water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

DETERMINATION OF WATER RESOURCE CLASSES AND ASSOCIATED RESOURCE QUALITY OBJECTIVES IN THE THUKELA CATCHMENT

Estuary Technical Task Group Meeting

Presented by:
Golder Project Team

Date: 26 April 2021

Agenda

13h00	1	Welcome and Introductions	Chair
13h05	2	Attendance and Apologies	**Chair**
13h10	3	Acceptance of Agenda	**All**
13h15	4	Purpose of Meeting: • Discuss and clarify the scope for the determination of classes and Resource Quality Objectives for Thukela Estuary • Propose a way forward for management of the estuary	**Chair**
13h20	5	Presentation by Estuarine Specialist on the approach and procedure followed for the determination of the Class and setting of associated Resource Quality Objectives for the Thukela Estuary	**Study Team**
13h50	6	Discussion on gaps identified	**All**
13h30	7	Additions 7.1 7.2	**All**
14h30	9	Way Forward and Closure	**DWS**

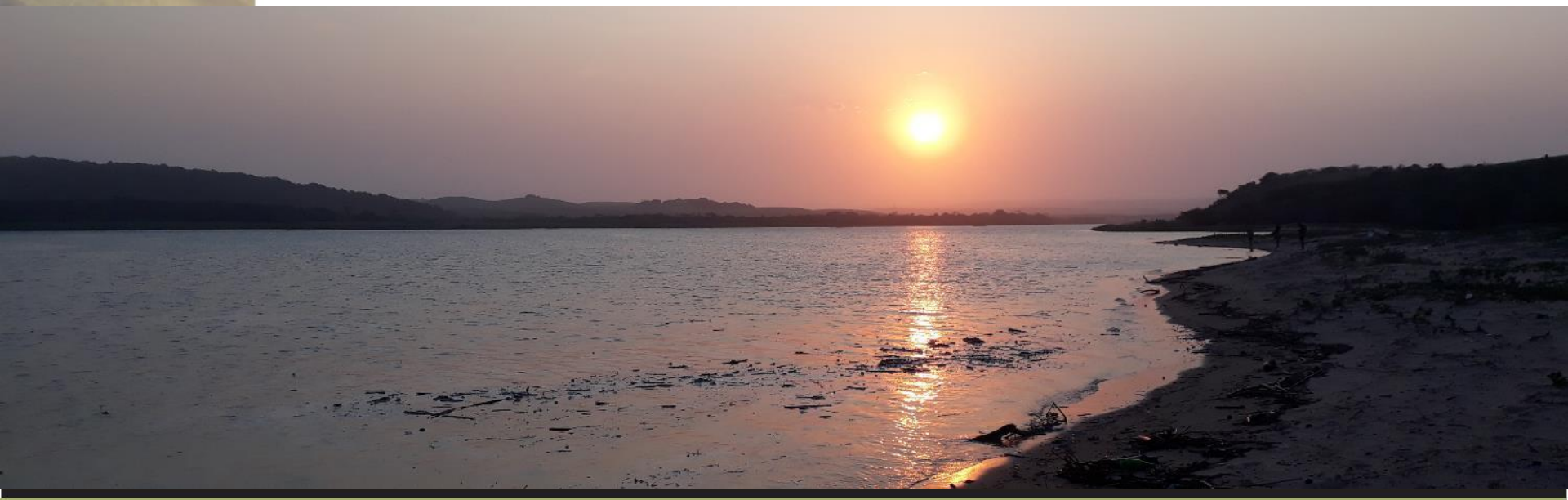
Objective

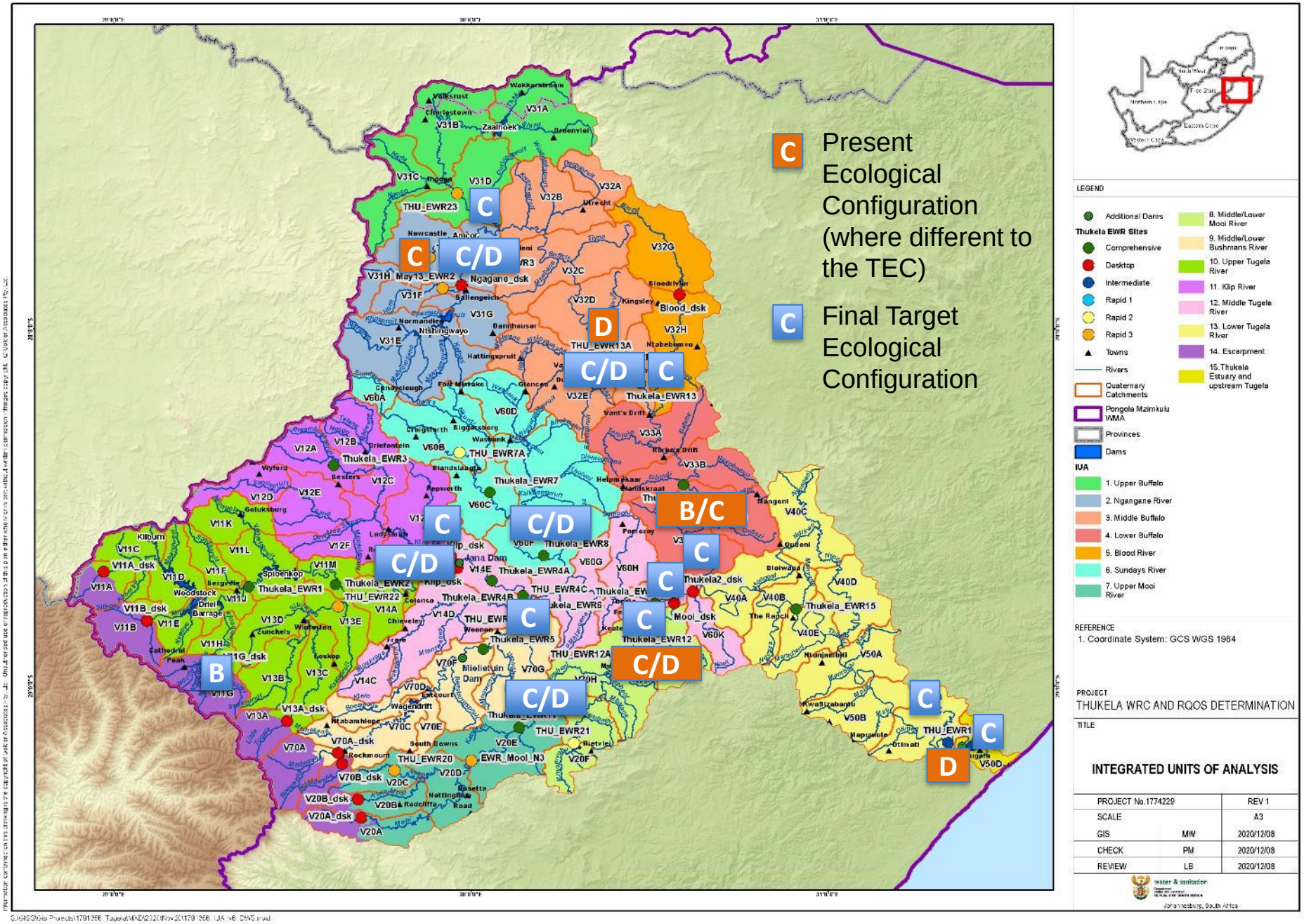
- Determine appropriate water resource class (Class I: Minimally used – Class III: Heavily used) and Resource Quality Objectives (RQOs) to facilitate the sustainable use of water resources while maintaining ecological integrity by maintaining or improving the Present Ecological Status (PES) of water resources.
- Specialist technical assessment and stakeholder engagement are key components to the process.

[NB: Preliminary intermediate level Ecological Reserve study (DWAF, 2004) is available and relevant. Information has been adopted and gaps filled where necessary.]

