water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

Determining Water Resources Classes and Associated Resource Quality Objectives in the Berg Catchment (WP10987)

Study Overview Presentation

26 October 2018
Saldanha Water Quality Forum Trust meeting

Overview of study objectives & tasks

Study Objectives

Co-ordinate implementation of the Water Resources Classification System (WRCS):

- **Determine Water Resources Classes (WRCs)**
- **Determine Resource Quality Objectives (RQOs)**
- **Support Gazetting of Recommended Water Resources Classes and RQOs**

for the water resources in the Berg Catchment:

- Rivers - Estuaries - Groundwater
- Dams - Wetlands

Project Duration: April 2016 to March 2019

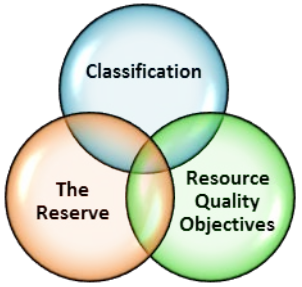
Main Study Tasks

- **Task 1: Inception** → Completed
  - Inception Report
  - Stakeholder Identification and Mapping Report
- **Task 2: Information gathering** → Completed
  - Water Resources Information and Gap Analysis
- **Task 3: Determine Water Resource Classes** → Completed
  - Resource Units & IUA Delineation Report
  - Status Quo Report
  - Linking the Value & Condition of Water Resources
  - Quantification of the EWR and changes in EGSAs
  - Ecological Base Configuration Scenarios Report
  - Report on Evaluation of Classification Scenarios
- **Task 4: Determine Resource Quality Objectives** → In Progress
  - Resource Unit Prioritization Report
  - Evaluation of Resource Units
  - Outline of Resource Quality Objectives
  - Monitoring Program to Support RQOs Implementation
  - Confidence Assessment of Resource Quality Objectives
- **Task 5: Support Gazetting done by DWS to legalise**
  - Final Report and Gazette template ← WE ARE HERE

Legal Mandate for Classification and RQOs

- Chapter 3 of the National Water Act, (No. 36 of 1998) deals with the protection of water resources

- The measures for protection of water resources are:
  - Classification (S13)
  - Reserve (S16)
  - Resource Quality Objectives (S13)



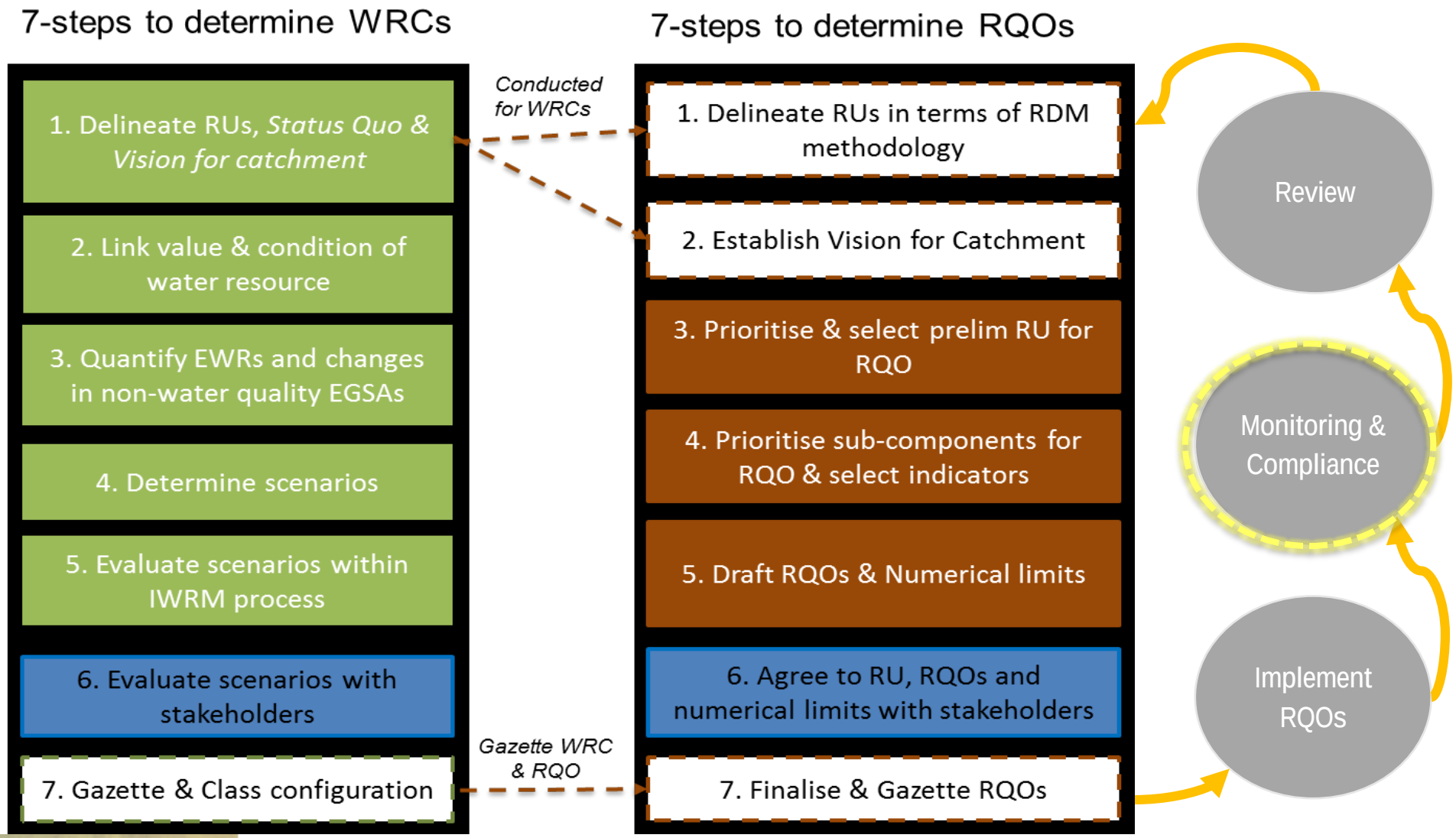
- S12 requires the Minister to establish the Water Resource Classification System, (WRCS)

- WRCS was published as Regulation 810 in Government Gazette No. 33541 dated 17 September 2010

- The WRCS defines:
  - water resource classes and
  - the procedure to determine Class, RQOs and Reserve

- According to the NWA, once the WRCS has been gazetted all significant water resources must be classified and Resource Quality Objectives determined.

Water Resource Classes & RQOs



Delineation of IUAs

Integrated Units of Analysis (IUAs)

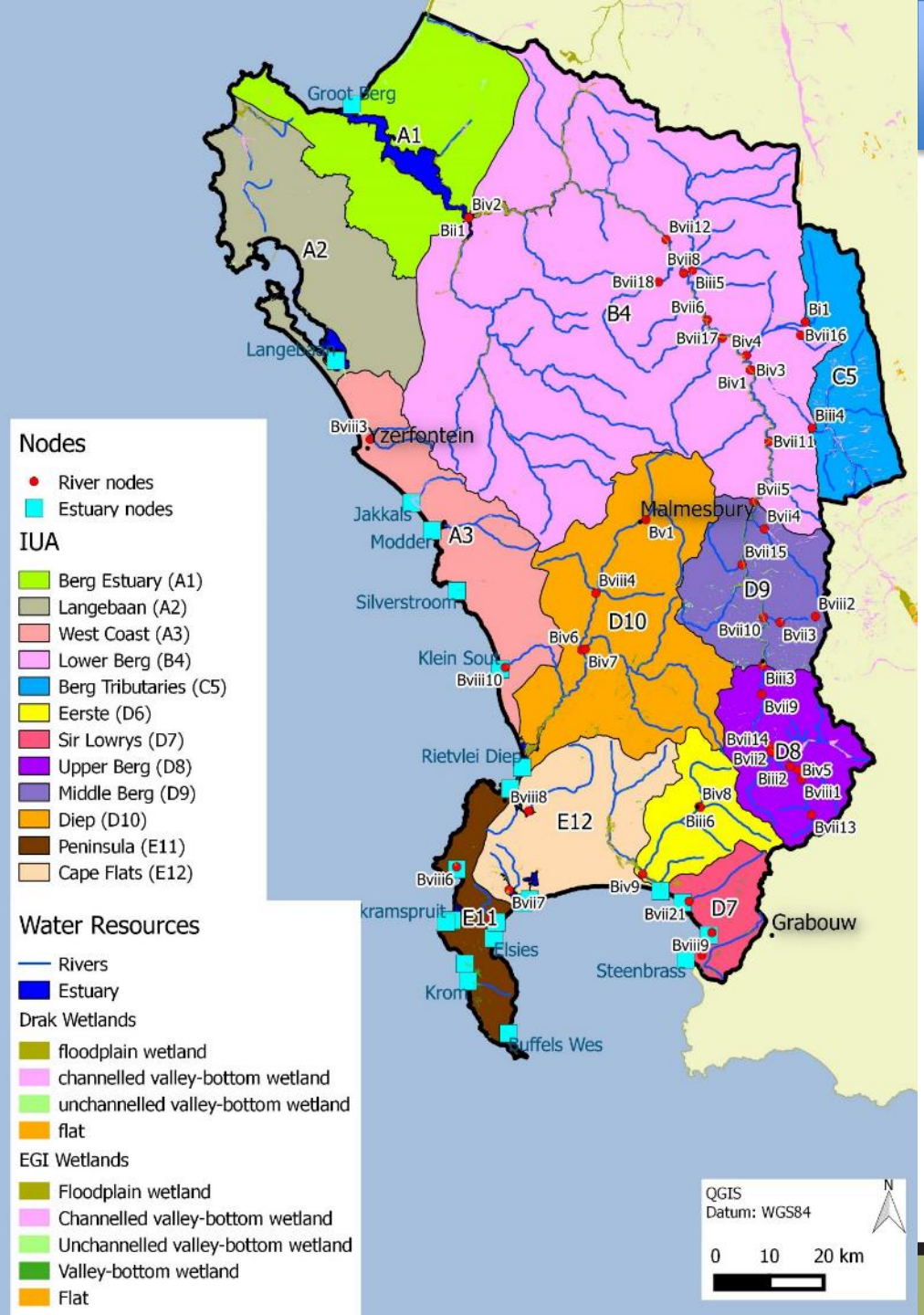
- Identified **significant resources**:
  - Based on Physical, Biological & Socio-economic factors
- Each IUA represents a similar area requiring a Water Resources Class (WRC)
- Why do we need these?
  - Broad-scale units to assess socio-economic implications of scenarios *(possible future situations)*
  - Report on ecological conditions at a sub-catchment scale
  - Set WR Classes for different parts of a catchment
- 12 IUAs delineated for the Berg Catchment.

Defined Resource Units (RUs) and Nodes

- **Resource units (RUs)** are grouped areas e.g. river basins, deemed similar in terms of various characteristics
- Are used to transfer information between catchments
- Groundwater RUs.

- **Nodes** are locations of interest (points) in a water resource (rivers, dams, wetlands, estuaries)
- Are sited using:
  - Water infrastructure
  - Aquatic ecosystem attributes
- Are used to allocate water for environment and development

Delineation of Resource Units and Integrated Units of Analysis



- 12 Integrated Units of Analysis (IUAs) identified In Study Area.
- Catchments G1, G2 and G40A.
- 45 river nodes identified.
- 8 existing Reserve Sites with EWRs already determined.
- 3 additional River EWR sites determined at Rapid Level III.
- 22 estuaries nodes identified.
- RDM studies undertaken to determined EWRs for 8 key estuaries in G2 catchments.
- 10 Groundwater Resource Units.

Scenarios Considered

Scenarios to be Considered

- Consider G1 and G2 catchments separately
  - G1 focused on the EWR impacts on the WCWSS.
  - G2 focused on impacts on estuaries and wetlands.
  - Groundwater scenarios considered separately.

- Scenarios to be considered:
  - Ecologically Sustainable Base Configuration (ESBC)
  - Present Ecological status (PES)
  - Recommended Ecological Category (REC)
  - Current and Future Developments
  - Possible Impacts of Climate Change
  - Individual specific estuary development scenarios
  - Catchment development scenarios for Wetlands

Scenarios Considered: G2 Catchments (Estuaries)

For estuaries with significant WWTW contributions.

