water & sanitation

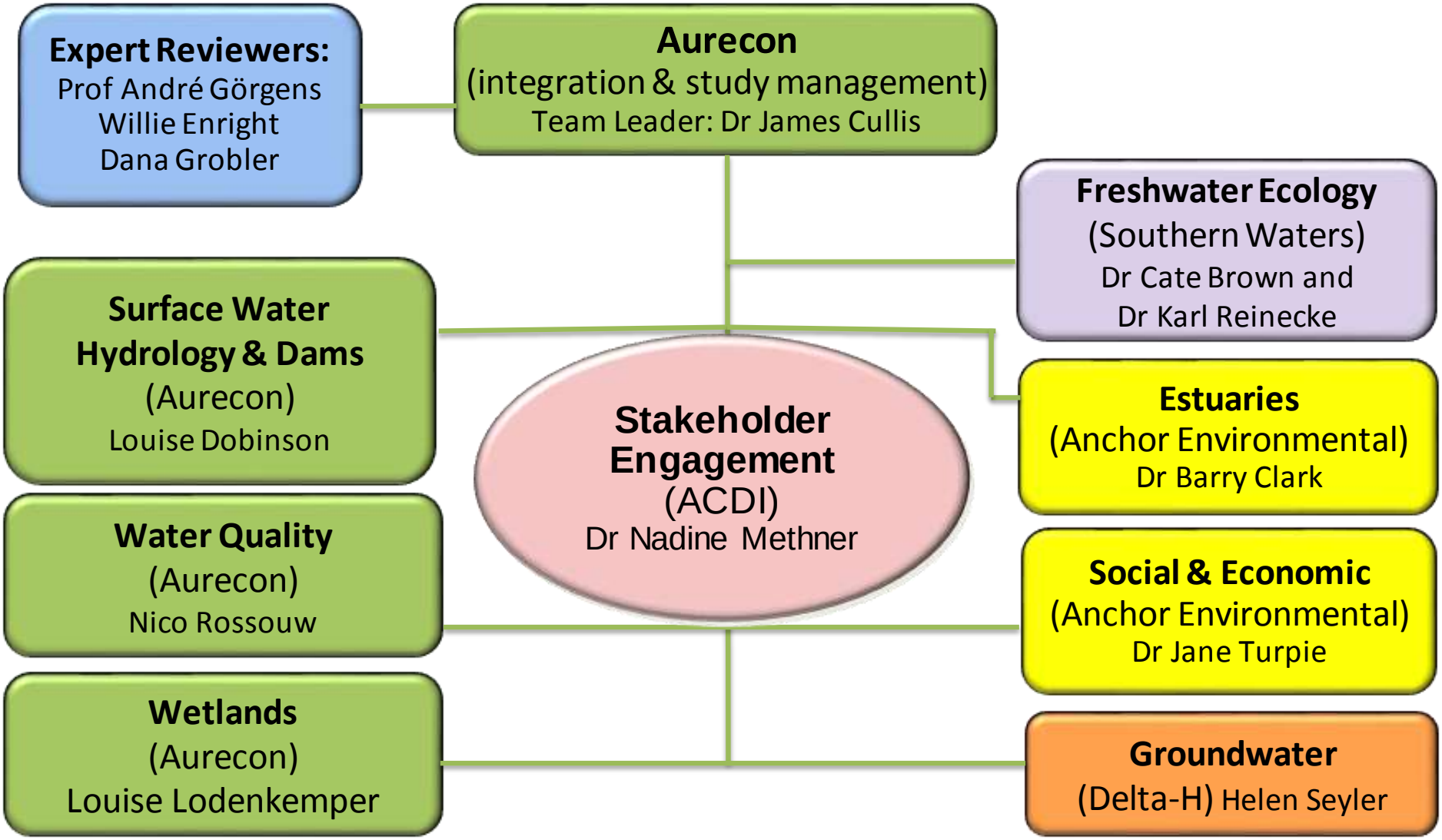
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Determination of Water Resource Classes and Associated Resource Quality Objectives for the Berg Catchment

