Conservation sector meeting on the Determination of Water Resource Classes, Reserve and RQOs - Luvuvhu

Background to “The Reserve” and Surface water Reserve determination

Presented by: Barbara Weston
Designation: Scientific Manager
Directorate: Reserve Determination

Date: 04 February 2025

WATER IS LIFE - SANITATION IS DIGNITY

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

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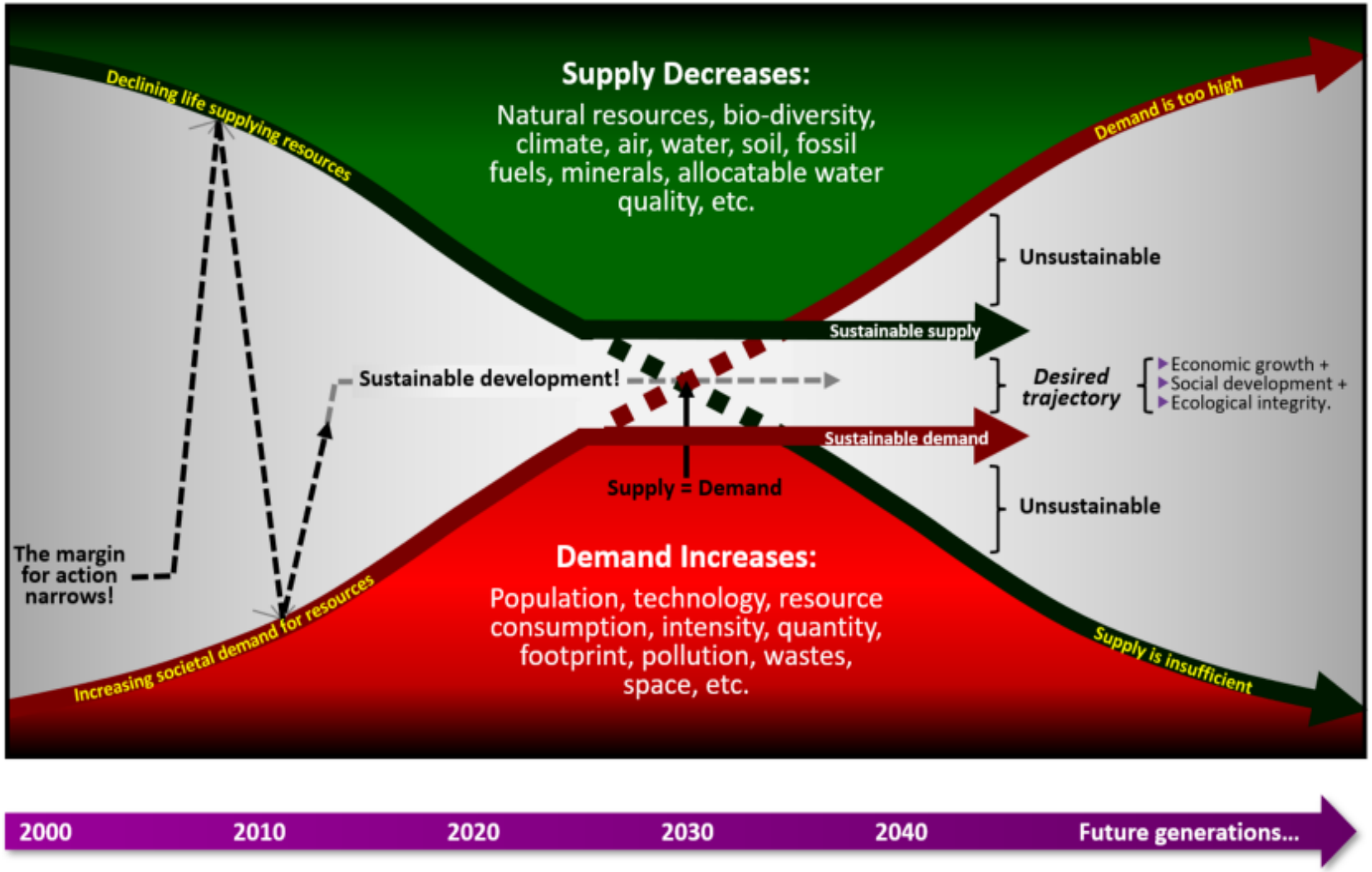
WATER RESOURCE PROTECTION FOR SUSTAINABLE DEVELOPMENT



WATER RESOURCE PROTECTION …

- Freshwater is fundamental to socio-economic development and environmental sustainability – **PROVIDE ECOSYSTEM SERVICES**
- Water in SA is scarce and unevenly distributed throughout the country
- Very few water sources that are in a natural state and therefore protection measures are critical (loss of wetlands and strategic water resources)
- The world has become more and more aware of the need to protect our natural water resources, hence the various treaties, conventions and agreements between RSA and other countries (i.e. RAMSAR, Sustainable Development Goals, National Biodiversity Plans, NFEPA, etc.)
- Global funding focussing on developing countries to assist with Natural Resource Protection with focus on **SUSTAINABILITY**

The National Water Act 36 of 1998

Purpose: Ensure that Nation's water resources are:

- **Protected**
- Used
- Controlled
- Managed
- Conserved
- Developed

Principles:

Sustainability

Promoting social and economic development at the same time ensuring the environment is protected now and for the future