Steps 1 & 2

1. Delineate and prioritise Resource Units (RUs) and select study sites
2. Describe status quo and delineate the study area into Integrated Units of Analyses (IUAs)




C
Present Ecological Configuration (where different to the TEC)
C
Final Target Ecological Configuration
LEGEND
Additional Dams
Thukela EWR Sites
Comprehensive
Desktop
Intermediate
Rapid 1
Rapid 2
Rapid 3
Towns
Rivers
Quaternary Catchments
Pongola Mzimkulu WMA
Provinces
Dams
IUA
1. Upper Buffalo
2. Ngagane River
3. Middle Buffalo
4. Lower Buffalo
5. Blood River
6. Sundays River
7. Upper Mooi River
8. Middle/Lower Mooi River
9. Middle/Lower Bushmans River
10. Upper Tugela River
11. Klip River
12. Middle Tugela River
13. Lower Tugela River
14. Escarpment
15.Thukela Estuary and upstream Tugela
REFERENCE
1. Coordinate System: GCS WGS 1984
PROJECT
THUKELA WRC AND RQOS DETERMINATION
TITLE
INTEGRATED UNITS OF ANALYSIS
PROJECT No.1774229
REV 1
SCALE
A3
GIS
MW
2020/12/08
CHECK
PM
2020/12/08
REVIEW
LB
2020/12/08
water & sanitation
Johannesburg, South Africa

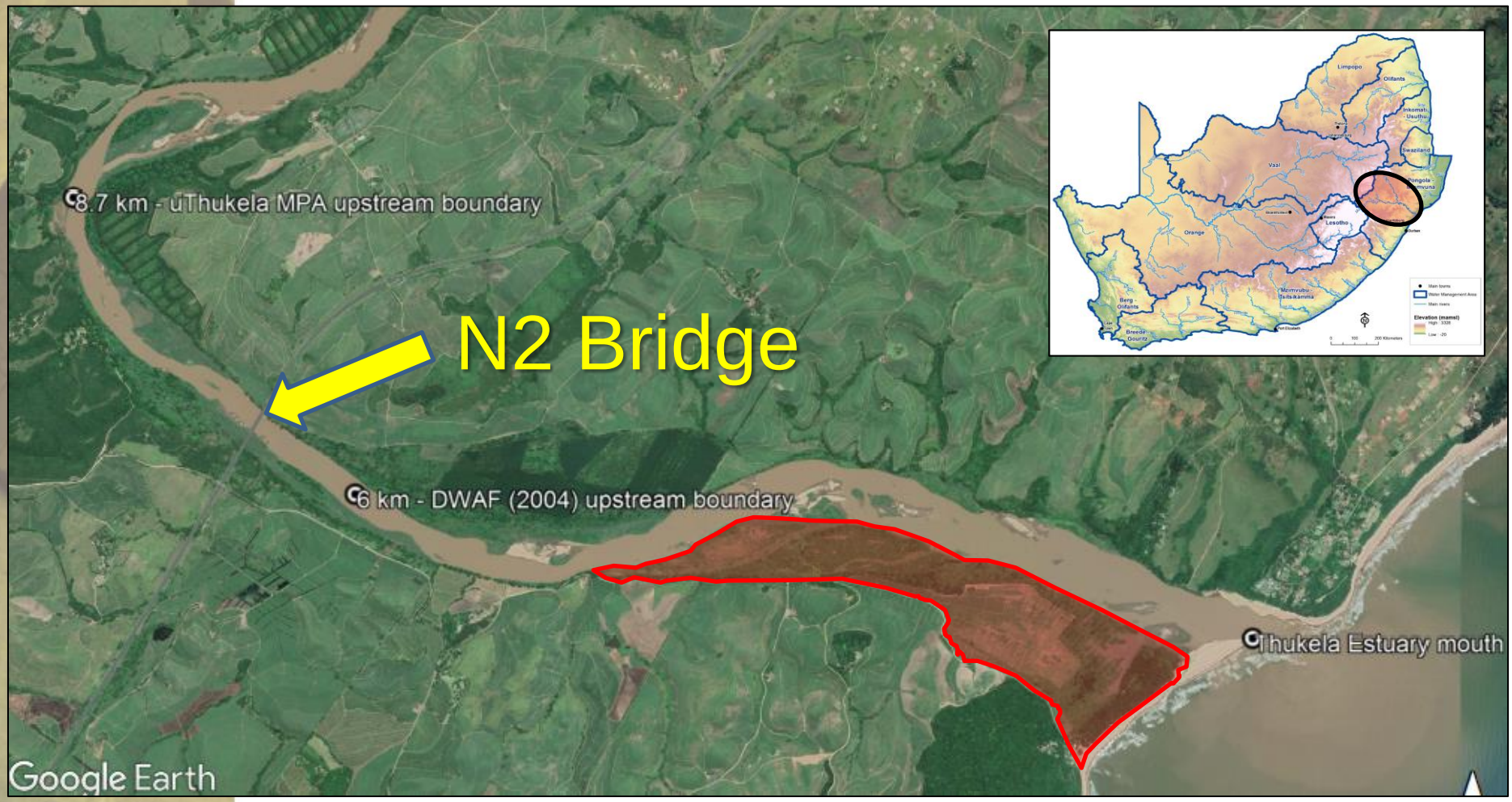
IUA Ecological Configurations for the PES and TEC

