Classification and RQOs
The South African experience

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Overview of presentation

- Where does it fit in/come from?

- Work completed to date in SA

- Overview of the process and outcomes of the steps followed

Where does it fit in?

- NWA prescribes Resource Directed Measures (RDM) they are:
  - The Water Resource Classification System (WRCS)
  - The Ecological Reserve (BHN+EWR)
  - The Resource Quality Objectives (RQO)
- The WRCS aims to reach a negotiated agreement on the future management of aquatic ecosystems
- Resource Quality Objectives (RQOs) are objectives to monitor the target conditions set

Work completed in SA to date

- Classification and RQOs done for 7 of the 9 water management areas in South Africa
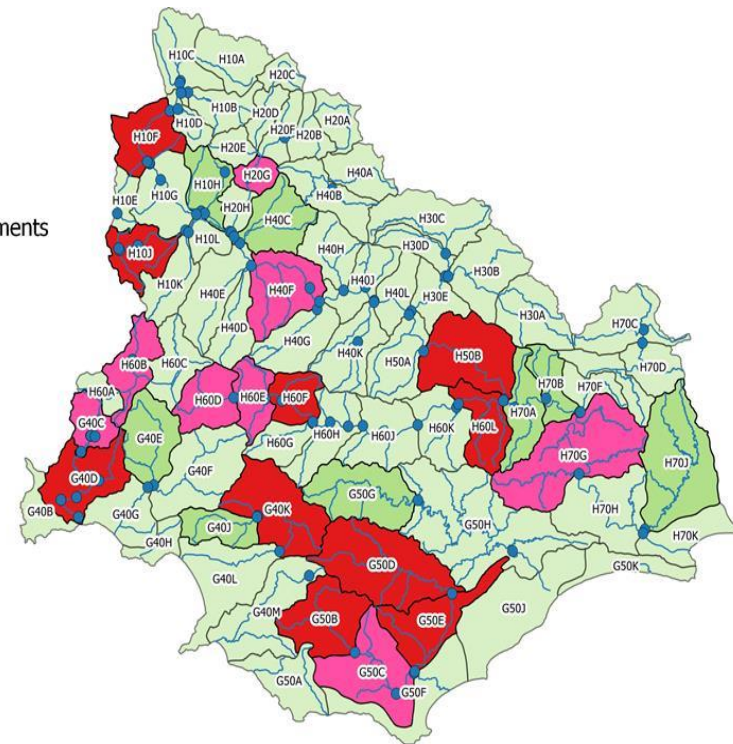
Overview of the process
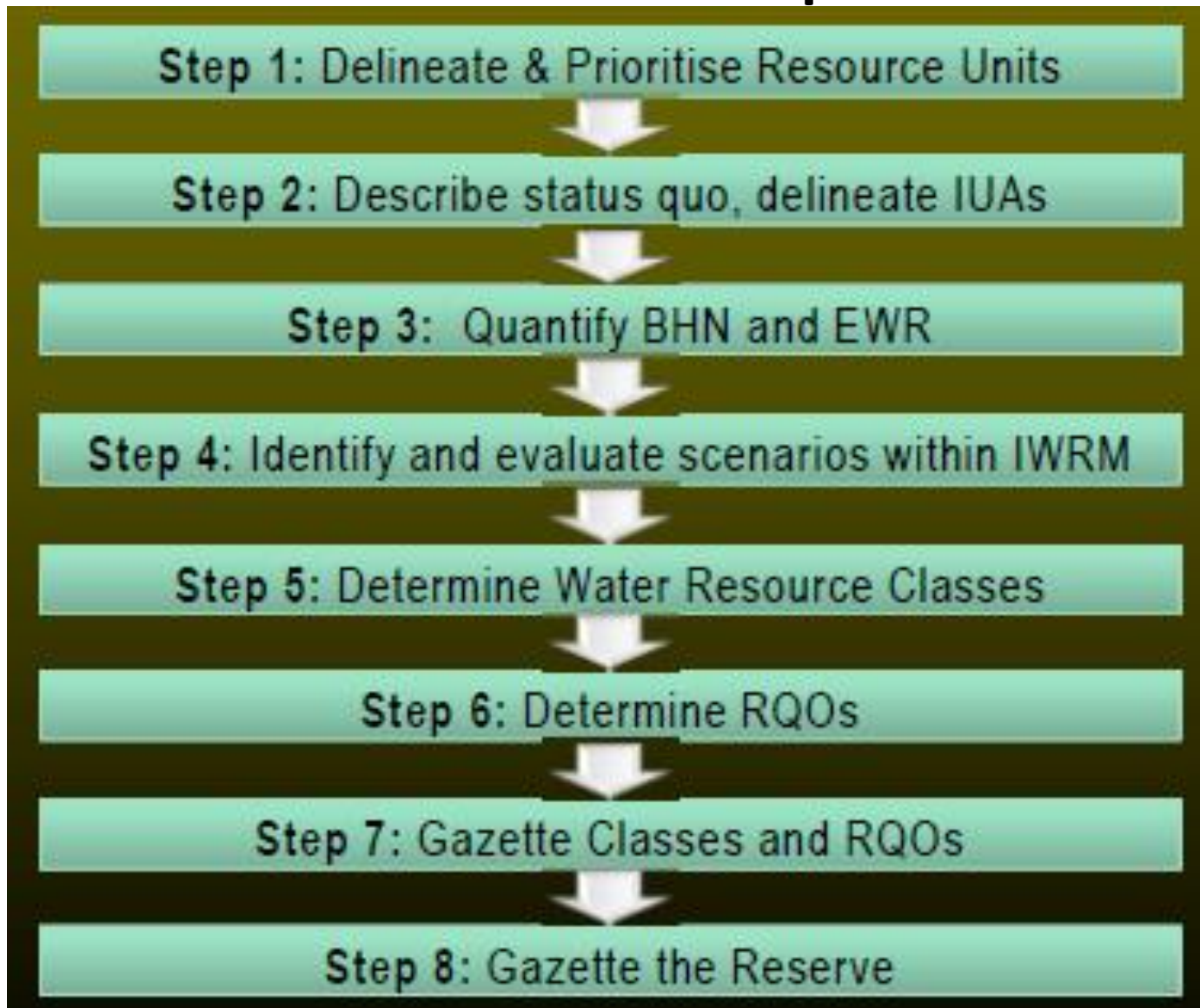
Step 1: delineate and prioritise resource units