Equity

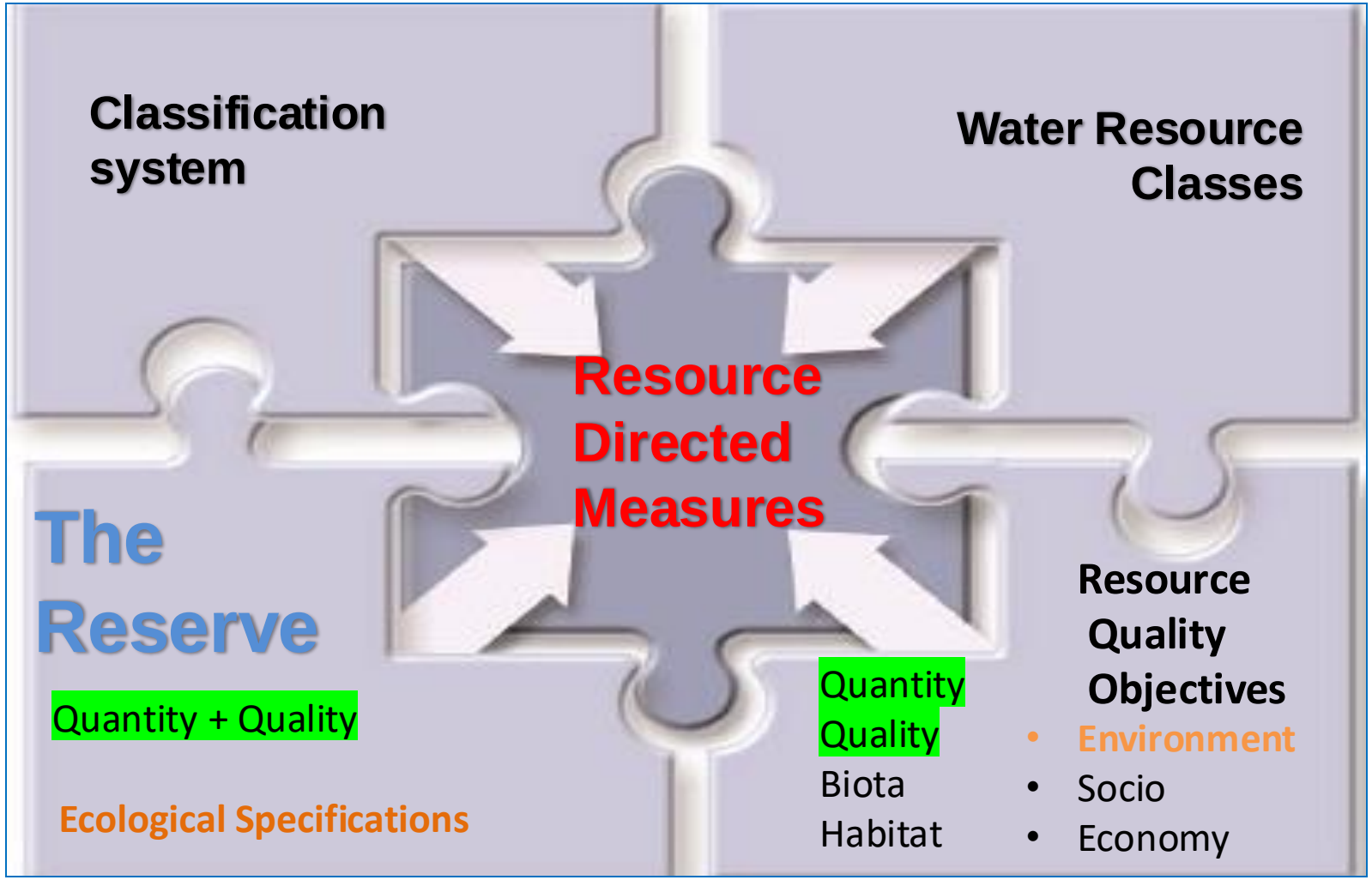
everyone must have access to water and to the benefits of using water.
- Fair allocation of water