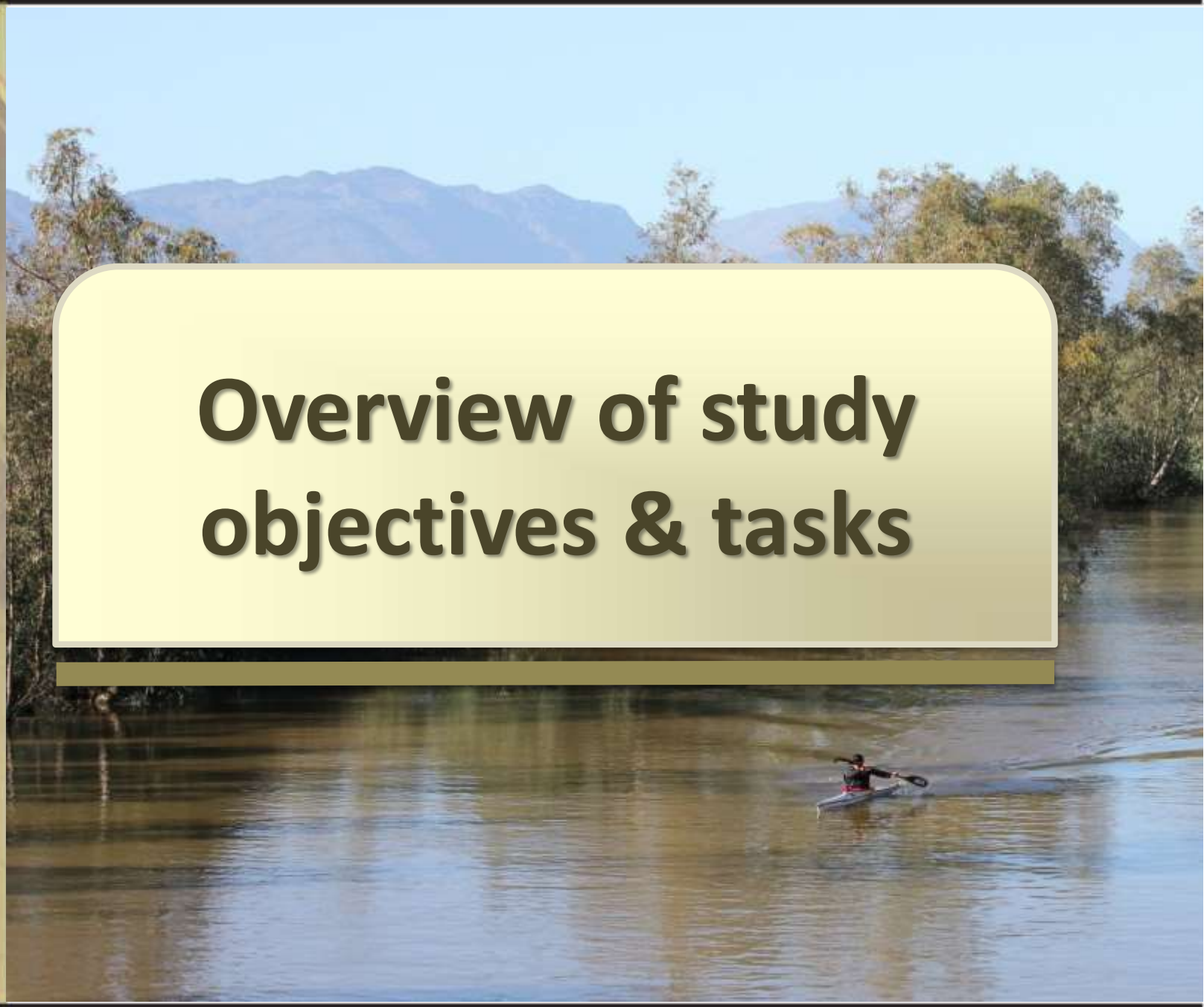
First Public Meeting

17th November 2016
Nelson Wine Estate, Paarl

The Study Team



Overview of study objectives & tasks

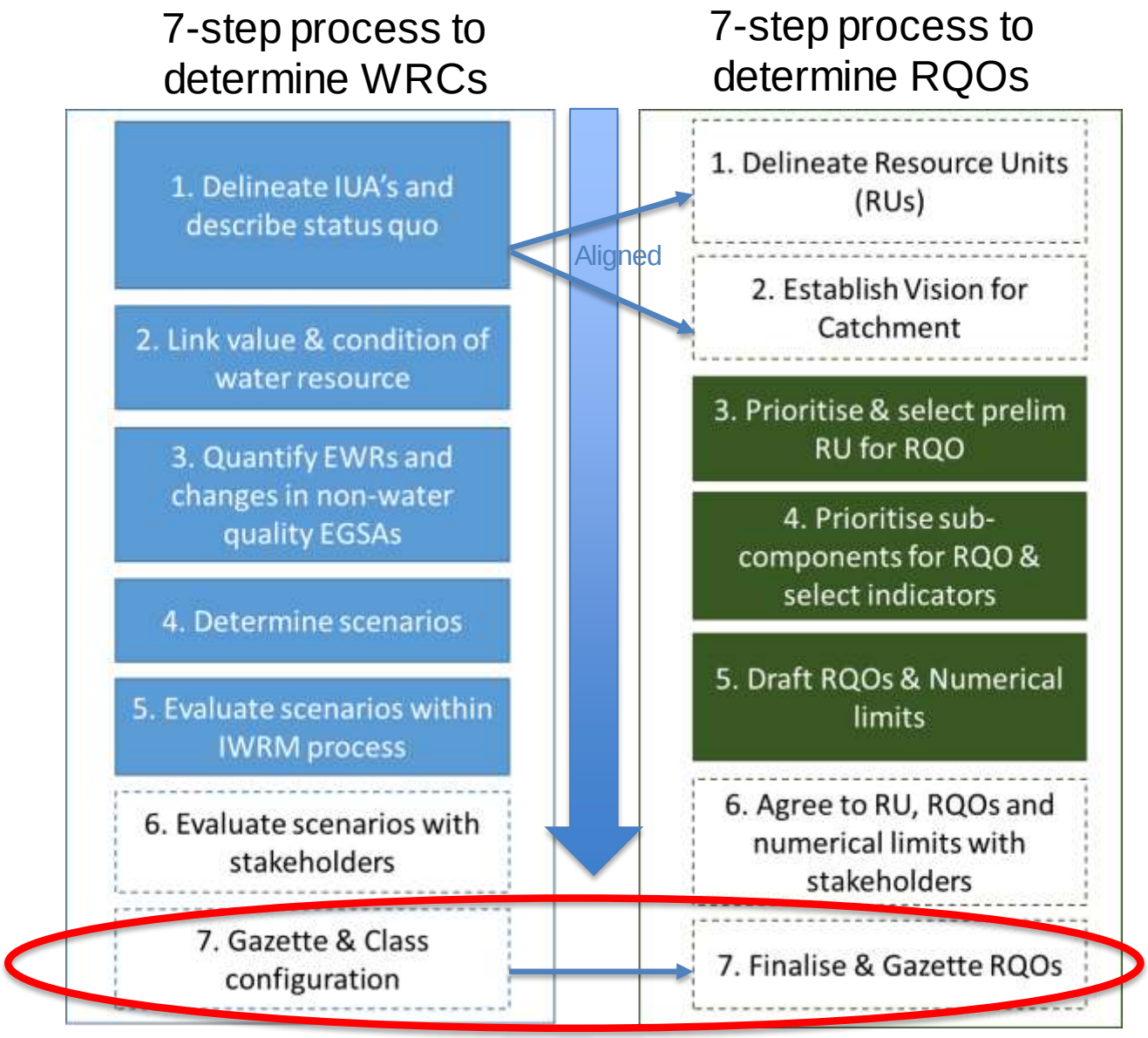


Study Objectives

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

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

Steps in Classification and RQOs Process



Main study tasks

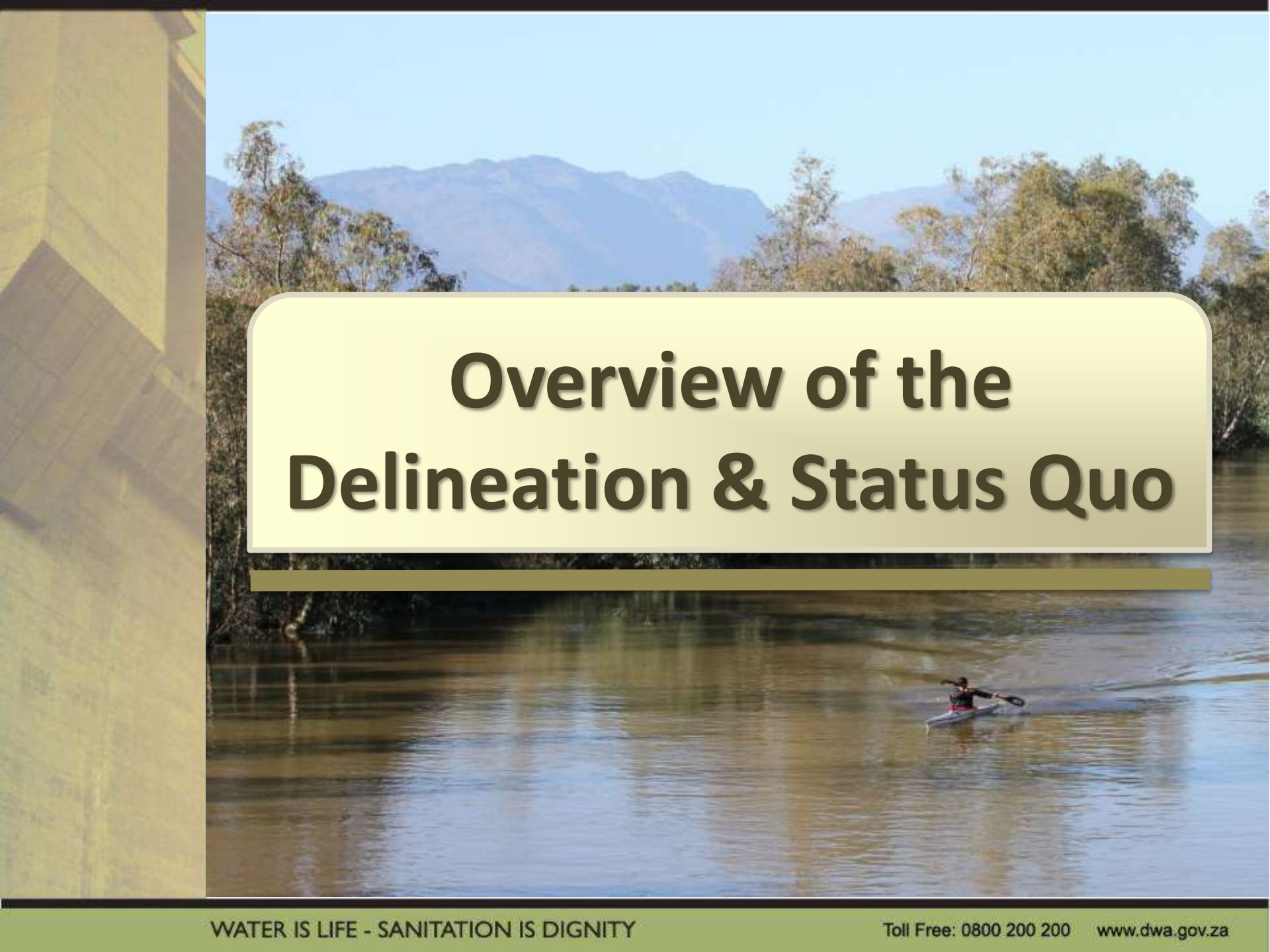
- **Task 1**: Inception → Completed
  - Inception Report
  - Stakeholder Identification and Mapping Report
- **Task 2**: Information gathering
  - Water Resources Information and Gap Analysis

Information gaps

- **Task 3**: Determine Water Resource Classes
  - 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

Current

- **Task 4**: Determine Resource Quality Objectives
  - 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



Overview of the Delineation & Status Quo

Resource Unit Delineation & IUA

- Divided catchment into Socio-Economic Zones
- Identified a network of significant water resources
- Established biophysical & allocation nodes
- Defined preliminary assessment areas called Integrated Units of Analysis (IUAs)



Status Quo Report

- Describes existing situation of significant water resources:
  - Surface water
  - Water quality
  - Wetlands (ecological state)
  - Dams
  - Groundwater
  - Estuaries (ecological state)
  - Rivers (ecological state)
- Describe existing socio-economics for the study area & including ecosystem goods and services.



Socio-economics

Link the Value and Condition of the Resource

- Describe current socio-economic status (from census)
- Describe current economic activities and outputs
- Identify socio-economic zones and group into IUAs
- Determine value relationships
  - Production/cost functions -marginal costs of abatement/water efficiency gains from different sectors.
  - Value of ecosystems goods and services
    - Provisioning – food production and water supply
    - Amenity - eg tourism, property value
    - Nursery value for fishery
    - Water quality improvement
    - Flood attenuation

Overview of Socio-Economic Aspects

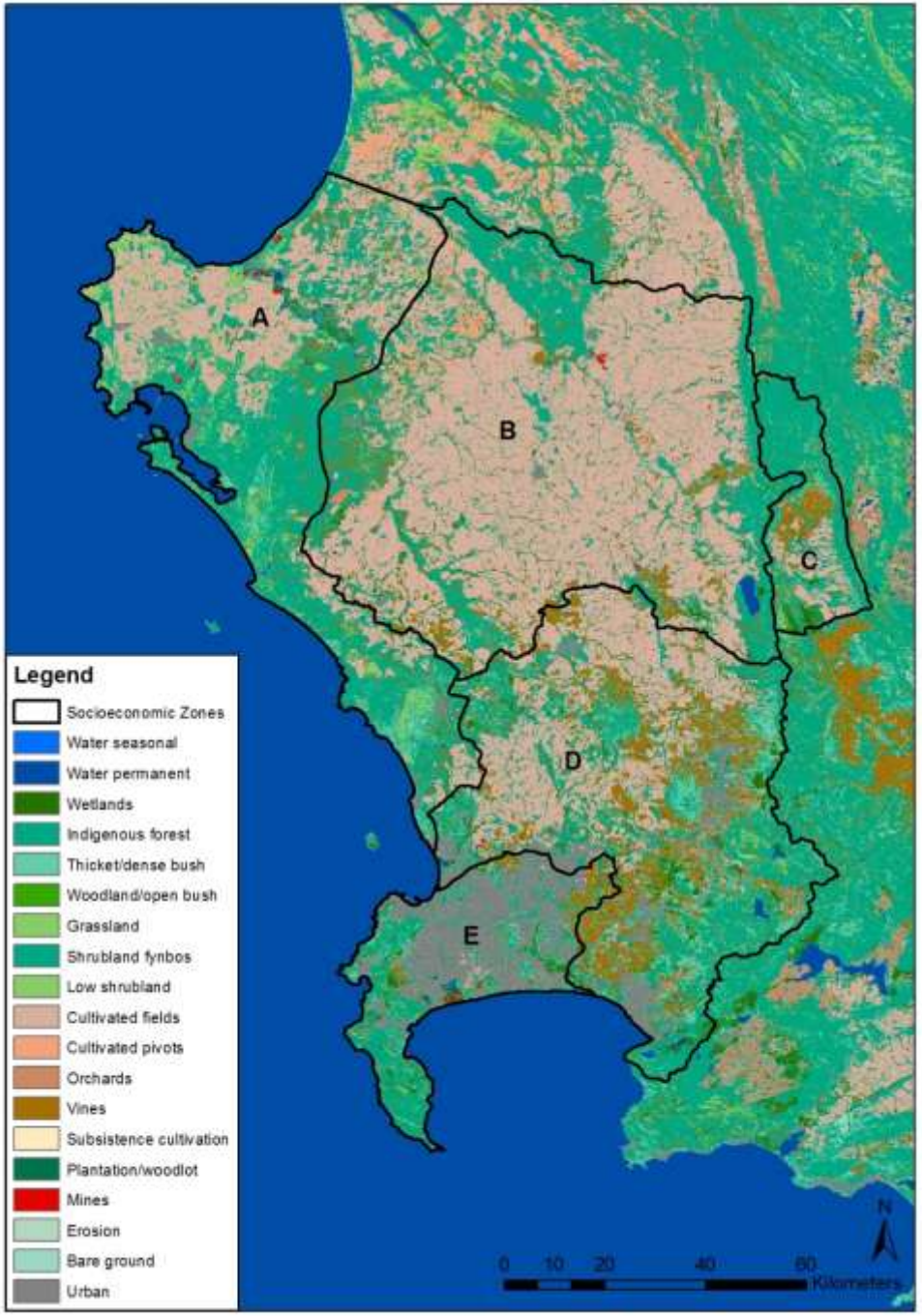
Key economic sectors in the Study Area

Economic Sub-Sector	Cape Metro	Cape Winelands & West Coast Combined
Manufacturing	16%	21%
Construction	4%	4%
Retail & Catering & Accommodation	16%	13%
Finance & Real Estate & Business	36%	24%
Transportation & Communication	11%	8%
Agriculture & Forestry & Fishing	2%	14%
Social Services	5%	5%
Government Services	10%	11%

Other important socio-economic considerations include the ecosystem goods and services value particularly with regards to the Berg River Estuary.