#	Scenario	Description
1	Natural	Reference condition
2	Present	Present day flows and conditions
3	Scenario 1	Present day flows but all effluent from WWTW to be treated to DWS Special Standards
4	Scenario 2	Reduce inputs from the WWTW by 50% and treat the remainder to DWS Special Standards
5	Scenario 3	Reduce inputs from the WWTW by 75% and treat the remainder to DWS Special Standards
6	Scenario 4	Divert/recycle 100% of effluent from WWTW

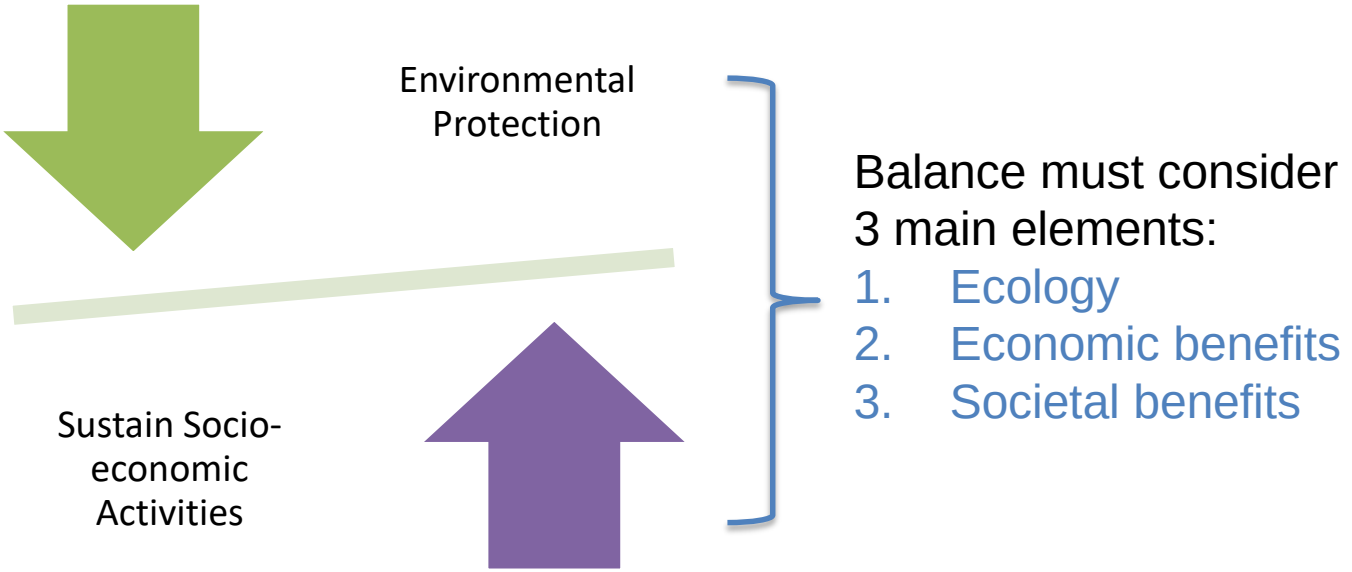
Alternative future development scenarios for other estuaries (i.e. Langebaan, Sandvlei, Lourens).

Methodology for Scenario Analysis

Scenario Evaluation Process

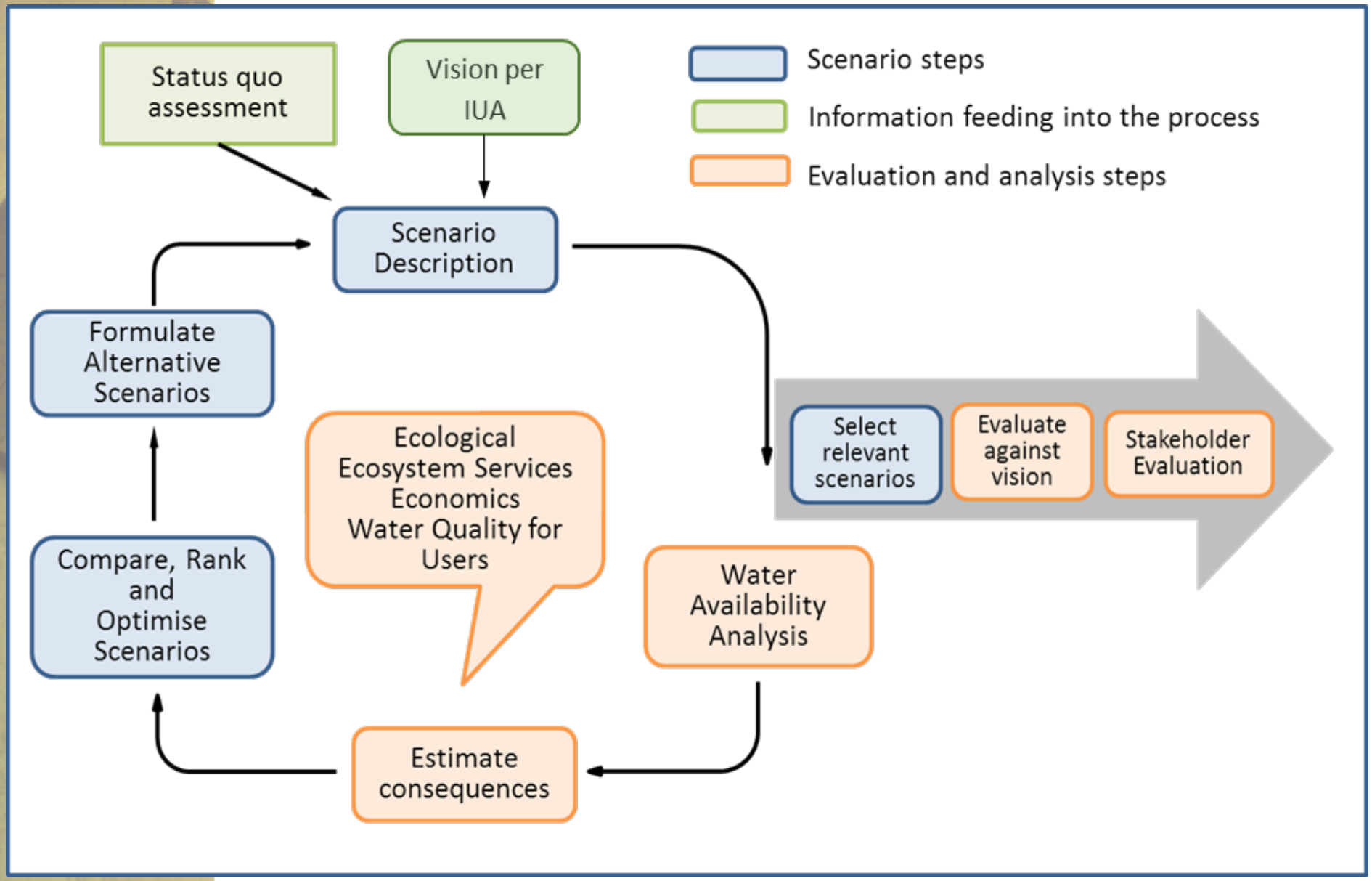
Aim of the scenario evaluation process:

- An appropriate balance between the level of environmental protection and the use of the water to sustain socio-economic activities



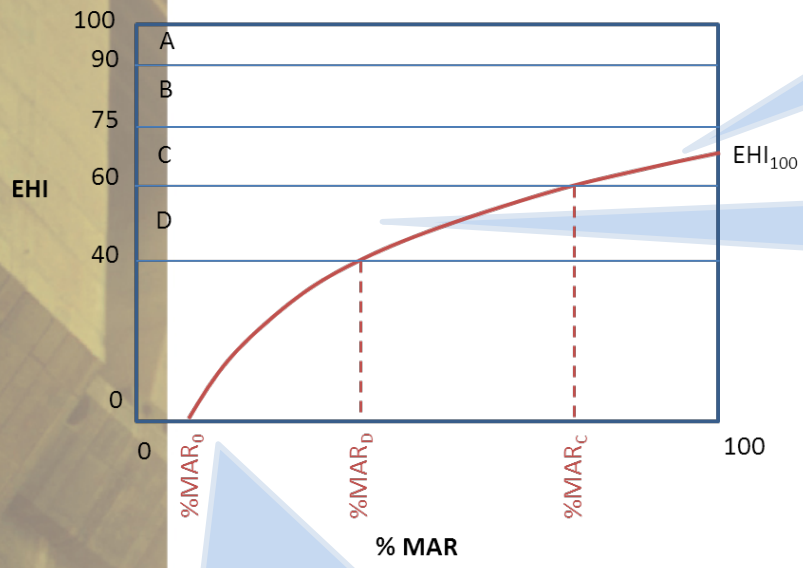
Scenario evaluation process estimates consequences of the scenarios on the three main elements

Evaluation of Scenarios Methodology



Estuaries

Estuaries



3. It is often not possible to restore health to 100% of natural through restoration of flow alone due to other non-flow related impacts

1. Relationship between health and flow is logarithmic – health declines increasingly rapidly as %MAR declines

2. The ability of an estuary to support biodiversity drops to zero before MAR drop to zero

A. Models were developed which allowed us to project likely changes in estuary health from A to E category as flows decline based on data from Reserve determination studies for individual estuaries

B. Proportional changes in the size of macrophyte, invertebrate, fish and bird populations were also estimated using matrices developed using data from Reserve determination studies for individual estuaries

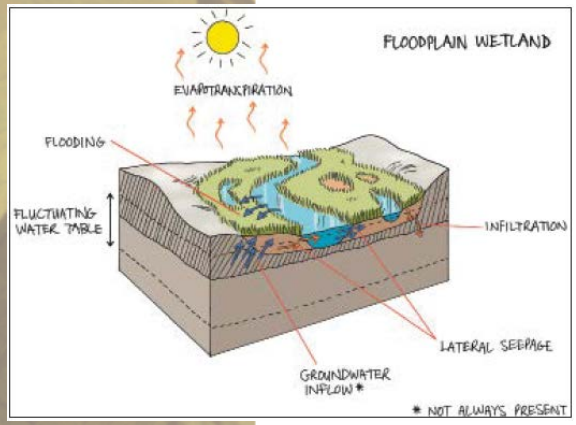
		Assigned Ecological Category					
		A	B	C	D	E	F
PES	A	1.0	0.9	0.7	0.5	0.3	0.1
	B	1.2	1.0	0.8	0.6	0.4	0.1
	C	1.4	1.2	1.0	0.7	0.4	0.1
	D	1.9	1.7	1.4	1.0	0.6	0.2
	E	3.2	2.8	2.3	1.7	1.0	0.3
	F	10.4	9.0	7.3	5.4	3.2	1.0

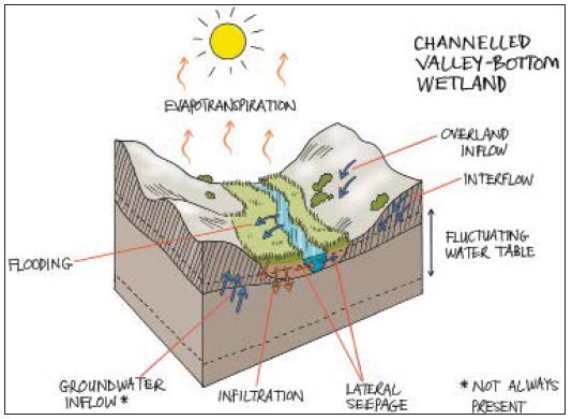
Target Ecological Condition (TEC) for Estuaries

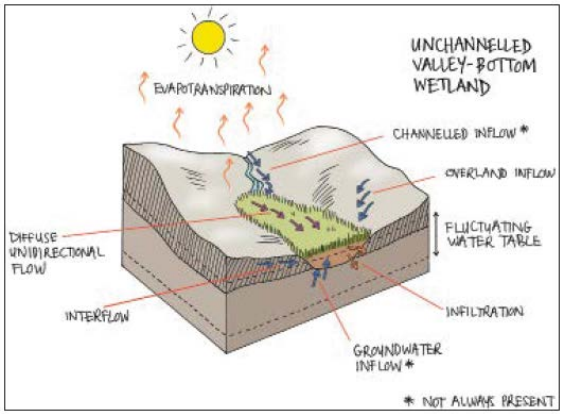
Estuary Node	IUA	Quat	Name	PES	REC	EIS	Minimum %MAR with Current WQ	Minimum %MAR with Improved WQ
Bxi1	A1	G10M	Berg River Estuary	D	C	H	46	33
Bxi3	A2	G10M	Langebaan Estuary	B	A	VH	94	94
Bxi12	A3	G21A	Modder Estuary	C	C	M	n/a	33
Bxi7	D10	G21F	Rietvlei/Diep Estuary	D	C	H	n/a	33
Bxi9	E12	G22K	Zandvlei Estuary	D	C	H	n/a	56
Bxi20	E12	G22D	Zeekoe Estuary	E	D	U	110	60
Bxi10	E11	G22B	Hout Bay Estuary	E	D	U	35	26
Bxi11	E11	G22A	Silvermine Estuary	D	D	U	35	26
Bxi19	E11	G22A	Elsies Estuary	E	D	U	35	26
Bxi18	E11	G22A	Buffels Wes Estuary	F	D	U	66	67
Bxi17	E11	G22A	Krom Estuary	A	A	U	95	95
Bxi16	E11	G22A	Schuster Estuary	A	A	U	95	95
Bxi15	E11	G22A	Bokramspruit Estuary	C	C	U	65	42
Bxi14	E11	G22A	Wildvoelvlei Estuary	D	C	M	79	62
Bxi3	D6	G22H	Eerste Estuary	E	D	M	61	26
Bxi4	D7	G22J	Lourens Estuary	D	D	U	69	56
Bxi6	D7	G22K	Sir Lowry's Pass Estuary	E	D	U	35	26
Bxi6	D7	G40A	Steenbras estuary	B	B	U	97	35