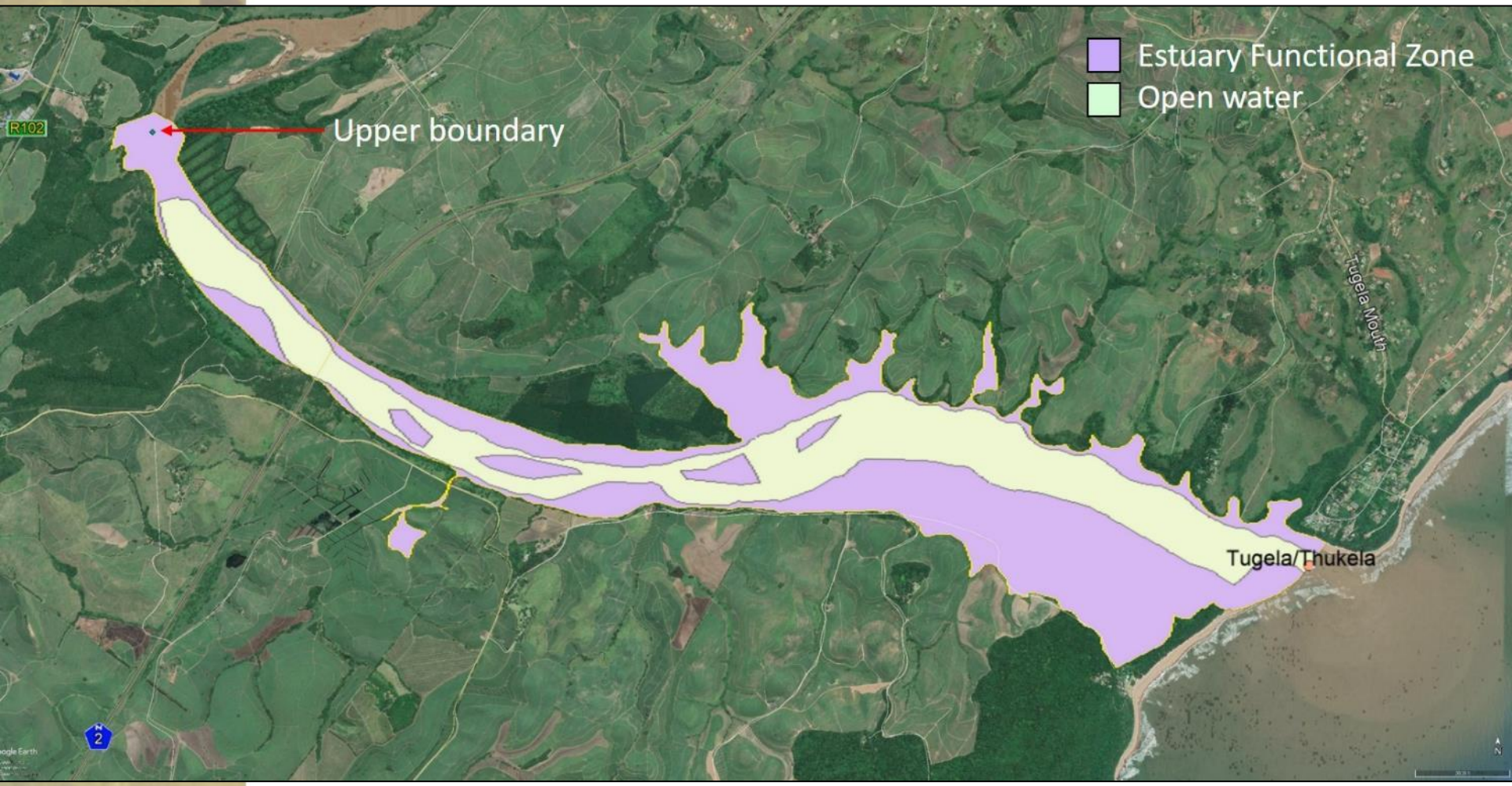
	IUA	Quaternary Catchment	PES	EI/ES	TEC
1	Upper Buffalo	V31D	C	High	C
2	Ngagane	V31K	C	Low	C/D
3	Middle Buffalo	V32H	D	Moderate	C/D
4	Lower Buffalo	V33B	B/C	High	C
5	Blood	V32H	C	High	C
6	Sundays	V60C	C/D	Moderate	C/D
7	Upper Mooi	V20G	C/D	Moderate	C/D (with a long term B/C)
8	Lower Mooi	V20H	C/D	High	C
9	Middle/ Lower Bushmans	V70G	D	High	C
10	Upper Thukela	V11M	C/D	Moderate	C/D
11	Klip	V12A	C	High/very high	C
12	Middle Thukela	V60J	C	Moderate	C
13	Lower Thukela	V50C	C	High/moderate	C
14	Escarpment	V11A/ V11B/ V11G/ V13A/ V70A/ V70B/ V20A/ V20B	B	High/very high/ moderate	B
15	**Estuary**	**V50D**	**D**	**High**	**C**

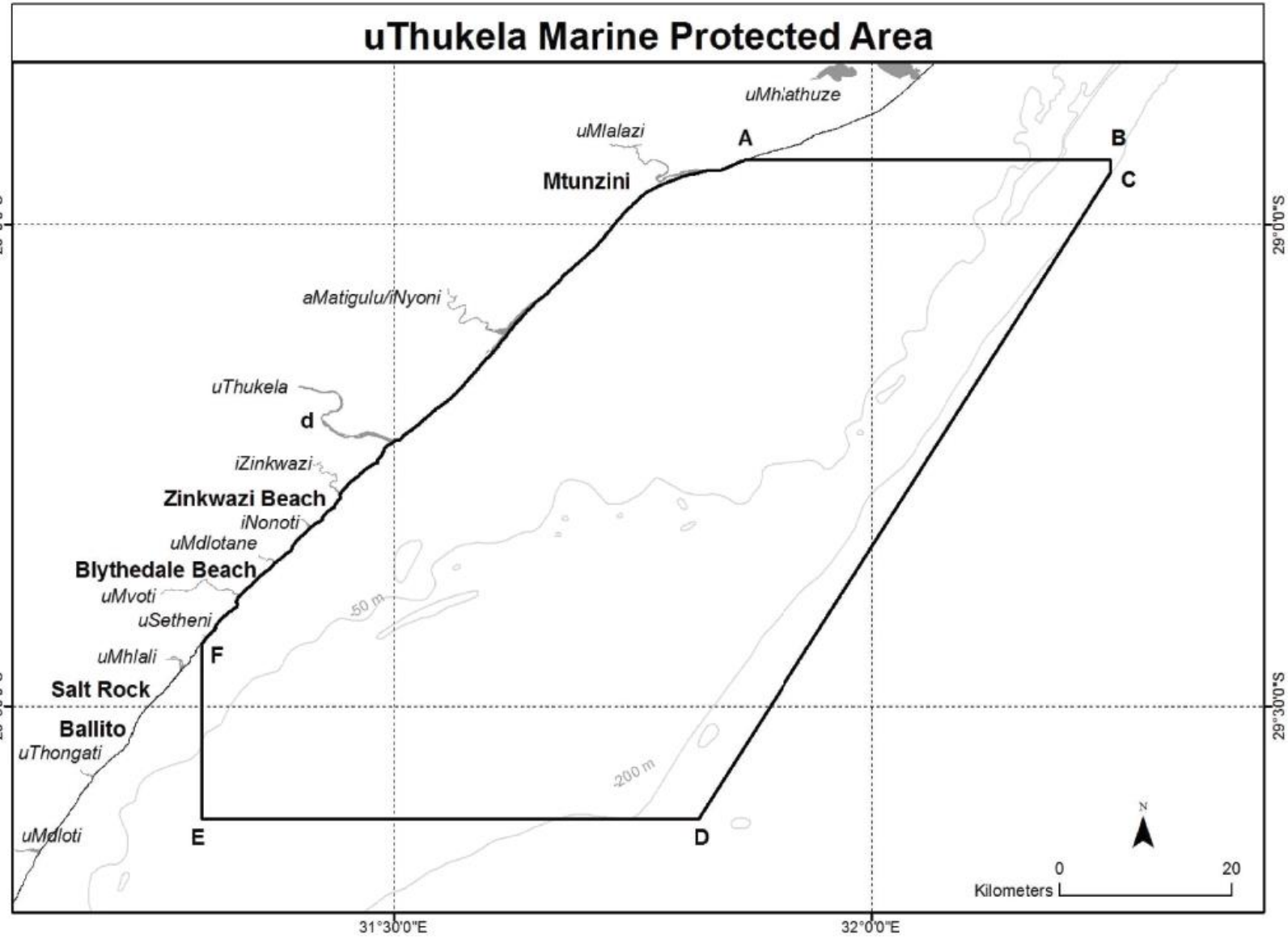
Thukela Estuary Delineation

Estuary Functional Zone (EFZ) :

- Downstream boundary – Estuary mouth (31°29’56”E, 29°13’24”S)
- Upstream boundary – Head of estuary, 8.7 km from estuary mouth (29°11’59.1”S, 31°25’27.1”E)
- Lateral boundaries - ~5 m contour above Mean Sea Level along each bank
- Estuary falls within newly proclaimed uThukela Marine Protected Area


8.7 km - uThukela MPA upstream boundary
N2 Bridge
6 km - DWAF (2004) upstream boundary
Thukela Estuary mouth
Google Earth


Estuary Functional Zone
Open water
Upper boundary
R102
Tugela Mouth
Tugela/Thukela
2



Boundaries of the uThukela Marine Protected Area; note that point d located within the Thukela Estuary is approximately 8.5 km upstream of the estuary mouth (Government Gazette 42478, 2019)

Estuary Importance (NBA 2018)

- Freshwater flow to sea transports nutrients, sediment and detritus to the marine environment.
- Approx. 73 river catchments along KZN coast, Thukela (35%) contributes the highest freshwater input of all.
- Discharge generates productive plumes and fronts (salinity, temperature, turbidity).
- These serve as temperature and turbid refugia; migration and spawning cues; fish nurseries and spawning habitat and facilitate coastal connectivity.