Efficiency

Water should not be wasted

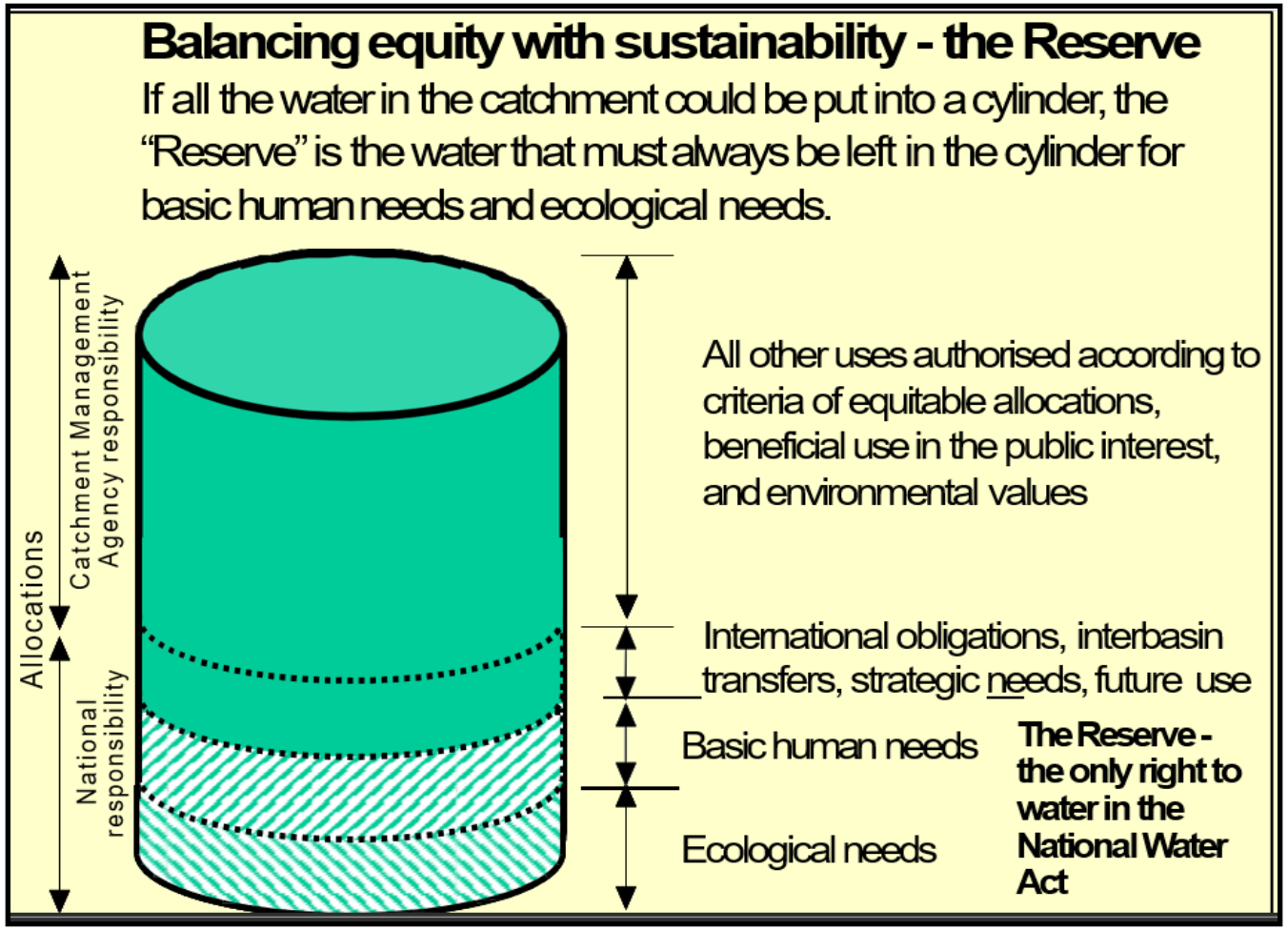
- Striking a balance between protection of water resources and usage ….
- Otherwise water resources may be used beyond its resilience capability to recover and it will become threatened and un- useable….

RESERVE AND WATER RESOURCES PROTECTION…



RESERVE

- NWA Chapter 3 Part 3: Reserve:
- Means the quantity and quality of water required:
- (a) to satisfy **basic human needs** by securing a basic water supply, for current and future populations; and
- (b) to **protect aquatic ecosystems** in order to secure ecologically sustainable development and use of the relevant water resource.



- S16 – Gazetted after class determined, and RQOs set
- S17 – preliminary Reserve

Same legal standing

Reserve cont.

- Specifies the **flow and water quality** required to keep the water resource in a certain state of health;
- Specifies not only the volume, but also the required **frequency and duration of certain flows;**
- Also specifies the **condition in which the Biota and Abiota should be managed** in order to maintain or improve the overall health of the River System

IMPACTS ON WATER RESOURCES AND OTHER NATURAL RESOURCES…

Forestry

Mining & Constructions

Urbanization

Roads Construction

Recreation

Reserve Determination

RESERVE: (4 levels)