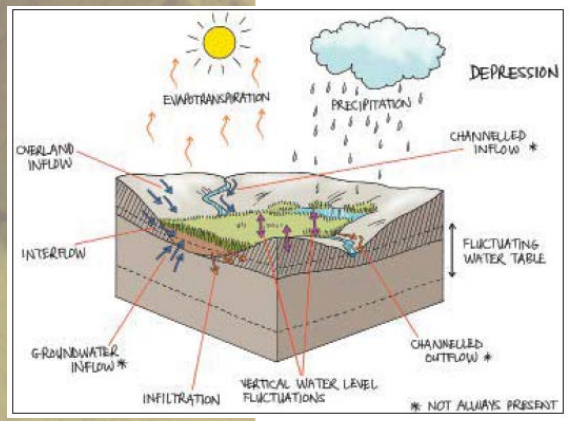
Wetlands

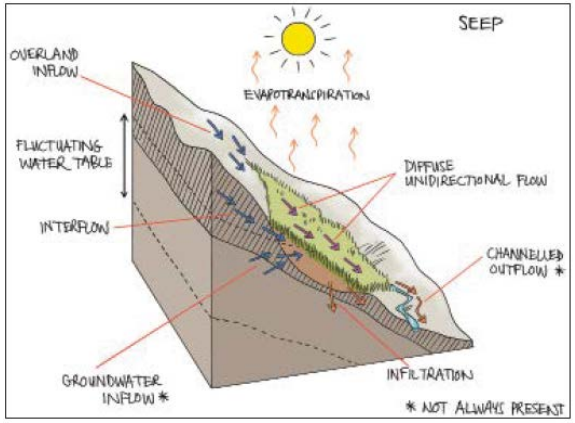
Wetland Regions, Wetland RUs, and Wetland Types

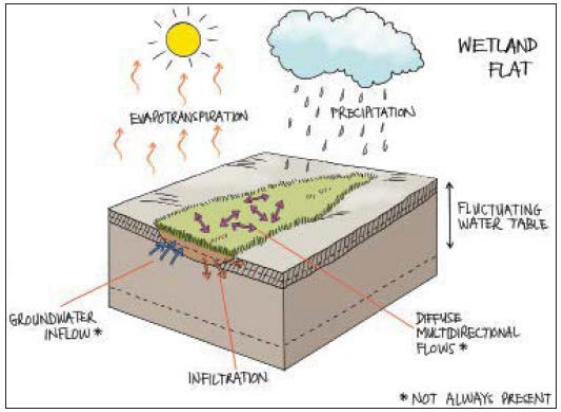






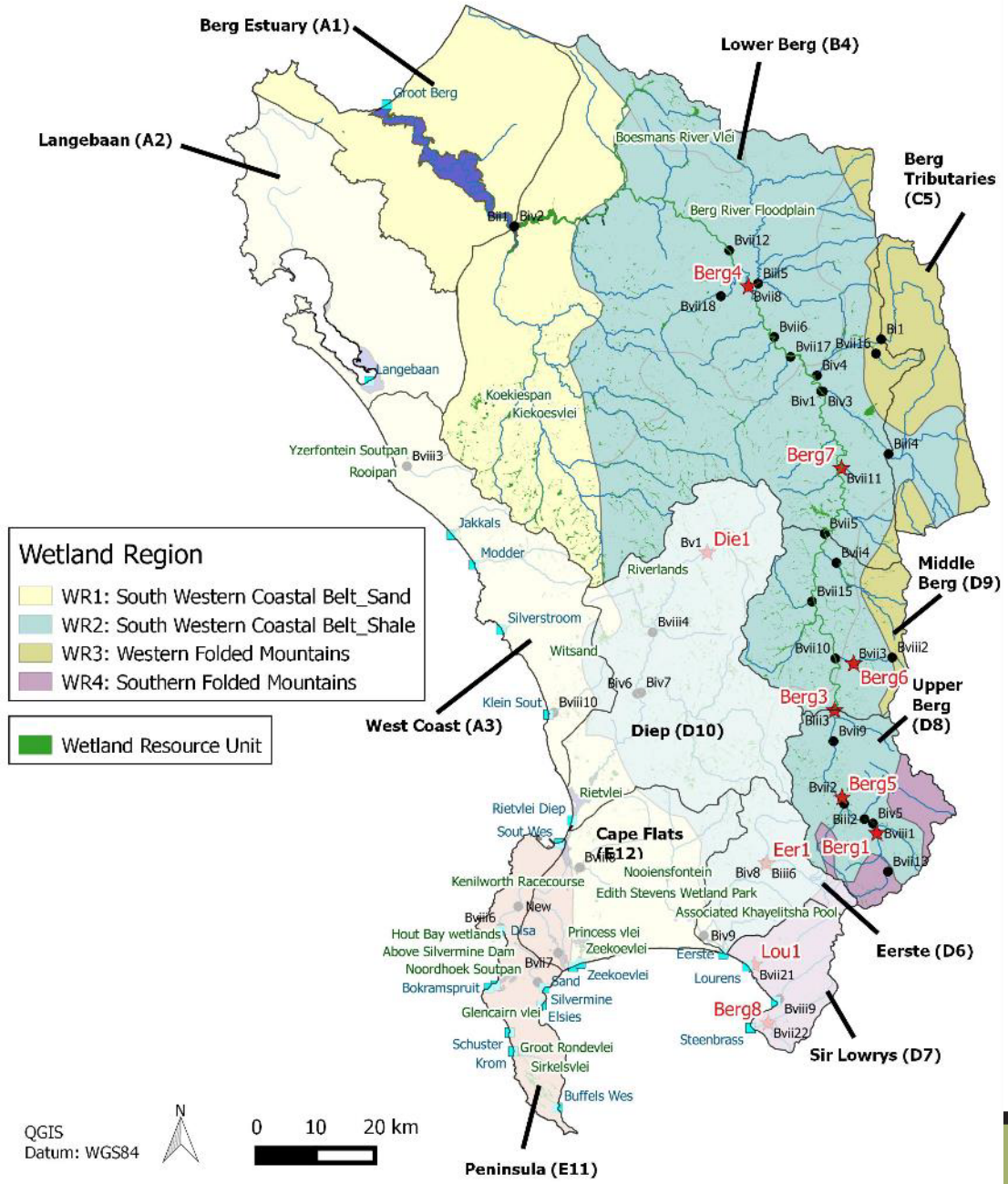






Wetland Regions are defined by Eco-region and Individual Wetland RUs defined by Wetland Type.

Wetland Scenarios (G1)



Surface water usage impacts:

- Berg River Floodplain wetlands threatened by water abstraction due to reduction of flow in the future scenarios
- Climate change increases this impact

Groundwater usage impacts:

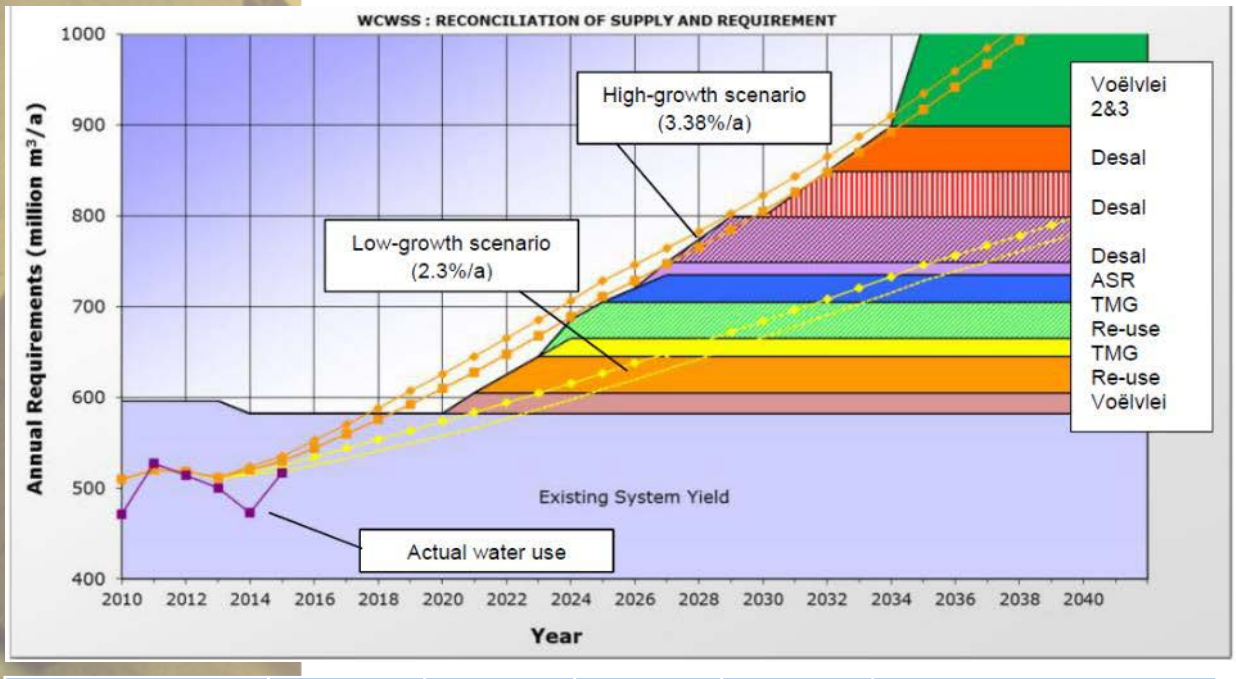
- Increased abstraction of Langebaan Road Wellfield impacts Berg River Floodplain
- Uncertain extent of impact to Geelbek wetlands due to Elandsfontein

Indirect impacts:

- Future scenarios with no catchment management results in transformation of wetland habitats, increased stormwater flow etc.
- Future scenarios with catchment management results in less transformation

Impact on Water Availability and Yield

Current and Future Demands from the WCWSS



Water Requirement Sector (million m³/a)	2017/18	2018/19	2019/20	2020/21	2039/40 Medium-Growth Urban (2.8%/a)
CoCT + Other Municipalities	193	210	275	330	560
Agriculture	93	110	135	190	210
Losses	11	12	14	20	20
Total	297	332	424	520	790

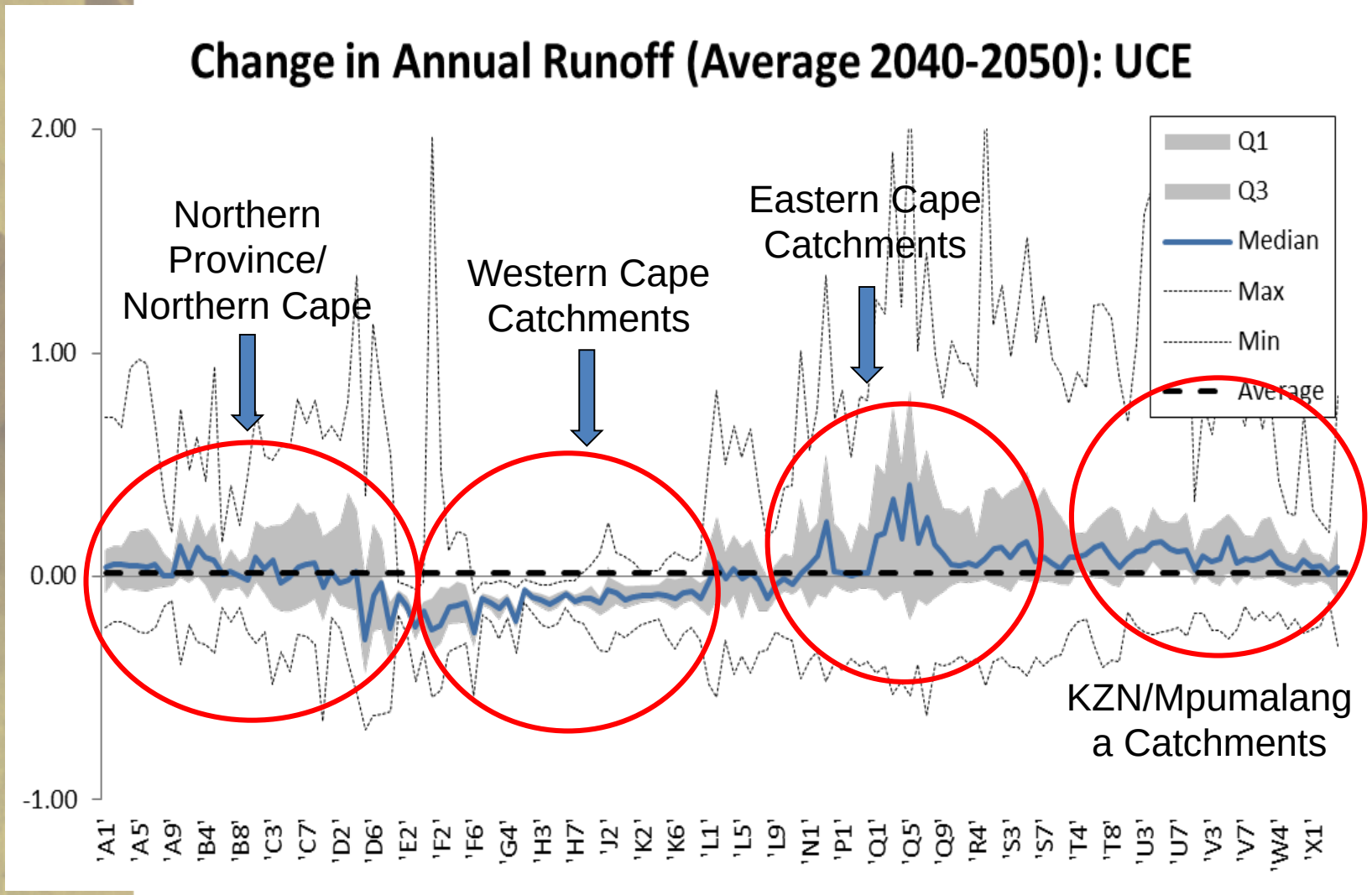
Progression of projected annual water requirements from 2017/17 to 2039/40

