water & sanitation

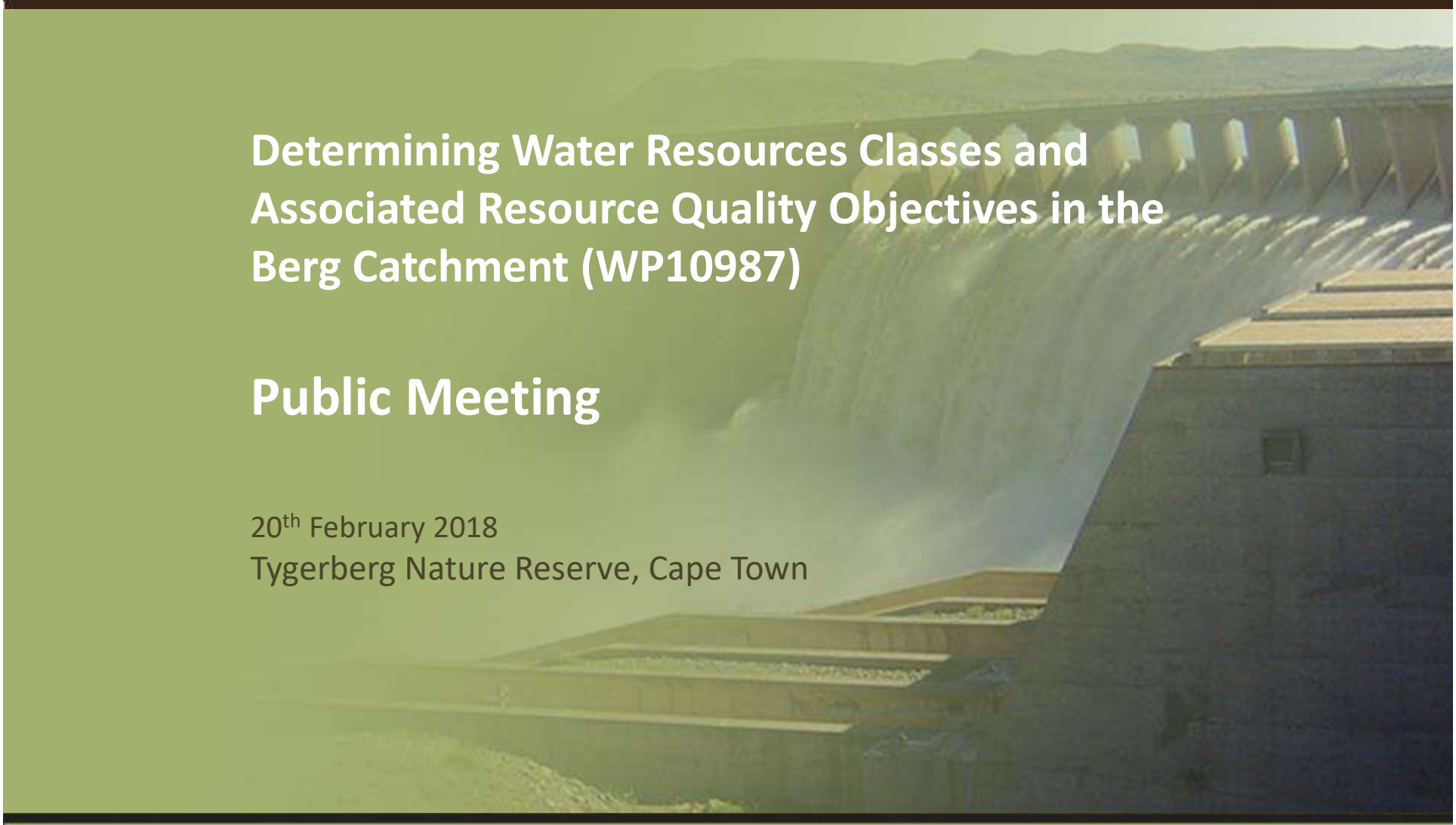
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

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

Public Meeting

20th February 2018
Tygerberg Nature Reserve, Cape Town



WATER IS LIFE, SANITATION IS DIGNITY

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

Overview of Study Processes followed

Stakeholder engagement

- 17th November 2016 (Paarl)
  - Public meeting
- 15th February 2017 (Bellville)
  - First Project Steering Committee (PSC) meeting
- 30th March 2017 (Cape Town)
  - First Technical Task Group (TTG) Meeting
- 26th February 2018 (Durbanville)
  - Second PSC meeting
- 30th -31st May 2018 (Durbanville)
  - Two TTG meetings
- 6th November 2018 (Paarl)
  - Third PSC meeting

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** → Completed
  - 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** ← WE ARE HERE
  - Final Report and Gazette template

Task 3: Determine Water Resource Class
Scenario analysis process

Resource Units (RUs) and Nodes

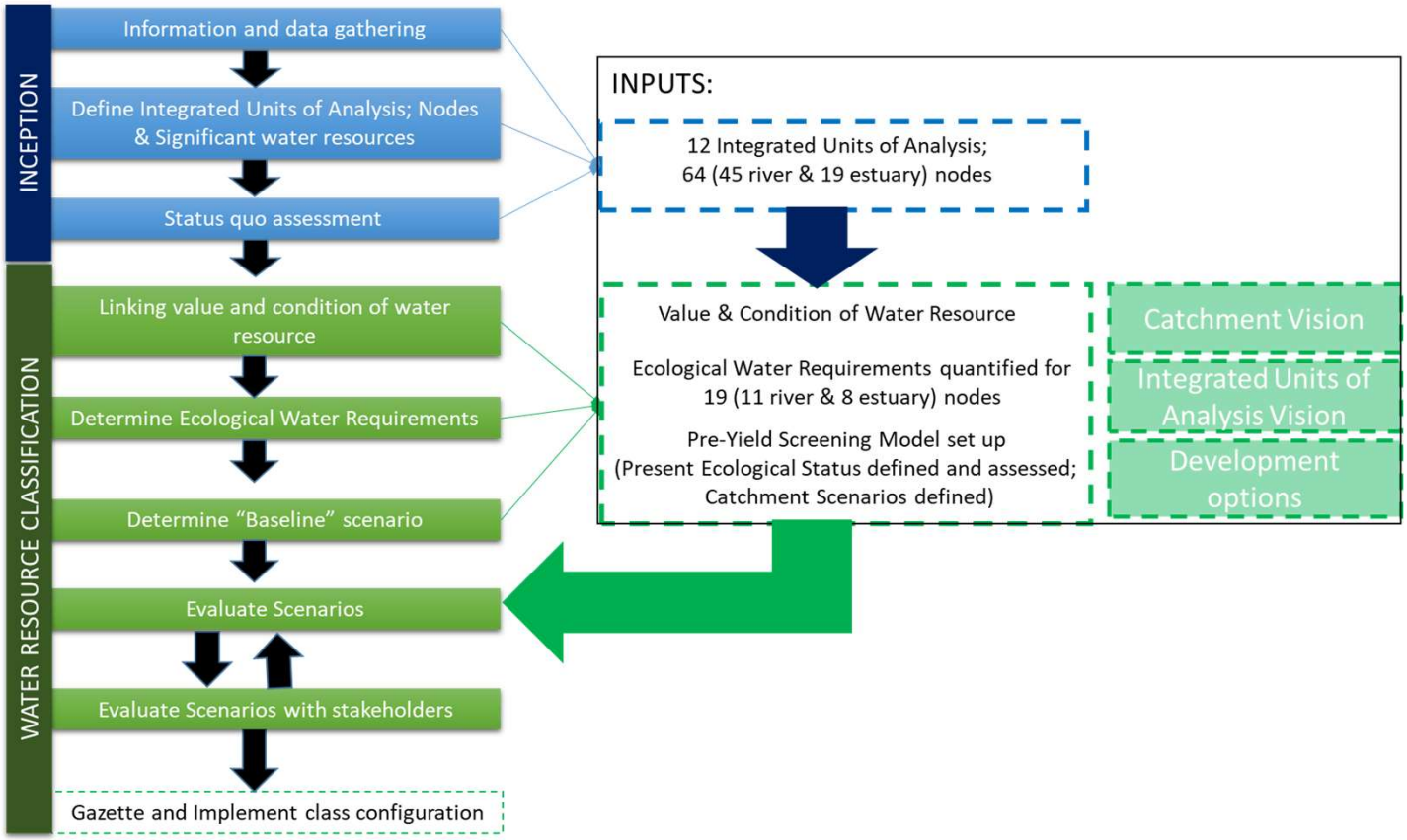
- **Resource units (RUs)** are grouped areas e.g. river basins, deemed similar in terms of various characteristics
- Are used to transfer information between catchments
- Groundwater

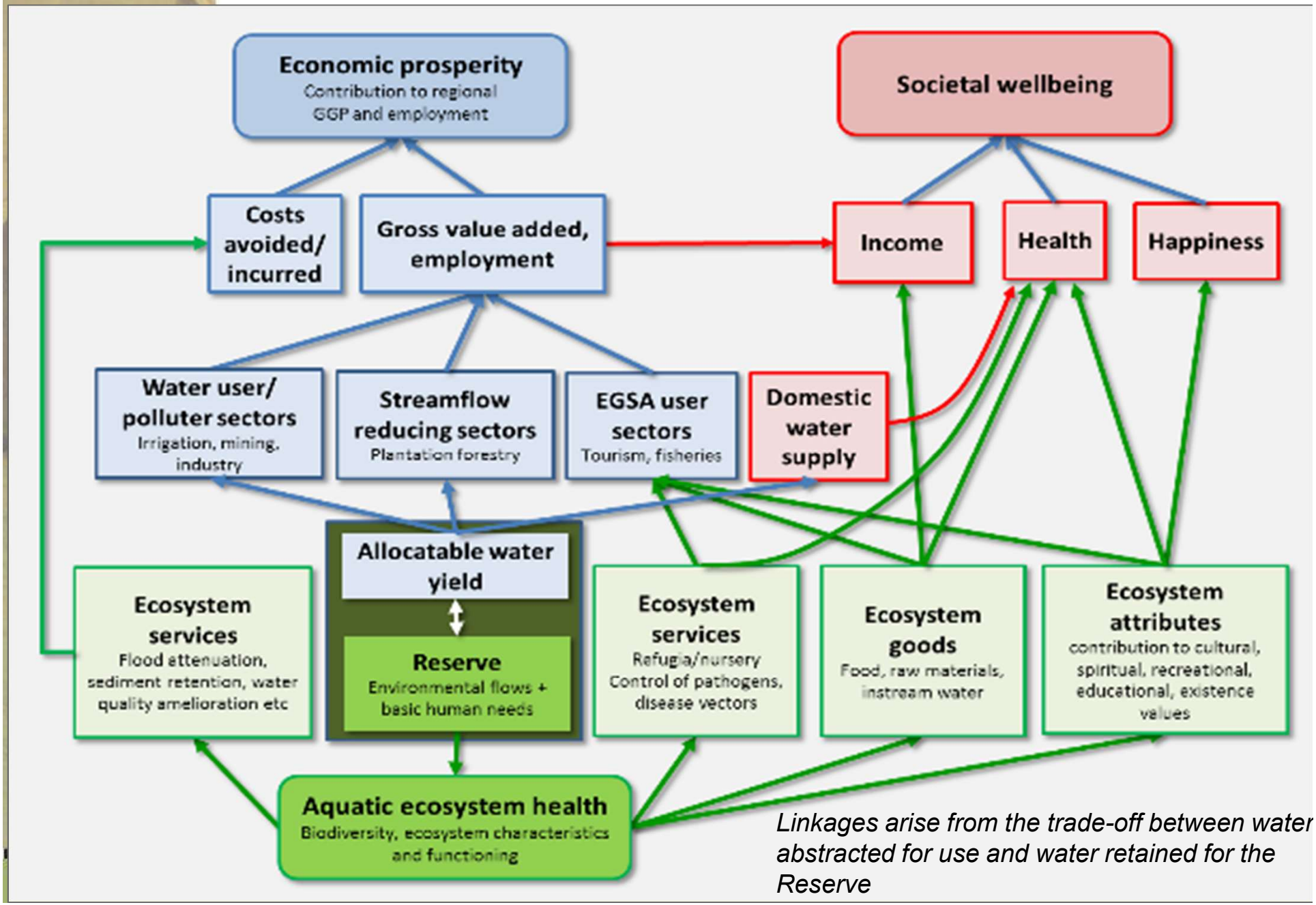
- **Nodes** are locations of interest (points) in a water resource (rivers, dams, wetlands, estuaries)
- Are sited using:
  - Water infrastructure
  - Aquatic ecosystem attributes
- Are used to allocate water for environment and development

Task 3: Determine Water Resource Class
Scenario analysis process

- Scenarios are possible future states of the WMA
- Evaluation was done for projected 2040 potential development.
- High growth in urban & industrial water demand, with implementation of planned schemes
- Urban & Industrial growth is met by augmentation

Task 3: Determine Water Resource Class
Data inputs for scenario assessment





Linkages arise from the trade-off between water abstracted for use and water retained for the Reserve

Task 3: Determine Water Resource Class
Scenarios evaluated

G1 and G2 catchments evaluated separately:

- G1 focused on the EWR impacts on the yield from WCWSS
- G2 focused on impacts on estuaries and wetlands
- Selected Groundwater scenarios considered separately

Scenarios considered:

- Ecologically Sustainable Base Configuration (ESBC)
- Present Ecological status (PES)
- Recommended Ecological Category (REC)
- Current and Future Developments
- Possible Impacts of Climate Change