PES + **EIS** =

REC

OPERATIONAL SCENARIOS

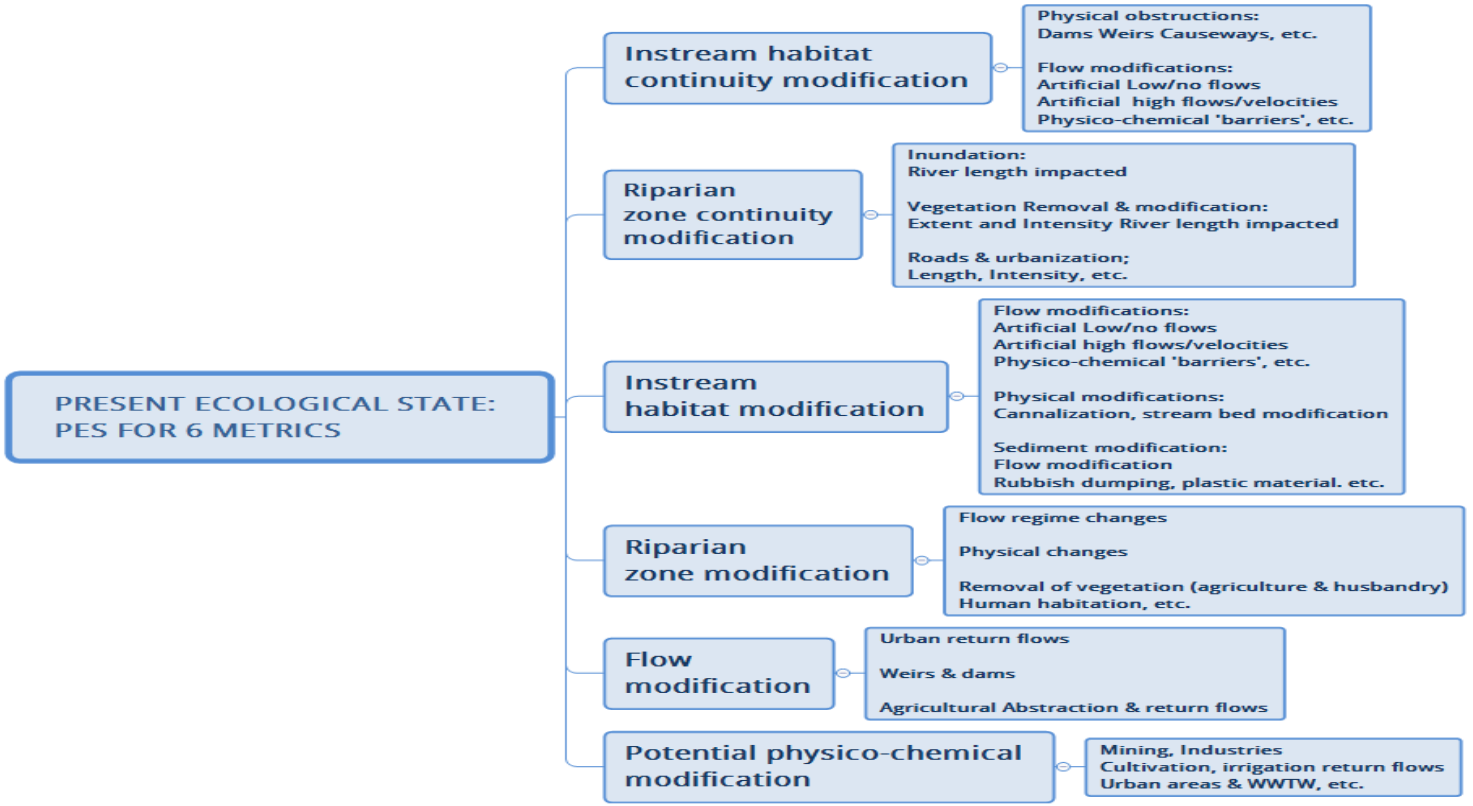
EWR

ECOLOGICAL CATEGORY (BAS)

RQO'S

Present Ecological State (PES)

- A description of the current health status of a water resource as compared to its natural conditions
- Determined using various indicators of water resource health.



The PES results are expressed as a category:

Ecological category	Description	Median rating
A	Natural, unmodified natural	<0.6
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A minor change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged	>0.5, <1.1
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged	>1, <2.1
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred	>2, <3.1
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive	>3, <4.1
F	Critically or extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, the basic ecosystem functions have been destroyed and the changes are irreversible	>4

Ecological Importance and Sensitivity (EIS)

- **Ecological importance:** of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales

- **Ecological sensitivity**: refers to a systems ability to resist disturbance and its capability to recover from disturbance once it has occurred

- Both **abiotic and biotic** components of the system are taken into consideration in the assessment

- The EIS results are given as one of 4 levels: Very High, High, Moderate & Low
  - Can be used to guide or influence the decision on the level of protection required for a water resource

Recommended Ecological Category (REC)

- The level of protection that can be afforded for the affected water resource
- Ecological Categories A to D are recommended as future states, depending on the PES and EIS.

PES	EIS	REC
C	**Very High**	B
C	**High**	B/C
C	**Moderate**	C
C	**Low**	C

- Ecological Categories **E and F are not recommended, because it :**
  - Not considered sustainable for the ecological integrity of a water resource
  - **regarded as ecologically unacceptable**, and remediation is needed.

Ecological Water Requirements…

Summary of EWR Estimate for the cumulative quaternary catchment G22D

Summary of Desktop (Version 2) estimate for Quaternary Catchment Area:
Total Runoff: Bvii7

Annual Flows (Mill. cu. m or index values):

MAR	=	4.495
S.Dev.	=	2.711
CV	=	0.603
Q75	=	0.037
Q75/MMF	=	0.099
BFI Index	=	0.345
CV(JJA+JFM) Index	=	1.250

Ecological Category = C

Total EWR	=	1.038 (23.08 %MAR)
Maint. Lowflow	=	0.664 (14.77 %MAR)
Drought Lowflow	=	0.312 (6.94 %MAR)
Maint. Highflow	=	0.374 (8.31 %MAR)

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

Month	Natural Flows			Modified Flows (EWR)			
				Low flows		High Flows	Total Flows
	Mean	SD	CV	Maint.	Drought	Maint.	Maint.
Oct	0.264	0.222	0.843	0.074	0.038	0.013	0.087
Nov	0.113	0.071	0.628	0.046	0.024	0.001	0.047
Dec	0.053	0.011	0.214	0.025	0.014	0.000	0.025
Jan	0.038	0.012	0.316	0.019	0.011	0.000	0.019
Feb	0.032	0.007	0.233	0.017	0.009	0.000	0.017
Mar	0.031	0.013	0.416	0.016	0.007	0.000	0.016
Apr	0.101	0.215	2.121	0.021	0.012	0.000	0.021
May	0.284	0.402	1.416	0.035	0.018	0.031	0.066
Jun	0.673	0.703	1.045	0.067	0.019	0.078	0.145
Jul	1.124	1.083	0.964	0.109	0.039	0.161	0.270
Aug	1.164	0.903	0.776	0.129	0.066	0.030	0.159
Sep	0.619	0.486	0.785	0.106	0.054	0.059	0.165

Tab table
- Natural Mean Annual Runoff
- Reserve Requirements

Recommended Ecological Category (REC) in which the River should be managed

The Ecological Reserve requirements to meet the REC.