"Planning Scenario" of the WCWSS Reconciliation Strategy

Bulk Water Supply Intervention	Yield (million m³/a)
Berg River-Voëlvlei Dam Diversion	23
Wastewater Re-Use - 1	40
TMG Aquifer - 1	20
Wastewater Re-Use - 2	40
TMG Aquifer - 2	30
West Coast Aquifer Recharge	14
Seawater Desalination - 1	50

New Bulk water supply interventions for WCWSS needed by 2039/40

Climate Change Impacts (Cullis et al.2015)



Range of potential impacts on MAR for Secondary Catchments for the Unconstrained Emissions Scenario (UCE) (Cullis et al 2015)

Ecosystem Goods, Services and Attributes

Main ecosystem services used in analysis

Category of service	Types of values	Description of EGSA	Independent variables related to estuary condition
Goods (Provisioning services) 	Subsistence fishing	Invertebrates and fish collected on a subsistence basis for consumption or bait	Invertebrate abundance Freshwater fish abundance Estuary line- and net fish abundance
Services (Regulating services) 	Nursery value	Contribution to marine fish catches due to the nursery habitat provided by estuaries	Abundance of estuary-dependent marine fish
Attributes (Cultural services) 	Tourism value & property value	A river, wetland or estuary's contribution to recreation/tourism appeal of a location	Overall health Line fish abundance Water quality

Impact on EGSAs: G2 Catchments (REC scenario)

ESTUARY	Property Value (R million/a)	Tourism Value (R million/a)	Total Value (R million/a)	PES	REC	Change in Value	Change in Total EGSA Value (R million/a)	NPV of Change in EGSAs (R million)
Langebaan	26.99	136.6	163.59	A	A	1	0.0	0.0
Rietvlei/ Diep	32.71	62.4	95.11	D	D	1	0.0	0.0
Wildevoël-vlei	0.19	29.6	29.79	D	D	1	0.0	0.0
Sand	4.74	98.5	103.24	D	C	1.4	41.3	731.2
Zeekoe	1.62	8.2	9.82	E	D	1.8	7.9	139.1
Eerste	1.76	8.9	10.66	E	D	1.8	8.5	151.0
Lourens	0.50	33	33.50	D	D	1	0.0	0.0
TOTAL	**39.81**	**377.2**	**445.71**				**57.7**	**1 021.3**

Net present value (NPV) of the change in the EGSAs value for the REC (from PES) (NPV: 30 years @ 6% discount rate)

Estuary Scenario Results - Example

Langebaan Lagoon

Scenario	WCDM wellfield abstraction (million m³/a)	Dispersed abstraction (million m³/a)	Total abstraction (million m³/a)
Base case	0	4.94	4.94
Scenario 1	1.35	6.53	7.88
Scenario 2	3.5	6.53	9.83
Scenario 3	5.5	6.53	12.03
Scenario 4	7	6.53	13.53
Scenario 5	12	6.53	18.53

	Drawdown at Langebaan Lagoon (m)		Aquifer Flux to Lagoon (million m3/a)			% change from Base case
	LAU	UAU	LAU	UAU	LAU+UAU	
Base case	n/a	n/a	-0.6	-5.1	-5.7	-
Scenario 1	<0.1	<0.1	-0.6	-5.1	-5.7	-1
Scenario 2	<0.1	<0.1	-0.6	-5	-5.6	-3
Scenario 3	<0.1, increasing to 0.1-0.5 ~680m from water	<0.1	-0.6	-5	-5.6	-4
Scenario 4	<0.1, increasing to 0.1-0.5 ~500m from water	<0.1	-0.6	-5	-5.6	-4
Scenario 5	<0.1, increasing to 0.1-0.5 500m from water	<0.1	-0.6	-5	-5.6	-6%

Estuary Scenario Results - Example

Langebaan Lagoon

Component	Present	Sc1	Sc2	Sc3	Sc4	Sc 5
Hydology	**99**	**99**	**99**	**99**	**99**	99
Hydrodynamics and mouth condition	95	95	95	95	95	91
Water quality	95	95	95	95	95	95
Physical habitat alteration	92	92	92	92	92	92
Habitat health score	**95**	**95**	**95**	**95**	**95**	**94**
Microalgae	90	90	90	90	90	90
Macrophytes	90	90	88	88	85	85
Invertebrates	90	90	90	90	90	90
Fish	50	50	50	50	50	50
Birds	50	50	50	50	50	50
Biotic health score	**74**	**74**	**74**	**74**	**73**	**73**
Estuary Health Score	**85**	**85**	**84**	**84**	**84**	**84**
Ecological Category	**B**	**B**	**B**	**B**	**B**	**B**

Groundwater

Overall Groundwater Balance and Stress

Groundwater Balance, Use/recharge (stress) and Present Status for Groundwater Resources Units in the Berg.

GRU Name	Recharge (Mm^3/a)	Use (Mm^3/a)	GWBF (Mm^3/a)	Balance (Mm^3/a)	Use/Recharge (%)	Present Status
GRU-1: Malmesbury	47.19	10.48	10.37	26.34	22%	II
GRU-10: Atlantis	10.43	7.51	1.31	1.61	72%	III
GRU-2: Cape Flats	38.34	11.78	7.57	19.00	31%	II
GRU-3: Peninsula	11.25	0.10	3.93	7.22	1%	I
GRU-4: Paarl-Upper Berg	86.92	10.77	19.79	56.36	12%	I
GRU-5: Helderberg	45.21	3.31	8.25	33.65	7%	I
GRU-6: 24 Rivers	49.85	2.00	8.41	39.45	4%	I
GRU-7: Tulbagh	30.86	5.63	6.51	18.71	18%	I
GRU-8: West Coast	153.50	8.92	5.47	139.11	6%	I
GRU-9: Piketberg	44.19	17.52	1.71	24.95	40%	II

Scenario consequences on groundwater condition

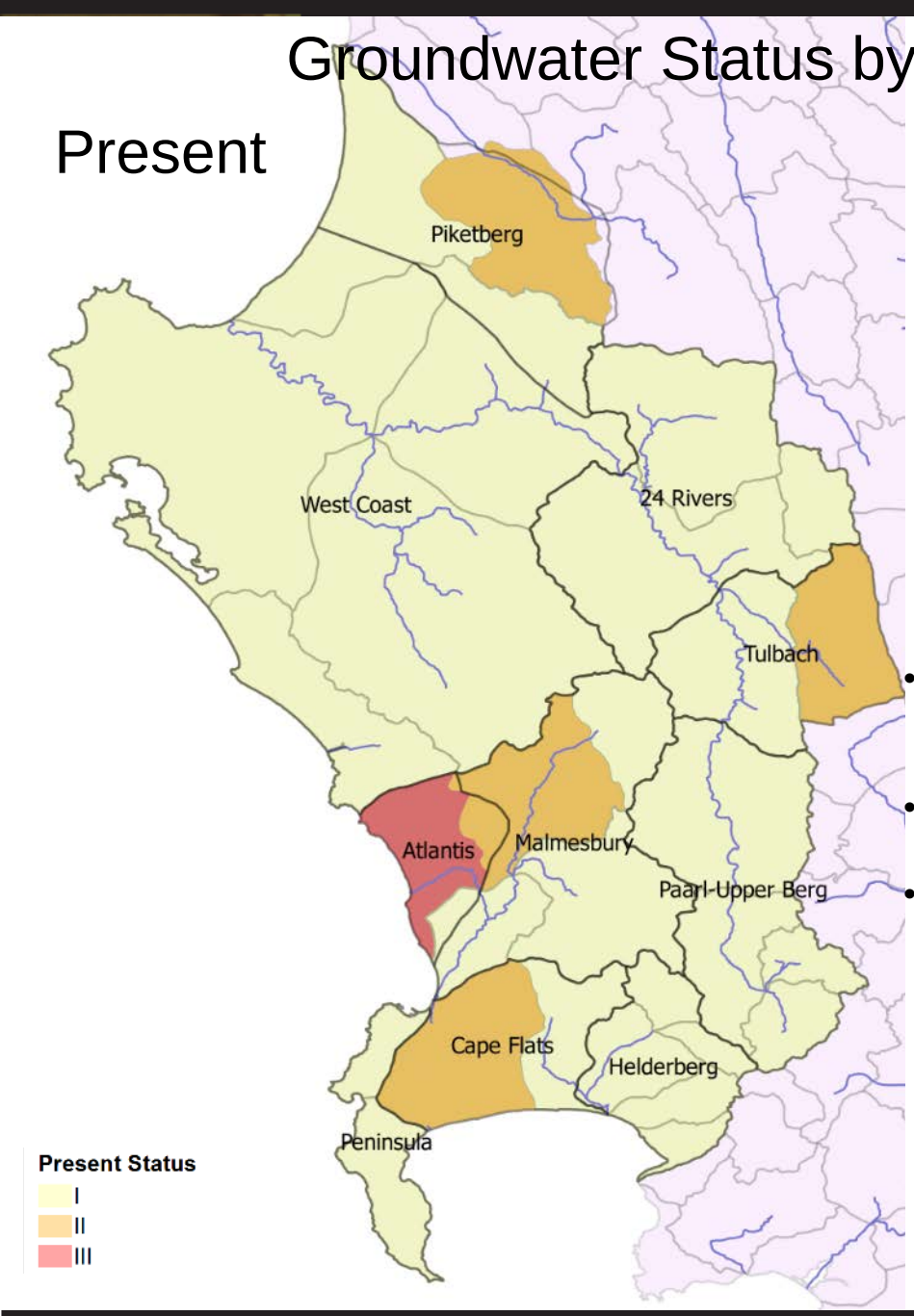
- Definition for groundwater status relates to alteration from pre-development state: informed by use/recharge ('stress') ratio
- Level of 'stress' used to determine the resulting groundwater status per water resources classification scenario, resulting from increases in groundwater use for future development, or meeting surface water deficits

Groundwater Status Category		Generic Description	Use/ Recharge (Stress)
I	Minimally used	The water resource is minimally altered from its pre-development condition	≤20%
II	Moderately used	Localised low level impacts, but no negative effects apparent	20-65%
III	Heavily used	The water resource is significantly altered from its pre-development condition	>65%