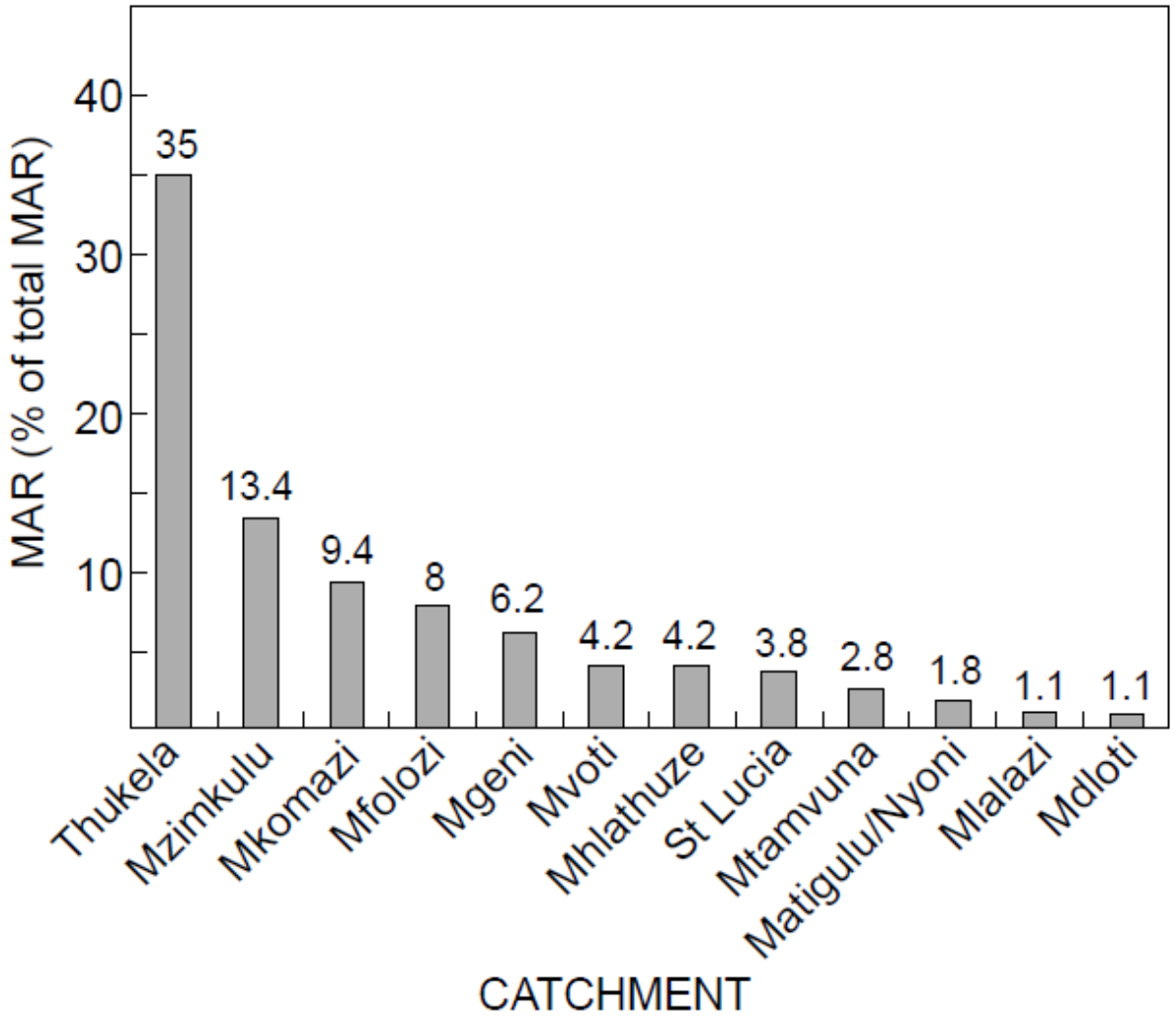
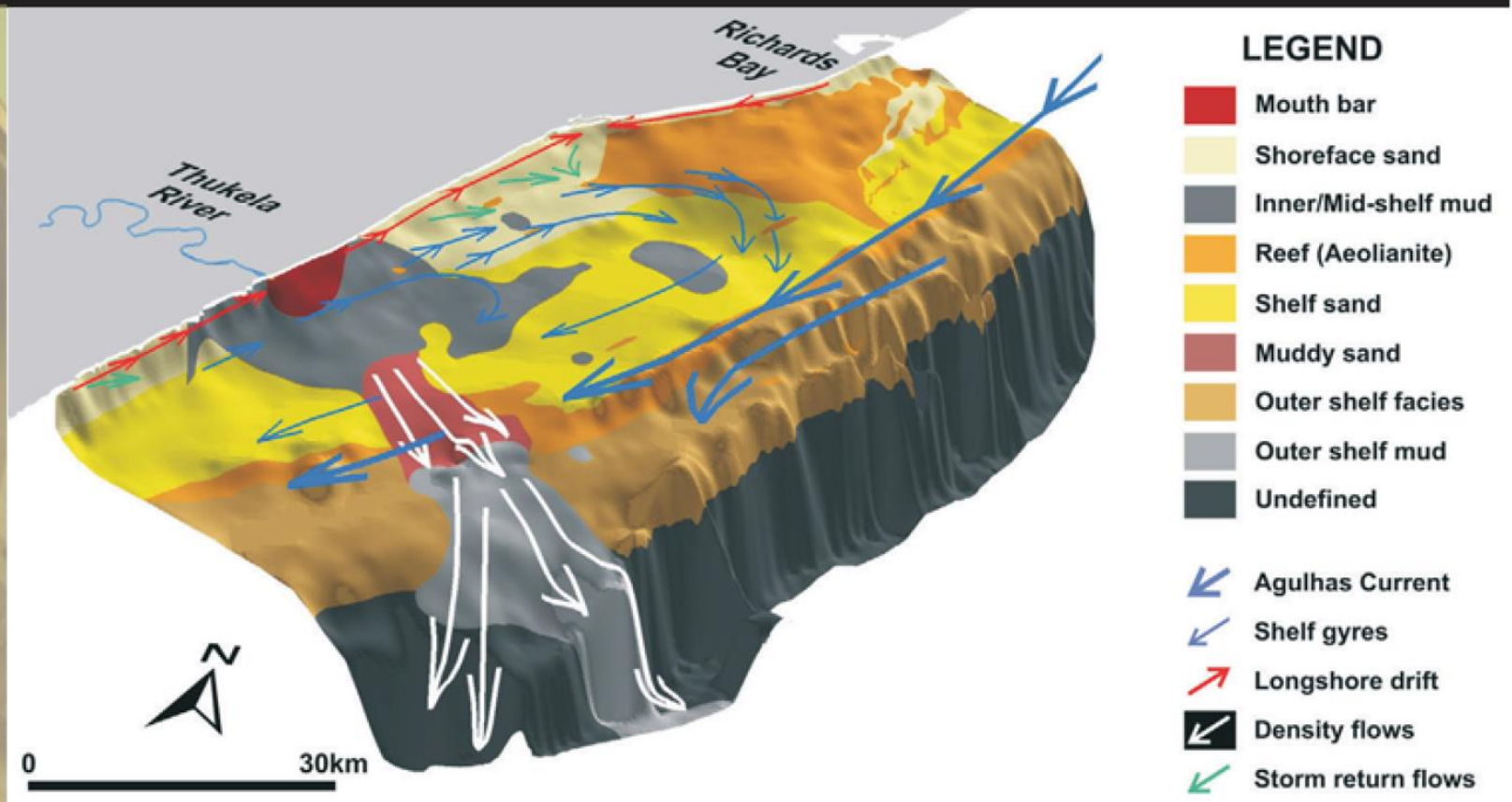


Figure 1: River catchments along the KZN coastline that contribute more than 1% to the total mean annual runoff (MAR) discharging into the sea along the KZN coast