Proposed water resource classes

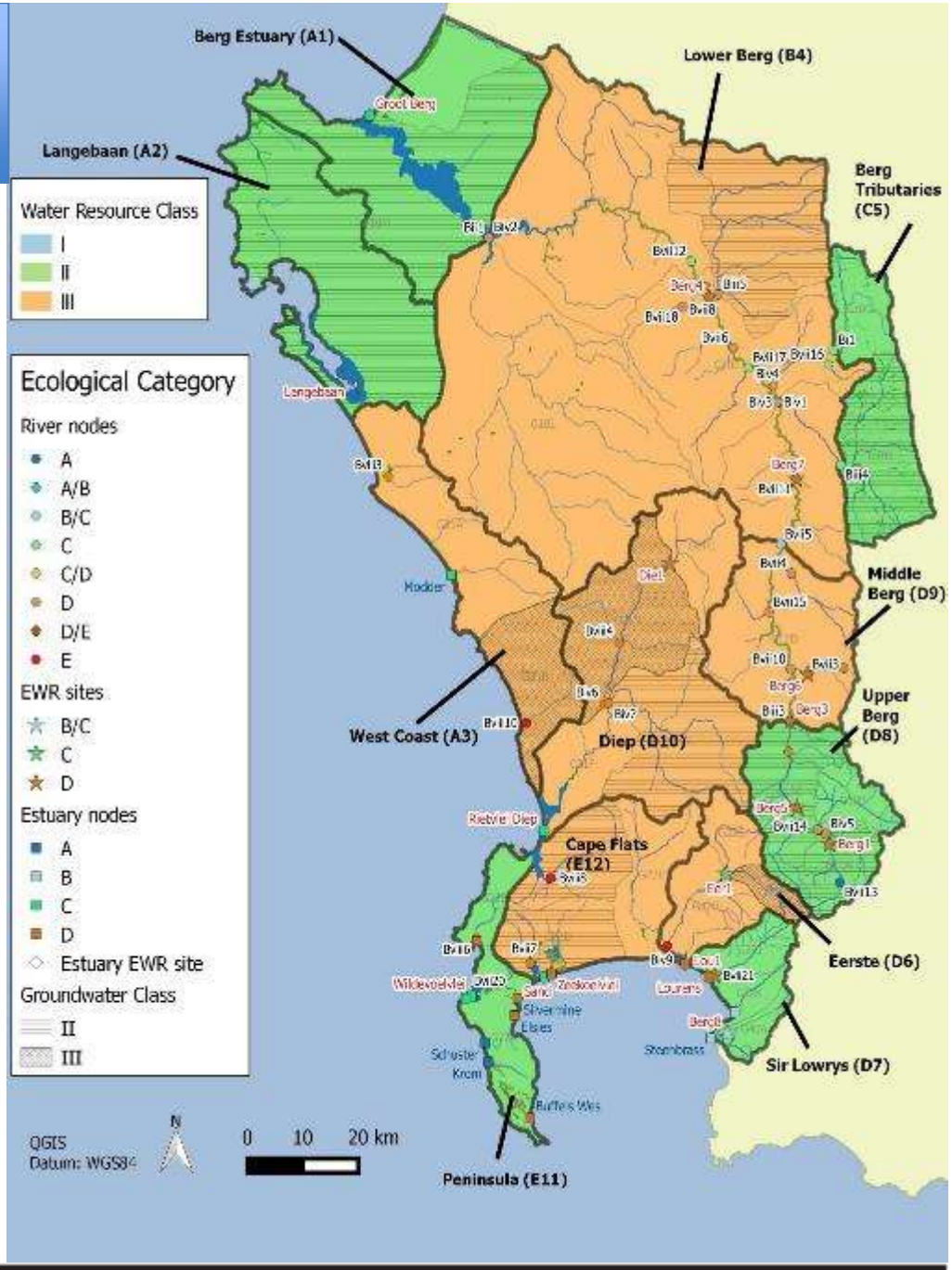
Task 3: Determine Water Resource Class
Recommended Ecological Condition

Proposed scenario

- The recommended water resource class is based on the REC scenario, but considering only the baseflow conditions as minimum with the flood EWRs being met on average and not necessarily every year.
- Best trade-off between the benefits of maintaining critical ecological systems, particularly key estuaries and the need to provide additional infrastructure to address any future water demands or shortfalls as a result of the recommended water resource class
- The impacts of this scenario are tested against future water demands only
- The recommended water resource class also takes into consideration Strategic Water Source Areas (SWSA).

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



Proposed RQOs

Task 4: Determine Resource Quality Objectives
Link between Classes & RQOs

Classification:

- Proposed Scenario
  (RUs with Targeted ECs (TECs) for water resources, per IUA class)

Resource Quality Objectives (RQOs):

- Resource Unit prioritisation
- Resource Unit evaluation
- Define RQOs & Numerical Limits
- Define Monitoring Program

Task 4: Determine Resource Quality Objectives
Evaluation of RUs - method

Customised DWS **RQO Tools are** used to prioritise RUs & then identify selected indicators *for prioritised RUs,* for which RQOs (descriptive and numerical) are written, by identifying:

Components

Quantity, Quality
Habitat, Biota

Sub-components

Indicators

Example of indicators: River Example

Component		Sub-Component	Indicator example
	QUANTITY	Flow	Water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles
	QUALITY	Nutrients	NO_3/NO_2
	HABITAT	Geomorphology	Sediment particle size (D_{50})
	BIOTA	Macroinvertebrates	SASS and ASPT scores

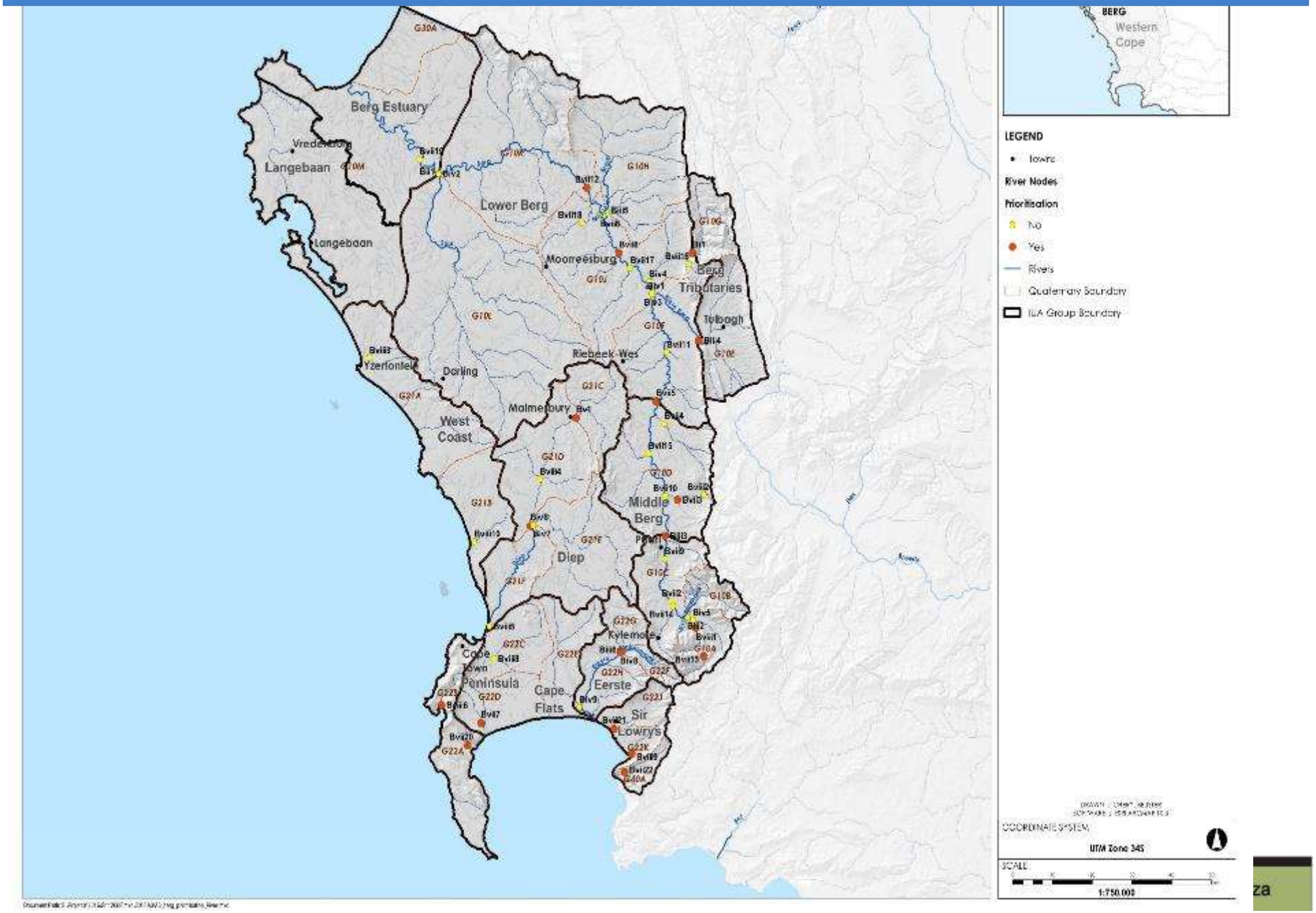
Rivers

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

River RQOs

- Detailed RQOs for 20 River RUs
- Hydrology and Ecological Category for all River RUs
- Table and maps indicating ecological infrastructure

High Priority River Nodes



EXAMPLE: Berg River u/s of Berg River Dam (Bvii13)

IUA	River	Node	Component	Sub-component	TEC	Indicator/ measure	RQO narrative	RQO numeric	TPC
D8 Upper Berg	Berg River	Bvii13	Quantity	Hydrology	A	Observed flow.	Flows sufficient to maintain the river in an A category.	Table 3-8	

Table 3-6 **Bvii13: Hydrology RQOs**

Source: DWS (2018)

Model: DRM (Hughes and Hannart 2003).

Monitor at: G1H076

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Desktop Version 2, Generated on 02/03/2017
Summary of Desktop (Version 2) estimate for Quaternary Catchment Area :
Total Runoff:            Bvii13
Annual Flows (Mill. cu. m or index values):
MAR                 =   84.848
S.Dev.              =   26.677
CV                  =    0.314
Q75                 =    0.980
Q75/MMF             =    0.139
BFI Index           =    0.351
CV(JJA+JFM) Index =      1.833

Ecological Category = A

Total IFR           =   41.016 (48.34 %MAR)
Maint. Lowflow      =   29.177 (34.39 %MAR)
Drought Lowflow     =    3.637 ( 4.29 %MAR)
Maint. Highflow     =   11.839 (13.95 %MAR)