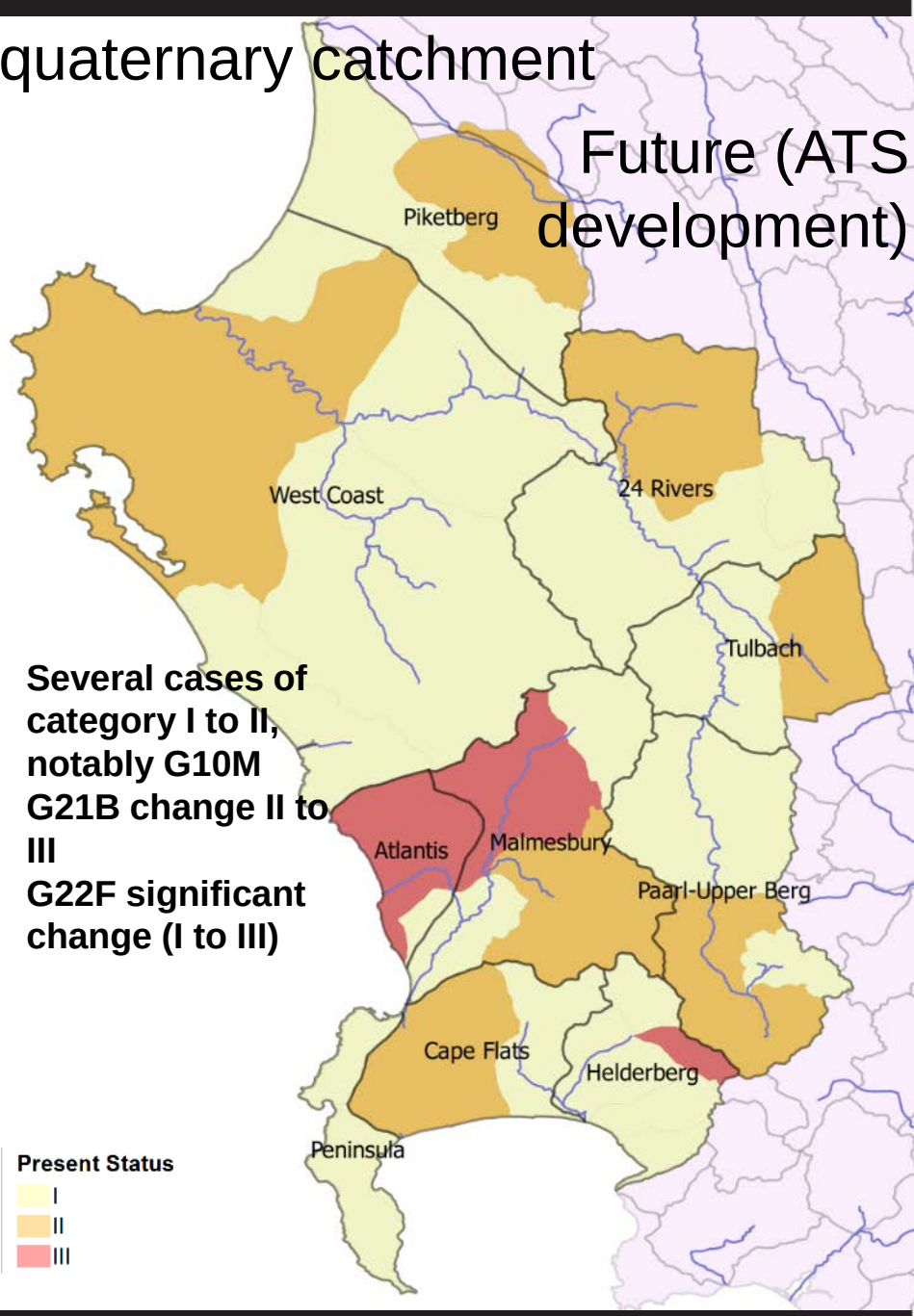
(modified from Dennis *et al*, 2013)

Groundwater Status by quaternary catchment

Present



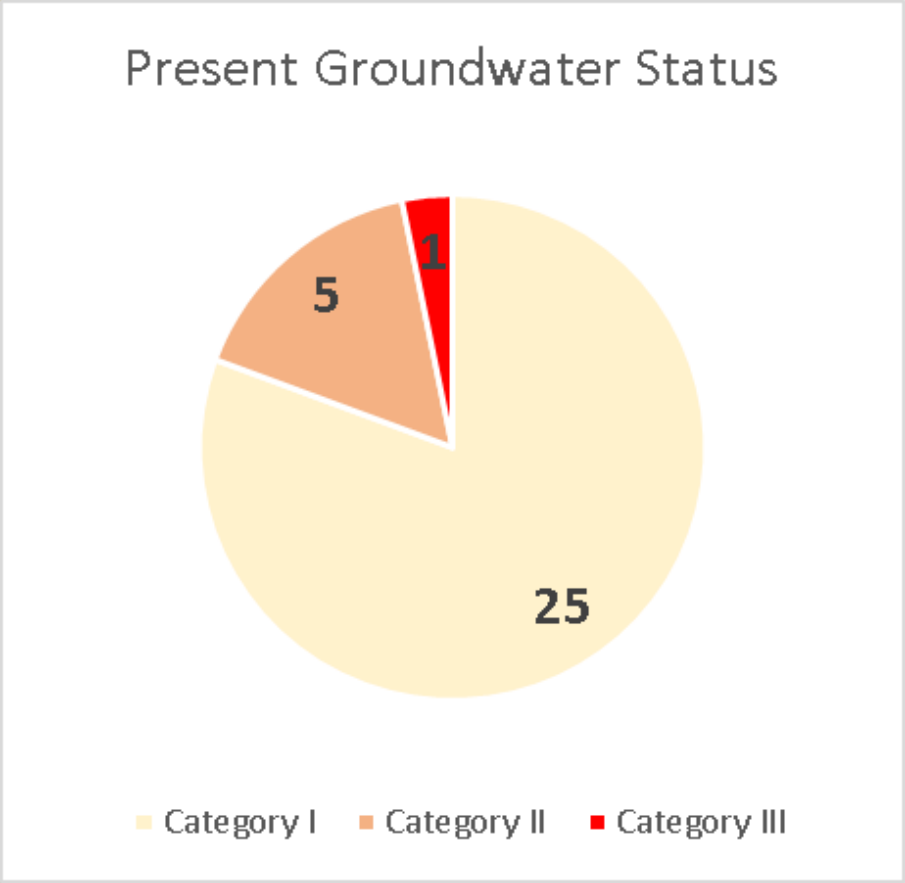
Future (ATS development)

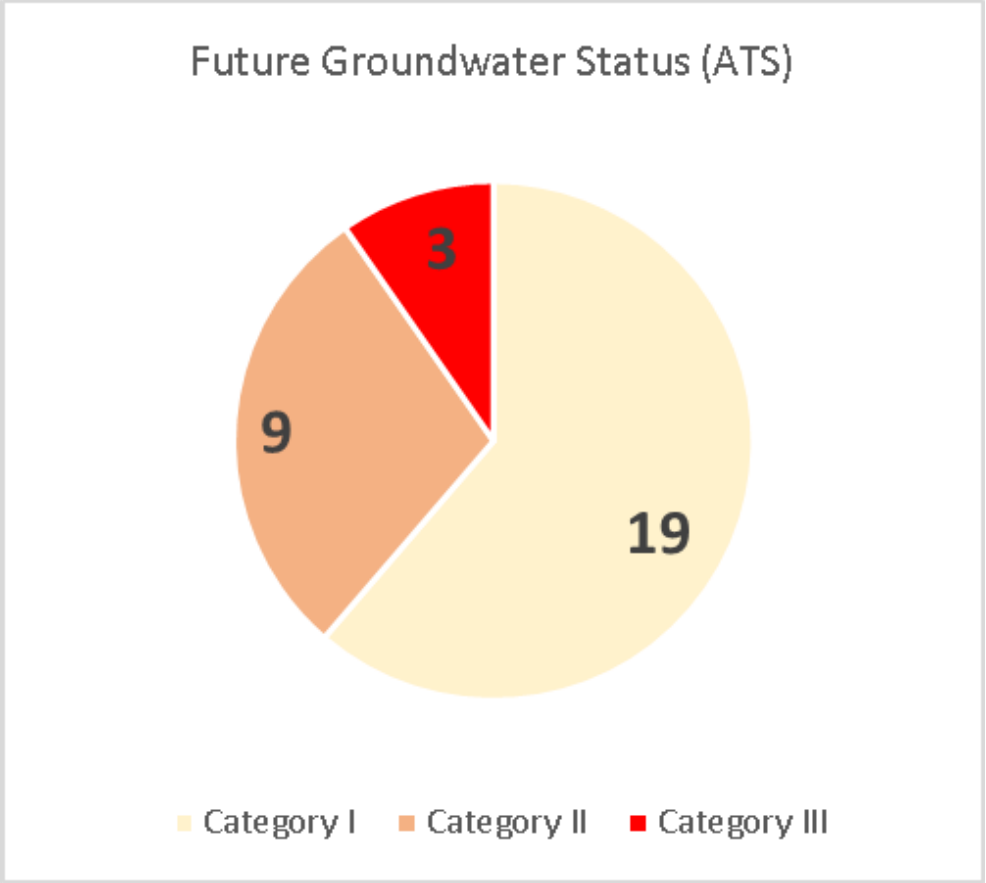


- **Several cases of category I to II, notably G10M**
- **G21B change II to III**
- **G22F significant change (I to III)**

Scenario consequences on groundwater condition

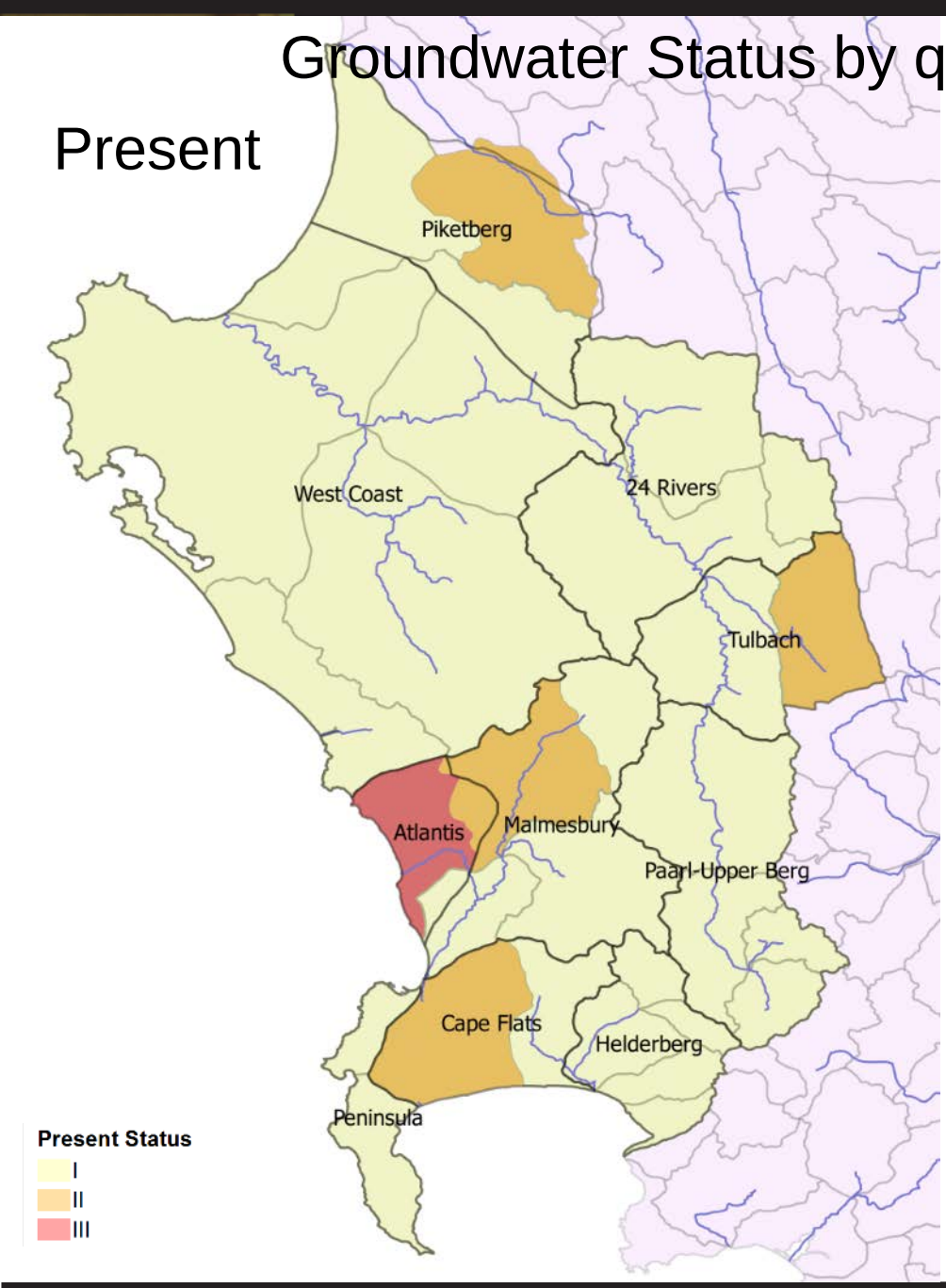
- Results: maximum impact of planned development according to All Towns water demand projections
- Groundwater use from 370 to 445 million m^3/a