- Resource units are aquatic ecosystems; rivers, lakes, wetlands, groundwater systems, estuaries, dams

- Priority is given to hotspots of ecological, socio-cultural and water resource use importance

- Nodes are locations used to allocate water in water resource models

Step 2: describe status quo and delineate IUAs

- Integrated Units of Analysis (IUAs) are sub-basins with similar water resource infrastructure, users, quality, socio-economics, geography, geomorphology and biology

Step 3: quantify BHN and flow regimes

- Basic Human Needs (25 l per day per person) are set aside for people directly dependent upon water from a natural aquatic ecosystem
- The flow regimes are the volumes and timing of water required to sustain aquatic ecosystems in a agreed upon condition
- Together, the BHN + flow regime = the ecological RESERVE

| Ecological Category	BES % Score	Description of the habitat
A	92-100%	Still in a Reference Condition.
A/B	87-92%	
B	82-87%	Slightly modified from the Reference Condition. A small change in natural habitats and biota has taken place but the ecosystem functions are essentially unchanged.
B/C	77-82%	
C	62-77%	Moderately modified from the Reference Condition. Loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged.
C/D	57-62%	
D	42-57%	Largely modified from the Reference Condition. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
D/E	37-42%	
E	22-37%	Seriously modified from the Reference Condition. The loss of natural habitat, biota and basic ecosystem functions is extensive.
E/F	17-22	
F	0-17%	Critically/Extremely modified from the Reference Condition. The system has been critically modified with an almost complete loss of natural habitat and biota. In the worst instances, basic ecosystem functions have been destroyed and the changes are irreversible.