Monthly Distributions (Mill. cu. m.)
Distribution Type : W.Cape(wet)
```

Month	Natural Flows			Modified Flows (IFR)			
				Low flows		High Flows	Total Flows
	Mean	SD	CV	Maint.	Drought	Maint.	Maint.
Oct	5.006	3.762	0.751	3.209	0.000	0.440	3.649
Nov	2.415	1.778	0.736	2.041	0.000	0.073	2.115
Dec	1.429	1.715	1.201	1.149	0.000	0.000	1.149
Jan	1.065	1.473	1.384	0.771	0.000	0.000	0.771
Feb	1.035	1.416	1.368	0.640	0.000	0.000	0.640
Mar	1.528	1.820	1.191	0.695	0.000	0.000	0.695
Apr	3.853	4.035	1.047	1.107	0.170	0.000	1.107
May	10.210	7.126	0.698	2.328	0.429	2.022	4.350
Jun	16.035	10.635	0.663	3.706	0.659	3.153	6.859
Jul	17.661	8.978	0.508	4.569	0.803	4.160	8.729
Aug	14.893	5.724	0.384	4.707	0.826	0.664	5.371
Sep	9.718	6.300	0.648	4.255	0.750	1.327	5.582

From 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

Vision Management class

Ecological requirements

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

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

Monitoring requirements

Reality check
Compare to present water quality

TPC (early warning)
100 cfu/100ml

EXAMPLE: Berg River u/s of Berg River Dam (Bvii13)

Component	Sub-component	TEC	Indicator/ measure	RQO narrative	RQO numeric	TPC
Quality	Nutrients	A	Phosphate (PO_4-P)	River nutrient levels must be maintained in an oligotrophic condition.	Median ≤ 0.025 mg/l PO_4-P	0.020 mg/l PO_4-P
			Total inorganic nitrogen (TIN)		Median ≤ 0.70 mg/l TIN	0.56 mg/l TIN
	Salts		Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that do not adversely affect aquatic ecosystems	95%tile ≤ 30 mS/m EC	24 mS/m EC
	System variables		pH	pH, temperature, and dissolved oxygen are important for the maintenance of ecosystem health.	5 ≥ pH ≤ 7	5.5 ≥ pH ≤ 6.5
			Water temperature		2°C difference from ambient water temperature	1.6 °C difference from ambient water temperature
			Dissolved oxygen		5%tile DO ≥ 8 mg/l	9.2 mg/l DO
	Pathogens		E coli	Concentrations of waterborne pathogens should be maintained in an Ideal category for full contact recreation.	95%tile ≤ 130 cfu/100ml E coli / Faecal coliforms	104 cfu/100ml E coli / Faecal coliforms

EXAMPLE: Berg River u/s of Berg River Dam (Bvii13)

Component	Sub-component	TEC	Indicator/ measure	RQO narrative	RQO numeric	TPC
Habitat	Geomorphology	A	GAI score -	Geomorphological condition	-	
			D_{50}	Sand particle size	$0.860 > D_{50} > 0.275$	$0.860 < D_{50} < 0.275$
	Riparian vegetation		VEGRAI level 3 score.	Vegetation condition	> 62% = C category	< 58% = D category
			Exotic species	Marginal zone cover abundance	No exotic plant species.	Exotic species present
			Terrestrial woody species		No terrestrial woody species.	Cover >5%
			Indigenous riparian woody species		Cover 5-25%.	Cover < 5%
			Non-woody indigenous species		Cover 25-50%.	Cover < 20%
			Reeds		No reeds	Reeds present
			Exotic species	Lower zone cover abundance	Cover < 5%.	Cover > 10%
			Terrestrial woody species		Cover < 10%.	Cover > 20%
			Indigenous riparian woody species		Cover 25-60%	Cover < 20%
			Non-woody indigenous species		Cover 25-50%	Cover < 20%
			Reeds		No reeds	Reeds present
			Exotic species	Upper zone cover abundance	Cover < 10%.	Cover > 20%
			Terrestrial woody species		Cover </= 15%.	Cover >30%
			Indigenous riparian woody species		Cover 25-50%	Cover < 20%
			Non-woody indigenous species		Cover 40-70%.	Cover < 30%

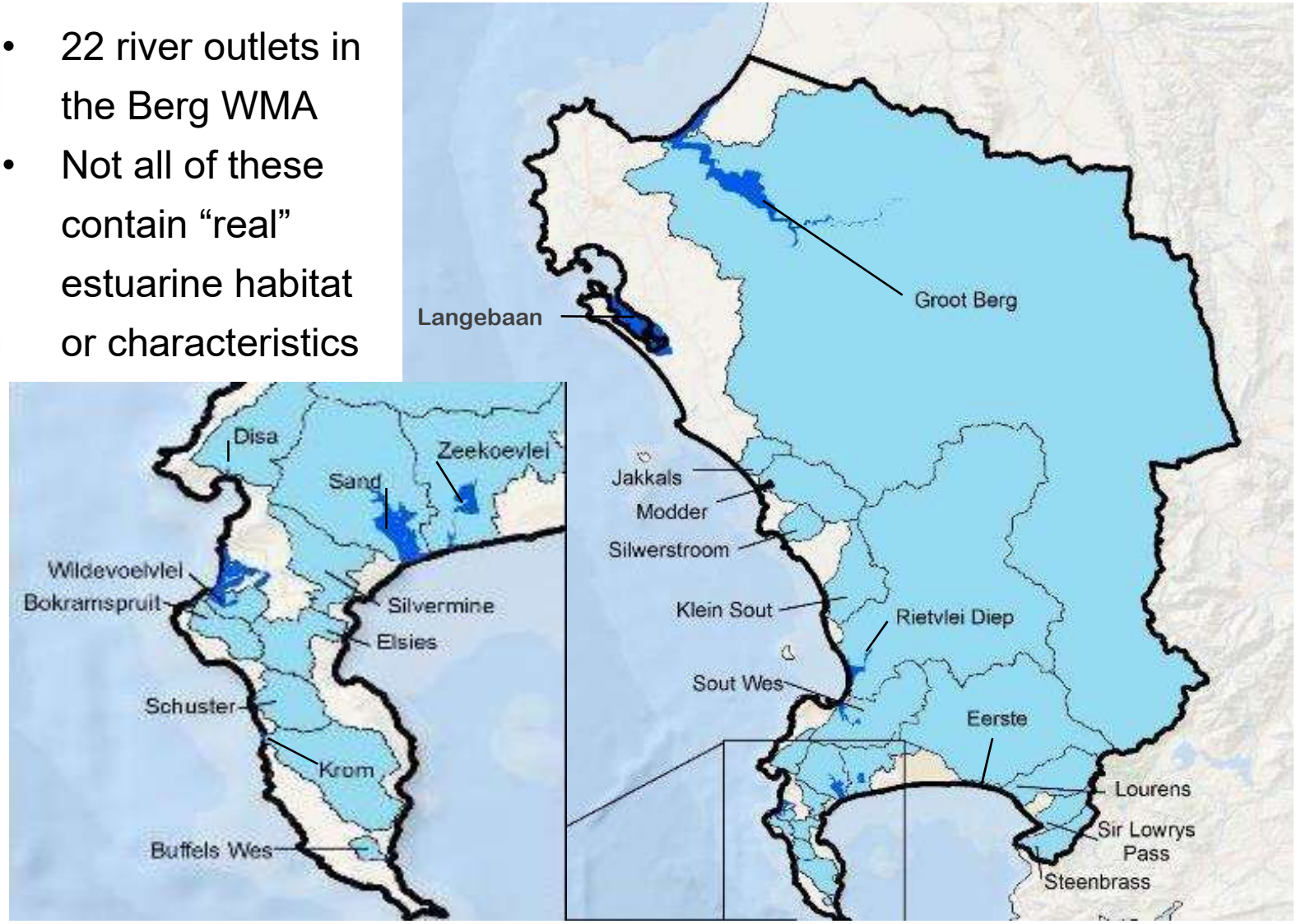
Component	Sub-component	TEC	Indicator/ measure	RQO narrative	RQO numeric	TPC
Biota	Fish	A	FRAI score	Fish condition	> 80% = B category	< 62% = C category
			Number of indigenous fish species.	Indigenous fish abundance	Three species present: *Sandelia capensis, Galaxia zebratus* and *Pseudobarbus burgi*	< 2 indigenous species
			Sandelia capensis		FROC = 5	*Sandelia capensis* absent for two consecutive surveys OR present at FROC of < 5.
			Galaxias zebratus		FROC = 5	*Galaxias zebratus* absent for two consecutive surveys OR present at FROC of < 5.
			Pseudobarbus burgi		FROC = 5	*Pseudobarbus burgi* absent for two consecutive surveys OR present at FROC of < 5.
			Exotic fish species		No increase in the number of exotic fish present: Onchorhyncus mykiss (FROC = 5)	More than 1 exotic fish species present.
