Quantity	Groundwater level	Minimum water level in abstraction boreholes within 2.5km from the ocean to avoid saline intrusion	Groundwater level
F10 Overberg East Renosterveld / H17 Overberg East Fynbos	BO-3	G50B, G50D, G50E				
G15 Coastal	GC-2	K40D				
B5 Overberg West	BO-1	G40A, G40C, G40D	Quantity	Discharge	Groundwater use should be sustainable for all users and the environment. In areas where groundwater and surface water are hydraulically connected, it is assumed that the reversal of the natural gradient with surface water would have unacceptable impacts. Where groundwater discharges to surface water, groundwater abstraction close to surface water (distance dependent	Relative water levels between groundwater and surface water (in mamsl)
H16 Overberg West Coastal	BO-2	G40H				
F10 Overberg East Renosterveld / H17 Overberg East Fynbos	BO-3	G50B, G50D, G50E				
A3 Breede Working Tributaries	BB-5	H20H, H10H, H40C				
B4 Riviersonderend Theewaters	BR-1	H60A, H60B, H60C				

IUA	RU	Quat	Component	Sub-component	Rationale for sub-component choice	Indicator selection
A3 Breede Working Tributaries / A2 Middle Breede Renosterveld	BB-7	H40J, H40K			on aquifer diffusivity), or groundwater abstraction rates that reduce aquifer water levels beneath that of the river, would reverse the gradient towards the river, and surface water would be 'lost' to groundwater (indirect recharge). The setting of this RQO assumes that this would be unacceptable (for surface water resources / ecology).	
F13 Lower Gouritz	GGo-1	J40C, J40D				
G14 Groot Brak / G15 Coastal	GC-1	K20A				
G15 Coastal	GC-2	K40D				
G15 Coastal	GC-3	K70A				
B5 Overberg West	BO-1	G40A, G40C, G40D	Quantity	Discharge	Whilst all abstraction reduces natural discharge to some extent and at some point in time, the timing of surface water depletion (the response time) is related to the distance to surface water, and the hydraulic diffusivity. It is therefore aquifer- and abstraction location-specific. Abstraction far from surface water, and in an aquifer with lower diffusivity, may for all practical purposes not impact on surface water (for millennia). Given the variability in hydraulic diffusivity even at different locations within the same aquifer, the data is not available in order to determine area-specific numerical values. The numerical value listed is in alignment with best-practice guidelines.	Buffer zones
H16 Overberg West Coastal	BO-2	G40H				
F10 Overberg East Renosterveld / H17 Overberg East Fynbos	BO-3	G50B, G50D, G50E				
A3 Breede Working Tributaries	BB-5	H20H, H10H, H40C				
B4 Riviersonderend Theewaters	BR-1	H60A, H60B, H60C				
A3 Breede Working Tributaries / A2 Middle Breede Renosterveld	BB-7	H40J, H40K				
C6 Gamka-Buffels	GGr-3	J11E				
C6 Gamka-Buffels	GGa-2a, 2b and 2c	J21A, J21B, J23A				
F13 Lower Gouritz	GGo-1	J40C, J40D				
G14 Groot Brak / G15 Coastal	GC-1	K20A				
G15 Coastal	GC-2	K40D				
G15 Coastal	GC-3	K70A				
B5 Overberg West	BO-1	G40A, G40C, G40D	Quantity	Low flow in river	It is assumed that (a portion of) the maintenance low flow is derived from groundwater. Whilst all abstraction reduces natural discharge to some extent and at some point in time, it would be unacceptable for abstraction to cause groundwater discharge to reduce below the maintenance low flow value, at locations that have been identified as having higher dependence on groundwater.	Compliance with the low flow requirements in the river
F10 Overberg East Renosterveld / H17 Overberg East Fynbos	BO-3	G50B, G50D, G50E				
A1 Upper Breede Tributaries / A3 Breede Working Tributaries	BB-3	H10L, H10F, H10G, H10J				
B4 Riviersonderend Theewaters	BR-1	H60A, H60B, H60C				
B5 Overberg West	BO-1	G40A, G40C, G40D	Quality	Nutrients, Salts	Groundwater management measures must ensure groundwater quality is protected. The parameters selected will support identification of a variety of pollution sources (captured in increase in salts), agricultural pollution (fertilisers), and saline intrusion. The numerical values represent either the 90 or the 95 percentiles for the listed aquifer within the Groundwater Resource Unit. This is taken as a limit of acceptable deviation from natural background. Where insufficient data exists to establish robust statistics for an aquifer within an area, numerical values are either taken from the same aquifer in neighbouring areas or from data for the same	NO_3 (as N), EC
H16 Overberg West Coastal	BO-2	G40H				
F10 Overberg East Renosterveld / H17 Overberg East Fynbos	BO-3	G50B, G50D, G50E				
A1 Upper Breede Tributaries	BB-1	H10A, H10B, H10C				
A1 Upper Breede Tributaries / A3 Breede Working Tributaries	BB-3	H10L, H10F, H10G, H10J				
A1 Upper Breede Tributaries / A3 Breede Working Tributaries	BB-2	H20A, H20B, H20C, H20F				