Step 4: identify and evaluate scenarios within IWRM

- Scenarios describe how baseline conditions change in response to water use for different possible futures
- Examples of scenarios include:
  - Maintain baseline conditions
  - Improve ecological conditions through restoration and constrain development
  - Allow for high development and reduced ecological conditions to bottom line acceptable
- Scenarios are selected by stakeholders

Routing flow through a basin

- A model describes how changes in flow, up or down, affects the ecological conditions of rivers and estuaries
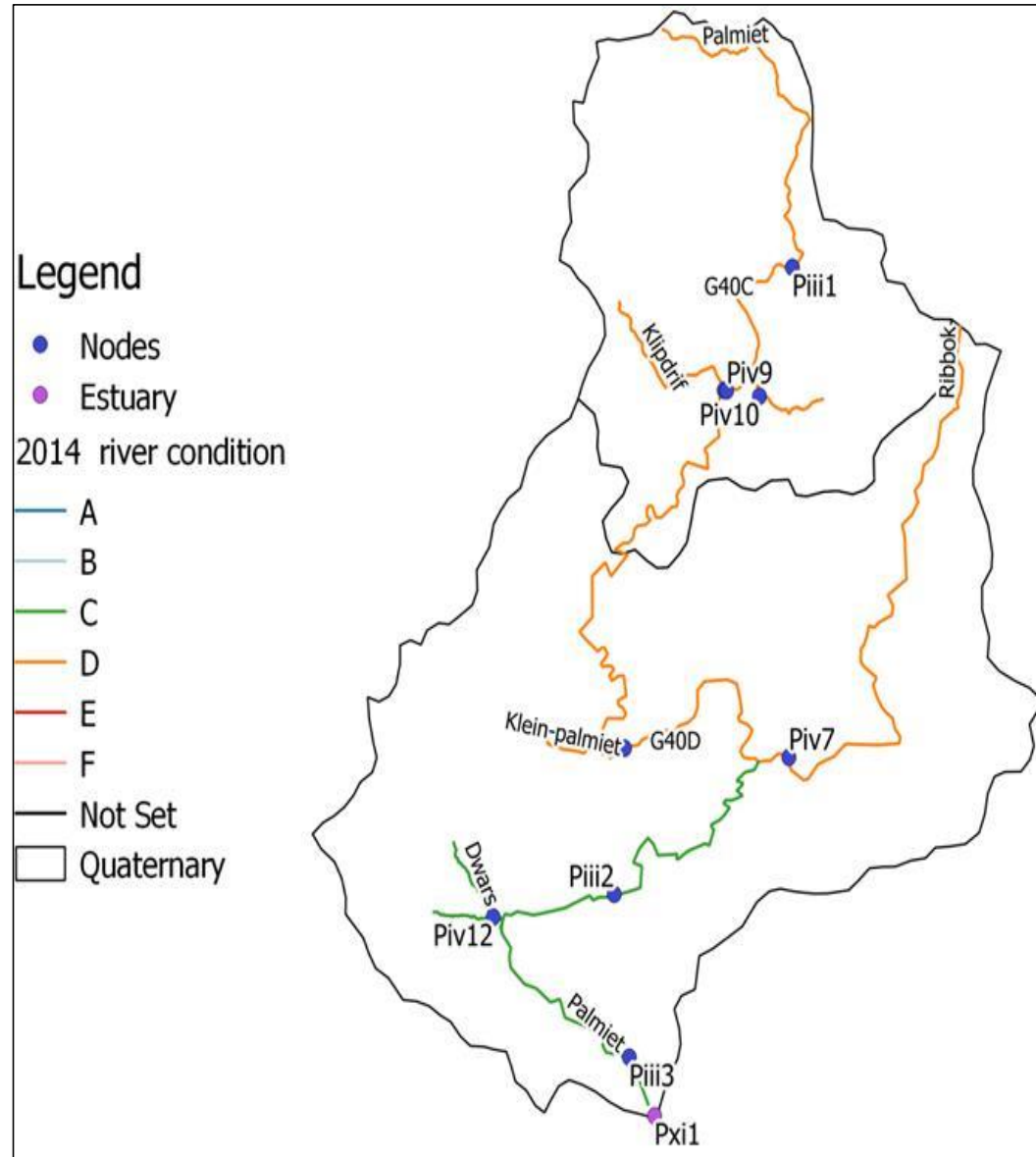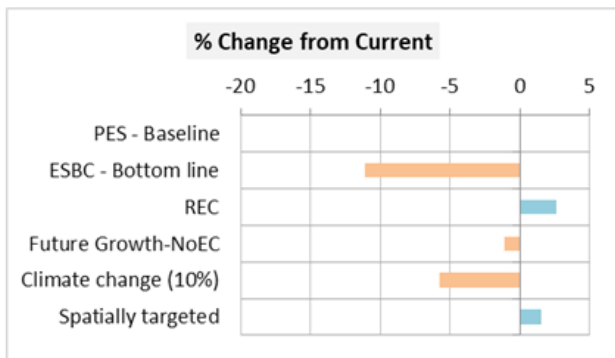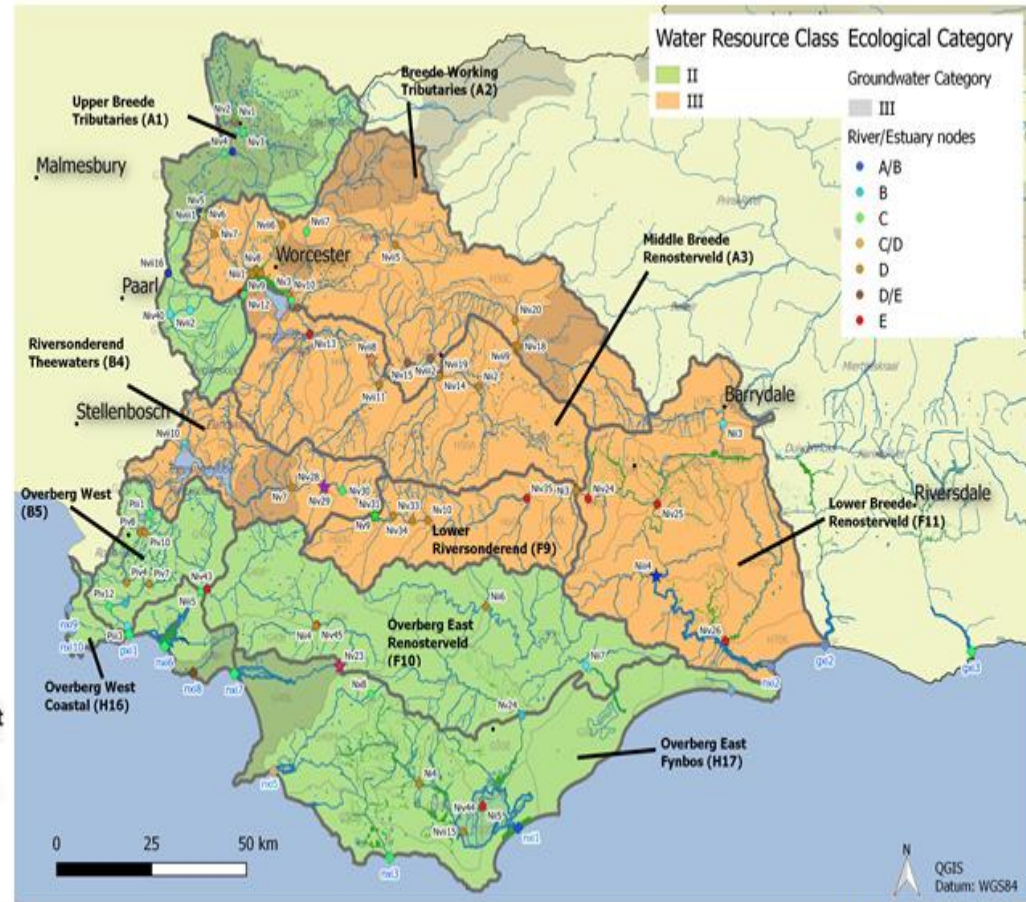
Modelling flow and ecological condition