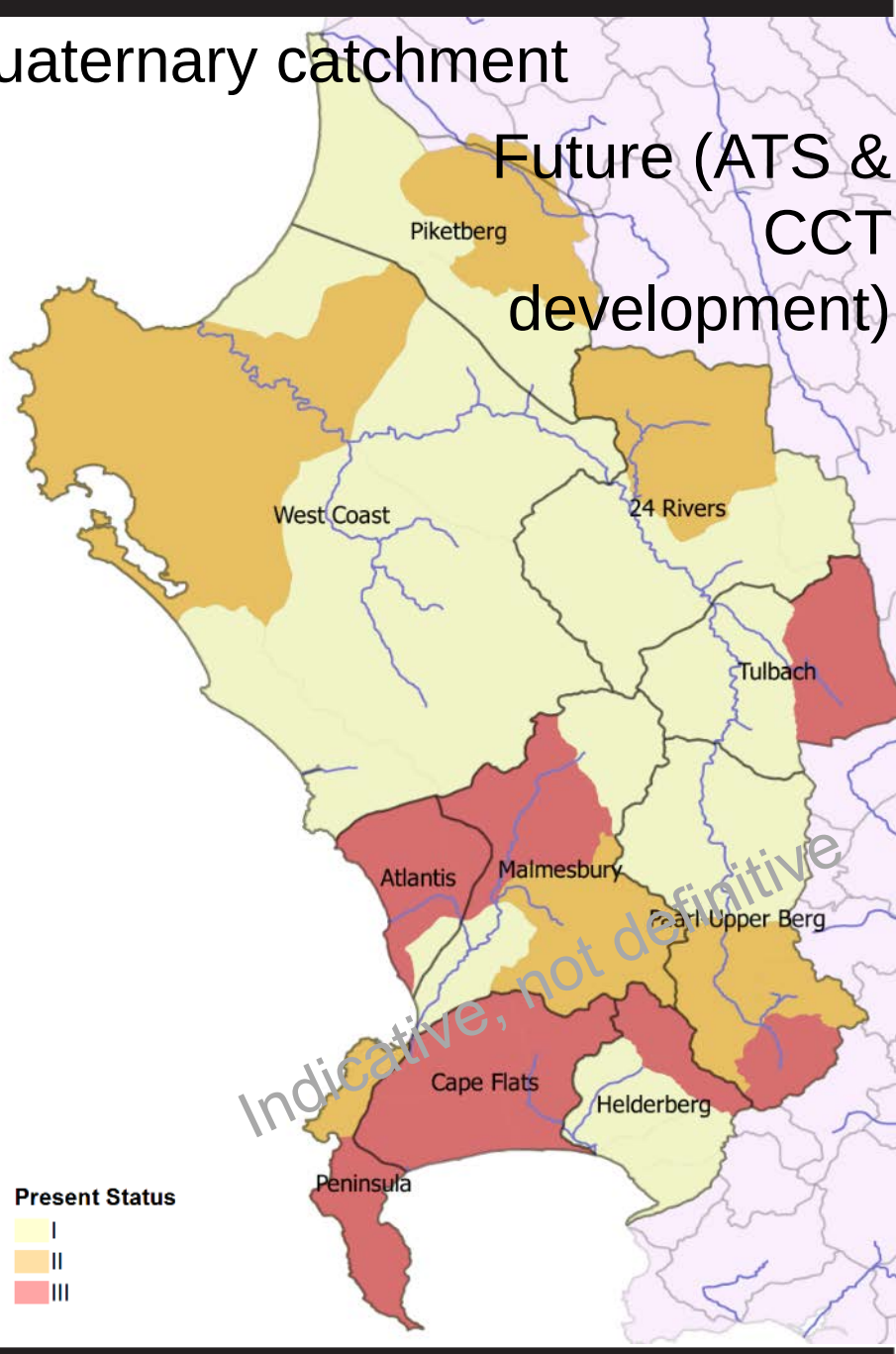


Groundwater Status by quaternary catchment

Present

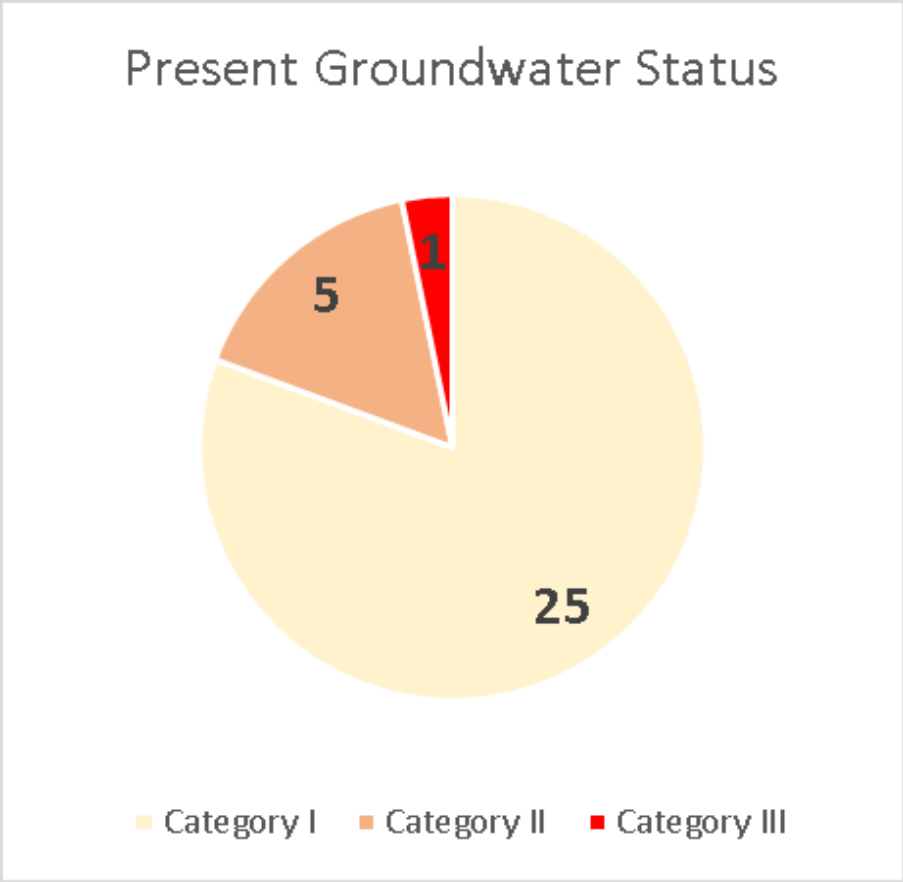


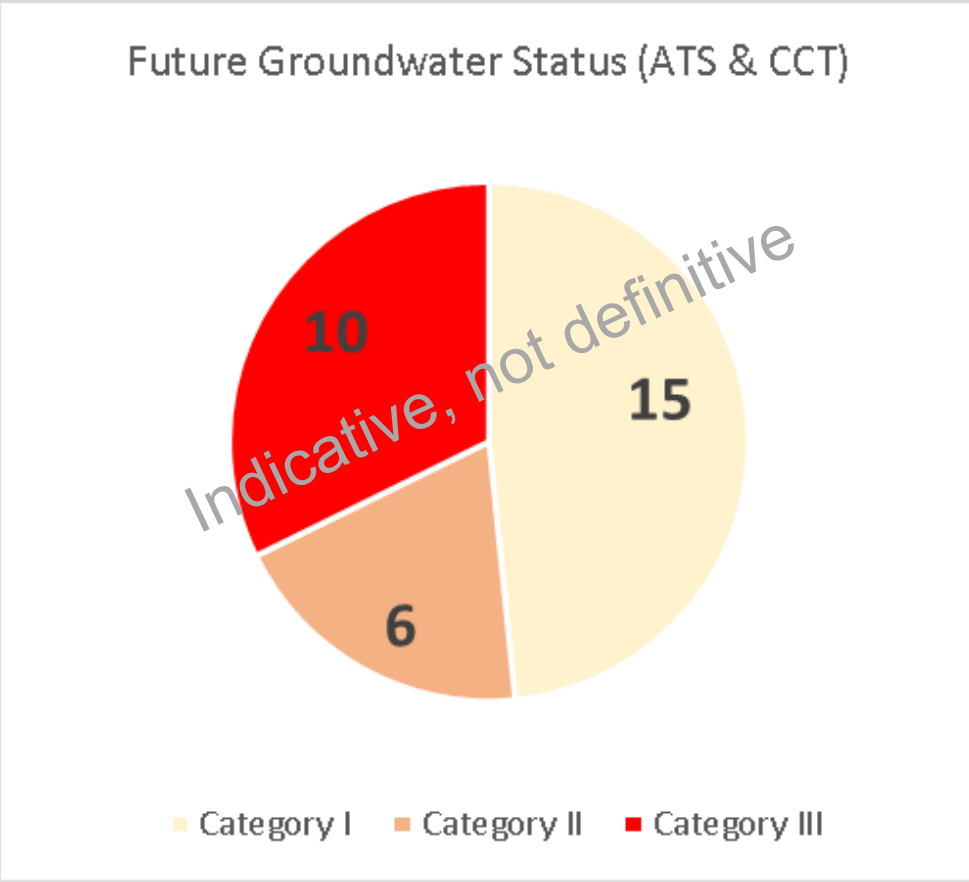
Future (ATS & CCT development)



Scenario consequences on groundwater condition

- Results: maximum impact of planned development according to All Towns water demand projections and CCT developments
- Groundwater use from 370 to 542 million m^3/a





Recommended Water Resource Classes

Determining the Water Resource Class

Description of the meaning for each Water Resource Class

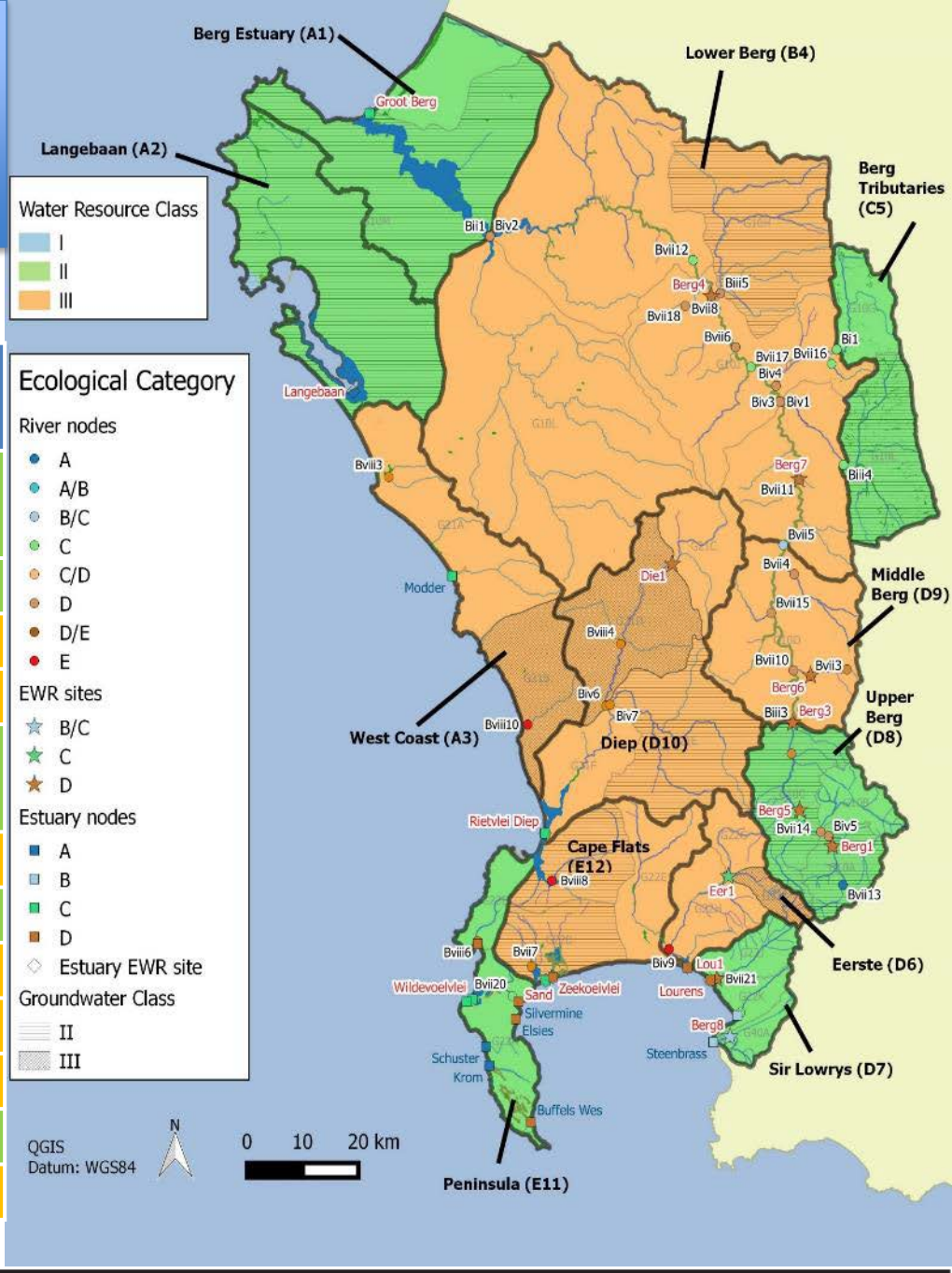
Water Resource Class	Description
Class I	Minimally used
Class II	Moderately used
Class III	Heavily used