IUA	RU	Quat	Component	Sub-component	Rationale for sub-component choice	Indicator selection
A3 Breede Working Tributaries	BB-4	H40B			aquifer across the region. In certain cases where local data is not available, and where regional data is considered inapplicable for this area, drinking water quality standards may be used, or no numerical limit set (only narrative).	
A3 Breede Working Tributaries	BB-5	H20H, H10H, H40C				
A3 Breede Working Tributaries	BB-6	H30B				
B4 Riviersonderend Theewaters	BR-1	H60A, H60B, H60C				
A3 Breede Working Tributaries / A2 Middle Breede Renosterveld	BB-7	H40J, H40K				
E8 Touws	GGr-1	J12C, J12D				
C6 Gamka-Buffels	GGr-3	J11E				
C6 Gamka-Buffels	GGa-1	J24B				
C6 Gamka-Buffels	GGa-2a, 2b and 2c	J21A, J21B, J23A				
D7 Gouritz-Olifants	GO-4	J35B				
F13 Lower Gouritz	GGo-1	J40C, J40D				
I18 Hessequa	GGo-2	H90E				
G15 Coastal	GC-2	K40D				
B5 Overberg West	BO-1	G40A, G40C, G40D		Pathogens	Groundwater management measures must ensure groundwater quality is protected. The parameters selected will support identification of pollution from waste water (pathogens) and other bacteriological sources. The numerical value is based on drinking water quality standards.	E-coli, Total Coliform
H16 Overberg West Coastal	BO-2	G40H				
F10 Overberg East Renosterveld / H17 Overberg East Fynbos	BO-3	G50B, G50D, G50E				
A1 Upper Breede Tributaries	BB-1	H10A, H10B, H10C				
A1 Upper Breede Tributaries / A3 Breede Working Tributaries	BB-3	H10L, H10F, H10G, H10J				
A1 Upper Breede Tributaries / A3 Breede Working Tributaries	BB-2	H20A, H20B, H20C, H20F				
A3 Breede Working Tributaries	BB-4	H40B				
A3 Breede Working Tributaries	BB-5	H20H, H10H, H40C				
A3 Breede Working Tributaries	BB-6	H30B				
B4 Riviersonderend Theewaters	BR-1	H60A, H60B, H60C				
A3 Breede Working Tributaries / A2 Middle Breede Renosterveld	BB-7	H40J, H40K				
E8 Touws	GGr-1	J12C, J12D				
C6 Gamka-Buffels	GGr-3	J11E				
C6 Gamka-Buffels	GGa-1	J24B				
C6 Gamka-Buffels	GGa-2a, 2b and 2c	J21A, J21B, J23A				
D7 Gouritz-Olifants	GO-4	J35B				
F13 Lower Gouritz	GGo-1	J40C, J40D				

IUA	RU	Quat	Component	Sub-component	Rationale for sub-component choice	Indicator selection
I18 Hessequa	GGo-2	H90E				
G15 Coastal	GC-2	K40D				
C6 Gamka-Buffels	GGr-3	J11E	Quality	Salts	Groundwater management measures must ensure groundwater quality is protected. The parameters selected will support identification of a variety of pollution sources (captured in increase in salts), agricultural pollution (fertilisers), and saline intrusion. The numerical values represent either the 90 or the 95 percentiles for the listed aquifer within the Groundwater Resource Unit. This is taken as a limit of acceptable deviation from natural background. Where insufficient data exists to establish robust statistics for an aquifer within an area, numerical values are either taken from the same aquifer in neighbouring areas or from data for the same aquifer across the region. In certain cases where local data is not available, and where regional data is considered inapplicable for this area, drinking water quality standards may be used, or no numerical limit set (only narrative).	SO_4
C6 Gamka-Buffels	GGa-1	J24B				
C6 Gamka-Buffels	GGa-2a, 2b and 2c	J21A, J21B, J23A				

4 Conclusion

4.1 Summary of sub-component prioritisation and indicator selection

A total of 47 sub-components were selected for RQO determination during Step 4 of the RQO determination procedure in the Breede-Gouritz WMA, including:

- 11 sub-components were selected to represent river resources from 37 prioritised RUs.
- 13 sub-components were selected to represent estuaries resources from 34 prioritised RUs.
- 7 sub-components were selected to represent dam resources from 8 prioritised RUs.
- 9 sub-components were selected to represent wetlands resources from 21 prioritised RUs.
- 7 sub-components were selected to represent groundwater resources from 42 prioritised RUs.

Table 4.1 comprises a summary of the selected sub-components on the different significant water resources for the Breede-Gouritz WMA.