Delineation of Socio-economic Zones (SEZ)

- Zones should have relatively similar economic activities with regard to water use
  - make it easier to describe potential socio-economic implications of different classification scenarios to stakeholders, who can relate to the various areas that they depend upon
- Zones were demarcated primarily on the basis of land use
  - after detailed inspection of a range of spatial information on geography, climate, drainage, vegetation and land use
- Initial boundaries were then compared with river characteristics and catchment boundaries and refined



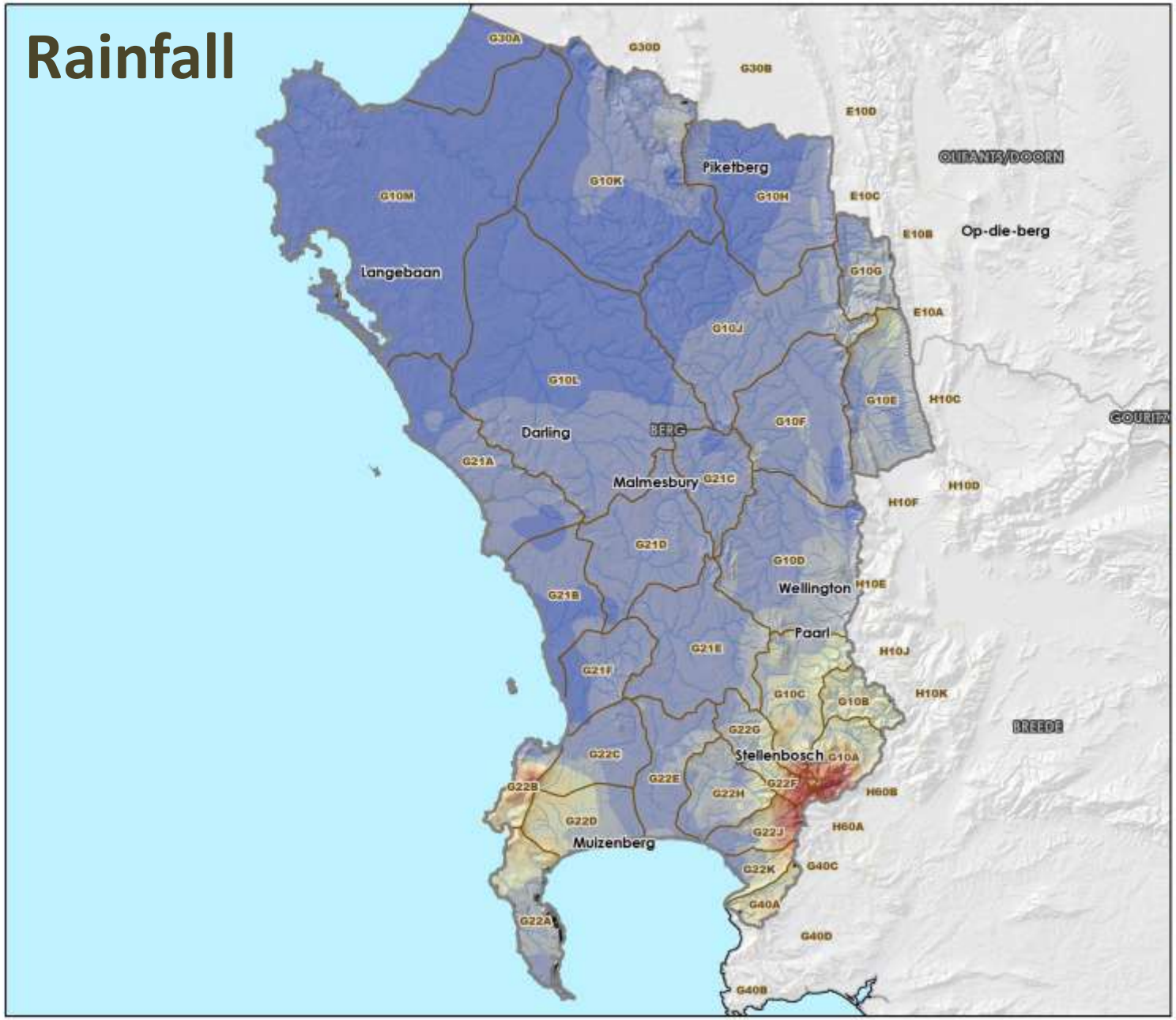
Socio-economic zones

Map Code	Socio-economic zone	Population	Land use
A	West Coast	265 988	Mostly dryland area and natural veld. Covers 15% dryland & 1% Irrigated crop of the study area (75% irrigated crop are wine grapes)
B	Lower Berg	110 058	Predominantly a grain growing area, with 62% of study areas dryland crop (60% of dryland crop are grains). Some mining/quarry.
C	Tulbagh Fruit Area	24 264	Surrounded by mountainous areas, with 8 500 Ha agriculture (60% of this dryland crops)
D	Winelands	960 670	Primarily wine growing area and has significant urban areas, with 135 000 Ha agriculture (65% dryland crops)
E	Cape Town	3 073 703	Mainly urban area, with 6 575 Ha agriculture (75% irrigated) and large tract of natural land along peninsula

Surface water hydrology and water supply infrastructure.

- Estimate river flows by quaternary for natural state & current situation using Berg WAAS data and WR2012 for G2.
- Using WR (of South Africa) 2012 hydrological modelling.
- Taking meteorology, water allocations, water use, water infrastructure and water transfers into account.
- Some disagregation needed to provide natural and current day streamflow estimates for determining EWRs at nodes.
- Current demands and yield estimates from the WCWSS.
- Impact of classification scenarios modelled using WRYM.
- Water supply infrastructure dominated by WCWSS.

Rainfall



LEGEND

- Rivers
- Quaternary Catchments
- Berg Water Management Area

Mean Annual Precipitaton (mm)

- 200 - 400
- 400 - 600
- 600 - 800
- 800 - 1,000
- 1,000 - 1,200
- 1,200 - 1,400
- 1,400 - 1,600
- 1,600 - 1,800
- 1,800 >

DRAWN : CHERYL BEUSTER
SOFTWARE : ESRI ARCMAP 10.2

COORDINATE SYSTEM
Transverse Mercator LO 19 WGS 84

SCALE
0 10 20 30 40 km
1:1,000,000

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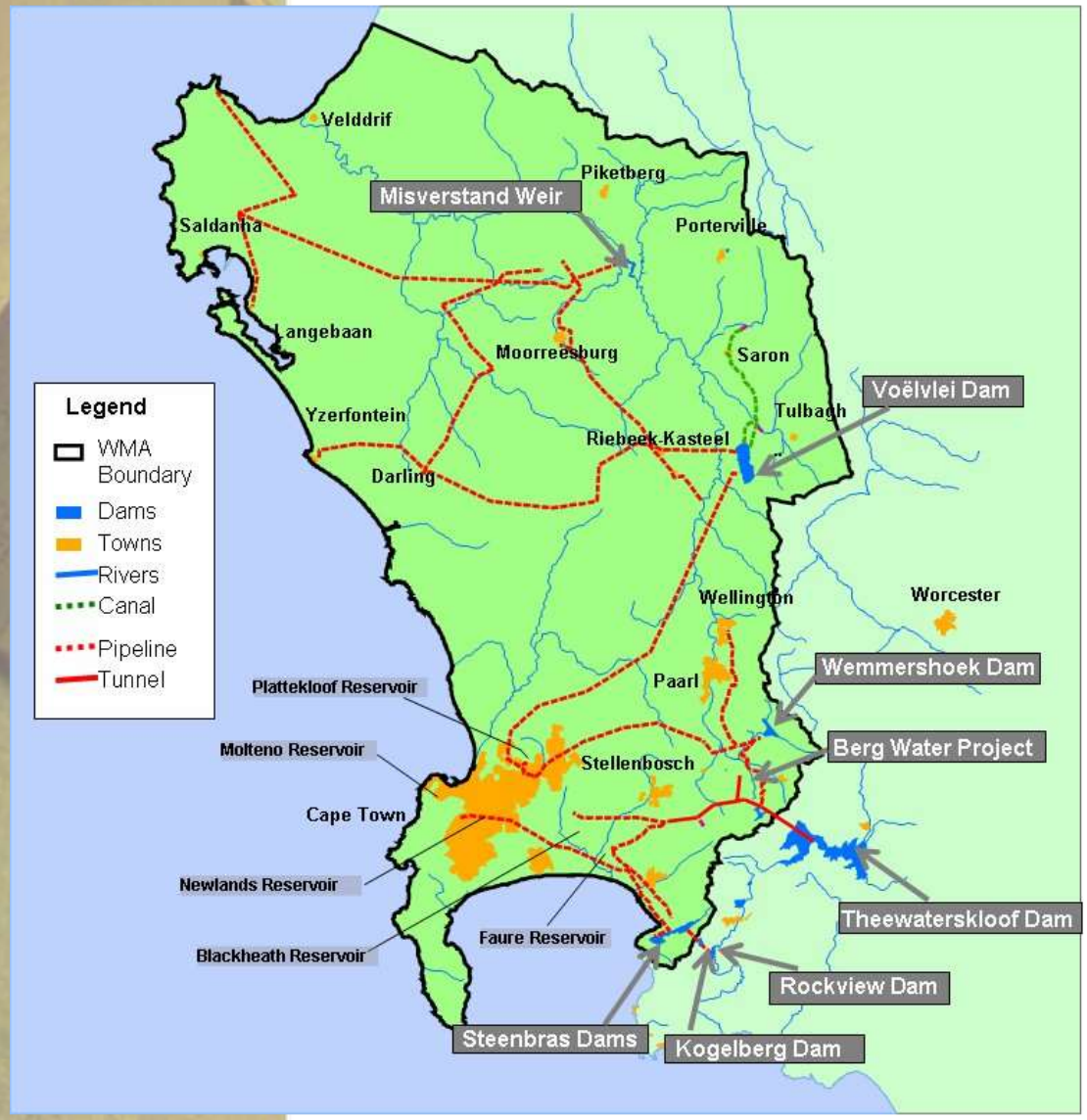
TITLES
DETERMINATION OF WATER RESOURCE CLASSES AND ASSOCIATED RESOURCE QUALITY OBJECTIVE IN THE BERG

MEAN ANNUAL PRECIPITATION

FIGURE NO.