- The model contains:
  - Baseline conditions for rivers and estuaries
  - Modelled current day flows and natural flows
  - Modelled EWRs for a range of conditions, based on various studies
- Allows the user to toggle flow and see changes in ecological condition
- Reports surpluses and deficits in flow relative to current day flow

Step 5: determine water resource classes

- The chosen scenario generates target conditions and classes

Figure 3 & Figure 4. Categories used by the WRCS and for the Reserve determination processes. The schematic indicates the relationship between the two (adapted from Pollard et al. (2007) and Palmer et al. (2004)).

Taken from Pollard et al. 2013, WRC project TT 574/13

Scenario analysis - outcome

- Target conditions for all nodes in the basin along with modelled flows to support this from the scenario selected

- These go into the RQO process where objectives for monitoring are written for sites to be monitored

- Not all nodes are monitored due to time and costs constraints

Step 6: determine RQOs

- Monitoring focussed at high priority areas, all available information is used to write the RQOs

- RQOs are word and number statements to monitor the condition of rivers, lakes, estuaries, floodplains

- In some instances there are no data to write these but gaps can be filled after some monitoring has been collected for a few years

RQOs

RIIVERS	Component	Sub-component
	QUANTITY	High flows
		Low flows
	WATER QUALITY	Nutrients
		Salts
		System variables (temperature, salinity, oxygen, pH, turbidity
		Toxins
		Pathogens
	HABITAT	Geomorphology
		Riparian vegetation
	BIOTA	Fish
		Invertebrates

ESTUARIES	Component	Sub-component
	QUANTITY	High flows
		Low flows
	WATER QUALITY	Nutrients
		Salts
		System variables (temperature, salinity, oxygen, pH, turbidity
		Pathogens
	HABITAT	Hydrodynamics
		Sediments
	BIOTA	Fish
		Invertebrates
		Micro-algae
		Macrophytes

RQOs

GROUNDWATER	Component	Sub-component
	QUANTITY	Abstraction
		Low flows
		Discharge
	WATER QUALITY	Nutrients
		Salts
		Pathogens

WETLANDS	Component	Sub-component
	QUANTITY	High flows
		Hydroperiod
	WATER QUALITY	Nutrients
	HABITAT	Geomorphology
		Vegetation
	BIOTA	Frogs
		Benthic algae
		Phytoplankton

Index of Habitat Integrity

INSTREAM CRITERIA		RIPARIAN CRITERIA	
water abstraction	3	indigenous vegetation removal	2
flow modification	3	exotic veg encroachment	0
bed modification	2	bank erosion	1
channel modification	2	channel modification	2
water quality	0	water abstraction	3
inundation	0	inundation	0
exotic macrophytes	0	flow modification	3
exotic fauna	0	water quality	0
solid waste disposal	0		
TOTAL (%)	66.8	TOTAL (%)	65.3
Weighting:	50		50
OVERALL SCORE:	**66.0**		

RIVER HEALTH INDICES

Index of Habitat Integrity

The availability and diversity of habitats are major determinants of aquatic biota that are present. The index assesses the impact of human disturbance on the riparian and instream habitats.

Geomorphological Index

Geomorphological processes determine the size and shape of river channels, which in turn defines the type of habitat. The index reflects the channel condition and channel stability.

Riparian Vegetation Index

Healthy riparian zones help to maintain river channel shape and filter sediment, nutrients and light. Plant material from these zones provides food for aquatic fauna. The index is a measure of riparian vegetation modification from its natural state.

South African Scoring System

Aquatic invertebrates (crabs, insects, snails) require specific habitats and water quality conditions. They are good indicators of recent localised conditions in a river. The index is based on invertebrate families found at a site.