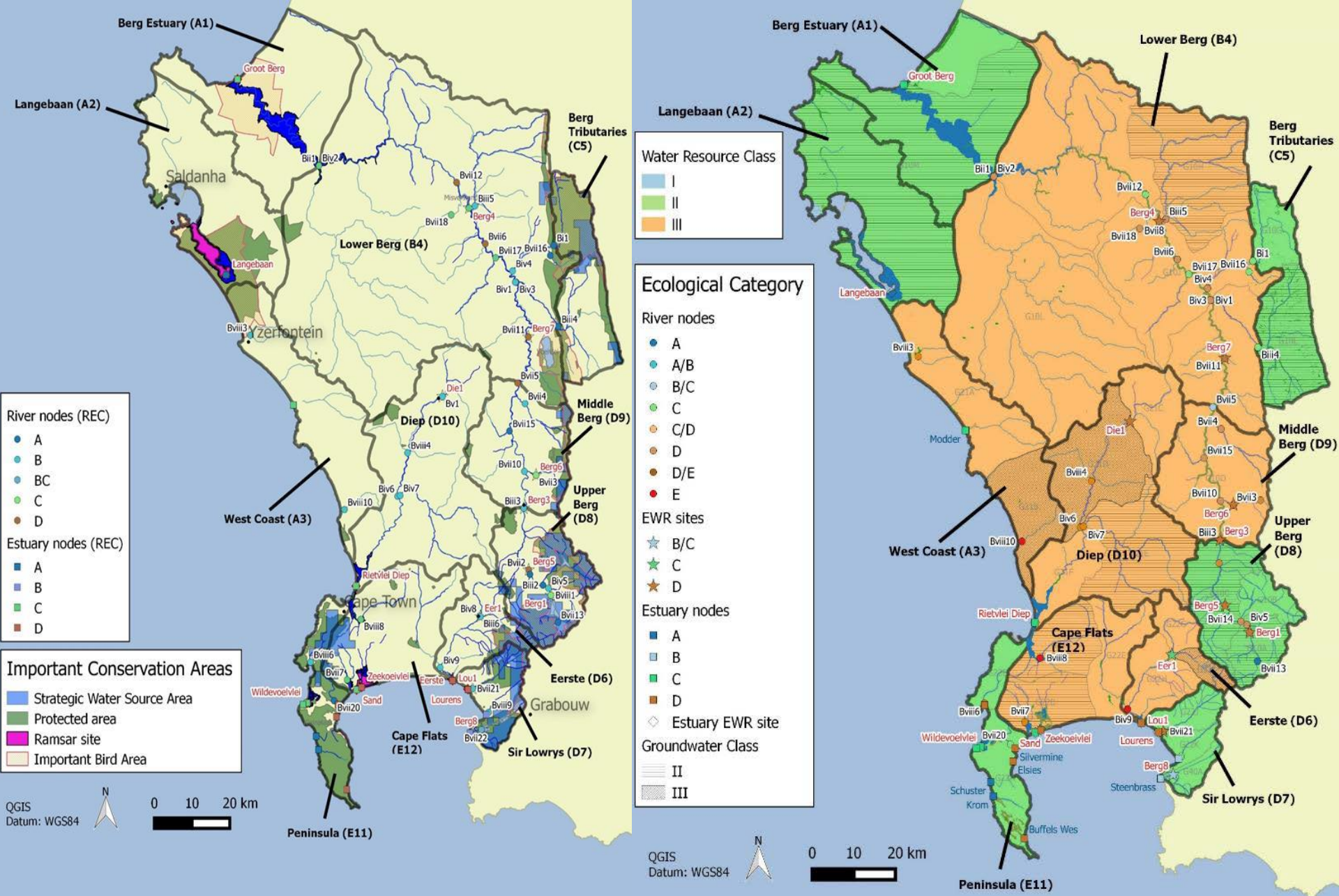
Guidelines for determining the IUA class based on ecological condition

	Percentage (%) of nodes in the IUA falling into the indicated groups				
	A or A/B	B or B/C	C or C/D	D	< D
Class I	60	40	20	1	-
Class II		60	30	5	-
Class III Either:			70	20	-

RECOMMENDED
Water Resource Classes for the Berg Catchment

IUA Name	IUA Code	Recommended Class
Berg Estuary	A1	II
Langebaan	A2	II
West Coast	A3	III
Lower Berg	B4	III
Berg Tributaries	C5	II
Eerste	D6	III
Sir Lowry's	D7	II
Upper Berg	D8	III
Middle Berg	D9	III
Diep	D10	III
Peninsula	E11	II
Cape Flats	E12	III





Management Considerations for Water Resource Classes

Determination of Resource Quality Objectives (RQOs)

Determining Resource Quality Objectives

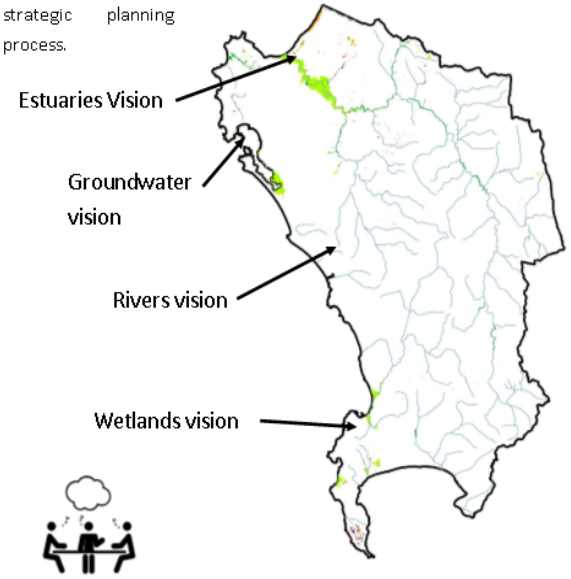
water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

STEP 1: DELINEATE CATCHMENT

Outcome: Integrated Units of Analysis and Resource units as defined in the Water Resource Classification System approach.

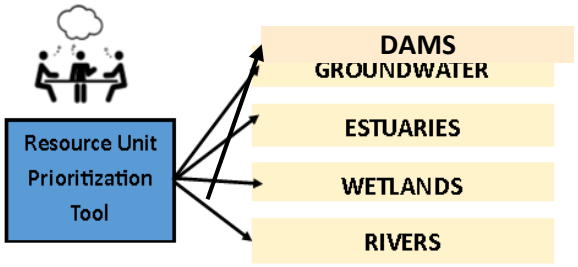
STEP 2: ESTABLISH VISION FOR CATCHMENT

Outcome: Align the diverse and competing interests in the resource into a collective desired future state. This involves multiple stakeholders in the strategic planning process.



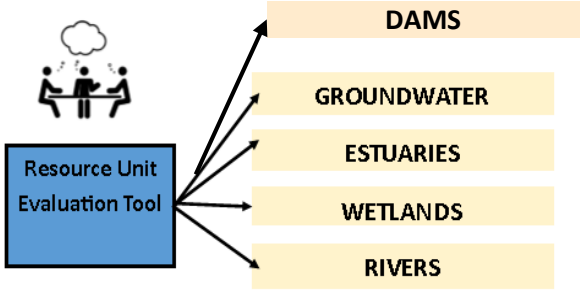
STEP 3: PRIORITISE & SELECT PRELIMINARY RESOURCE UNITS FOR RQO

Outcome: Use the resource unit prioritization tool to sect priority resource units.



STEP 4: PRIORITISE SUB-COMPONENTS FOR RQO & SELECT INDICATIORS FOR MONITORING

Outcome: Identify and prioritize sub-components that may be important to users or environment. Select sub-components and associated indicators for RQOs and Numerical Limits.



STEP 5: DEVELOP DRAFT RQOs & NUMERICAL LIMITS

Outcome: RQOs are essentially narrative but sometimes broadly quantitative descriptions of the resource. These are gazette, whilst Numerical Limits are not. These should be set for discussion with stakeholders.

STEP 6: AGREE RESOURCE UNITS, RQOs AND NUMERICAL LIMITS WITH STAKEHOLDERS

Outcome: .Stakeholders who were involved in the setting of the vision are involved in reviewing how their input has been considered and taken forward. Decide on Resource Units, RQOs and Numerical Limits.

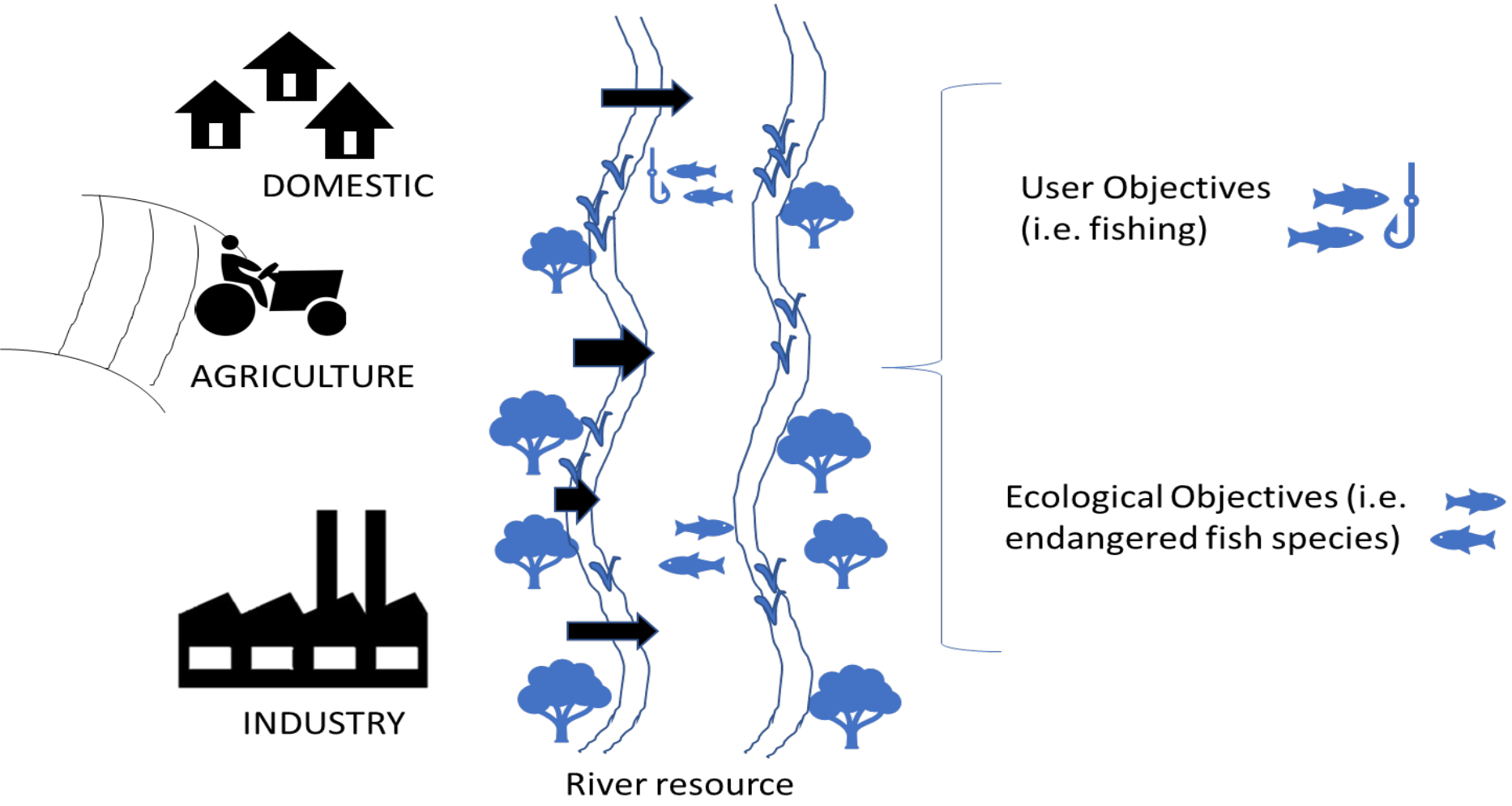
STEP 7: GAZETTE RESOURCE QUALITY OBJECTIVES

Outcome: A Water Resource Class configuration and associated RQOs for the entire catchment is published by the Minister in the Government Gazette as required in the National Water Act of 1998.