Source: Hutchings *et al*. (2010)



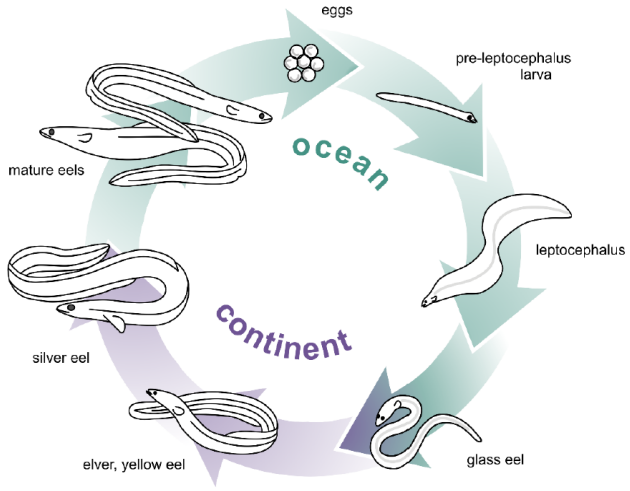
Source: Bosman *et al*. (2007)

De Lecea *et al*. (2016) – *"Thukela River organic matter is an important input to the food web of the Thukela Bank, indicating that any future damming of the catchment area could have serious consequences for this ecosystem."*

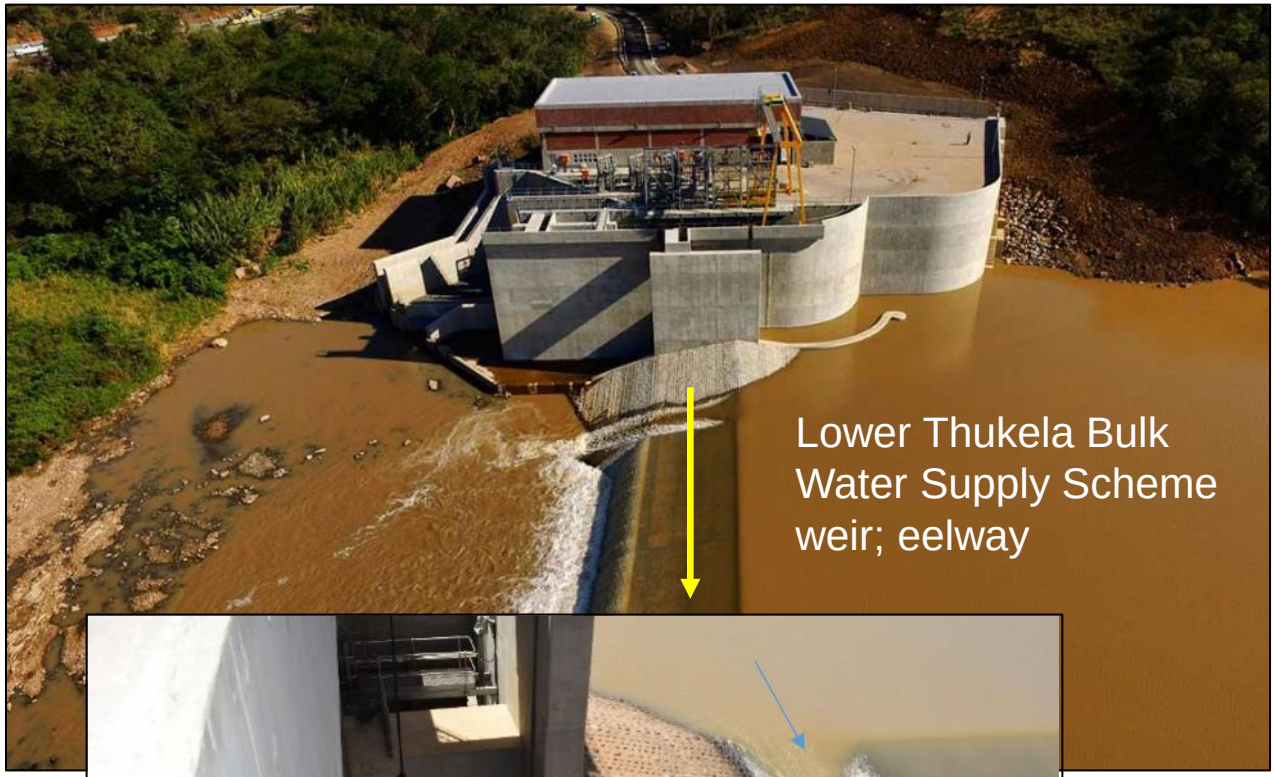
Estuary Importance (NBA 2018)

- Reduced river flow reduces coastal sediment supply affecting beach and subtidal habitats.
- Fluvial sediments maintain subtidal fluvial fans or deltas outside the Thukela Estuary mouth.
- Nearshore habitats are important for ecological processes, supporting unique biotic communities.
- Altered freshwater flow and associated supply of sediment, salinity, turbidity, nutrients and detritus impacts on marine biodiversity and fisheries resources – incl. prawn trawl and line fisheries - and decrease their socio-economic value.

- Many invertebrate and fish species migrate through the estuary, between ocean and river catchment.
- Catadromous species, e.g. Freshwater Eels (*Anguilla* spp.) and River Swimming Crabs (*Varuna litterata*), migrate from Thukela River catchment to spawn at sea.
- Threatened by loss of habitat availability and connectivity, changes to river flow and quality, and growing harvest demand.

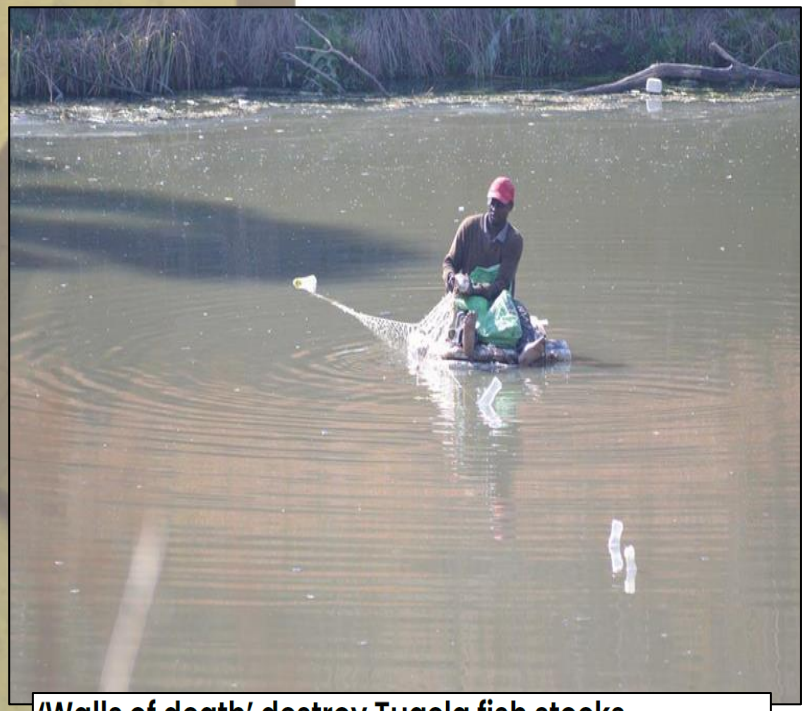


Source: Henkel et al. 2012



Source: Basson & McLeod (2019)

NBA (2018) *"River Swimming Crab recruitment through the Thukela Estuary has been impacted by the construction of the bulk water transfer scheme weir upstream of the estuary at Mandini."*



'Walls of death' destroy Tugela fish stocks

• March 14, 2019 The North Coast Courier 6 minutes read

Poaching free-for-all on the North Coast

Present Ecological Status (PES)