Table 4.1 Summary of sub-component prioritisation selection for the Breede-Gouritz WMA

Component	Sub-component	Rivers	Estuaries	Dams	Wetlands	Groundwater
Quantity	Abstraction					x
	Groundwater level					x
	High flows	x	x	x	x	
	Low flows	x	x	x		x
	Discharge					x
	Hydroperiod				x	
Quality	Nutrients	x	x	x	x	x
	Salts	x	x	x		x
	System variables (temperature, oxygen, pH, turbidity	x	x			
	Toxins	x				
	Pathogens	x	x	x		x
Habitat	Geomorphology	x			x	
	Vegetation/Riparian vegetation	x			x	
	Hydrodynamics		x			
	Sediments		x			
Biota	Micro-algae		x			
	Macrophytes		x			
	Invertebrates	x	x		x	
	Fish	x	x	x		
	Birds		x		x	
	Amphibians & reptiles				x	
	Diatoms				x	
	Phytoplankton			x		
	Totals	**11**	**13**	**7**	**9**	**7**

4.2 Addressing uncertainties

Since the submission of the first draft of this Evaluation of Resource Units Report, on March 2018, until its final submission, July 2018, several stakeholder meetings have been held, as follows:

- Technical Task Group Meeting 2, from 12 to 16 March 2018
- Sector Meeting 1: Estuaries, on 17 April 2018
- Sector Meeting 2: Agriculture, on 24 May 2018
- Project Steering Committee Meeting 3, on 12 June 2018
- Sector Meeting 3: Municipalities (and Agriculture), on 13 June 2018.

Some of the key limitations and uncertainties, which may influence the confidence of the outcomes of the resource unit evaluation process, and which should be considered when implementing the RQOs are described below.

4.2.1 Rivers

Unsurprisingly the high priority RUs aligned quite well with the location of the Intermediate and Comprehensive EWR sites since the location of EWR sites is chosen using much the same criteria as the RU evaluation tool. In fact, it would have been strange if the EWR hotspot tool, used to identify the location of EWR sites, and the RU evaluation tool produced different results. Nonetheless, the two *tools* are just that and are simply there to guide and facilitate the process.

At the stakeholder workshop sessions, the proposed RUs, sub-components and indicators were presented and discussed with stakeholders and the final RUs, sub-components and indicators were reviewed, updated and refined. Furthermore, all the comments received have been addressed and incorporated in the relevant sections of this report.

4.2.2 Estuaries

Some large discrepancies were evident between importance scores allocated using the Resource Unit Prioritisation Tool and the conservation importance ranking that has been established for estuaries in South Africa (Turpie *et al*. 2013). This was taken into consideration when selecting estuaries for which detailed RQOs were developed. However, there will always be some estuaries which stakeholders feel merit more detailed RQOs than those that have been prepared as part of this study, and this may require increasing the subset of estuaries for which RQO will ultimately be developed.

At the stakeholder workshop sessions, the proposed RUs, sub-components and indicators were presented and discussed with stakeholders and the final RUs, sub-components and indicators were reviewed, updated and refined. Furthermore, all the comments received have been addressed and incorporated in the relevant sections of this report.

4.2.3 Dams

The following limitations and uncertainties are relevant to the outcomes of this assessment:

- It will be a challenge to implement especially high-flow EWR flows, given the restriction of inadequate outlet structures and unseasonal irrigation releases.
- There are several instances where the assessment was based purely on desktop information. There is a risk that some important sub-components could have been omitted from the assessment, especially where data is not readily available.
- This assessment was largely based on the probability that the sub-components and indicators selected will be suitable indicators of the protection and/or water dependent activities of the water resources considered. This probability consideration is largely based on qualitative information and expert solicitations. These outcomes should be monitored and updated using quantitative data where possible.

At the stakeholder workshop sessions, the proposed RUs, sub-components and indicators were presented and discussed with stakeholders and the final RUs, sub-components and indicators were reviewed, updated and refined. Furthermore, all the comments received have been addressed and incorporated in the relevant sections of this report.

4.2.4 Wetlands

The use of the outputs from the updated Wetland Prioritisation Tool was useful in that the determination of the wetlands that provide certain services and the threats to these services used a GIS application. This allowed for a desktop review of the identification of sub-components, with reference to the more detailed studies in order to determine realistic indicators for sub-components. Refinement of these indicators was necessary with consultation with varied stakeholders in order to ensure effective representation. Stakeholders emphasised the need to have an understanding of the key drivers to individual wetlands through a conceptual model and recommended the use of responder indicators such as diatoms and invertebrates to monitor seasonality of particular wetlands.

At the stakeholder workshop sessions, the proposed RUs, sub-components and indicators were presented and discussed with stakeholders and the final RUs, sub-components and indicators were reviewed, updated and refined. Furthermore, all the comments received have been addressed and incorporated in the relevant sections of this report.

4.2.5 Groundwater

Appropriate indicators have been selected for groundwater which give effect to the management of groundwater yield quantity and quality. No significant limitations or uncertainties affected the selection of these sub-components and indicators for groundwater, however, adjustments were made on this final version of the report, after the stakeholder meetings where the RUs, the sub-components and indicators were presented and discussed with stakeholders. Furthermore, all the comments received during the stakeholder meetings as well as the comments received on the report were addressed and incorporated in the relevant sections of this report.

4.3 Way forward

The next step of the RQO determination process, Step 5, comprises the proposed draft ROQs and numerical limits for the prioritised water resources in the Breede-Gouritz WMA. RQOs are narrative statements and the numerical limits translate the narrative RQOs into numerical values which can be monitored and assessed for compliance.

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