Resource Quality Objectives (RQOs)

Source Directed Control

Resource Quality Objective



Components of Resource Quality Objectives

- **Prioritised Resource Unit per IUA**
  - i.e. grouped areas e.g. river basins, deemed similar in terms of various characteristics
- **Target Ecological Category (TEC)**
  - Ecological Category taken forward from the proposed scenario
- **Component/Sub-component**
  - E.g. Quantity/Flow
- **Indicator**
  - Representation of trend tracking the measurable change in a system over time. Focuses on a small manageable set of information to get a sense of the "bigger picture"
- **Resource Quality Objective (RQO)**
  - Descriptive broad statements describing overall objectives for the Resource Unit
- **Numerical limit**
  - Quantitative descriptors of different components of the Resource Unit

Summary of Priority RUs

LEGEND

- Towns

Estuary

Prioritisation

- Yes

Dam

Prioritisation

- Yes

Groundwater

Prioritisation

- No
- Yes

River Nodes

Prioritisa

- Yes

Wetland

Prioritisation

- No
- Yes

- Rivers
- IUA Group Boundary

WQ RQOs to Limits and TPC

The water must be safe for me to swim in.

The water must be safe for recreational use

Narrative RQO
Maintain the river in a state that is **Ideal** for recreation water users.

Indicators
Escherichia coli
Faecal coliforms

User requirements

SA Recreation Water Quality Guidelines
Intermediate contact
E coli < 1000 cfu/100ml
Full contact
E coli < 130 cfu/100ml

I don't want to get sick when I canoe in the river

Vision Management class

Ecological requirements

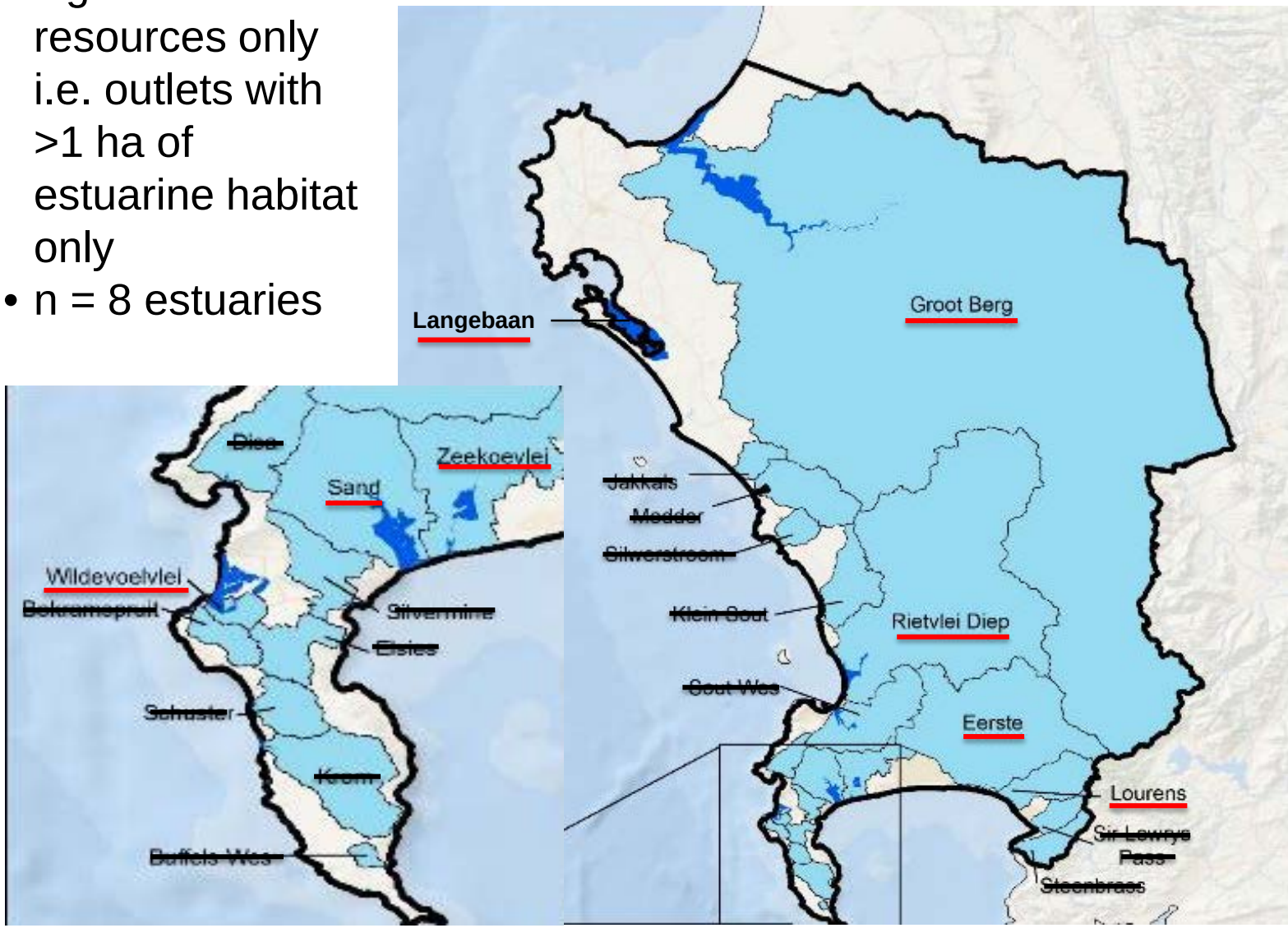
Numerical Limits
95% of the time < 130 cfu/100ml

Monitoring requirements

Reality check
Compare to present water quality

TPC (early warning)
100 cfu/100ml

- Classification of significant water resources only i.e. outlets with >1 ha of estuarine habitat only
- n = 8 estuaries



RU Evaluation for Estuaries

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
	System variables (temperature, salinity, oxygen, pH, turbidity)		
	Toxic substances		
	Pathogens		
HABITAT	Sedimentary processes	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
	Mouth state	Provides a score for the water quality condition.	Specifications for the state of the mouth
BIOTA	Fish	Estuaries are important as nursery areas for marine fish.	Community composition and abundance of fish
	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
	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	Chlorophylla
	Macrophytes	Macrophytes provide important habitat and food for other estuarine biota	% cover of indigenous aquatic macrophytes

Resource Unit Evaluation Tool (RUEV)

	Quantity		Hydro-dynamics		Quality							Physical habitat			Biota				
	Low Flows	High Flows (Floods)	Mouth Condition	Abiotic states	Salinity	Dissolved inorganic nitrogen	Dissolved inorganic phosphate	Water clarity	Dissolved oxygen	Toxic substances	Pathogens	Intertidal	Subtidal	Substrate type	Microalgae	Macrophytes	Invertebrates	Fish	Birds
Berg (Groot)	Y	Y	Y		Y	Y		Y	Y		Y				Y	Y	Y	Y	Y
Langebaan	Y	Y	Y		Y	Y		Y	Y		Y				Y	Y			Y
Rietvlei/ Diep	Y	Y	Y		Y	Y		Y	Y								Y	Y	Y
Wildevöelvlei	Y	Y	Y		Y	Y			Y						Y	Y	Y	Y	Y
Sand	Y	Y	Y		Y	Y		Y	Y		Y				Y	Y	Y	Y	Y
Zeekoe	Y	Y	Y		Y	Y		Y	Y		Y				Y	Y	Y	Y	Y
Eerste	Y	Y	Y		Y	Y		Y	Y		Y				Y	Y			Y
Lourens	Y	Y	Y		Y	Y		Y	Y		Y						Y	Y	Y

RQO Template for Estuaries

IUA	Node	Quat	REC		Current		Target	
			EC	%nMAR	PES	%nMAR	EC	%nMAR
A1-Berg estuary	Bxi1	G10M	B	57.0	C	50.0	C	57.0
TEC SPECIFICATIONS								
Flow	•							
Mouth condition and sedimentary processes	•							
Water quality	•							
Microalgae	•							
Macrophytes (plants)	•							
Invertebrates	•							
Fish	•							
Birds	•							
Additional (non-flow related) interventions to achieve the TEC:								
Source of information	DWAF (2003) Intermediate Determination of Resource Directed Measures for the Breede River Estuary							

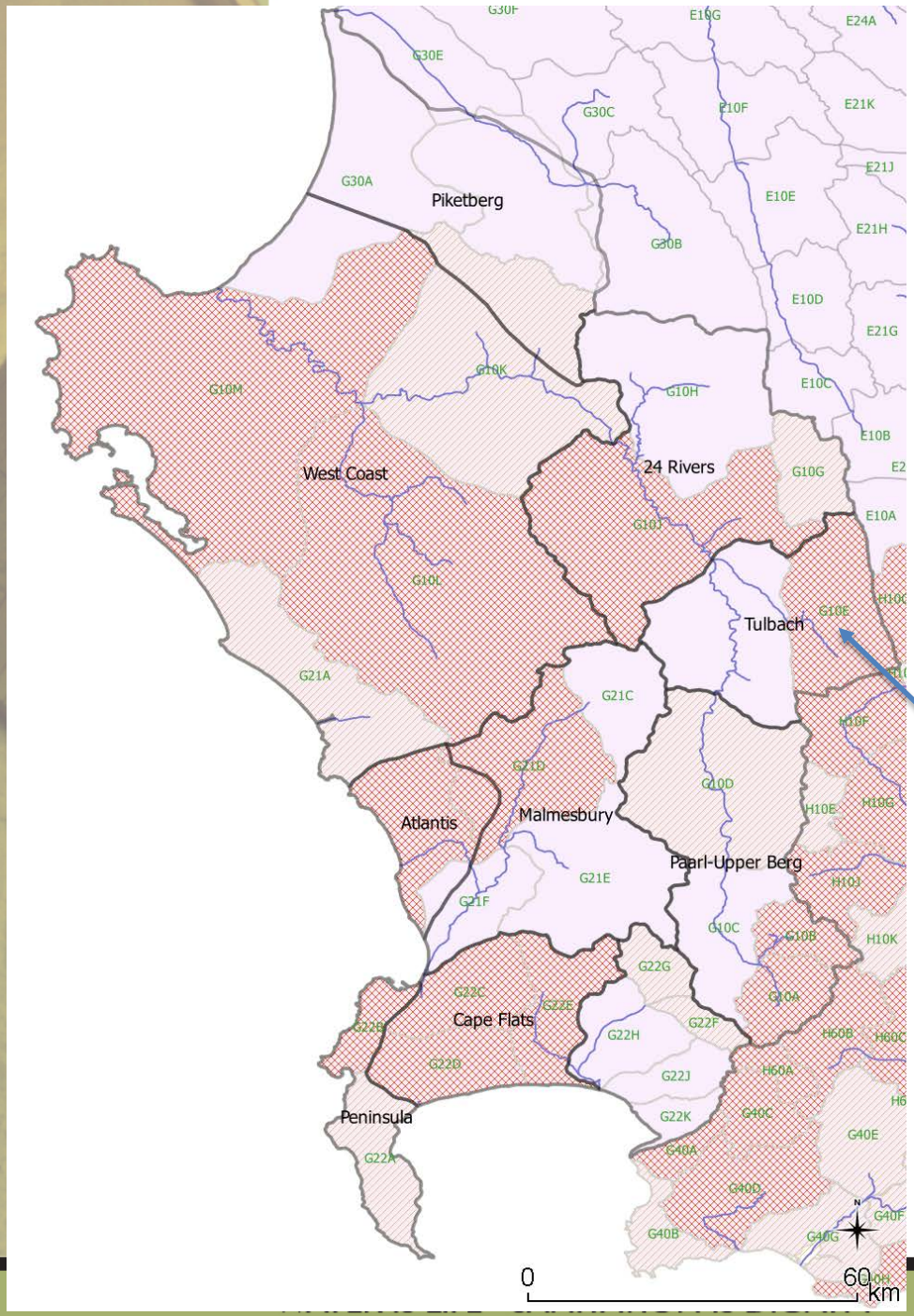
e.g. Berg

GW Prioritisation Criterion

- A set of criteria and sub-criteria were selected based on:
  - The framework for RU prioritisation (DWA, 2011)
  - Previous studies
  - **Applied to quaternary catchment scale, grouped together and handled per GRU in RQOs**

Criterion	Points (out of 100)
Importance for users	25
Level of surface water – groundwater interaction	30
Threat posed to users	30
Practical Considerations	15

Prioritisation result for GW



High priority resource unit (rated 3) for which RQOs are developed

Evaluation of Groundwater RUs

Component	Sub-Component	Indicator
Quantity	Abstraction	Water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles
	Groundwater level	Water level
	Discharge	Relative water levels between groundwater and surface water
	Low flow in river	Compliance with the lowflow requirements in the river
Quality	Nutrients	NO_3
	Salts	EC
	Pathogens	E-coli
	Pathogens	Total Coliform

2. Develop an RQO (objective-descriptive), and numerical limit per indicator (if possible)

1. Consider the relevant components / sub-components / Indicators in each prioritised RU

3. Per major aquifer, per prioritised quaternary (grouped per GRU)

Questions?