			MIRAI score	Macroinvertebrate condition	> 78 % = B/C category	< 58% = C/D category
			SASS5 and ASPT score	SASS scores	SASS5 score >180, ASPT ≥ 7.2.	SASS5 scores < 162, ASPT < 6.5.
	Invertebrates		Number of families	Diversity of invertebrate community	>/= 23 families, at an abundance of A to C.	<20 families. Any taxon (adult) with an abundance of 1.

Estuaries

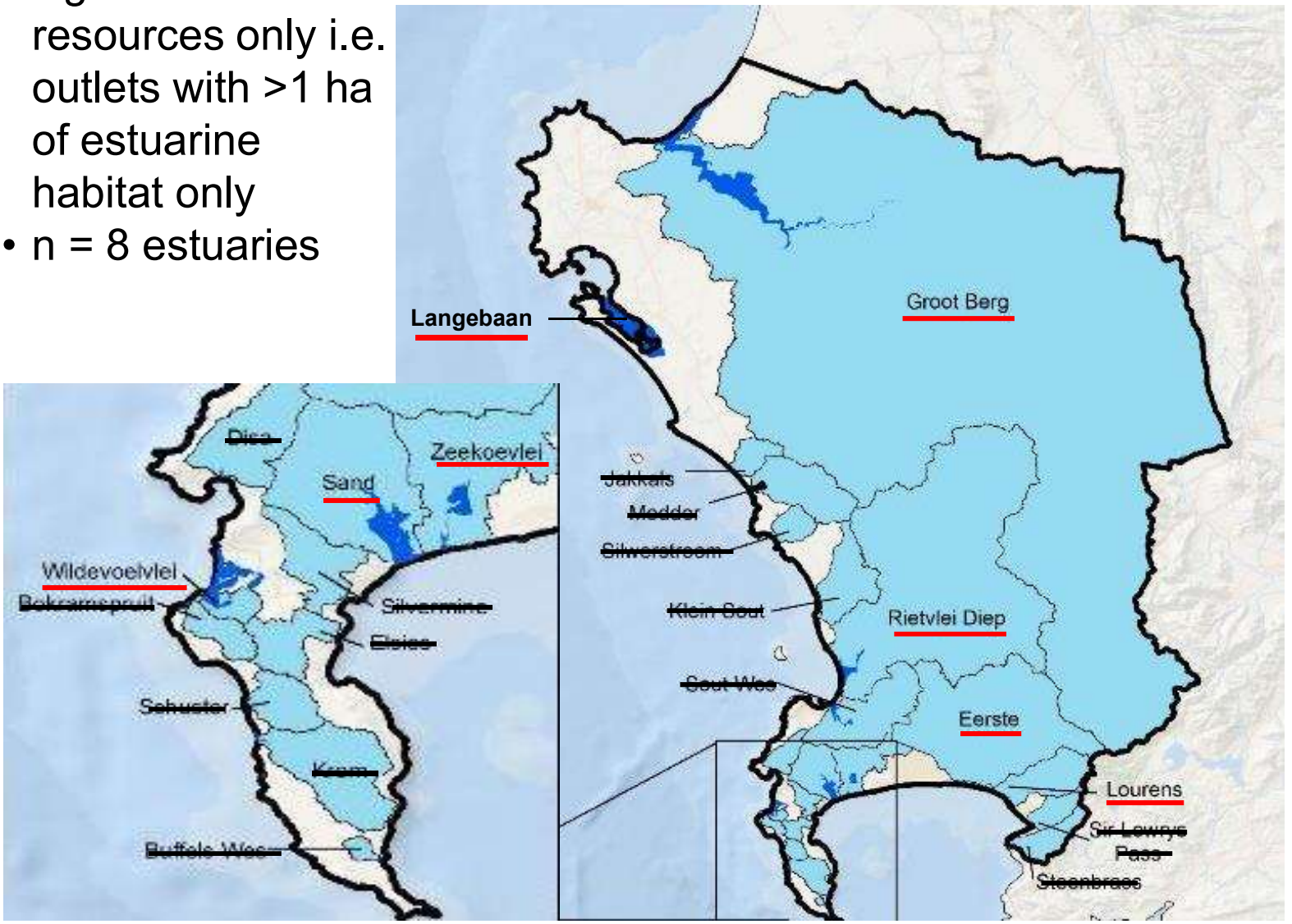
	Component	Sub-component
	QUANTITY	High flows
		Low flows
	WATER QUALITY	Nutrients
		Salts
		System variables (temperature, salinity, oxygen, pH, turbidity
		Pathogens
	HABITAT	Hydrodynamics
		Sediments
	BIOTA	Fish
		Invertebrates
		Micro-algae
		Macrophytes

Estuaries in the Berg Catchment

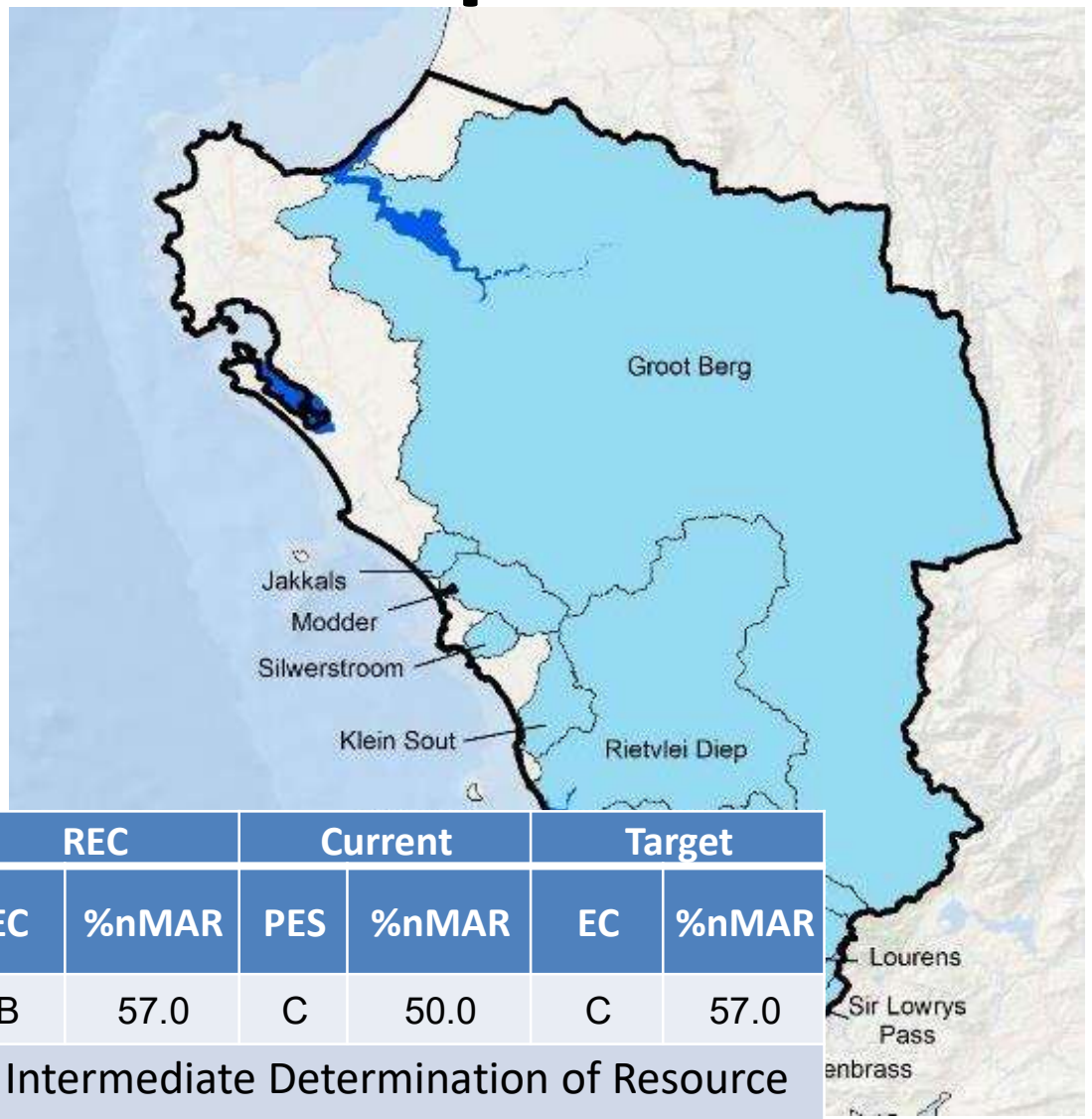
- 22 river outlets in the Berg WMA
- Not all of these contain “real” estuarine habitat or characteristics



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



Estuary RQO Template



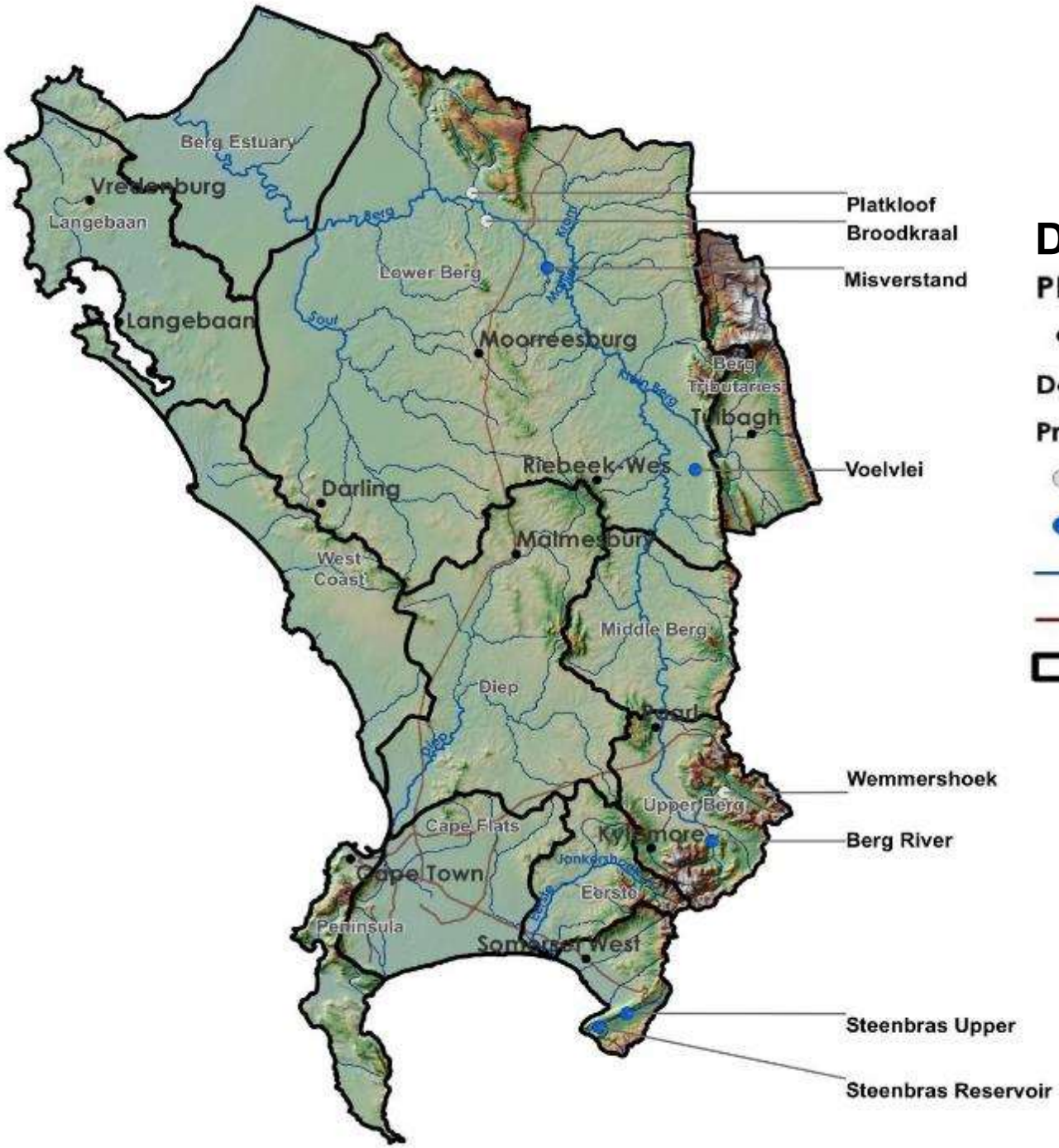
IUA	Node	Quat	REC		Current		Target	
			EC	%nMAR	PES	%nMAR	EC	%nMAR
A1-Berg estuary	Bxi1	G10M	B	57.0	C	50.0	C	57.0
Source of information	DWAF (2003) Intermediate Determination of Resource Directed Measures for the Breede River Estuary							

IUA	Class	Quat	RU	Resource Name	Biophysical Node Name	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numeric													
A1 Berg Estuary	II	G10M	A1-E01	Berg (Groot) Estuary	Bxi1	B	Quantity	Surface flow	Flow	River inflow should never drop below 0.6 m3.s^{-1} and should not below 1 m3.s^{-1} for longer than 4 months; Flood frequency Should not increase/decrease by more than 10% from 2004 baseline conditions	Months	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
											MMR/MAR (% Nat)	55	39	28	23	28	32	60	38	58	87	88	81	70
							Quality	Nutrients	DIN	Inorganic nutrient concentrations not to exceed TPCs for macrophytes and microalgae	Estuary (low flows < 1 m3.s-1, summer): DIN <300 µg/l; DRP <100 µg/l in Zones A and B, DIN <80 µg/l ; DRP <30 µg/l in Zones C and D													
									DIP		Estuary (high flows > 5 m3.s-1, winter): DIN <800 µg/l; DRP <60 µg/l in Zones A-D River inflow (< 1 m 3.s-1, summer): DIN <80 µg/l; DRP <20 µg/l River inflow (>5 m3.s-1, winter): DIN <800 µg/l; DRP <60 µg/l													
								Salinity	Salinity	Salinity distribution not to exceed TPCs for fish, invertebrates, macrophytes and microalgae	Salinity <20 for longer than 3 months at 20 km upstream from the mouth; Salinity <1 ppt above 40 km upstream of the mouth; Salinity of Salinity everywhere in estuary <35; Groundwater salinity on floodplain <45; TDS of river inflow <3500 mg/l													
								System variables	Temperature	System variables not to exceed TPCs for biota	"River inflow: 7 < pH > 8.5													
									pH		Estuary: 7 < pH > 8.5 "													
									Dissolved oxygen		"River inflow: DO >4 mg/l Estuary DO >4 mg/l"													
									Secchi depth															
								Pathogens	Enterococci	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	Zones A and B <1.0 m during low flow (< 1m3.s-1)													
									Escherichia coli		≤185 Enterococci/100 ml) (90th percentile, hazen system)													

IUA	Class	Quat	RU	Resource Name	Biophysical Node Name	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numeric
A1 Berg Estuary	II	G10M	A1-E01	Berg (Groot) Estuary	Bxi1	B	Habitat	Hydrodynamics	Mouth state	Habitat health adequate for microalgae, macrophytes, invertebrates, fish, birds and recreational use	Permanently open
									Tidal variation		<10% change from present state
								Sediments	Sediment characteristics, Channel shape/size		Bathymetry and sediment MdØ change <10% from baseline
							Biota	Microalgae	Biomass and community composition of phytoplankton and benthic microalgae community	Phytoplankton biomass and composition suitable for invertebrates, fish, birds and recreational use	Blue-green algae <10% of phytoplankton cell counts, Benthic microphytobenthic < 40 mg/m2 chlorophyll a, The frequency of dinoflagellates < 5% of the total phytoplankton counts

Dams