Summarizes the average flows required per month to maintain the system in that REC

Rul table TABLE

Summary of EWR rule curves for : Harts_EWR17
Determination based on defined BBM Table with site specific assurance rules.
Regional Type: Lowveld

Ecological Category = D

Data are given in m^3/s mean monthly flow

Reserve with high flows

Month	% Points 10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
Oct	0.646	0.407	0.399	0.396	0.396	0.285	0.133	0.061	0.029	0.017
Nov	1.752	0.516	0.401	0.386	0.382	0.378	0.378	0.378	0.376	0.374
Dec	3.118	1.296	0.694	0.597	0.564	0.545	0.366	0.148	0.052	0.021
Jan	3.776	3.584	2.307	1.090	0.851	0.780	0.458	0.170	0.050	0.025
Feb	7.239	6.843	5.560	1.128	0.790	0.695	0.608	0.532	0.317	0.246
Mar	10.503	9.817	4.406	2.285	0.728	0.590	0.362	0.276	0.246	0.240
Apr	5.182	4.891	3.434	1.377	0.775	0.255	0.120	0.104	0.101	0.062
May	1.527	1.191	0.810	0.743	0.646	0.523	0.067	0.066	0.064	0.053
Jun	0.961	0.849	0.752	0.698	0.648	0.292	0.122	0.052	0.026	0.020
Jul	0.904	0.758	0.680	0.627	0.405	0.178	0.077	0.036	0.021	0.016
Aug	0.732	0.579	0.429	0.385	0.191	0.080	0.035	0.018	0.012	0.010
Sep	0.428	0.266	0.158	0.154	0.154	0.068	0.029	0.014	0.009	0.008

Reserve flows without High Flows

Oct	0.646	0.407	0.399	0.396	0.396	0.344	0.165	0.074	0.034	0.018
Nov	1.752	0.516	0.401	0.386	0.382	0.378	0.306	0.133	0.054	0.024
Dec	3.108	1.296	0.694	0.597	0.564	0.545	0.282	0.113	0.043	0.021
Jan	3.765	3.531	2.307	1.090	0.851	0.780	0.344	0.127	0.042	0.025
Feb	7.259	6.933	5.560	1.128	0.790	0.695	0.608	0.570	0.348	0.246
Mar	6.381	6.022	4.406	2.285	0.728	0.590	0.362	0.276	0.106	0.042
Apr	5.182	4.891	3.434	1.377	0.775	0.255	0.120	0.104	0.101	0.062
May	1.527	1.191	0.810	0.743	0.646	0.523	0.067	0.066	0.064	0.053
Jun	0.961	0.849	0.752	0.698	0.648	0.359	0.151	0.062	0.029	0.020
Jul	0.904	0.758	0.680	0.627	0.475	0.215	0.093	0.042	0.022	0.016
Aug	0.732	0.579	0.429	0.385	0.191	0.080	0.035	0.018	0.012	0.010
Sep	0.428	0.266	0.158	0.154	0.154	0.082	0.034	0.016	0.009	0.008

Natural Duration curves

Oct	0.646	0.407	0.399	0.396	0.396	0.395	0.392	0.392	0.392	0.388
Nov	1.752	0.516	0.401	0.386	0.382	0.378	0.378	0.378	0.376	0.374
Dec	3.805	1.296	0.694	0.597	0.564	0.545	0.541	0.541	0.538	0.537
Jan	19.609	6.870	2.307	1.090	0.851	0.780	0.765	0.754	0.752	0.750
Feb	28.807	19.742	5.560	1.128	0.790	0.695	0.608	0.570	0.563	0.561
Mar	29.514	13.534	4.406	2.285	0.728	0.590	0.362	0.276	0.246	0.240
Apr	23.646	9.383	3.434	1.377	0.775	0.255	0.120	0.104	0.101	0.099
May	1.527	1.191	0.810	0.743	0.646	0.523	0.067	0.066	0.064	0.063
Jun	0.961	0.849	0.752	0.698	0.648	0.579	0.421	0.062	0.061	0.059
Jul	0.904	0.758	0.680	0.627	0.586	0.564	0.444	0.093	0.091	0.090
Aug	0.732	0.579	0.429	0.385	0.362	0.343	0.258	0.119	0.117	0.115
Sep	0.428	0.266	0.158	0.154	0.154	0.154	0.152	0.150	0.150	0.147

Occurrence of flow volumes for a certain amount of time in a year for each month.