Fish Index

Fish are good indicators of long-term influences on general habitat conditions within a reach. The index is an expression of the degree to which a fish assemblage deviates from its undisturbed condition.
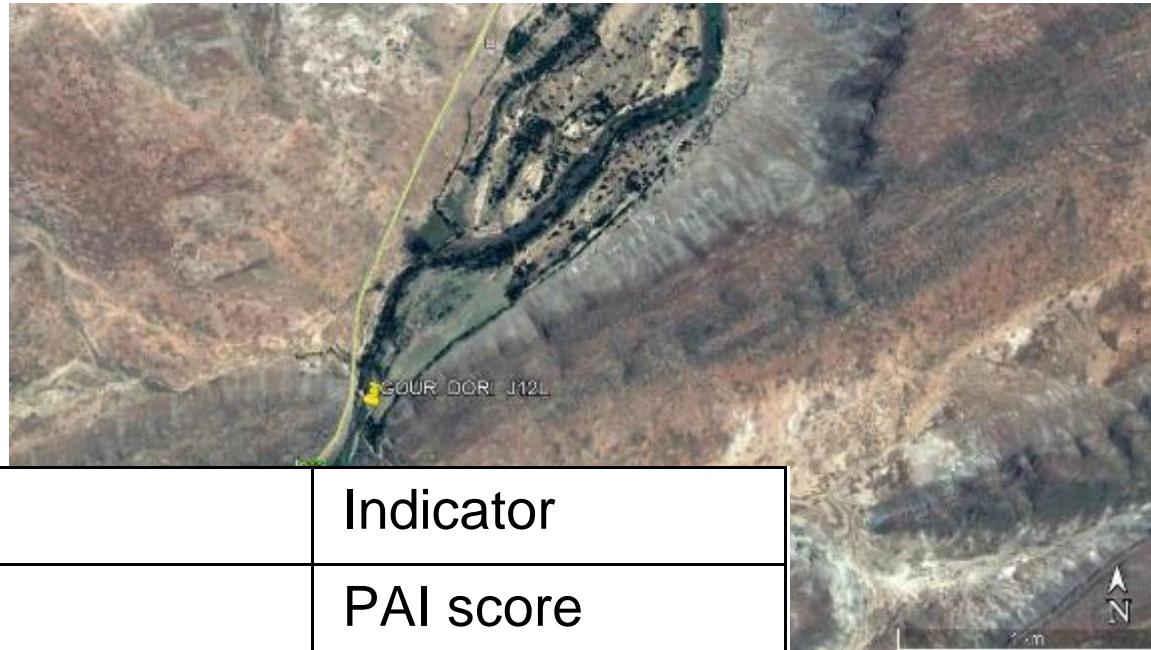
Water Quality

Water quality indicates suitability of water for aquatic ecosystems. This assessment is based on pH, electrical conductivity, total phosphate, total nitrogen, ammonia and dissolved oxygen measured in the rivers.

Doring River – Gour_Dori_J12L

- Monitoring river condition using standard methods

Component	TEC	Indicator
Water quality	C	PAI score
Geomorphology	-	GAI score
Riparian vegetation	C/D	VEGRAI score
Invertebrates	D	MIRAI score
Fish	C/D	FRAI score
EcoStatus	C/D	IHI score

Macroinvertebrates

Parameters	RQOs	TPCs
SASS5 and ASPT score	SASS5 score >90, ASPT ≥ 4.5.	SASS5 scores < 90, ASPT < 4.5.
Diversity of invertebrate community	>/= 15 families, at an abundance of A to C.	<15 families. Any taxon (adult) with an abundance of 1.

Fish

Metric	RQOs	TPC
Indigenous species richness	All four of the indigenous fish species should be present: *Labeo umbratus, Pseudobarbus asper , Sandelia capensis, Barbus anoplus*	< 2 indigenous species
Pseudobarbus asper	FROC = 0.5	*Pseudobarbus asper* absent for two consecutive surveys OR present at FROC of < 0.5. Also absence of juvenile fish in catches.
Barbus anoplus	FROC = 0.5	*Barbus anoplus* absent for two consecutive surveys OR present at FROC of < 0.5. Also absence of a range of life stages (juvenile to adult) in catches.
Labeo umbratus	FROC = 0.5	*Labeo umbratus* absent for two consecutive surveys OR present at FROC of < 0.5. Also absence of juvenile fish in catches.
Sandelia capensis	FROC = 0.5	*Sandelia capensis* absent for two consecutive surveys OR present at FROC of < 0.5. Also absence of juvenile fish in catches.
Exotic fish species	No increase in CPUE for: *Tilapia sparmanii* (0.6 ind/min)	Presence of any additional exotic/introduced species or increase in CPUE of any listed.

Step 7 and 8

- Step 7: gazette management classes and RQOs
- Step 8: gazette the Ecological Reserve