	Component	Sub-component
	QUANTITY	High flows
		Low flows
	WATER QUALITY	Nutrients
		Salts
		Pathogens
	BIOTA	Fish
		Phytoplankton



Dams

PRIORITISED RESOURCE UNITS

- Towns

Dams

Prioritisation

- No
- Yes
- Rivers
- Major Roads
- IUA Group Boundary

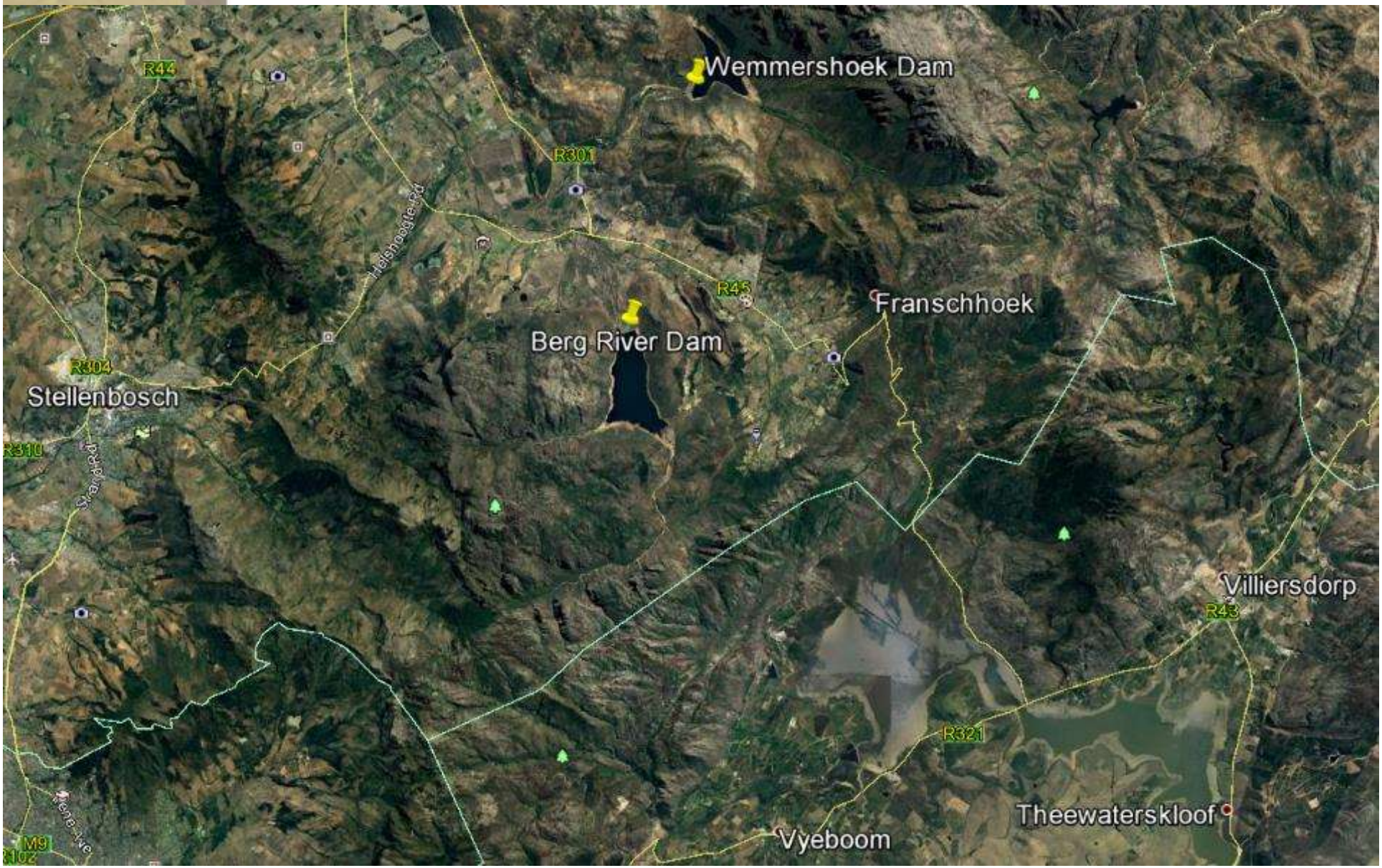
EXAMPLE: Berg River Dam

(IUA D8 Upper Berg)

- Located on the upper Berg River.
- Largely natural upstream of the dam.
- Key water supply dam in the Western Cape Water Supply System, providing urban water supply to the City of Cape Town.
- Transferred water for irrigation is released downstream, along with compensation releases for irrigation.
- Regulation: the dam is operated as in integral part of the WCWSS and the downstream Supplement Scheme, with transfers made to and from Theewaterskloof Dam.
- Berg EWR1 site located immediately downstream of the dam and upstream of the Franschhoek River junction.
- Outlet works able to make high flow release; 1:2 year flood
- EWR releases made according to DSS tool.

Resource Quality Objective

Berg River Dam (IUA D8 Upper Berg)



Resource Quality Objective

Berg River Dam (IUA D8 Upper Berg)

Sub-comp.	Rationale for sub-component choice	Indicator selection
Low flows (QUANTITY)	Dam levels must remain sufficient to provide for transfers and releases for irrigation, urban & industrial water use, as well as ecosystem function downstream. Water intake temperatures to be managed.	Dam levels EWR
High flows (QUANTITY)	During the wet season high flow ecological releases should be made according to the EWR decision-support system.	EWR
Nutrients (QUALITY)	The system must be maintained in a mesotrophic (moderately enriched) state or better to protect against nuisance algal blooms and excessive water treatment costs.	Ortho-phosphate, total inorganic nitrogen
Salts (QUALITY)	Salt levels must be maintained at concentrations where they do not impact negatively on the ecosystem, are maintained in an Ideal category for domestic and irrigation water supply.	Electrical conductivity
System variables (QUALITY)	The water in the dam is naturally acidic and it should be maintained within the historical range	pH
Fish (BIOTA)	The wellbeing of the fish community of Berg River Dam must be maintained in a suitable condition to contribute to, or not impact negatively on regional biodiversity. Consumption of fish must not pose a health risk to users.	Implementation of the Index of Reservoir Habitat Impairment (IRHI) by Miranda and Hunt (2011)
Phytoplank-ton (BIOTA)	The system must be maintained in a mesotrophic state or better.	Chlorophyll a

Resource Quality Objective

- Targeted Ecological Category (TEC) = Spatially Targeted Scenario, where info is available
- 6 high priority RUs in the Berg area
  - Evaluate present status and suitability of data
- For the selected sub-components and indicators of each dam:
  - **Write descriptive RQOs (narratives)**
  - **Set numerical limits**
  - **Set Thresholds of Potential Concern (TPCs)**

Quantity & Biota RQOs for Berg River Dam

Sub-comp.	RQO Narrative description	Indicator/ measure	Numerical limits	TPC
Low flows	During the dry season dam levels must be sufficient for releases for irrigation and human use and protection of ecosystem function downstream. Water intake temperature to be managed.	Flow releases: Berg EWR1 in G10A nMAR = 141.68 million m^3/a pMAR = 126.00 million m^3/a REC = C category	Berg EWR 1 site in upper Berg River – specified flows	Not applicable
High flows	During the wet season high flow ecological releases are made according to the decision-support system.			
Fish	The wellbeing of the fish community of Berg River Dam must be maintained in a suitable condition to contribute to, or not impact negatively on regional biodiversity.	Implementation of the Index of Reservoir Habitat Impairment (IRHI) by Miranda and Hunt (2011)	Habitat suitability and fish wellbeing (FRAI) in a state which is equivalent to a B or better ecological category.	Habitat suitability and fish wellbeing (FRAI) in a state worse than a B ecological category (low impairment).

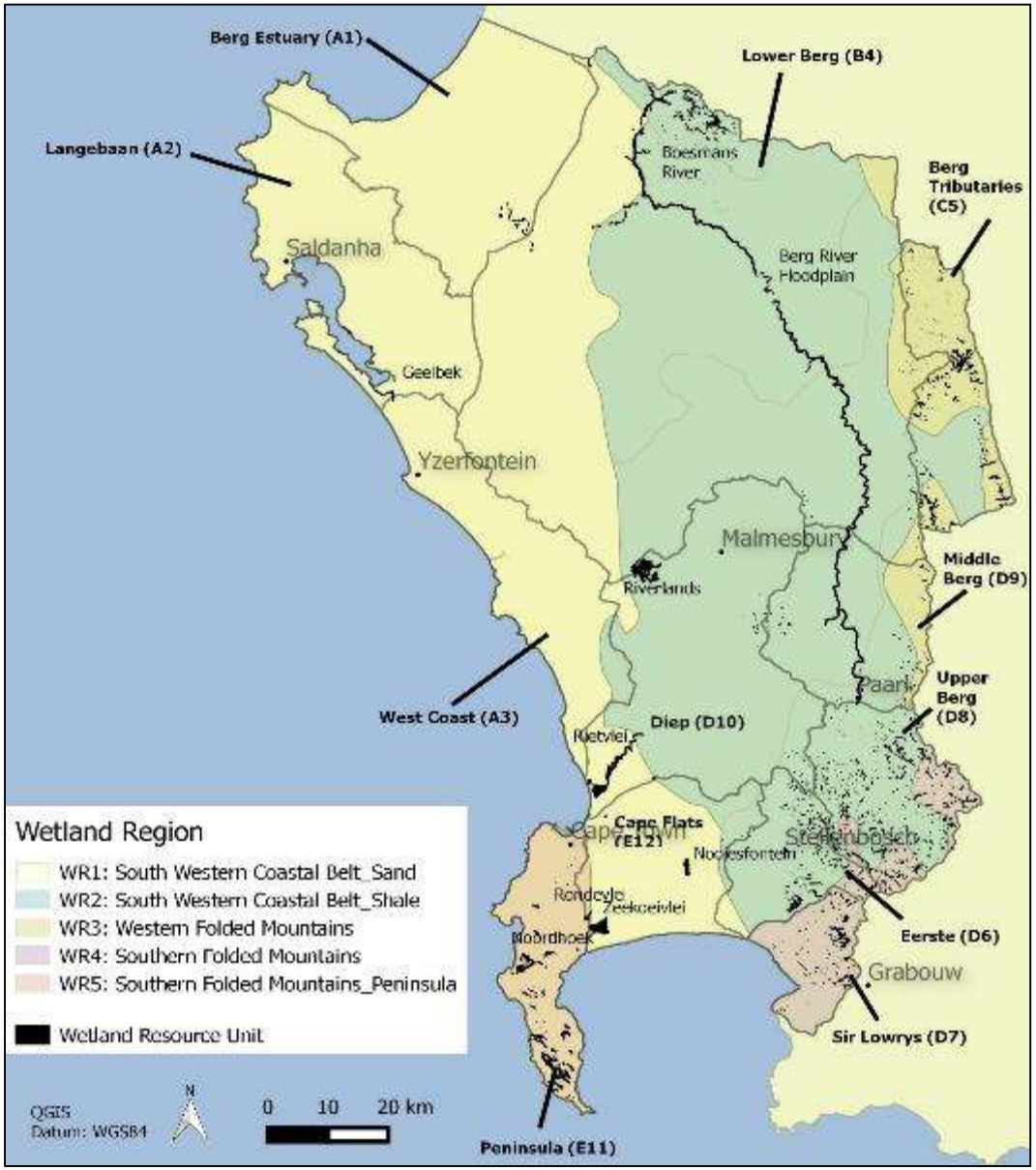