- Sources; DWAF (2004) and NBA (2018)
- Determined using Estuary Health Index.
- DWAF (2004): PES (C) = TEC (C)
- NBA (2018): PES (D) = REC (D)
- Estuary rated as Important; REC should be PES + 1 or BAS (minimum C)
- To improve the estuary to a TEC of a C, several non-flow related interventions are required:

Variable	PES (DWAF, 2004)	PES (NBA, 2018)
Hydrology	87 (B)	70 (C)
Hydrodynamics & mouth condition	80 (B)	75 (C)
Water quality	54 (D)	54 (D)
Physical habitat alteration	80 (B)	70 (C)
Habitat health score	**75 (C)**	**67 (C)**
Microalgae	65 (C)	60 (D)
Macrophytes	60 (D)	60 (D)
Invertebrates	60 (D)	40 (D)
Fish	70 (C)	45 (D)
Birds	70 (C)	45 (D)
Biotic Health Score	**65 (C)**	**48 (D)**
Estuarine Health Index scores	**70 (C)**	**58 (D)**

Suggested Interventions

- Rehabilitate areas within the Estuarine Functional Zone (EFZ) that have been disturbed.
- Establish a programme to manage alien invasive species within the EFZ.
- Manage fishing pressure in the estuary by including exclusion zones to protect important fish stocks and sensitive habitats.
- Improve conservation efforts, particularly focusing on eliminating the use of gillnets.
- Address possible point-source pollution from Mandini; e.g Sappi Tugela Mill, Isithebe Industrial Estate, Tugela Rail and Sumdumbili Wastewater Treatment Works.

- Prevent further disturbance and development within the EFZ, including floodplain habitat within the 5 m contour.
- Reduce human disturbance of birds.
- Develop a baseline for toxic substances in the estuary.
- Ensure Mandini gauging station V2H005 and tidal gauge V5T003 are working and well-maintained; data are crucial for long-term monitoring and management of the Thukela Estuary.
- Narrow, deeply incised estuary with large catchment, so 1:100-year flood lines lie above 5 m contour; floods reach 12 to 15 m above mean sea level. Conduct a detailed topographical survey to estimate the flood line to demarcate physically dynamic areas and indicate flood risk on a more local scale.

Step 3 – Quantify EWR

- Ecological Water Requirement (EWR) to meet DWAF (2004) Ecological Reserve; [Excl. LTBWSS abstraction; 0.64-1.27 m^3/s.]

%ile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
0,1												
1												
5												
10	33,4	65,5	151,8	302,5	534,7	275,4	96,1	34,0	24,4	19,0	16,9	24,5
15												
20	33,2	49,0	96,9	205,4	378,1	210,9	81,6	33,7	24,2	18,9	16,8	24,4
30	32,5	48,3	87,3	129,4	238,2	148,5	60,9	33,1	23,8	18,6	16,5	23,8
40	31,0	47,1	78,0	80,6	195,4	115,1	55,9	31,8	23,0	17,9	16,0	20,6
50	28,7	44,6	68,2	71,0	170,0	90,9	50,6	29,9	21,5	16,7	14,9	16,0
60	24,9	40,7	55,4	61,5	157,1	86,9	44,4	26,4	19,0	14,9	13,2	14,5
70	19,6	34,1	47,1	49,0	110,6	76,2	35,8	21,5	15,3	12,2	10,8	13,6
80	14,2	25,3	33,4	33,8	77,7	51,4	25,6	15,7	11,5	9,1	8,2	11,0
85												
90	9,3	15,4	19,9	21,3	45,2	31,0	17,0	10,9	8,1	6,5	5,9	7,4
95												
99	7,0	8,4	9,9	13,5	24,8	17,0	12,9	8,6	6,5	5,3	4,8	5,8
99,9												

Step 4 – Identify & evaluate scenarios

1. Full allocation to demand, zero water allocated to EWR:
   - Scenario 1 (1N) – Current state, no water allocated to EWR. Excess unallocated water (in the wet season), irrigational runoff, return flows and through the distribution of water by use of waterways is independent of water management allocations. Limited water available for ecological use during dry months (winter-spring).
   - Scenario 6 (2N)
   - Scenario 9 (3N)

2. Allocate to maintain current state (PES) and where possible to demand.

   - Scenario 2 (1PR) – Allocate 1474 Mm^3/a (40% of MAR) to maintain PES in rivers, allocate where possible to demand.
   - Scenario 3 (1PE) – Allocate 2947 Mm^3/a (80% of MAR) to maintain PES in rivers and estuary, allocate where possible to demand.

3. Allocate to achieve Target Ecological Category (TEC) and where possible to demand.

   - Scenarios 4 (1TR), 7 (2TR) and 10 (3TR) – Allocate 1474 Mm^3/a (40% of MAR) to ensure EWR for rivers are met. The TEC for IUA 15 (river only) is equivalent to the PES for IUA 15 (environmental effects equivalent to Scenario 2).

   - Scenarios 5 (1TE), 8 (2TE) and 11 (3TE) – Allocate 3352 Mm^3/a (91% of MAR) to ensure EWR for rivers and estuary are met. The TEC for IUA 15 (rivers and estuary) is 405 Mm^3/a larger than the current PES, so environmental effects likely to be significantly decreased.

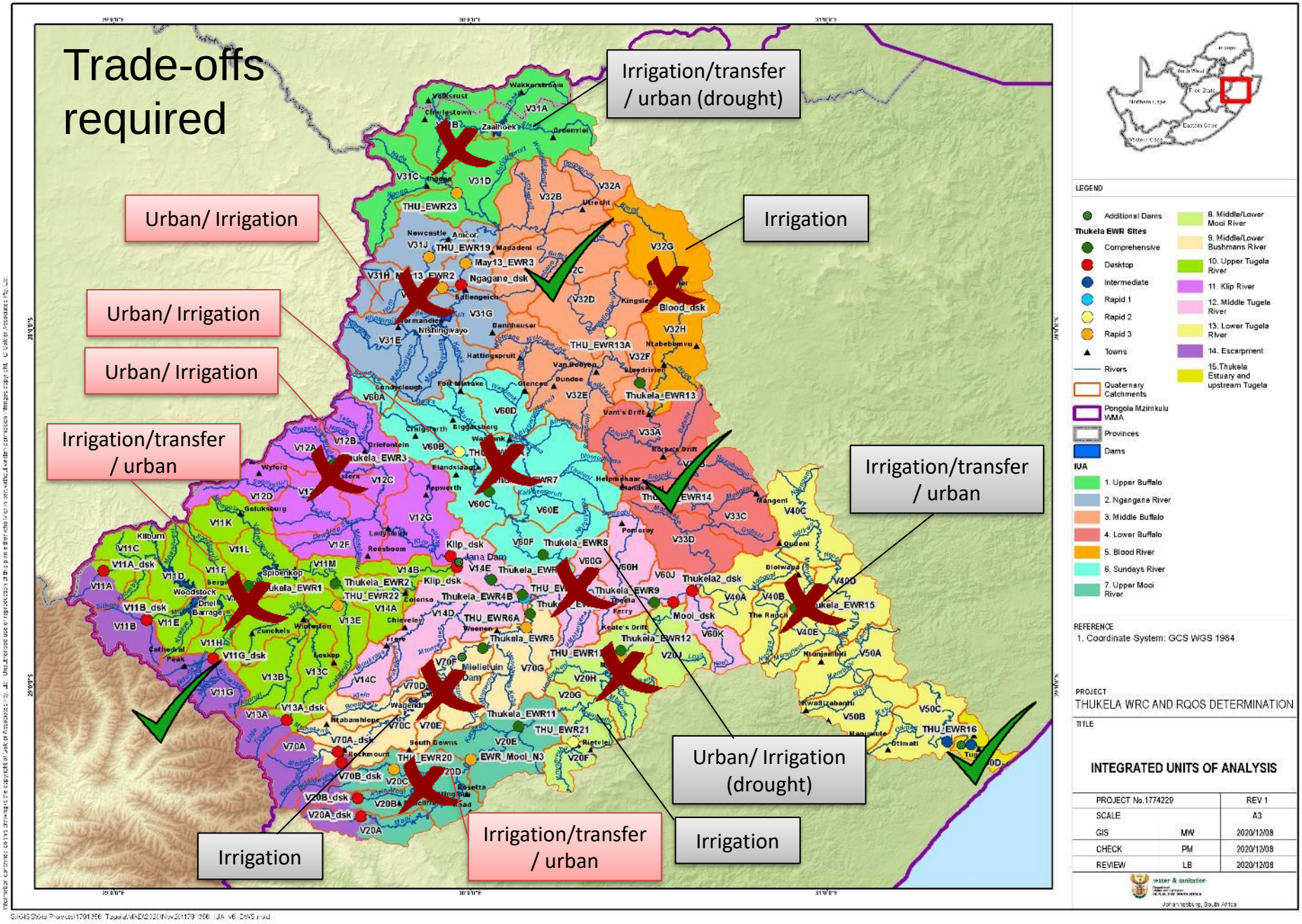
Step 5 – Determine Water Resource Classes