Low flows
flows that should be equaled or exceeded in a month to satisfy the Reserve requirements

Natural flows

Example of SW Reserve QUALITY Parameters

River: Vaal		EWR 1: at Uitkoms	Water quality monitoring site/gauge: C1H007/ VS4 GDDC11
Inorganic Salts	$MgSO_4$	The 95th percentile of the data must be ≤ 28 mg/L	
	Na_2SO_4	The 95th percentile of the data must be ≤ 38 mg/L	
	$MgCl_2$	The 95th percentile of the data must be ≤ 36 mg/L	
	$CaCl_2$	The 95th percentile of the data must be ≤ 69 mg/L	
	NaCl	The 95th percentile of the data must be ≤ 243 mg/L	
	$CaSO_4$	The 95th percentile of the data must be ≤ 351 mg/L	
Physical variables	Electrical Conductivity	The 95th percentile of the data must be ≤ 70 mS/m	
	pH	The 5th percentile of the data must be 6.5 to 8.0, and the 95th percentile 8.0 to 8.8	
	Dissolved oxygen	The 5th percentile of the data must be ≥ 7.0 mg/L	
Nutrients	Total inorganic Nitrogen (TIN)	The 50th percentile of the data must be ≤ 0.7 mg/L	
	PO_4-P	The 50th percentile of the data must be ≤ 0.020 mg/L	
Response variables	Chl-a phytoplankton	The 50th percentile of the data must be < 20 µg/L	
	Chl-a periphyton	The 50th percentile of the data must be < 21 mg/m^2	
Toxics	Ammonia	The 95th percentile of the data must be ≤ 0.044 mg/L	
	Atrazine	The 95th percentile of the data must be ≤ 0.064 mg/l	
	Fluoride	The 95th percentile of the data must be ≤ 2.5 mg/L	
	Endosulfan	The 95th percentile of the data must be ≤ 0.13 µg/l	

Wetlands

- Mostly triggered by WULAs
- For all activities occurring within a wetland including its 500m radius
- Activities usually Sec 21 (c) and (i) (non-consumptive):
  - Pipelines;
  - Roads;
  - Various mining activities;
- Wetland Delineation:
  - Delineation not done in-house

Results of wetland Reserve determination

Quat	Wetland group	PES	EIS	REC
G22D	Channelled valley bottom wetland	C	Moderate	C
	Hillslope seep	B/C	Moderate	B/C
	Depressions associated with Dams	C/D	Moderate	C/D