Surface water supply infrastructure



- Western Cape Water Supply System (WCWSS)
  - Berg River Dam
  - Wemmershoek Dam
  - Voelvlei Dam
  - Steenbras Dam
  - Misverstand Dam
  - 24 Rivers Diversion Canal
  - Klein Berg Diversion Canal
- Table Mountain Dams
- Farm Dams

Total 1:50 Year Yield of the WCWSS: 559 million m^3/a

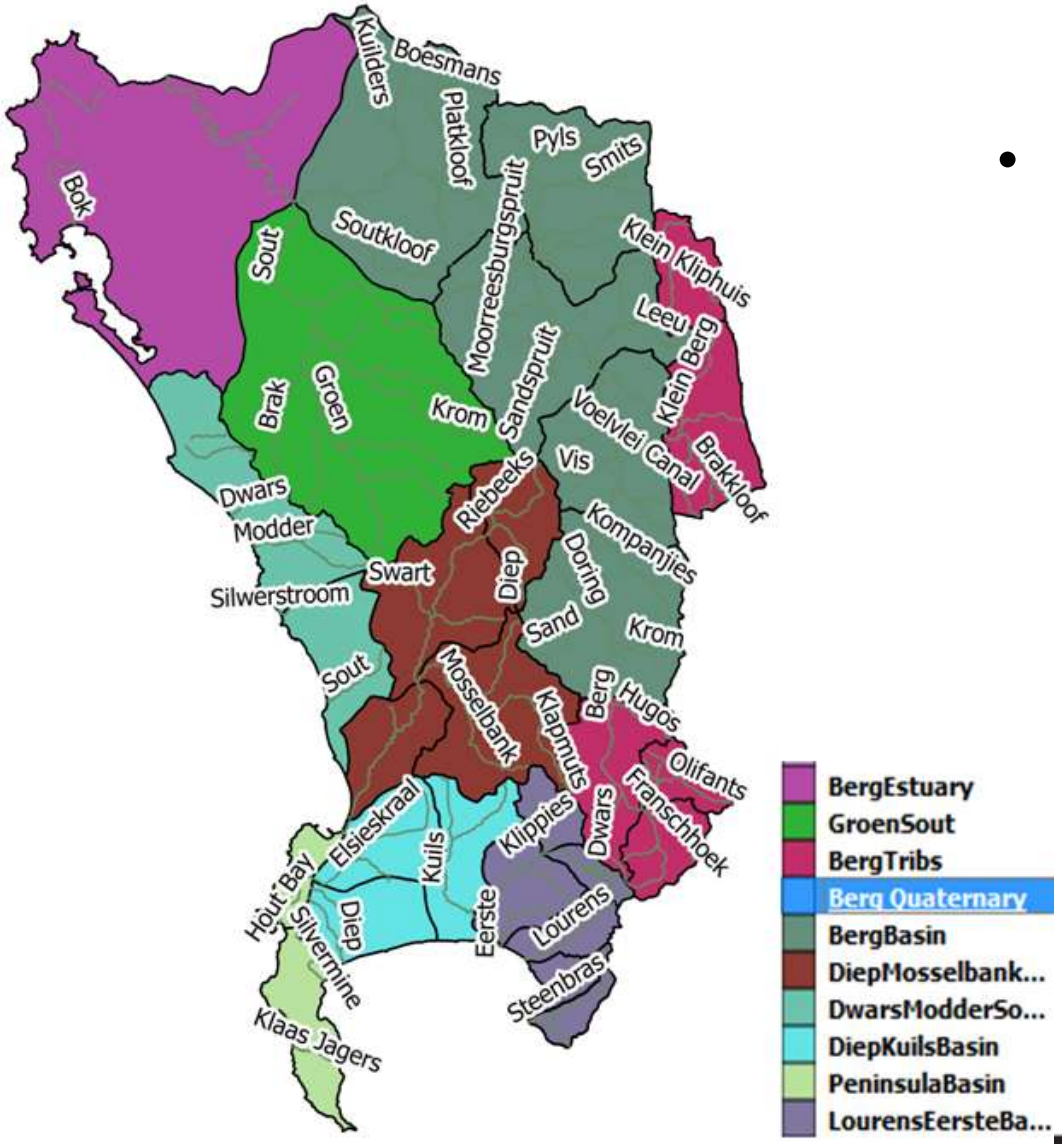
Estimate of Surface Water Demands by IUA for the Berg catchment (Mm^3/a).

IUA	Urban / Industrial	Irrigation	Afforestation & Alien Plants	Total
Upper Berg	24	52	12	88
Middle Berg	9	73	3	85
Lower Berg	10	55	1	65
Berg Tributaries		15	5	20
Lourens Eerste	34	23	6	63
Cape Flats	229	14	2	245
Peninsula	27		2	29
Diep Mosselbank		67	1	68
Dwars Mosselbank	6		1	7
Langebaan	18		1	19
Total Demand	357 (52%)	299 (43%)	34# (5%)	690

Including about 15 million m^3/a surface and groundwater use by invasive alien plants

Additional estimated average GW use = 65 Mm^3/a

Delineation of River Resource Units

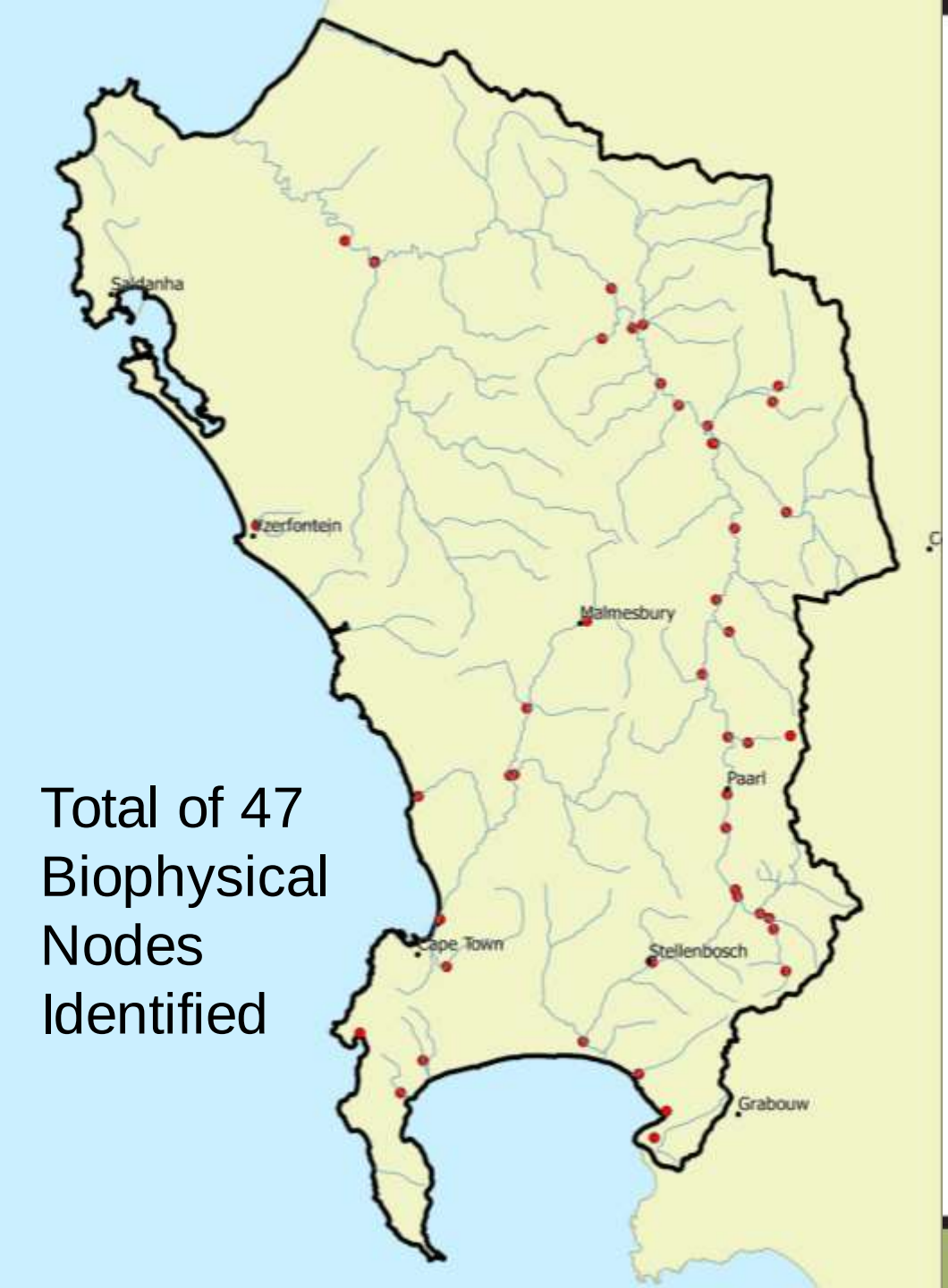


- Delineation of 10 River RUs resulted from overlay of six relevant spatial data layers:
  - ecoregions
  - geomorphic zones
  - hydrological index
  - present ecological status
  - aquatic vegetation classes
  - vegetation bioregions

What are nodes and River RUs?