Quality RQOs for Berg River Dam

Sub-comp.	RQO Narrative description	Indicator	Numerical Limits	Threshold of Potential Concern	Present state (50/95%tile) G1H077Q01
Nutrients	The system must be maintained in a mesotrophic state or better	Ortho-phosphate (PO_4-P)	Median ≤ 0.015 mg/ℓ P	0.012 mg/ ℓ P	PO4 0.005 / 0.045
		Total inorganic nitrogen (TIN)	Median ≤ 0.70 mg/ℓ N	0.56 mg/ℓ N	TIN 0.162 / 0.25
Salts	Salt levels must be maintained at concentrations where they do not impact negatively on the ecosystem and are in an Ideal category for domestic water supply	Electrical conductivity	95th percentile ≤ 30 mS/m	24 mS/m	EC 5 / 7.5
System variables	Water is naturally acidic and it should be maintained within the historical range	pH	5.5 ≥ pH ≤ 7.5 (5^{th} & 95^{th} %tiles)	5 ≥ pH ≤ 8	No data
Phytoplanc ton	Maintain in a mesotrophic state or better	Chlorophyll a	Median ≤ 10 µg/ℓ Chl a	8 µg/ℓ	No data

Wetlands

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

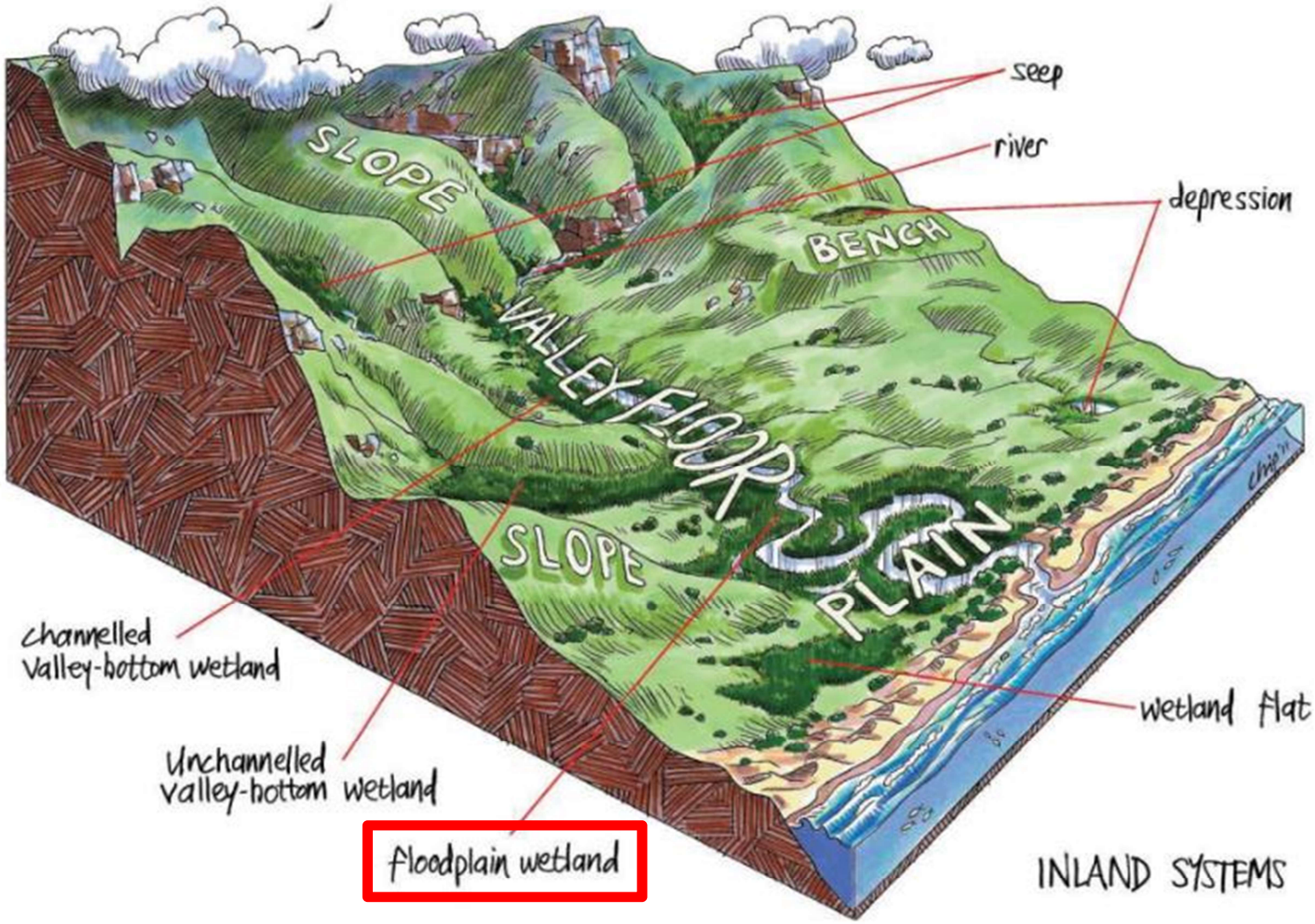
Resource Unit Prioritisation



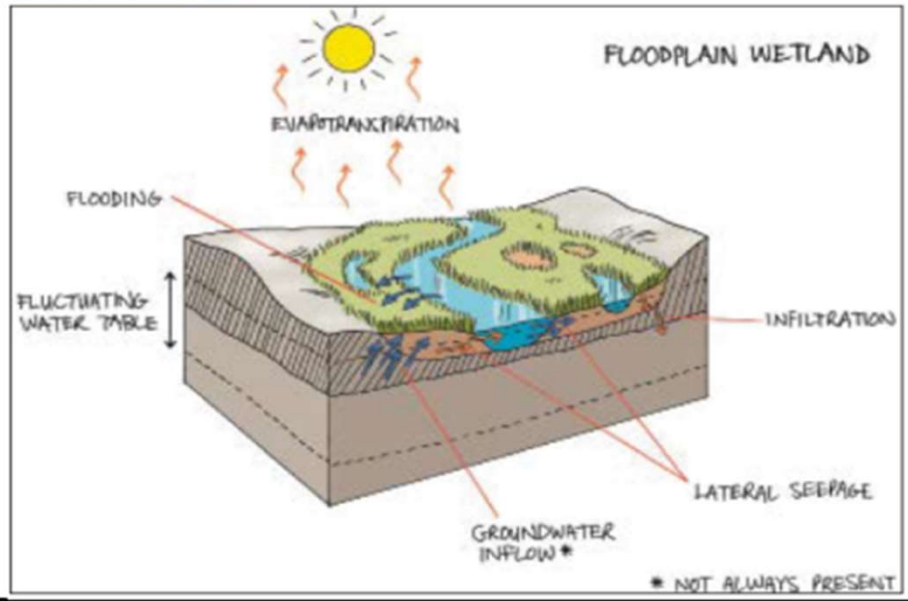
Drivers and Responders

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

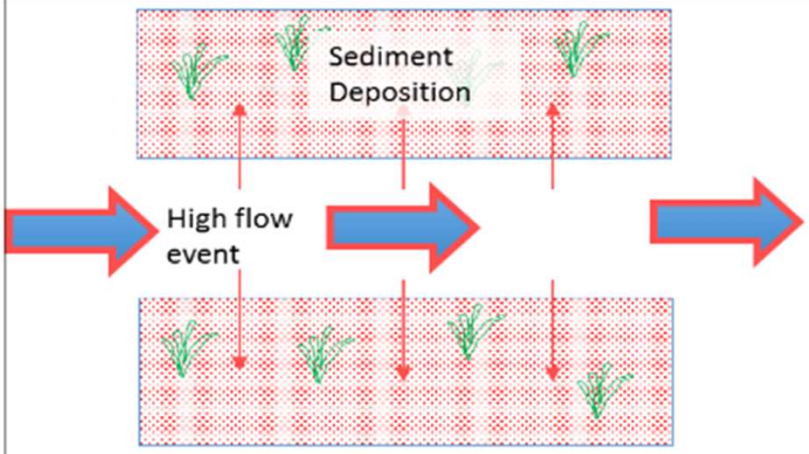
Wetland HGM type	Driver				Driver/ Responder	Responder		
	QUANTITY		HABITAT	WQ	HABITAT	BIOTA		
	Flow	Hydroperiod	Geomorphology	Water Quality	Vegetation	Benthic algae	Phytoplankton	Frogs
Floodplain	xx	xx	xx	x	x			x
Channelled Valley-Bottom		xx	xx	x	x			x
Unchanneled Valley-Bottom		xx	xx	x	x			x
Seep		xx	xx	x	x	xx		x
Depression		xx	xx	x	x	xx	xx	x
Flat		xx		x	xx	xx		x


seep
river
depression
SLOPE
BENCH
VALLEY FLOOR
PLAIN
SLOPE
channelled
valley-bottom wetland
Unchannelled
valley-bottom wetland
floodplain wetland
wetland flat
INLAND SYSTEMS

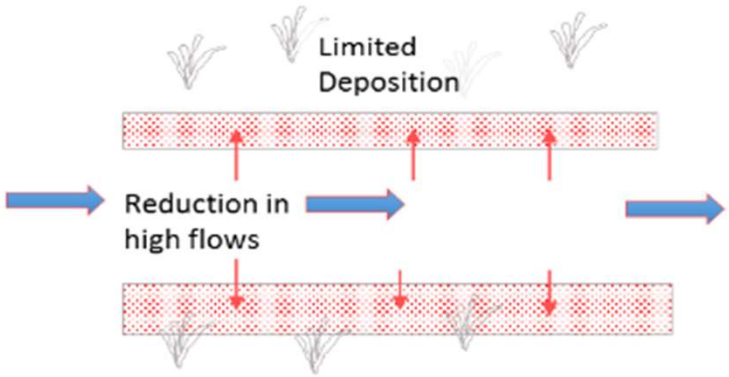
Key drivers of FLOODPLAIN



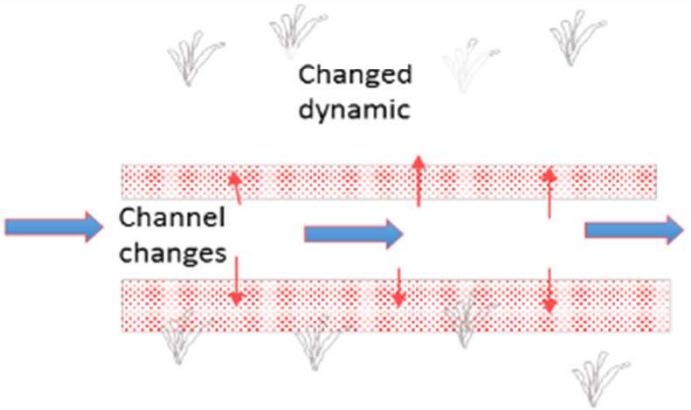
KEY DRIVER: Generally receive most water during high flow events when waters overtop the streambank.



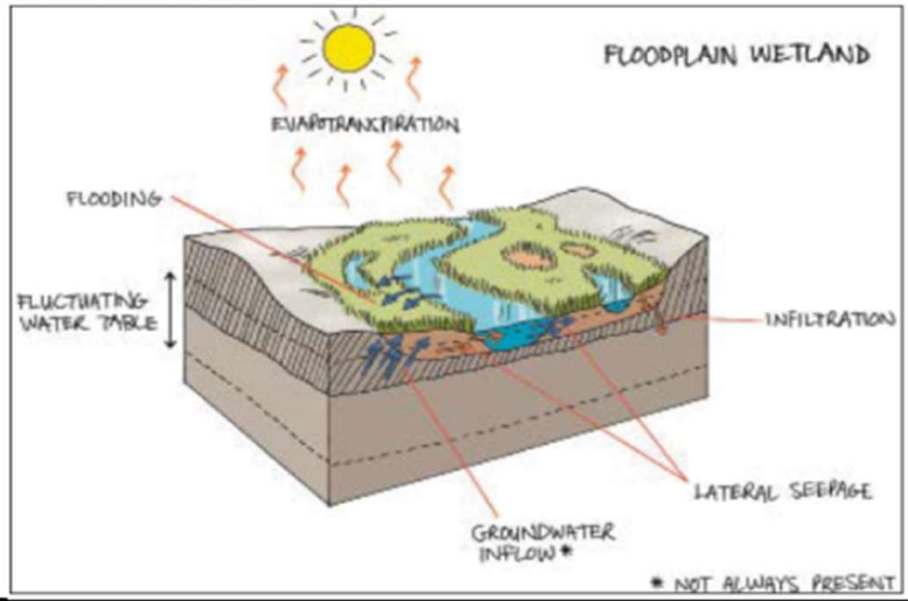
KEY THREAT: consumptive usage reduces high flows



KEY THREAT: channel straightening and infilling, erosion changes natural dynamic



Key drivers of FLOODPLAIN



KEY DRIVER: Generally receive most water during high flow events when waters overtop the streambank.

QUANTITY: High Flow

KEY THREAT: consumptive usage reduces high flows

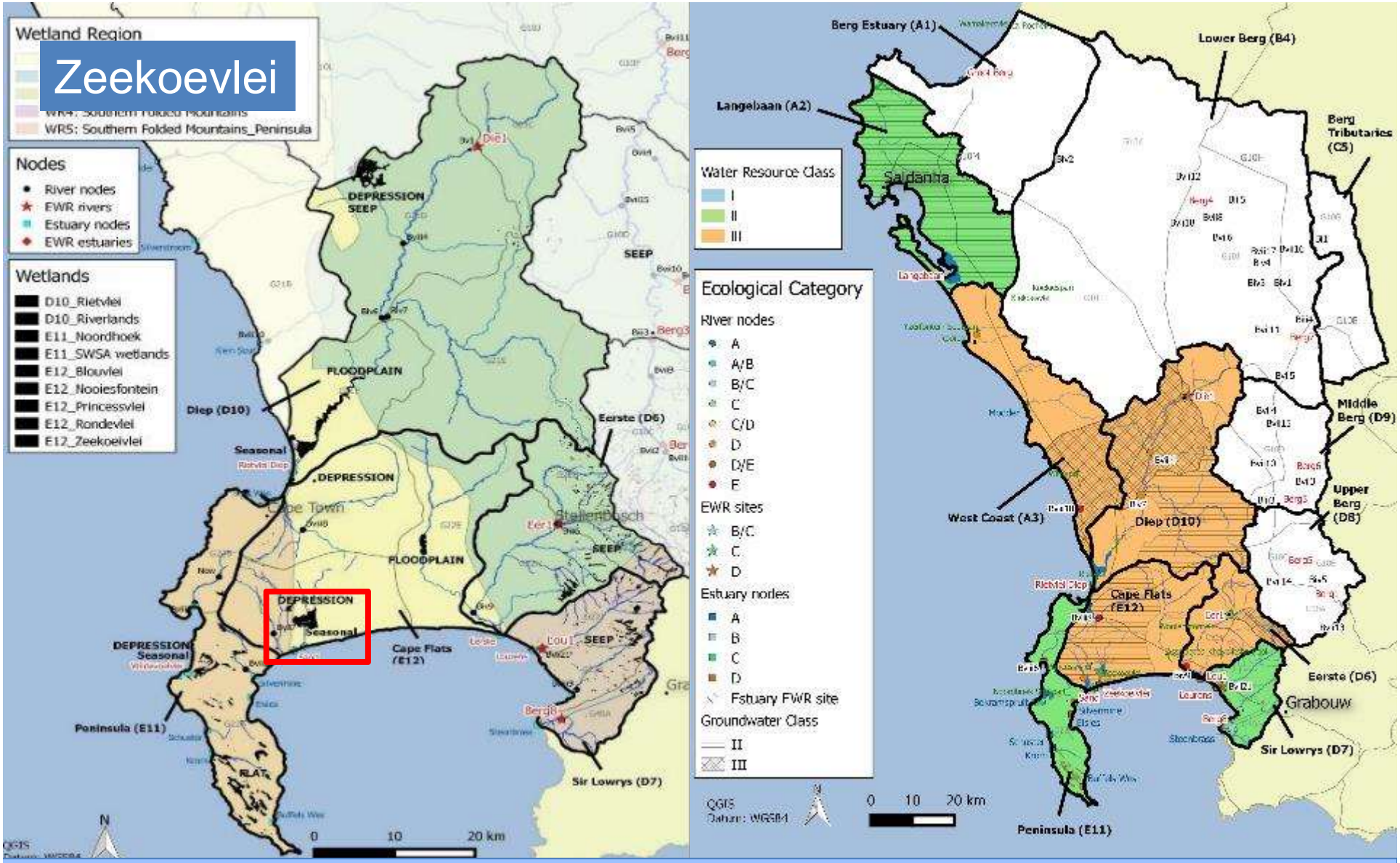
QUANTITY: High Flow (Threat)

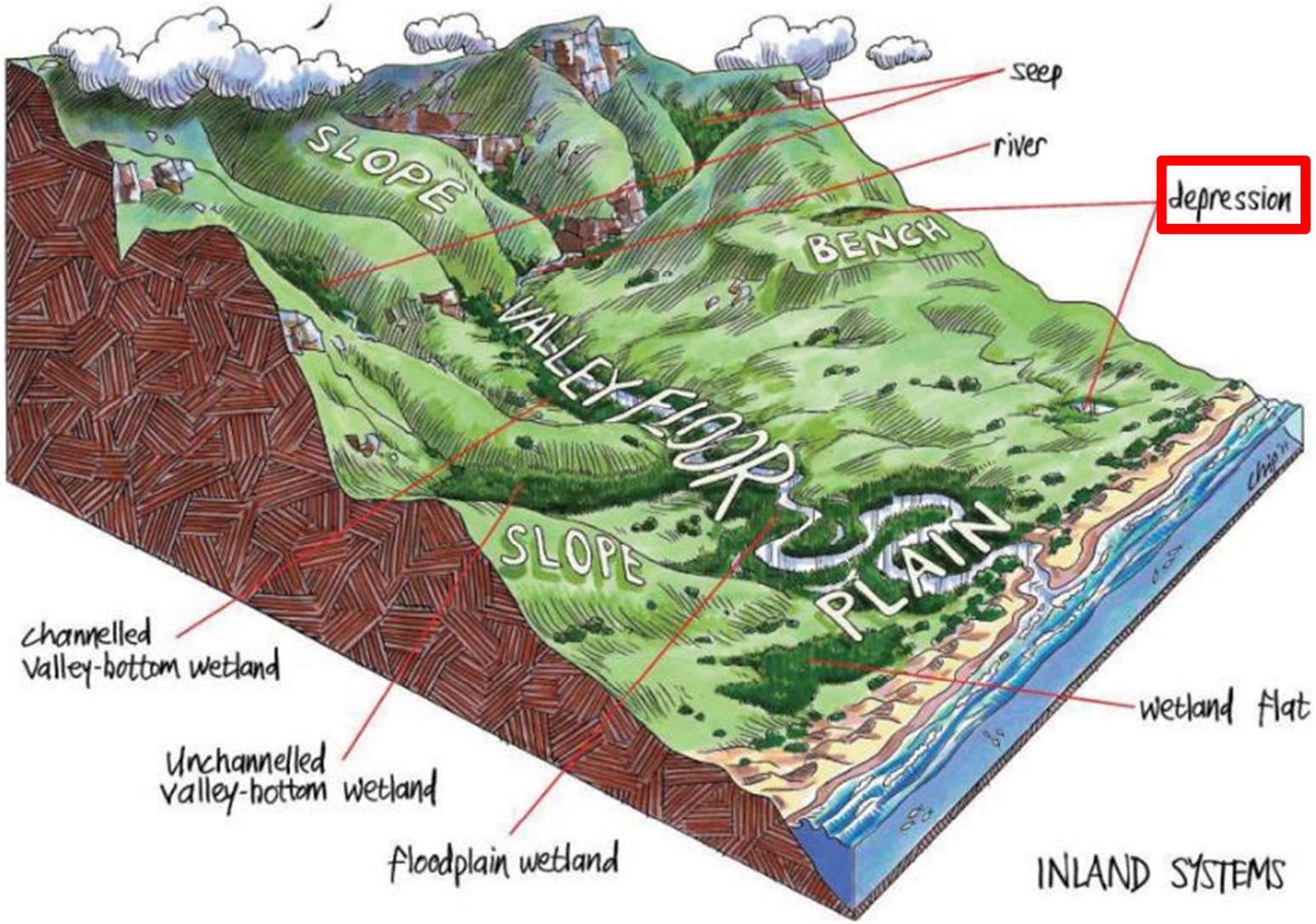
KEY THREAT: channel straightening and infilling, erosion changes natural dynamic

HABITAT: Erosion and vegetation (Threat)

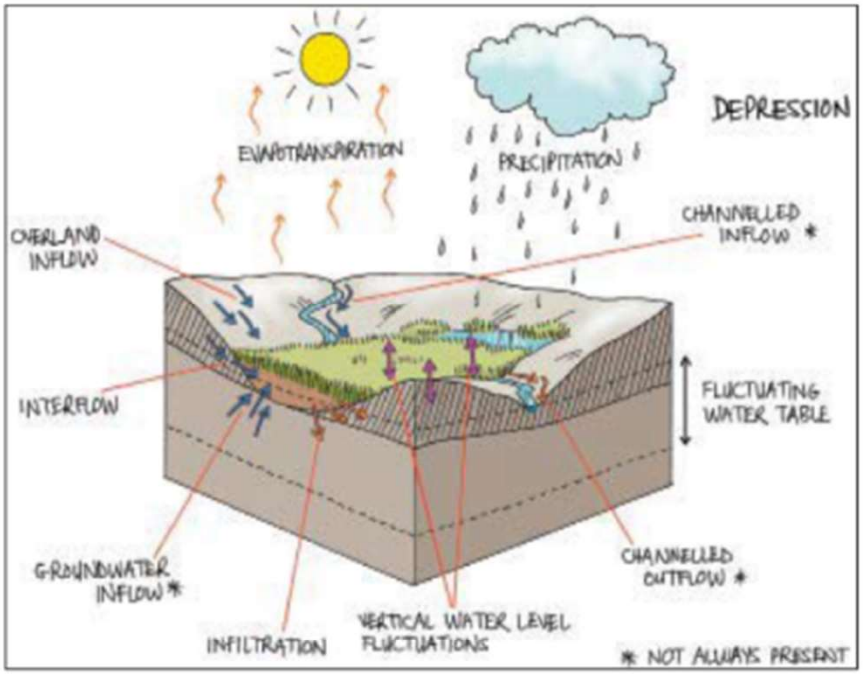
RQO example

UA	Wetland Region	RU	Wetland Name	Component	Sub-component	Indicator/ measure	RQO	Numerical limits
B4	South Western Coastal Belt_Sand (WR1) and South Western Coastal Belt_Shale (WR2)	B4-W4	West Coast Shale Renosterveld (Berg FLOODPLAIN)	QUANTITY	Flow	High flow	High flows need to be maintained in order to overtop banks and inundate floodplain vegetation.	High flow at river node Biii3 to be maintained.
				HABITAT	Geomorphology	Alien invasive plants on floodplain banks	Critically endangered vegetation versus invasive vegetation (both alien invasive plants and invasive plants) to be maintained.	Define wetland vegetation community structure and monitor annually.
				HABITAT	Vegetation	Wetland vegetation community structure	Alien invasive vegetation on floodbanks need to be maintained in order to limit erosion features.	Assess geomorphology and monitor annually. Alien invasive plants on river banks to be managed.

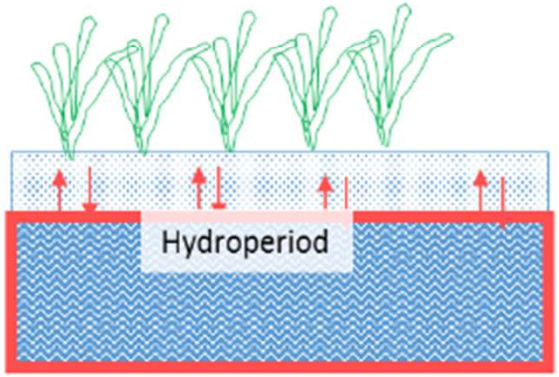

Zeekoevlei
Wetland Region
WR5: Southern Folded Mountains_Peninsula
Nodes
River nodes
EWR rivers
Estuary nodes
EWR estuaries
Wetlands
D10_Rietvlei
D10_Riverlands
E11_Noordhoek
E11_SWSA wetlands
E12_Blouvlei
E12_Nooiesfontein
E12_Princessvlei
E12_Rondevlei
E12_Zeekoevlei
DEPRESSION
SEEP
FLOODPLAIN
Diep (D10)
Seasonal
Eerste (D5)
Cape Flats (E12)
Peninsula (E11)
Sir Lowrys (D7)
Berg Estuary (A1)
Langebaan (A2)
Lower Berg (B4)
Berg Tributaries (C5)
Saldanha
Middle Berg (D9)
Upper Berg (D8)
West Coast (A3)
Grabouw
Water Resource Class