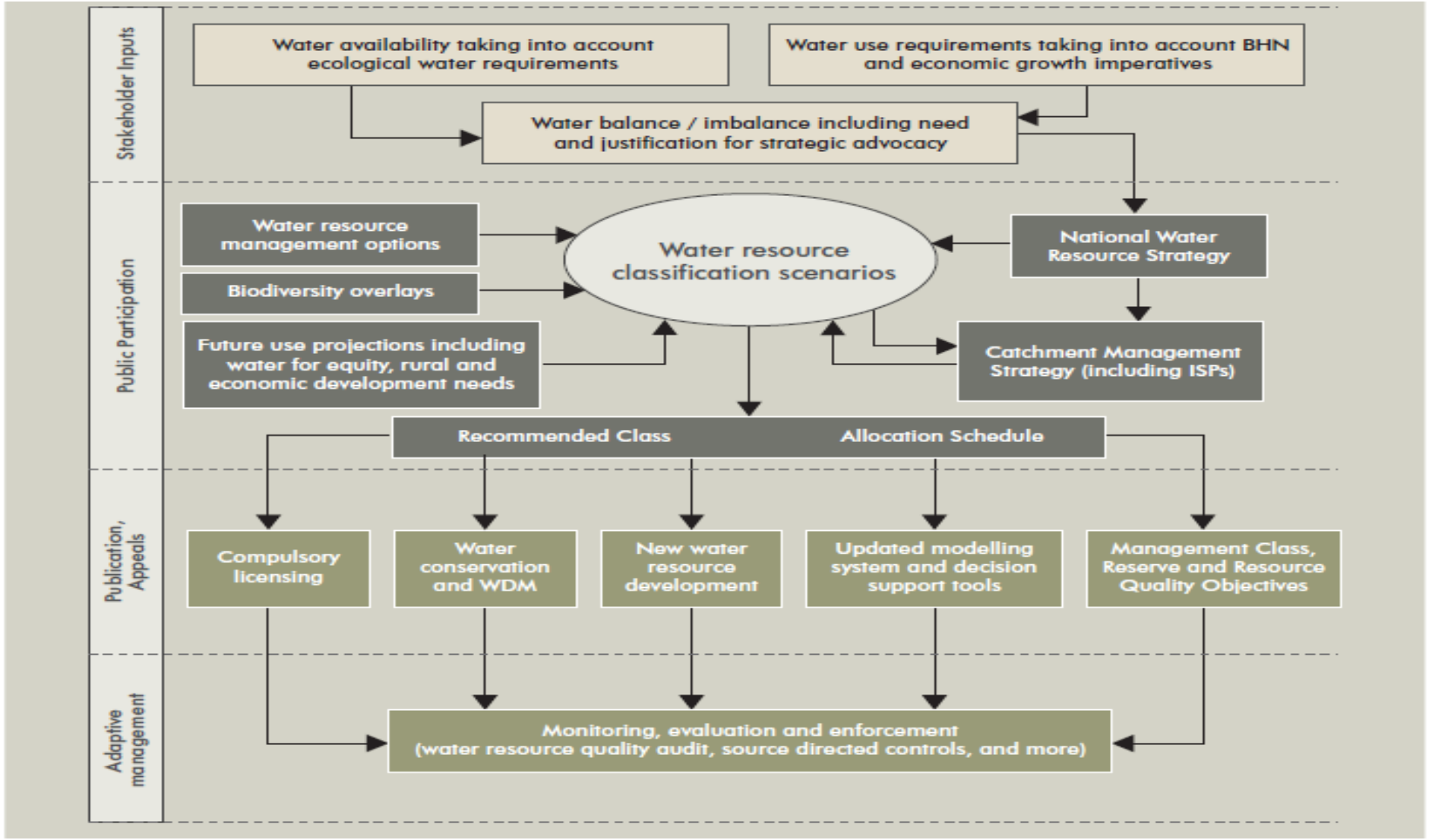
What the Reserve is Not…

- The Reserve is not a quick fix to get water to a water user's property….
- It is not set for a specific user…
- It can not be implemented on its own…
- It is not a tool to prevent development or other environmental authorization…
- It is not a simple method…..
- It does not require more than what would have been required naturally…
- The Reserve is not the "Fixer" of an already degraded and impacted catchment, water resources SURFACE AND GROUNDWATER should be managed from **source to sea** and that requires integration and partnerships.

What the Reserve is …

- Determine requirements to obtain Healthy ecosystems that provide ecosystem services that society is dependent on;
- In order to achieve the desired protection and sustainable use water resource, there's a need to ensure that the **Reserve is implemented,** and that **land use is integrated in Integrated Water Resource Management** **which is not just the DWS responsibility**:
- **MONITORING** is THE key , **you can't manage what you can't MEASURE** - Constant and accurate flow (quantity) and water quality monitoring;
- **Assessment, interpretation of data -**, to be used and applied in implementation plans, compliance monitoring, regulation and enforcement; requires not only trained technical officials, but it is also **a sectoral responsibility;**

RDM IN THE CONTEXT OF IWRM



THANK YOU!

https://www.dws.gov.za/wem/currentstudies/

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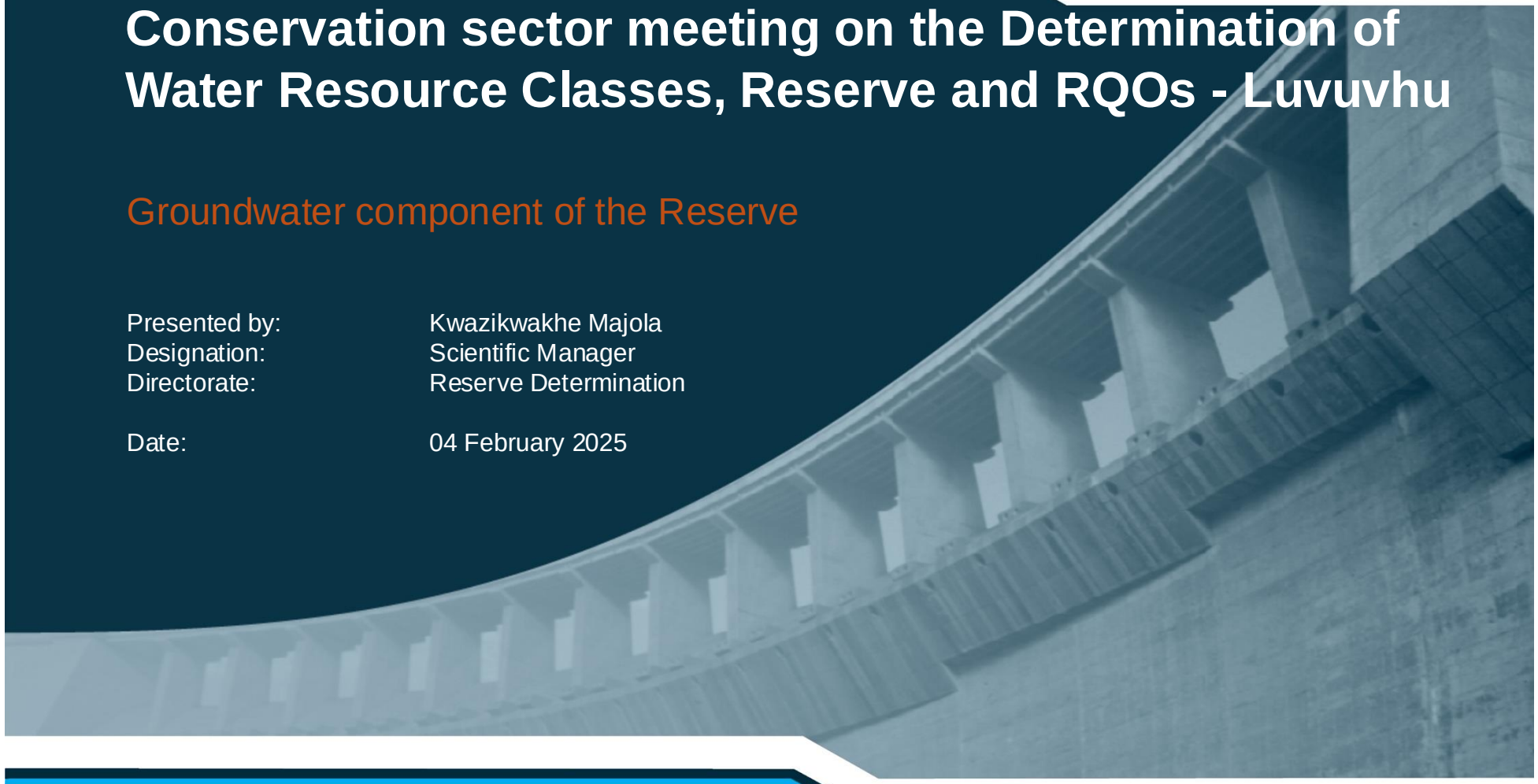
Groundwater component of the Reserve