- **Nodes** are locations of interest (points) in a river basin (rivers, dams, wetlands, estuaries)
- Are sited using:
  - Water infrastructure (gauging weirs, dams, water transfers)
  - Aquatic ecosystem attributes (flow, geology, vegetation, ecological condition)
- Are used to allocate water for environment and development

- **River resource units (RUs)** are river basins (grouped areas) deemed similar in terms of:
  - Flow (constant flow or not)
  - Where it is located in the basin (mountain streams, foothills, lowlands)
  - River bank vegetation type
  - Neighbouring land-based vegetation type
- Are used to transfer information between basins

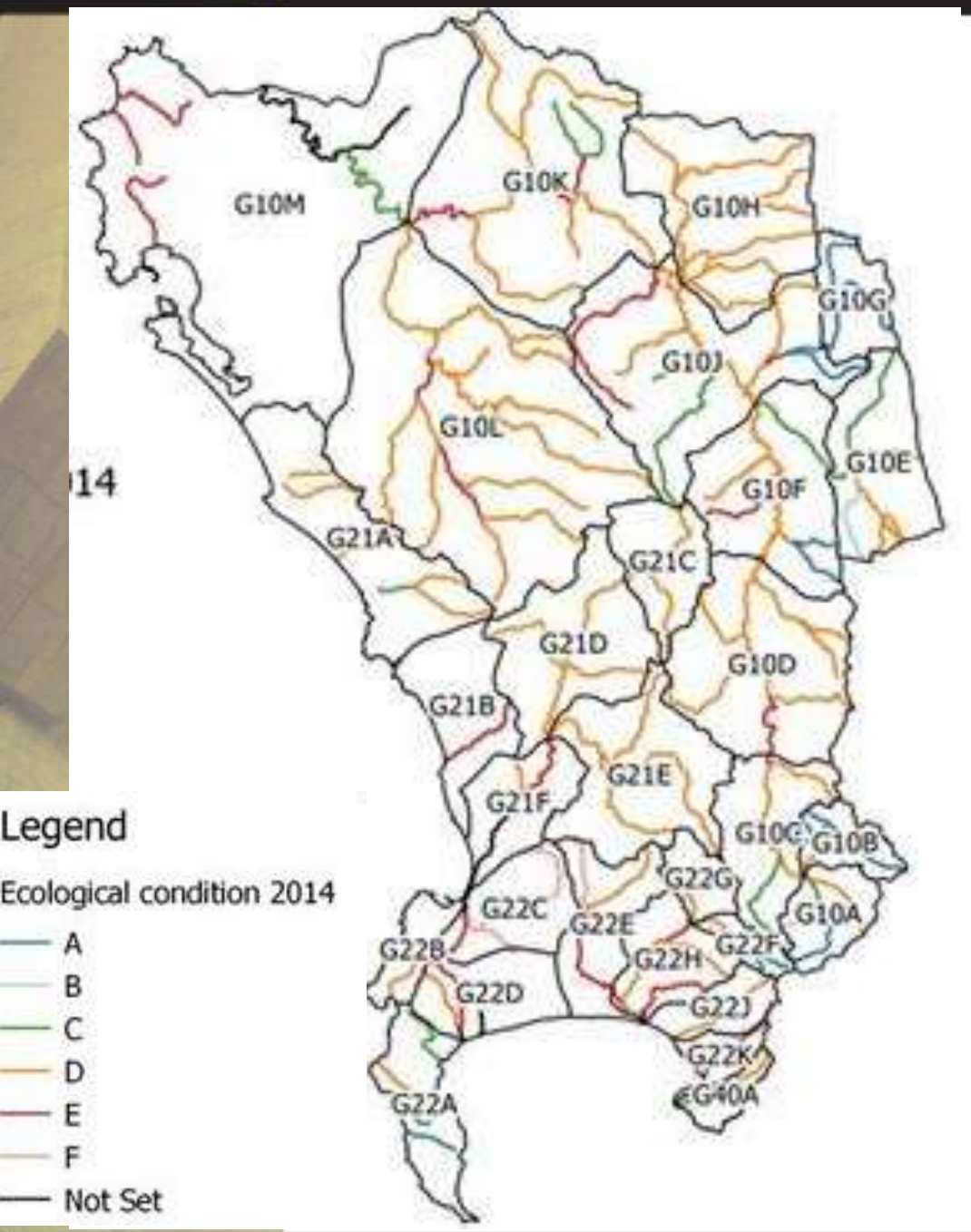


Total of 47 Biophysical Nodes Identified

Biophysical Nodes identified for EWRs

- A total of 47 biophysical nodes identified using standardised approach.
- Many existing reserves studies have been undertaken (preliminary and comprehensive).
- PES from previous studies:
  - 1999
  - 2014
- Updated EWRs to be determined for all nodes
- Additional sampling required in G2 nodes.
- Existing desktop reserves upgraded to Rapid Level II

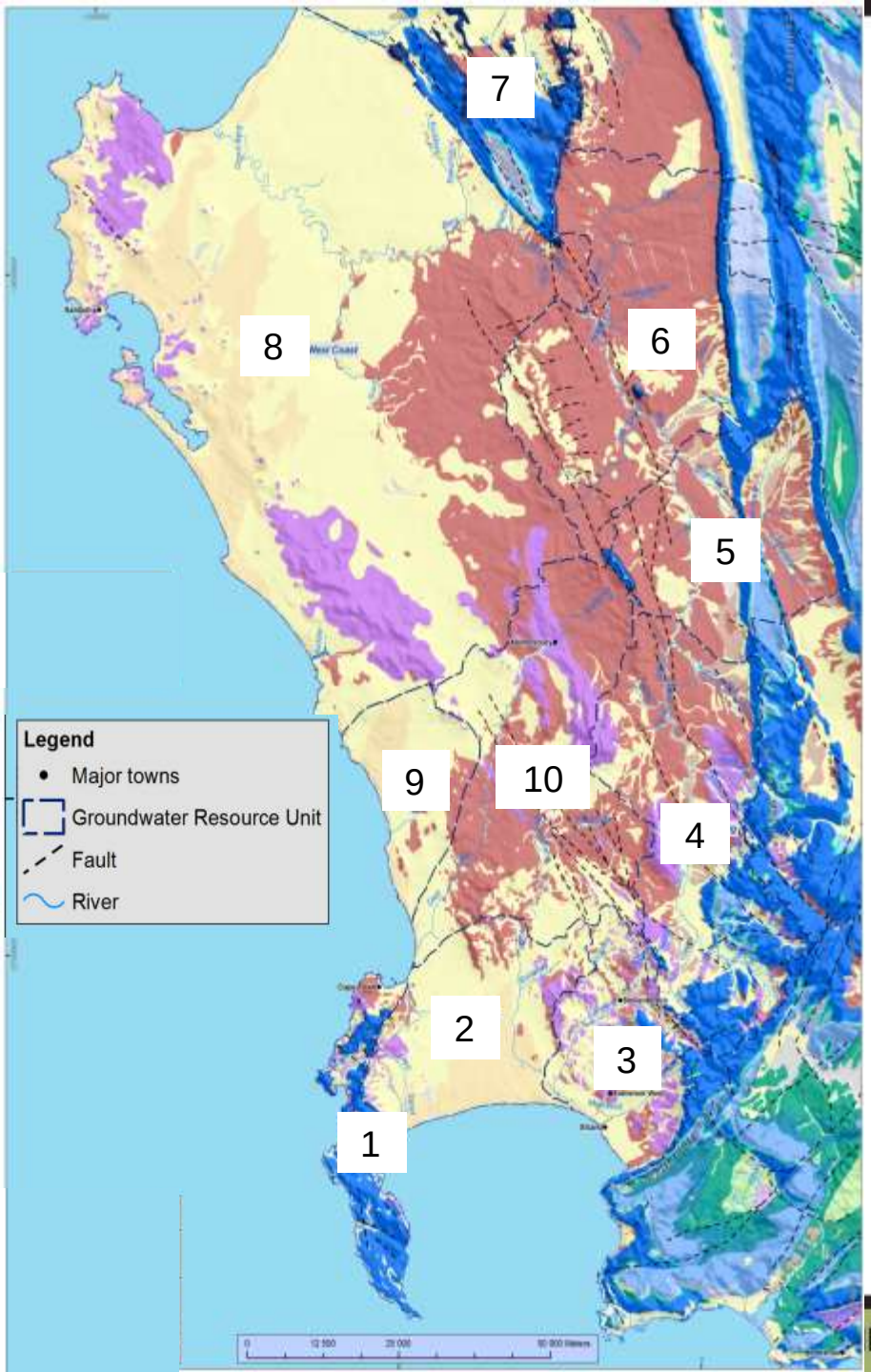
Present Ecological State of River Nodes



BERG	EC	A	B	C	D	E
Dwars Mosselbank	1999			50	50	
	2014				50	50
Diep Mosselbank	1999			20	80	
	2014				100	
Cape Flats	1999					100
	2014				50	50
Peninsula	1999			100		
	2014			50	50	
Lourens Eerste	1999			33	67	
	2014			17	50	33
Upper Berg	1999				100	
	2014	13		25	50	13
Middle Berg	1999				100	
	2014				100	
Lower Berg	1999			8	92	
	2014	8		8	77	8
Berg Tributaries	1999		50	50		
	2014	50	50			
Berg Estuary	1999			100		
	2014			100		

Groundwater RUs and Status Quo

- Delineation of Groundwater Resource Units (GRUs)
  - Surface water divides on a quaternary and secondary level
  - Geological structures (i.e. fault, hydrostratigraphy or lithological contact zones)
  - River systems
  - Recharge and discharge zones
  - Groundwater use
  - Groundwater management (size and extent of units)
- Status Quo Assessment:
  - Annual Recharge (Annual sum = 721 Mm^3/a)
  - Discharge (including to baseflow)
  - Groundwater use (Registered use = 66 Mm^3/a)
  - Groundwater quality (assessed based on average samples according to DWAF drinking water limits)
- Potential for additional GW modelling in study.