I
II
III
Ecological Category
River nodes
A
A/B
B/C
C
C/D
D
D/E
E
EWR sites
B/C
C
D
Estuary nodes
A
B
C
D
Fstuary FWR site
Groundwater Class
II
III
QGIS
Datum: WGS84
0
10
20 km
N


seep
river
depression
SLOPE
BENCH
VALLEY FLOOR
SLOPE
PLAIN
channelled
valley-bottom wetland
Unchannelled
valley-bottom wetland
floodplain wetland
wetland flat
INLAND SYSTEMS

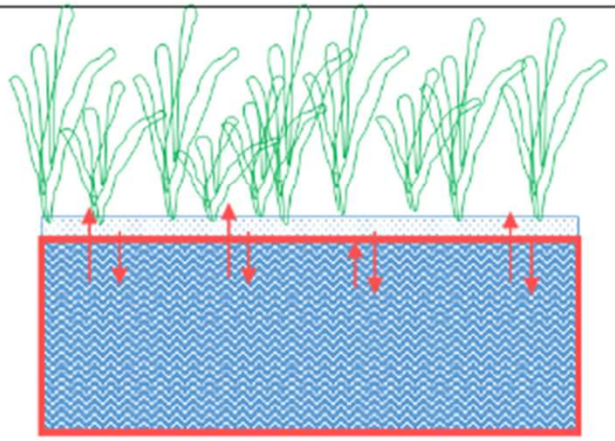
Key drivers of DEPRESSION



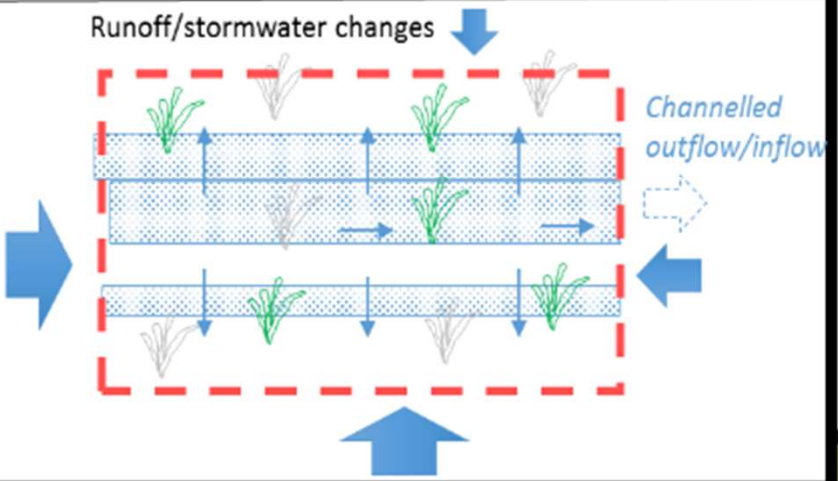
KEY DRIVER: Hydroperiod is a key driver associated by both groundwater and surface water inputs, which accumulate in the depression



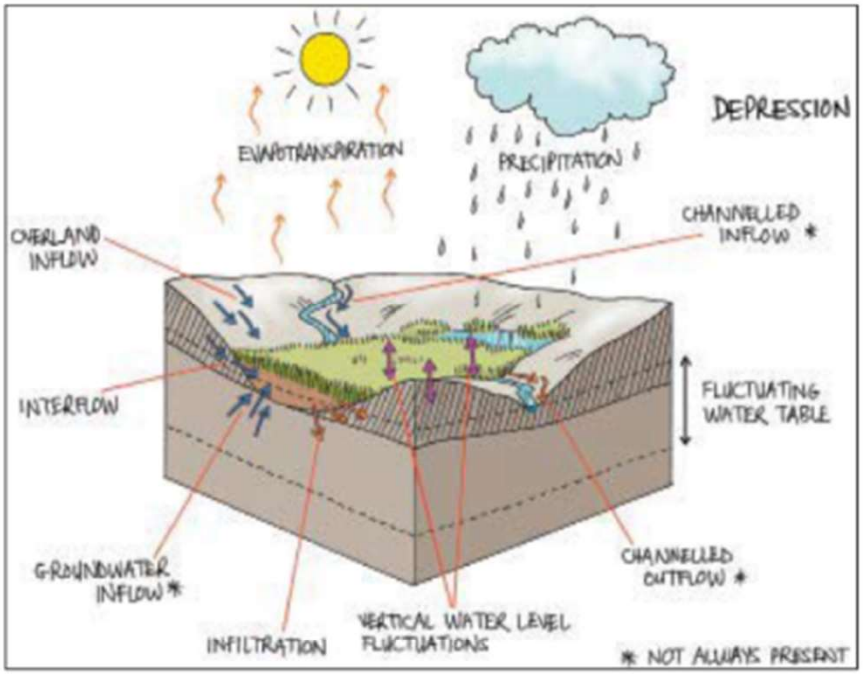
KEY THREATS: Changes to water inputs changes the seasonality of depression wetlands



KEY THREATS: Habitat transformation also has impacts.



Key drivers of DEPRESSION

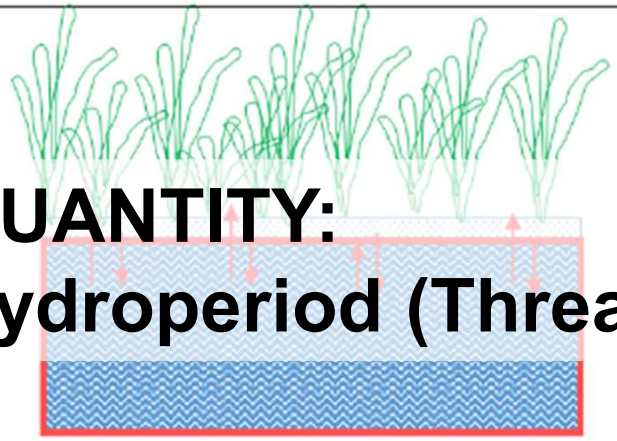


KEY DRIVER: Hydroperiod is a key driver associated by both groundwater and surface water inputs, which accumulate in the depression

QUANTITY: Hydroperiod

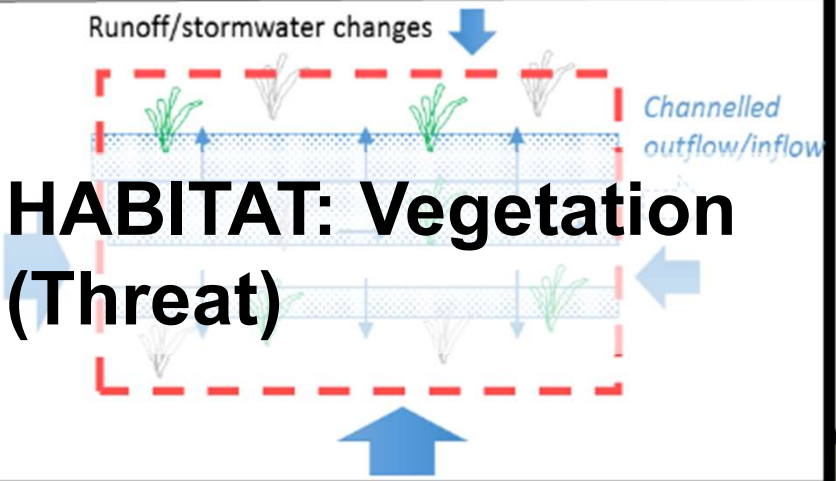
KEY THREATS: Changes to water inputs changes the seasonality of depression wetlands

QUANTITY: Hydroperiod (Threat)



KEY THREATS: Habitat transformation also has impacts.

HABITAT: Vegetation (Threat)

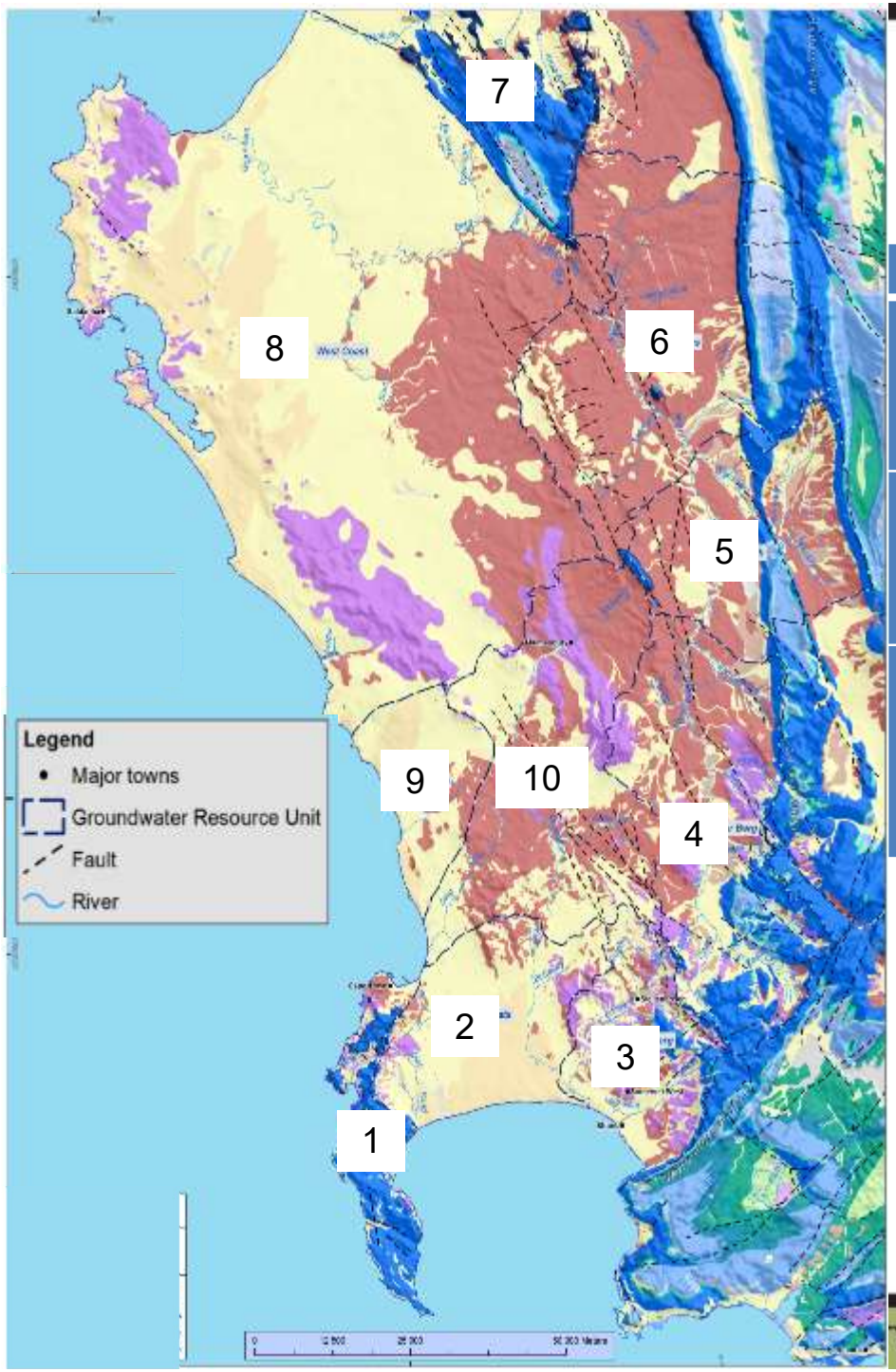


Seasonal Wetlands

IUA	Wetland Region	RU	Wetland Name	TEC	Component	Sub-component	Indicator/ measure	RQO	Numerical limits
E12	South Western Coastal Belt_Sand (WR1)	E12-W2	DEPRESSION (Zeekoeivlei main waterbody)	C	QUANTITY	Hydroperiod	Wetland water inundation extent	Water levels and water retention to be maintained.	Define wetland extent and monitor every 5 years.
					QUALITY	Water quality	Nutrients	Nutrient levels for present state rating value at a tolerable (D) level.	PO_4-P (mg/L) Tolerable: 0.025-0.125
									TIN-N (mg/L) Tolerable: 1.0-4.0
							Pathogens	Pathogen levels for recreational use (intermediate contact) need to be maintained at an acceptable level.	E. coli Acceptable: 2500
					HABITAT	Vegetation	Water weed	Limited water weed infestation.	Seasonal infestation of water weed monitored every year.
					BIOTA	Phytoplankton	Chl-a	Nutrient levels for present state rating value at a tolerable (D) level.	Phytoplankton Chl-a (µg/L) Tolerable: 20-30
E12	South Western Coastal Belt_Sand (WR1)	E12-W2	DEPRESSION (Zeekoeivlei seasonal)	B	QUANTITY	Hydroperiod	Wetland extent	Seasonality of wetland water inputs to be maintained.	Define groundwater level and monitor annually.
					HABITAT	Vegetation	Wetland vegetation community structure	Endangered vegetation to be maintained and invasive plants managed.	Define wetland vegetation community structure and monitor annually.

Groundwater

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



Groundwater Resource Units

Sub-Region	GRU	Quaternary
Greater Cape Town	1-Peninsula	G22A and G22B
	2-Cape Flats	G22C, G22D and G22E
	3-Helderberg	G22G; G22H; G22K and G22J
Upper Berg	4-Paarl-Upper Berg	G10A; G10B; G10C and G10D
	5-Tulbagh Valley	G10E and G10F
	6-24 Rivers	G10G; G10H and G10J
Lower Berg	7-Piketberg	G30A and G30D
	8-West Coast	G10K; G10M; G10L and G21A
	9-Atlantis	G21B
	10-Malmesbury	G21C; G21D and G21E

Geology
- Quaternary Deposits
- Tertiary Deposits

Coastal Deposits
- Bredasdorp Group

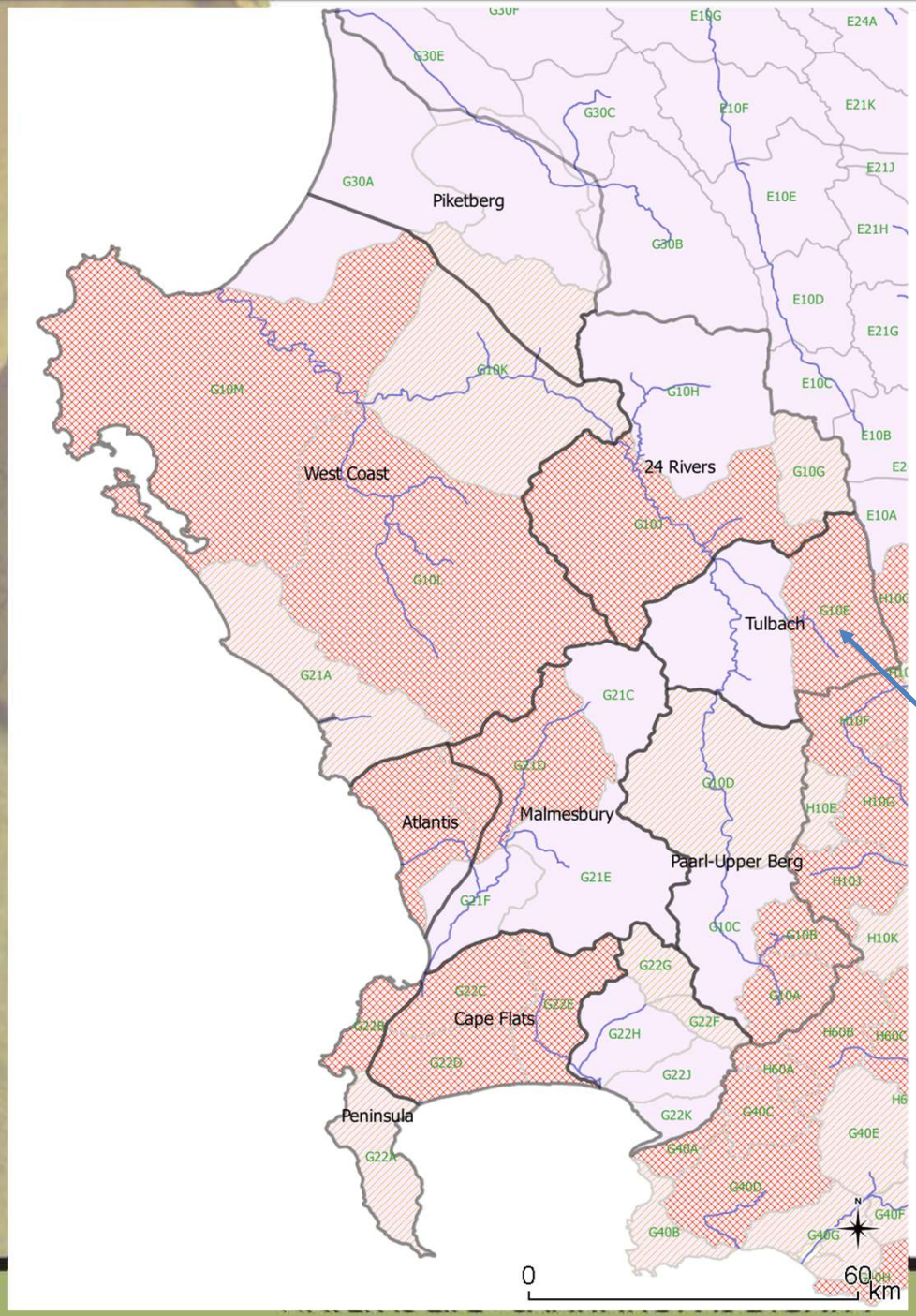
Cape Supergroup
- Witteberg Group

Bokkeveld Group
- Traka/Bidouw Sub-Grp
- Ceres Sub-Grp

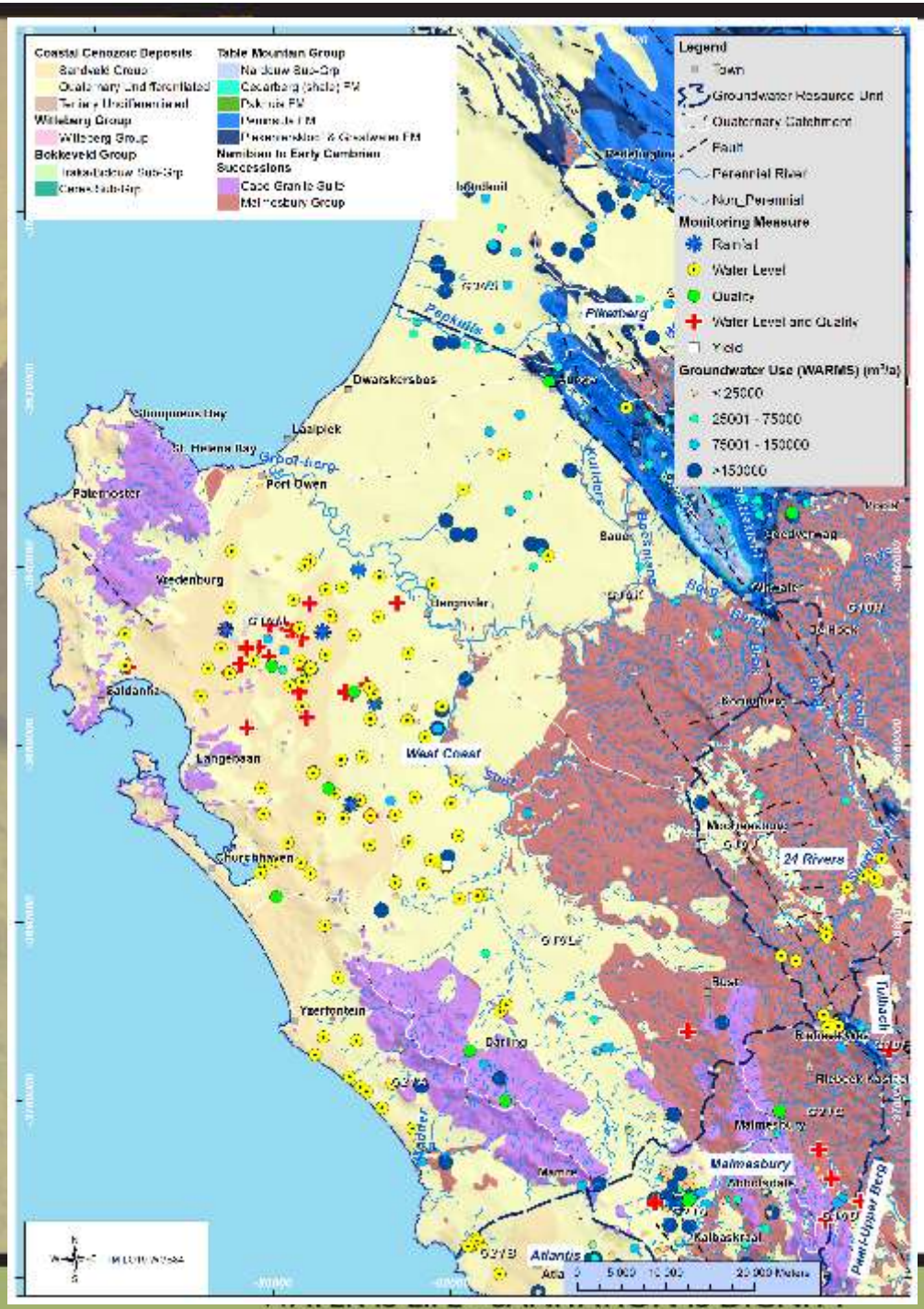
Table Mountain Group
- Nardouw Sub-Grp
- Skurweberg FM
- TMG (undifferentiated)
- Cedarberg (shale) FM
- Peninsula FM
- Piekenierskloof & Graafwater FM

Namibian to Early Cambrian Successions
- Cape Granite Suite
- Malmesbury Group

Prioritisation result



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

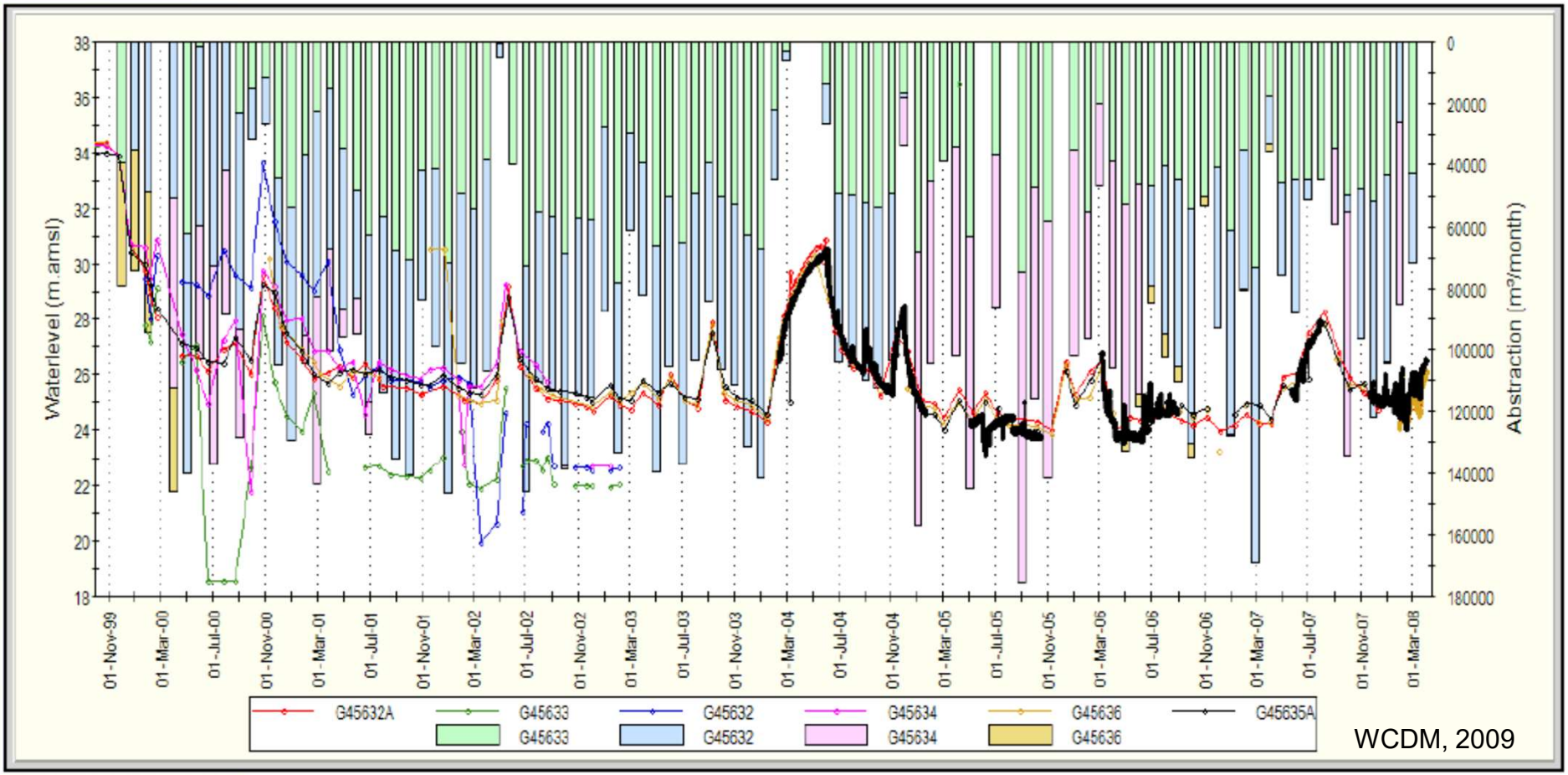


GRU8 West Coast: G10M

GRU8 West Coast: G10M (1)

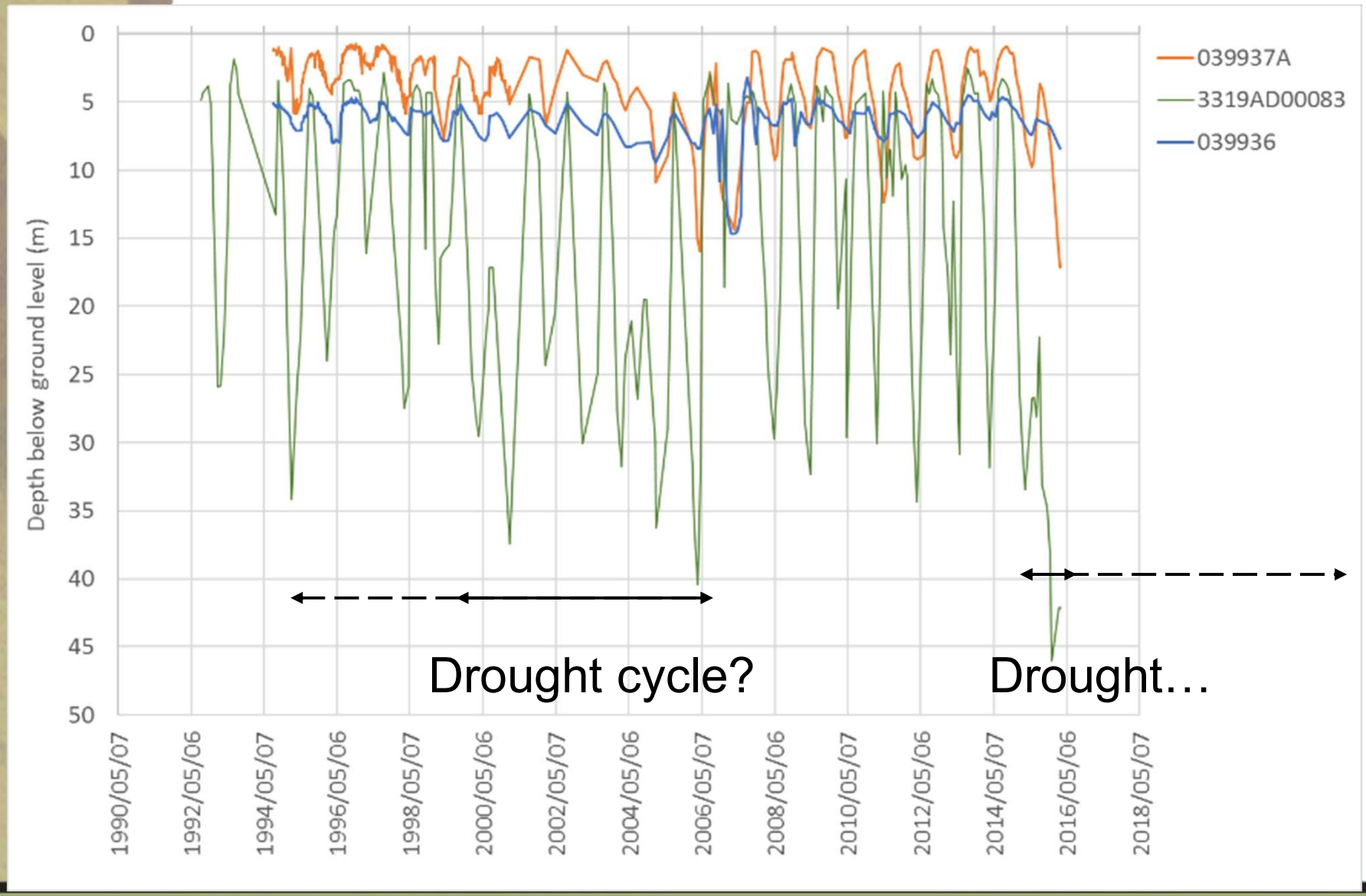
GRU	Quat(s)	Aquifer	Component	Sub-Component	RQO Description (narrative)	Indicator	Numerical Value