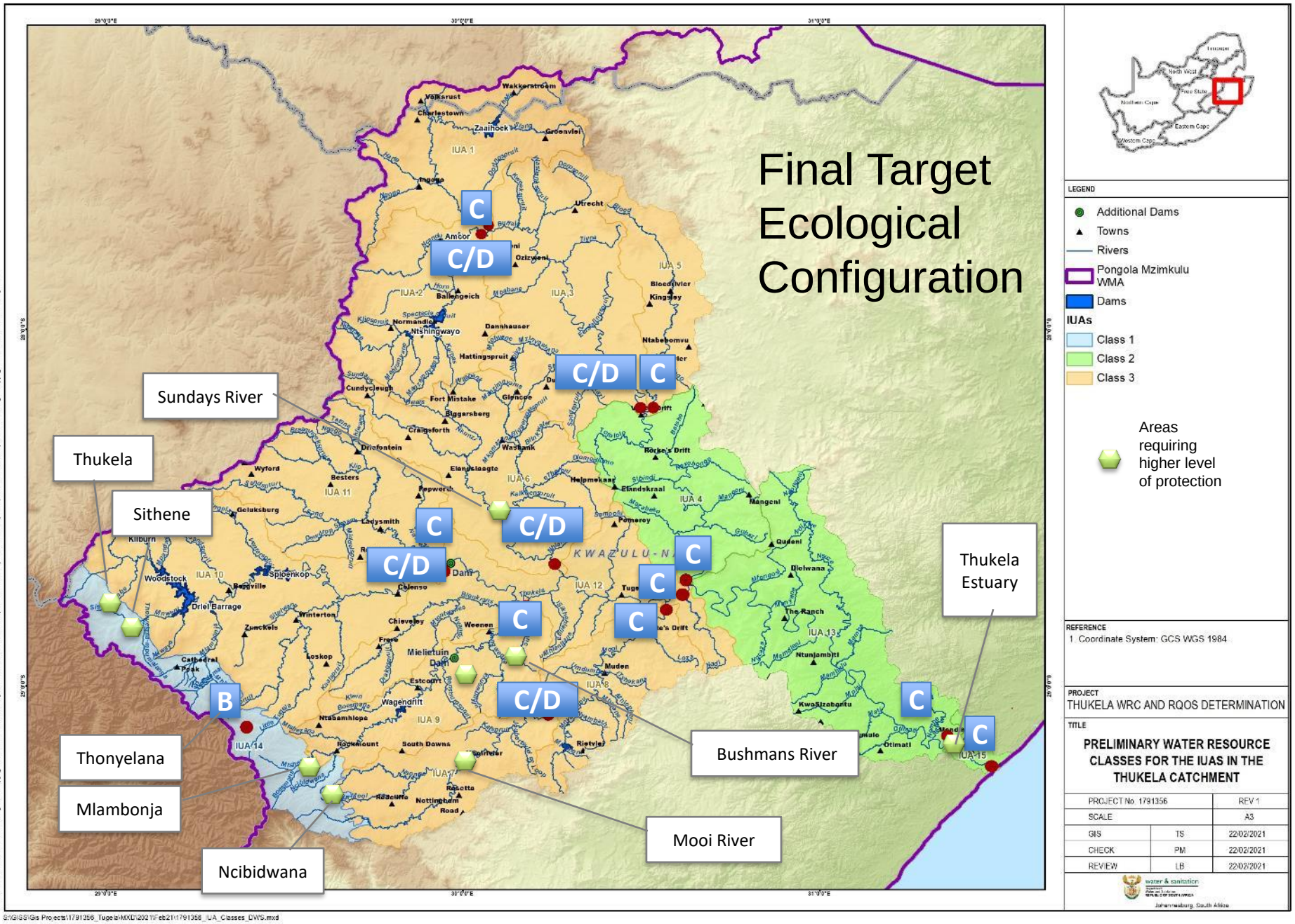
- The estuary was categorised as a D in the latest NBA (2018), however, the ecological condition (based on the Water Resource Classification System) requires that the Aggregated Ecological Category (EC) of IUA 15 be a C.

- 100% of the nodes within this IUA fall within C category, therefore, the IUA should be classified as Class III (heavily used).

- The estuary is recognised as Important, providing a crucial link between river catchment and coastal waters, and it falls within a newly proclaimed Marine Protected Area. This requires a higher level of ecological protection so it is rather classified as Class II.