10 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

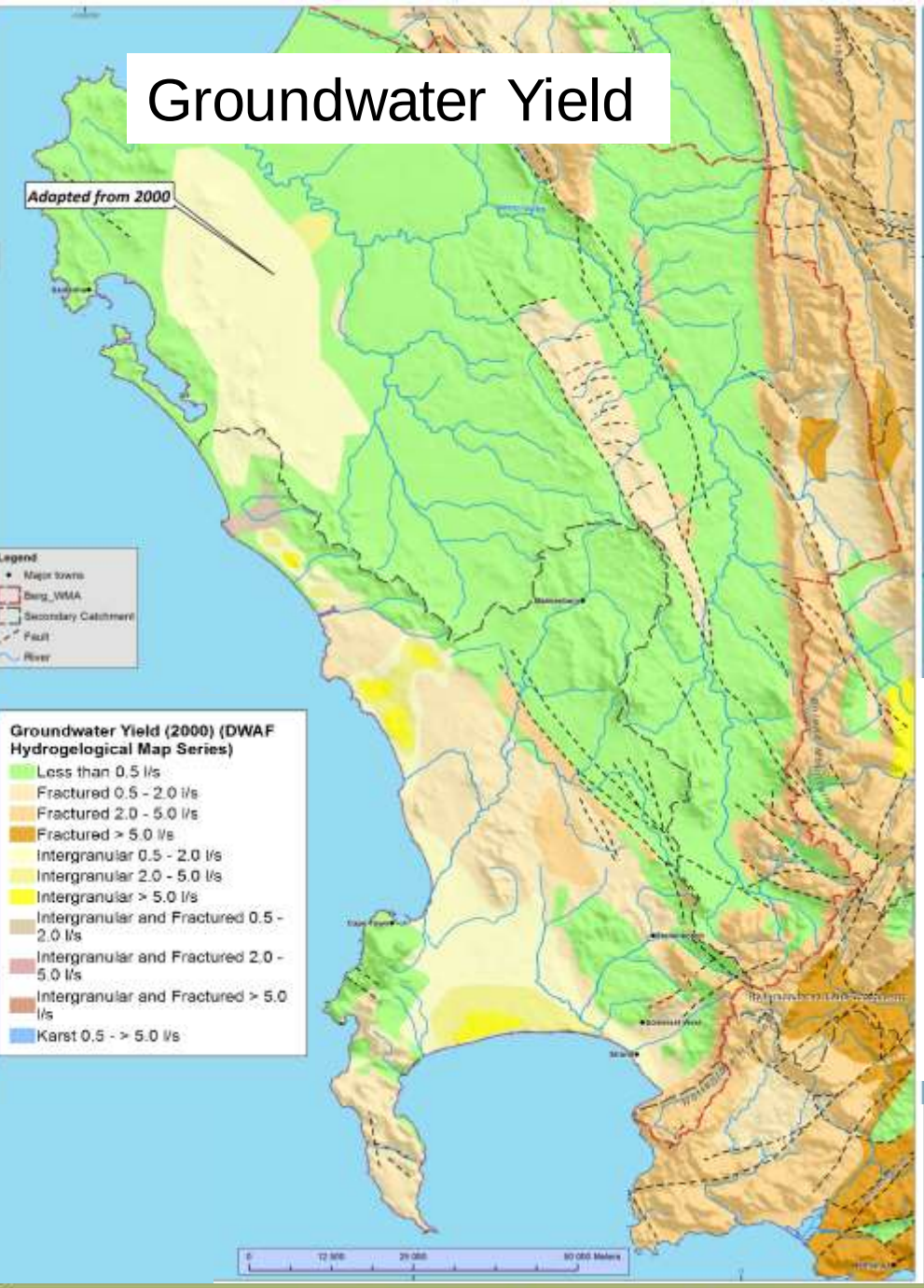
Cape Supergroup
- Witteberg Group

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

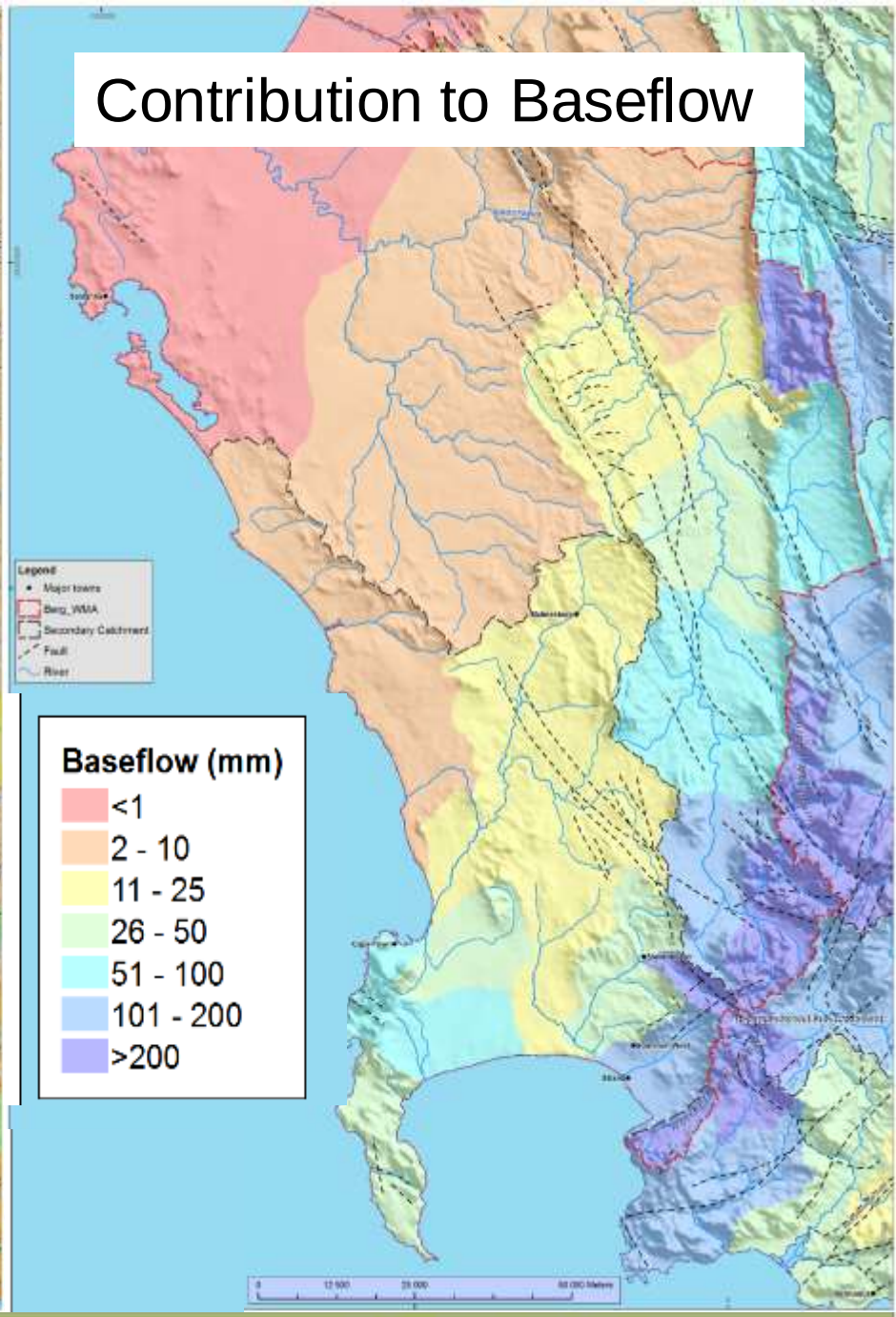
Table Mountain Group
- Nardouw Sub-Grp
- Skurweberg FM
- TMG (undifferentiated)
- Cedarberg (shale) FM
- Peninsula FM
- Piekenierskloof & Graafwater FM

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

Groundwater Yield



Contribution to Baseflow



Water Quality

- Water quality (WQ) is a significant concern particularly in the lower Berg River IUA, but also in the Cape Flats aquifer and rivers.
- Existing information from DWS and CoCT data.
- Status quo assessment includes ‘fitness-for-use’ estimate for different water user groups:
  - irrigation water use
  - domestic water use
  - water ecosystems

Water Quality Analysis – Present day "fitness for use" for selected water quality variables at selected sampling locations.