8-West Coast	G10M	All	Quantity	Abstraction	Groundwater use should be sustainable for all users and the environment	Seasonal abstraction: water level recovers from abstraction impact during wet season, under consideration of climate change and drought cycles. Permanent abstraction: water level decline stabilises under consideration of aquifer response time.	n/a
		All		Groundwater level	Water level in abstraction boreholes within 2.5km from the ocean does not fall below minimum, to avoid saline intrusion	Water level	>1 mamsl
		All		Discharge	The natural gradient between groundwater and surface water should be maintained	Relative water levels between groundwater and surface water (in mamsl)	n/a
		All		Discharge	No groundwater abstraction around wetland and river FEPAs in accordance with the implementation manual for FEPAs	Buffer zones	250m
				Discharge	Compliance to the groundwater flow requirements to the estuary, as per estuary RQO requirement	Compliance with the groundwater flow requirements to the estuary	See section 3.1
		All		Low flow in river	Compliance to the low flow requirements in the river, as per surface water RQO requirement	Compliance with the low flow requirements in the Sout & Berg River	See section 3.1

Sub-component: abstraction, Indicator: Water level



WCDM, 2009

Sub-component: abstraction, Indicator: Water level



Component: Water quality

- Status quo analysed
  - Statistics for main chemical parameters per major geology per catchment & GRU
  - Establish “natural background” per major geology per catchment, and natural variability (majority are ‘normal’)
- Analysis for RQO development included
  - Establish appropriate limit to “natural background”
  - Most are 95%tile, or 90%tile where impacted

GRU8 West Coast: G10M (2)

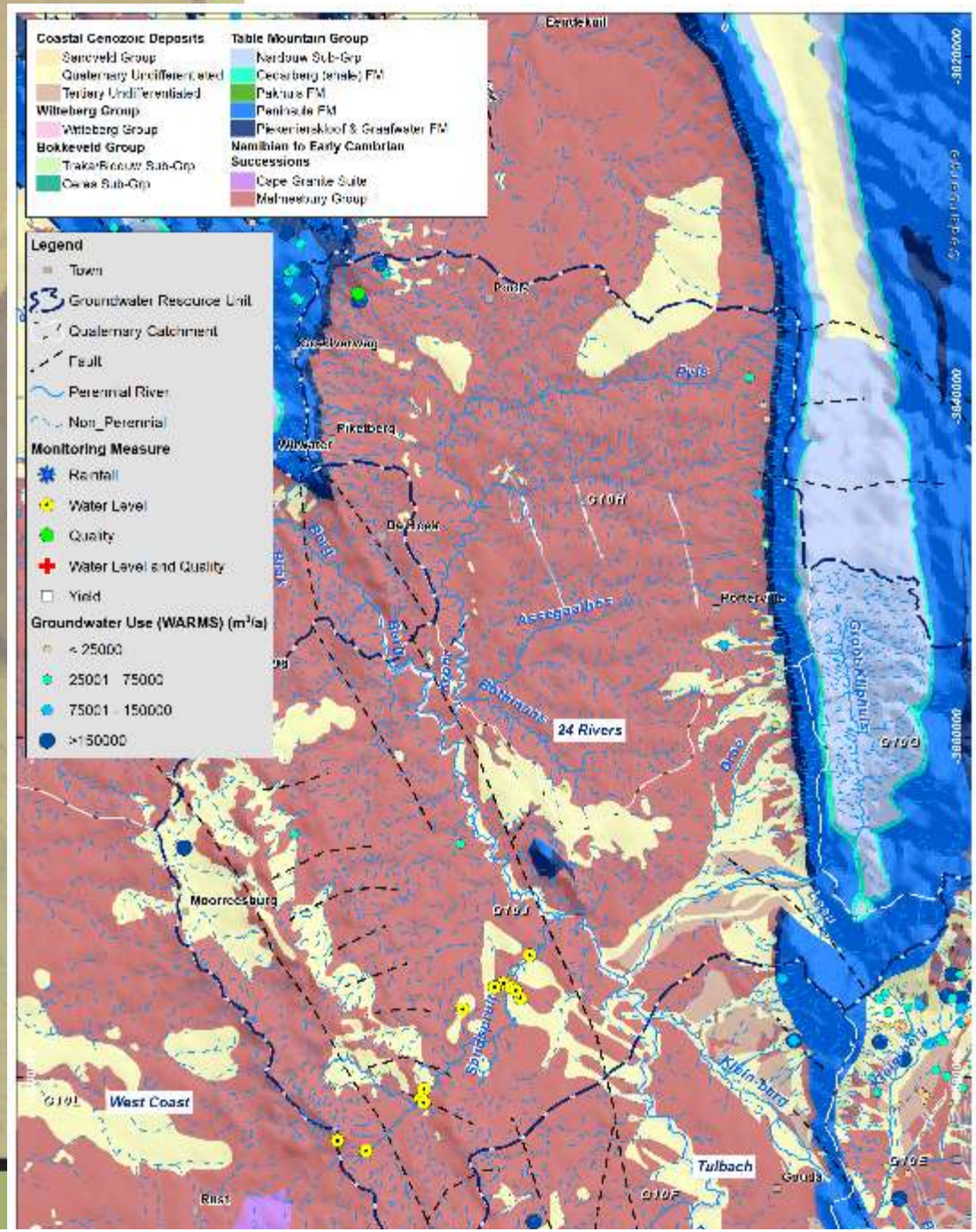
GRU	Quat(s)	Aquifer	Component	Sub-Component	RQO Description (narrative)	Indicator	Numerical Value
8-West Coast	G10M	Coastal cenozoic sand	Quality	Nutrients	Groundwater should be fit for domestic use after treatment; and groundwater quality shall not show a deteriorating trend from natural background	NO_3 (as N)	< 11.0 mg/l
				Salts		EC	< 520 mS/m
		Basement		Nutrients		NO_3 (as N)	< 11.0 mg/l
				Salts		EC	< 1571 mS/m
		All		Pathogens		E-coli	0 counts / 100 ml
		All		Pathogens		Total Coliform	<10 counts / 100ml

Based on 95%tile of this area & geology (=11.3mg/l, but for simplicity applied 11.0)

Based on 75%tile of this area & geology because low median (~500mg/l, but for simplicity applied 520 as old DWS class 3)

Insufficient local data: based on SANS214 which matches local data from neighbouring G10L

Based on 90%tile of this area & geology (median is ~800mg/l)



GRU6 24 Rivers: G10J

GRU6 24 Rivers: G10J

GRU	Quat	Aquifer	Component	Sub-Component	RQO Description (narrative)	Indicator	Numerical Value
6 – 24 Rivers	G10J	Superficial aquifers	Quantity	Discharge	The natural gradient between groundwater and surface water should be maintained	Relative water levels between groundwater and suface water (in mamsl)	n/a
		All		Discharge	No groundwater abstraction around wetland and river FEPAs in accordance with the implementation manual for FEPAs.	Buffer zones	250m
		All		Low flow in river	Compliance to the low flow requirements in the river, as per surface water RQO requirement	Compliance with the lowflow requirements in the river	See section 3.1

Excludes buried Peninsula Formation; not connected to SW, essentially no “natural gradient”

RQO focus: protection of GW discharge to SW (sustainable abstraction RQO not applied)

RQOs summary

GRU	Quat	Abstraction	Groundwater level	Discharge (relative gradient)	Discharge (Buffer zones)	Low flow in river	Nutrients	Salts	Pathogens
BO-1	G40A	x		x	x	x	x	x	x
2-Cape Flats	G22C, G22D, G22E	x	x	x	x	x	x	x	x
4-Paarl-Upper Berg	G10A	x				x	x	x	x
4-Paarl-Upper Berg	G10B			x	x	x	x	x	x
5-Tulbagh Valley	G10E	x			x		/	/	x
6-24 Rivers	G10J			x	x	x	x	x	x
8-West Coast	G10L	x		x	x		x	x	x
8-West Coast	G10M	x	x	x	x	x	x	x	x
9-Atlantis	G21B	x	x	x	x		x	x	x
10-Malmesbury	G21D	x		x	x	x	x	x	x

Thank you

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DWS documents on the processes can be accessed on DWS website using the following link: https://www.dwa.gov.za/rdm/Documents.aspx