Trade-offs required




Final Target Ecological Configuration
Sundays River
Thukela
Sithene
Thonyelana
Mlambonja
Ncibidwana
Bushmans River
Mooi River
Thukela Estuary
C
C/D
B
IUA 1
IUA 2
IUA 3
IUA 4
IUA 5
IUA 6
IUA 7
IUA 8
IUA 9
IUA 10
IUA 11
IUA 12
IUA 13
IUA 14
IUA 15
KWAZULU-N
LEGEND
Additional Dams
Towns
Rivers
Pongola Mzimkulu WMA
Dams
IUAs
Class 1
Class 2
Class 3
Areas requiring higher level of protection
REFERENCE
1. Coordinate System: GCS WGS 1984
PROJECT
THUKELA WRC AND RQOS DETERMINATION
TITLE
PRELIMINARY WATER RESOURCE CLASSES FOR THE IUAS IN THE THUKELA CATCHMENT
PROJECT No 1791356
REV 1
SCALE
A3
GIS
TS
22/02/2021
CHECK
PM
22/02/2021
REVIEW
LB
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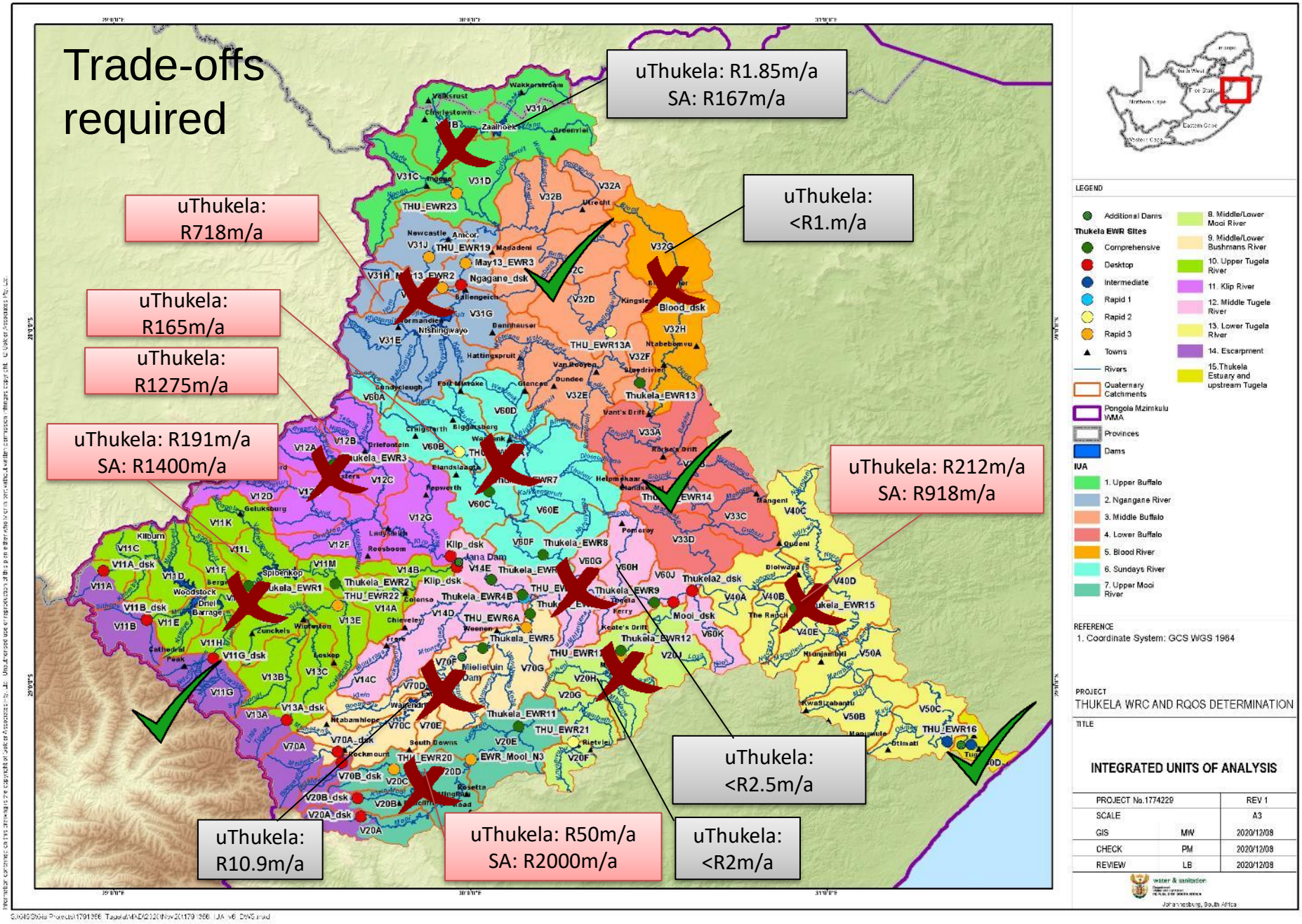
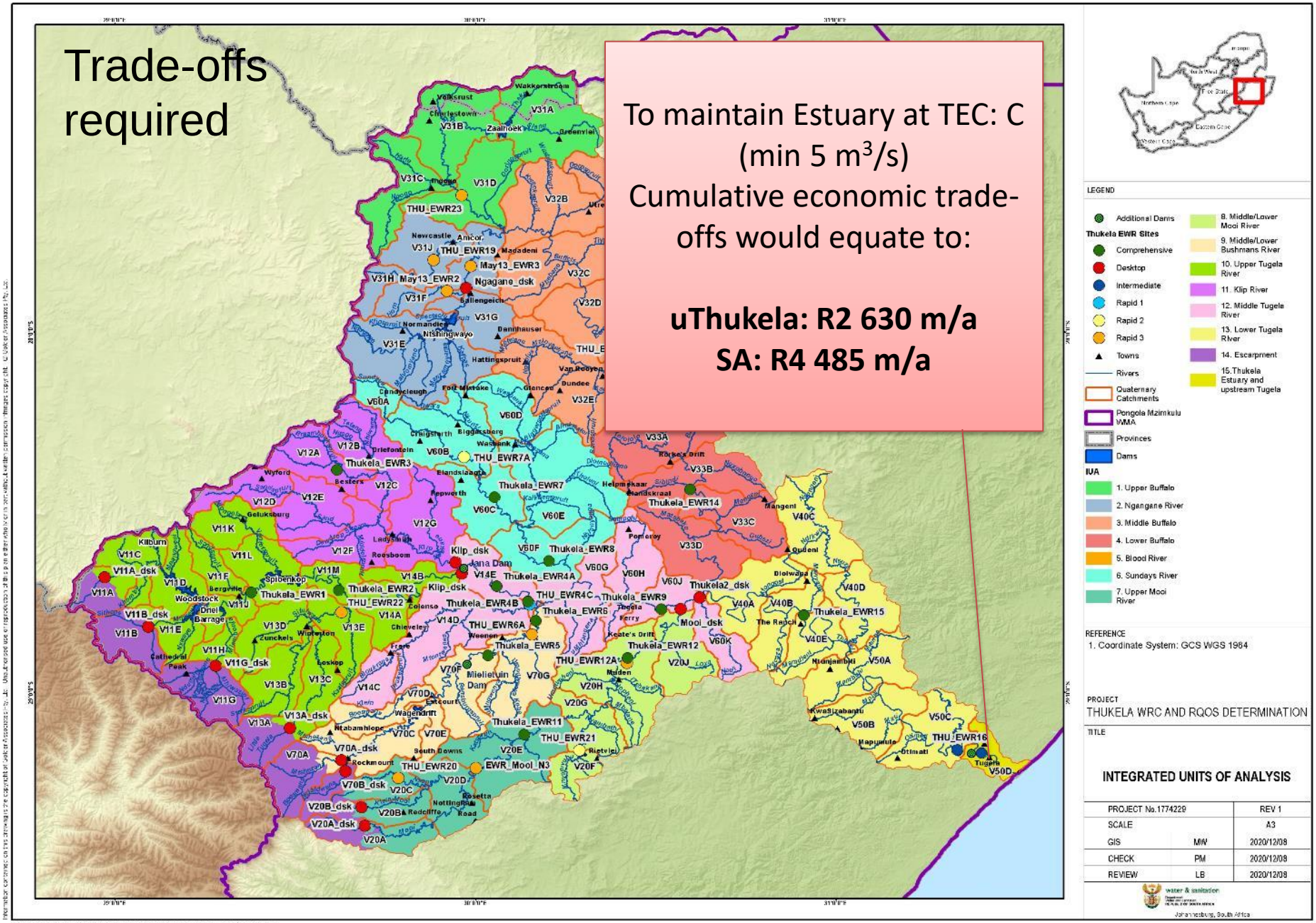
water & sanitation
Johannesburg, South Africa

Trade-offs required



Trade-offs required



Step 6 – Determine RQOs

- RQOs provide short to medium goals that relate to the quality and quantity of the relevant water resources, capturing the Management Class of the Classification System.
- Ecological needs, determined in the ecological Reserve, are described as measurable management goals in the RQOs that guide resource managers on how to manage the resource needs of the relevant estuaries.
- There are 9 components considered when determining the ecological Reserve and setting the RQOs; 4 abiotic (drivers) and 5 biotic (responses).

- Examples of key issues in the Thukela Estuary include reduced river input, which can lead to mouth closure.
- Mouth closure can prevent the migration of catadromous fish and invertebrate species between coastal and river catchment waters.
- Of the 20 RQOs, an example that addresses the above issue:

Resource Unit	Component	Sub-component	RQO	Indicator	Numerical Limit	Context
Thukela Estuary – V50D	Hydro-dynamics	Mouth condition	Mouth needs to be open to support river-coast exchange	Mouth condition - Open	Water level in estuary tidal and within tidal range (0-1.5 m)	When closed, estuary backfloods and water level exceeds tidal range.

Way Forward