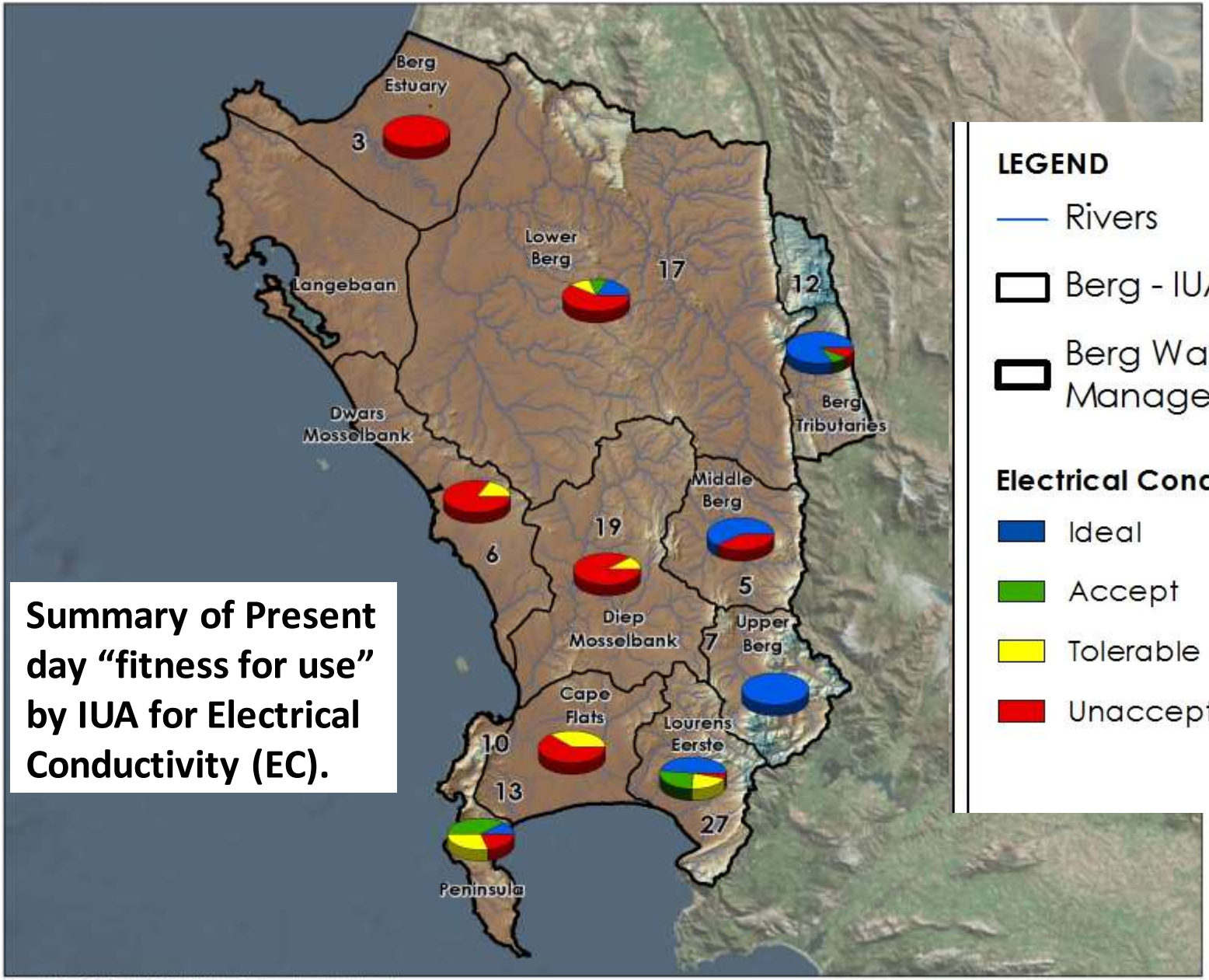
Lower Berg IUA (B4)

		Chloride		TDS		EC		NO3+NO2-N		pH		PO4-P		SO4		
Station	IUA	50	95	50	95	50	95	50	95	50	95	50	95	50	95	
G1H013Q01	B4															
G1H029Q01	B4															
G1H031Q01	B4															
G1H034Q01	B4															
G1H035Q01	B4															

Upper Berg IUA (D7)

		Chloride		TDS		EC		NO3+NO2-N		pH		PO4-P		SO4	
Station	IUA	50	95	50	95	50	95	50	95	50	95	50	95	50	95
G1H003Q01	D7														
G1H004Q01	D7														
G1H019Q01	D7														
G1H020Q01	D7														
G1H038Q01	D7														

Note: 50 = median or 50th percentile, 95 = 95th percentile. Categories: Blue = Ideal, Green = Acceptable, Yellow = Tolerable, and Red = Unacceptable, Blank = No data



Summary of Present day "fitness for use" by IUA for Electrical Conductivity (EC).

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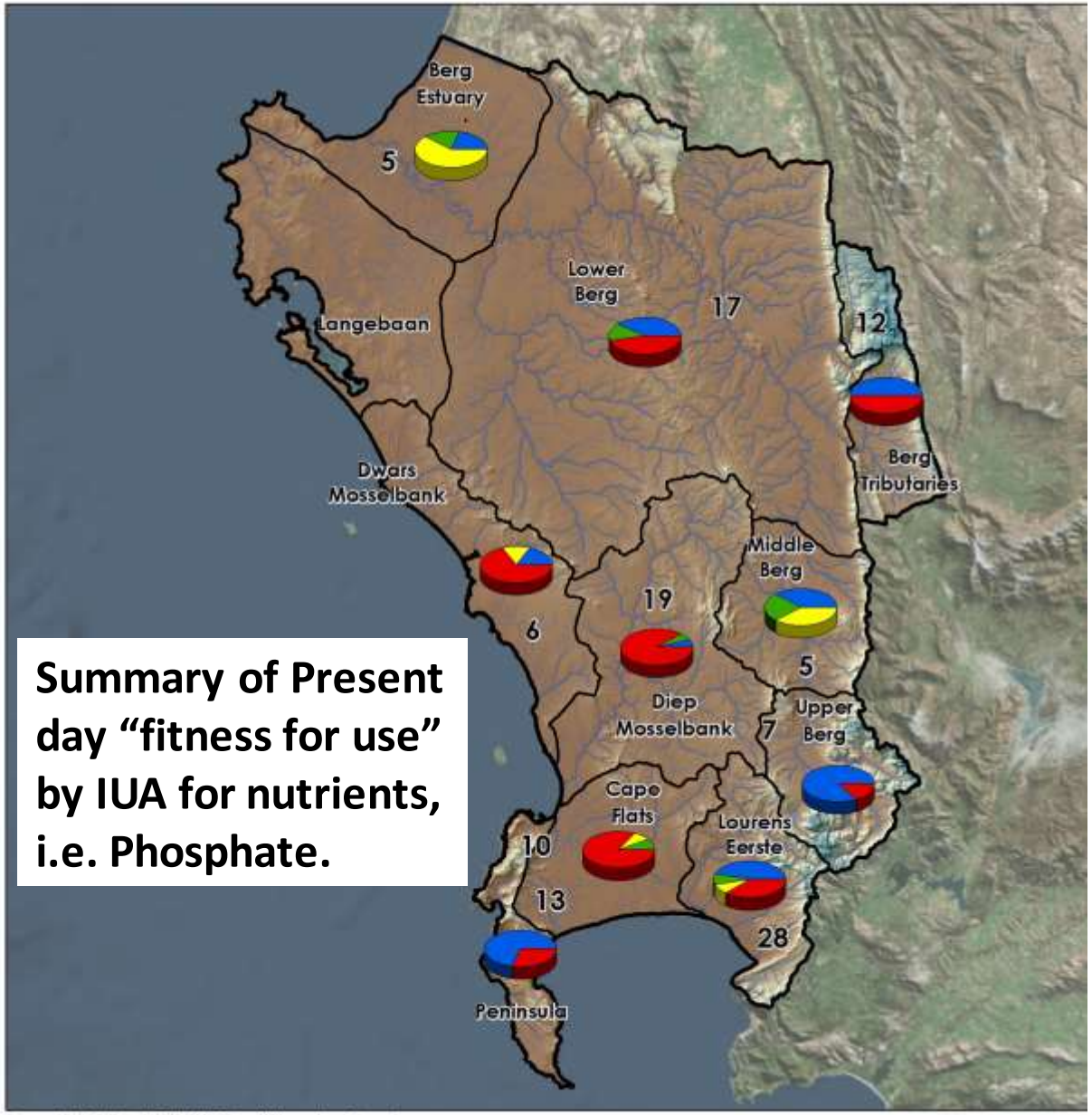
Berg Estuary
5
Lower Berg
17
12
Langebaan
Berg Tributaries
Dwars Mosselbank
Middle Berg
19
6
5
Diep Mosselbank
7
Upper Berg
Cape Flats
Lourens Eerste
10
13
28
Peninsula
Summary of Present day "fitness for use" by IUA for nutrients, i.e. Phosphate.
LEGEND
Rivers
Berg - IUAs
Berg Water Management Area
Phosphates (%)
Ideal
Accept
Tolerable
Unacceptable
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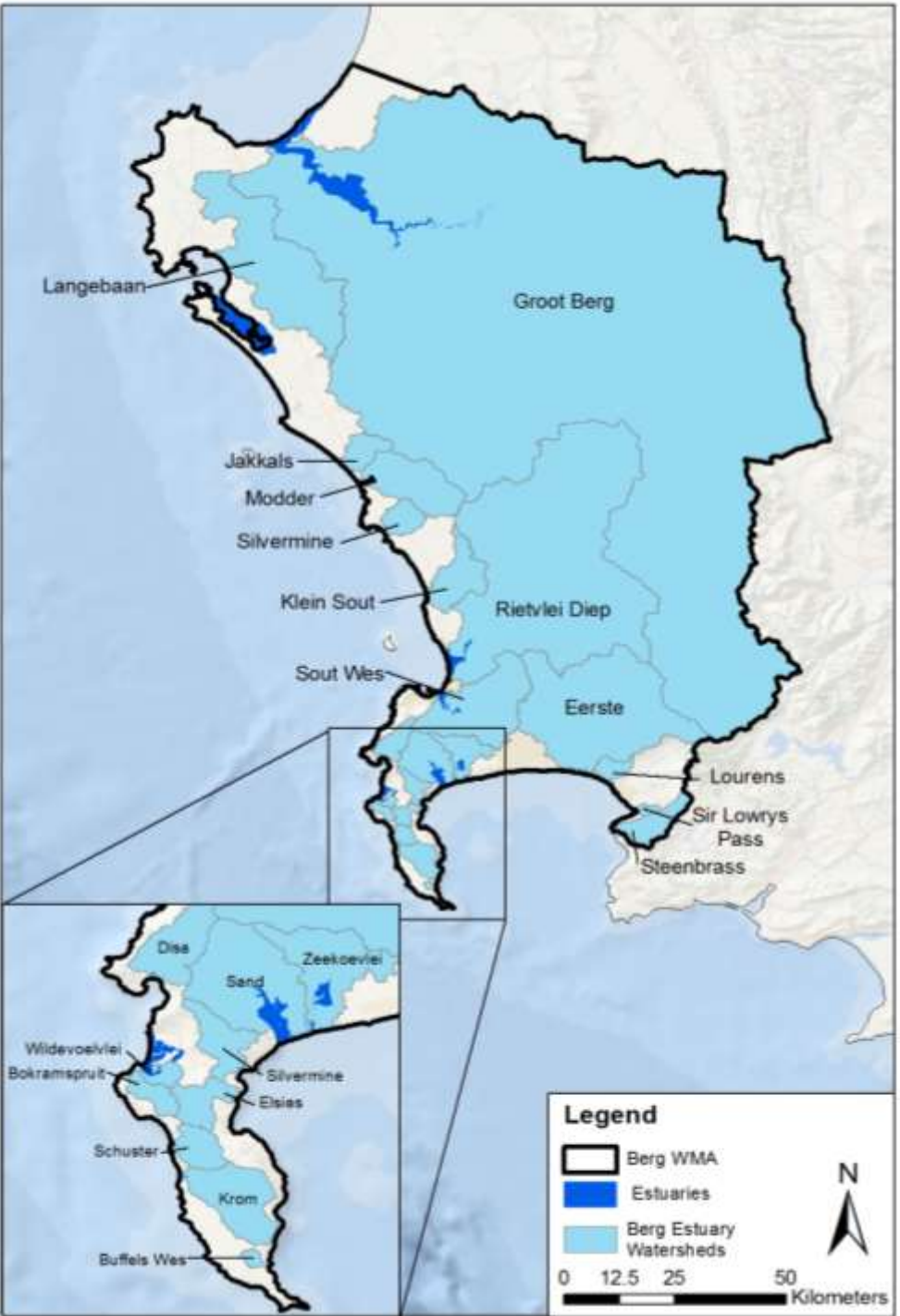


Estuaries

- 22 estuaries in total (8 priority)
- Berg River estuary and Langebaan are most important
- Langebaan primarily GW fed.
- Updated PES as part of study.

Estuary	Catchment size (km^2)	MAR (million $m^3.yr^{-1}$)	Estuary Functional Zone (ha)	Type Whitfield (1992)
Berg (Groot)	7 765	562	9 197	Permanently open
Langebaan	502	Ground water	6 260	Estuarine Bay
Rietvlei/Diep	1 522	37	834	Temporarily open
Wildevöelvlei	7	5.9	266	Temporarily open
Sand	87	30	307	Temporarily open
Zeekoe	60	17	366	Permanently open
Eerste	628	101	55	Temporarily open
Lourens	27	59	38	Temporarily open

Status Quo Assessment for Priority Estuaries in Berg Study Area

Estuary	PES	Ecological Importance	REC
Groot Berg	C	98	Best attainable state
Langebaan	B	Highly important	Best attainable state
Diep	E	96	C
Wildevoelvlei		86	
Sand	D	92	C
Zeekoe	E	Low importance	D
Eerste	E	65	D
Lourens	C	52	D

5 Wetland Resource Units

- Many wetland types identified in the study area.
- 5 Wetland Resource Units (WRUs) defined.
- 13 priority wetlands identified (excluding in estuaries)
- PES of priority wetlands from recent studies (Malan, 2014).

	Wetland Resource Unit
1	South Western Coastal Belt (Sand)
2	South Western Coastal Belt (Shale)
3	Western Folded Mountains
4	Southern Folded Mountains
5	Southern Folded Mountains (Peninsula)

Status Quo Assessment (EIS and PES) of Priority Wetlands

Priority Wetlands	EIS	PES
Witsand	5.2	
Yzerfontein Soutpan	6.1	B
Koekispan	2.8	D
Kiekoesvlei	4.9	D
Rietvlei	A	C
Kleinplaats West	5.3	A
Noordhoek Soutpan	5.1	
Silvermine Dam	5.9	A
Kennilworth Racecourse		A
Princess Vlei	C	C
Zeekoevlei		B
Khayelitsha Pool		C/D
Nooiensfontein	C	E

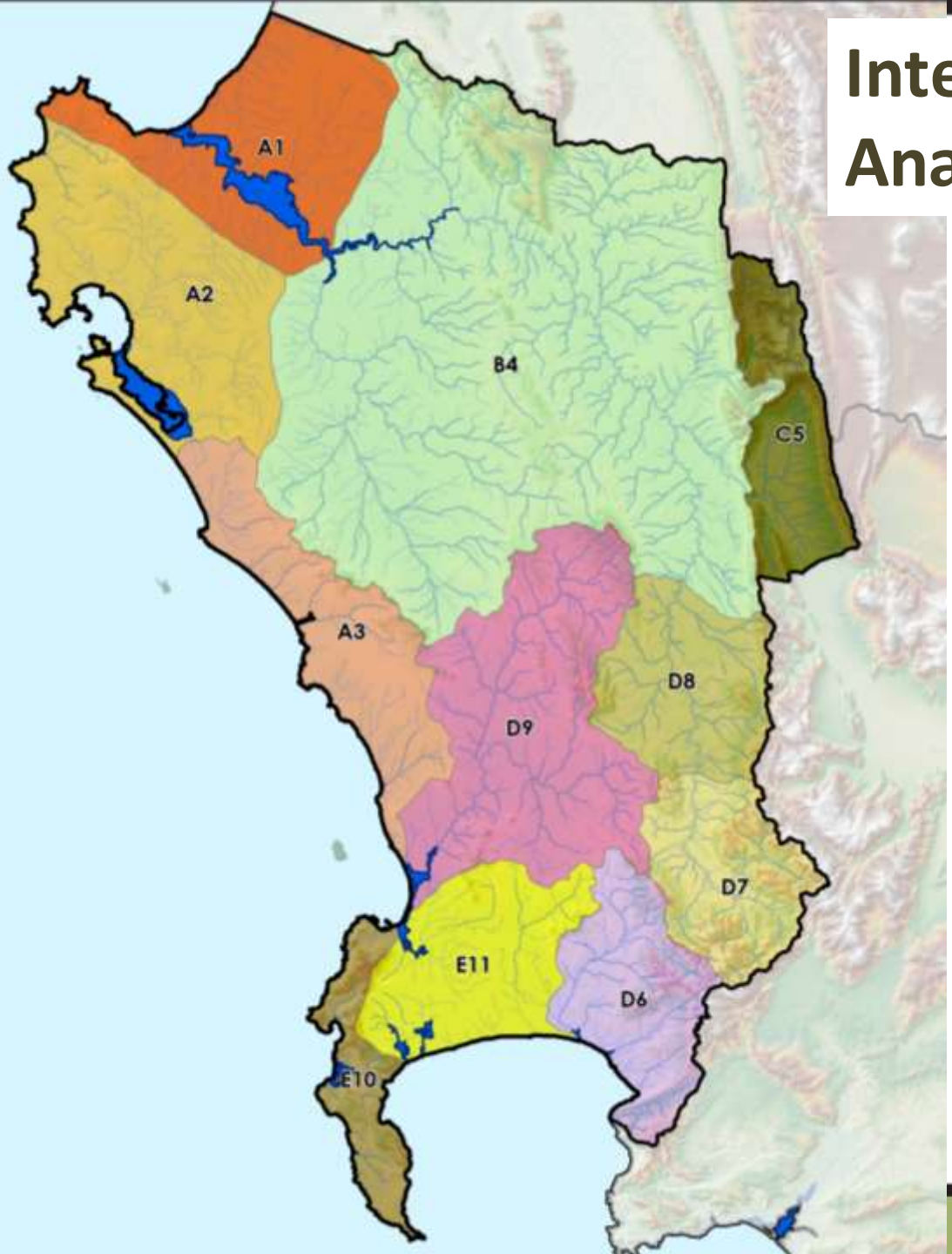
Integrated Units of Analysis (IUAs)

- Identified **significant resources**:
  - Based on Physical, Biological & Socio-economic including critical infrastructure and land use types.
- Each IUA represents a similar area requiring a Water Resources Class (WRC)
- Why do we need these?
  - Broad-scale units to assess socio-economic impacts of scenarios *(possible future situations).*
  - Report ecological condition at sub-catchment scale.
  - Set WR Classes for different parts of the catchment.
- 11 IUAs delineated for the Berg Study Area

Summary of Proposed IUAs for Berg

Socio-economic Zone	Zone Code	IUA Name	IUA Code	Quaternary Catchments
West Coast	A	Berg Estuary	A1	G30A, G10M
		Langebaan	A2	G10M
		Dwars Mosselbank	A3	G21A, G21B
Lower Berg	B	Lower Berg	B4	G10K, G10L. G10J, G10H, G10F
Tulbagh Fruit Area	C	Berg Tributaries	C5	G10G, G10E
Winelands	D	Lourens Eerste	D6	G22G, G22H, G22F, G22J, G22K. G40A
		Upper Berg	D7	G10C, G10B, G10A
		Middle Berg	D8	G10D
		Diep Mosselbank	D9	G21C, G21D, G21E, G21F
Cape Town	E	Peninsula	E10	G22B, G22A
		Cape Flats	E11	G22C, G22D, G22E

Integrated Units of Analysis (IUAs)



A1	Berg Estuary
A2	Langebaan
A3	Dwars Mosselbank
B4	Lower Berg
C5	Berg Tributaries
D6	Lourens Eeerste
D7	Upper Berg
D8	Middle Berg
D9	Diep Mosselbank
E10	Peninsula
E11	Cape Flats

Thank you!

- For more information:
  - Previous studies and relevant documents:
    - DWS RDM Website: Documents and Projects www.dwa.gov.za/rdm/Documents.aspx
  - Register on project specific web-site or email:
    - www.BergClassRQO@wix.com
    - Berg.Class.RQO@gmail.com
- For more information contact:
  - DWS (Pretoria): Adaora Okonkwo (OkonkwoA@dws.gov.za)
  - DWS (WC): Derril Daniels (DanielsD@dws.gov.za)
  - Project Team: James Cullis (James.cullis@aurecongroup.com)

Information gaps identified

- Many existing EWR and Reserve studies in catchment.
- Recent assessment of PES missing for G2 river nodes.
- Update assessment of PES for estuaries is needed, but there is sufficient information to not require additional sampling.
- Existing hydrological and water resources models.
- Potential need for additional GW modelling and analysis.
- Updated analysis of linking value to the resource is required, but can use existing studies for ecosystems services value.

- Slide 6

Berg IUAs and River, Dam, Estuary and Wetland Nodes.

Berg IUAs and River, Dam, Estuary and Wetland Nodes.