Presented by: Kwazikwakhe Majola
Designation: Scientific Manager
Directorate: Reserve Determination

Date: 04 February 2025



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PRESENTATION OUTLINE

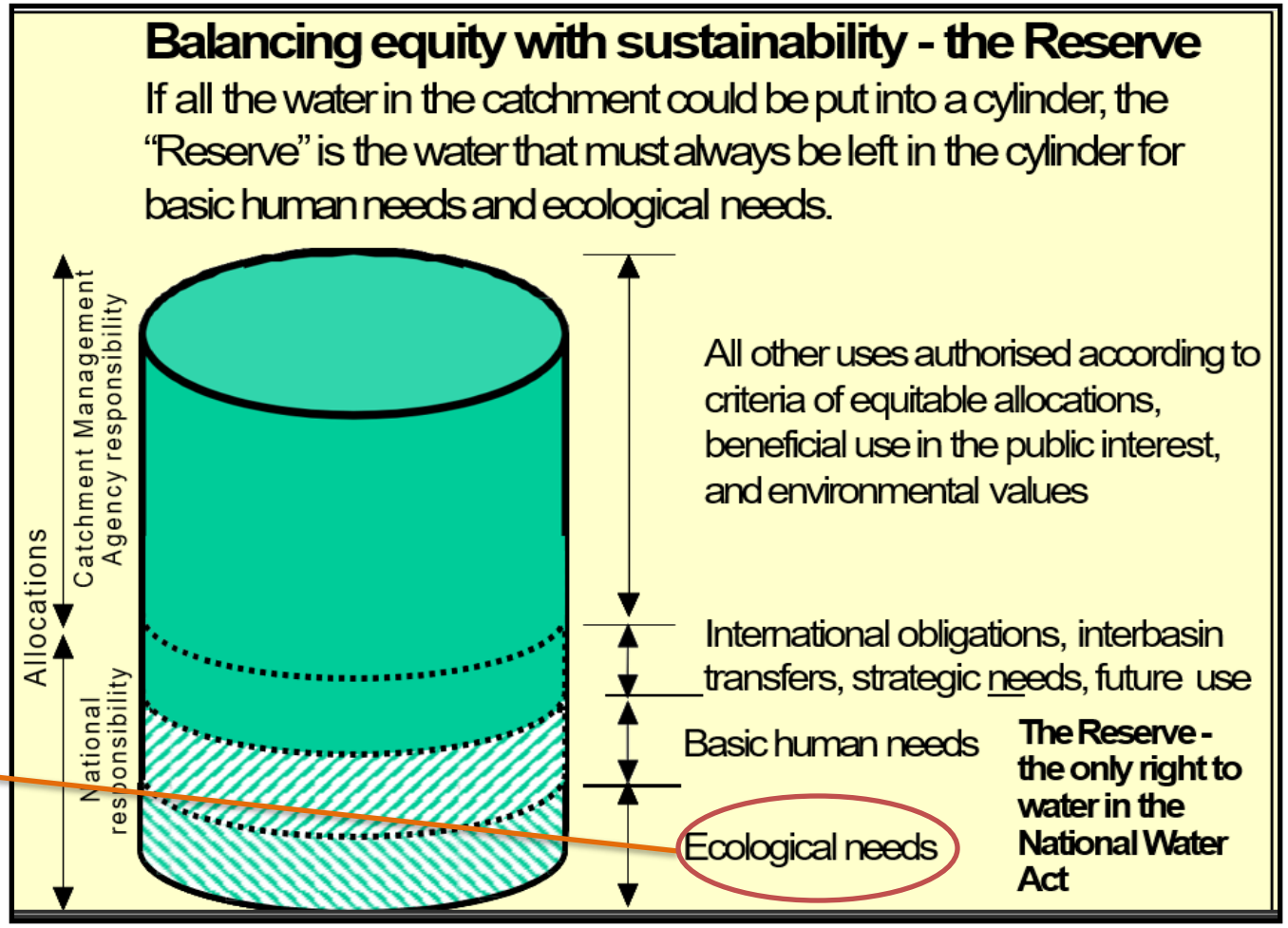
1. Definition of the Reserve

2. Groundwater Quantity component of the Reserve

3. Groundwater Quality component of the Reserve

Ecological Needs – from groundwater:

- EWR-Maintenance Low Flow,
- Groundwater contribution to Baseflow,
- Water requirements by Groundwater-Dependent Ecosystems (aquatic & terrestrial),
- Etc.



- S16 – Gazetted after class determined, and RQOs set
- S17 – preliminary Reserve

Same legal standing

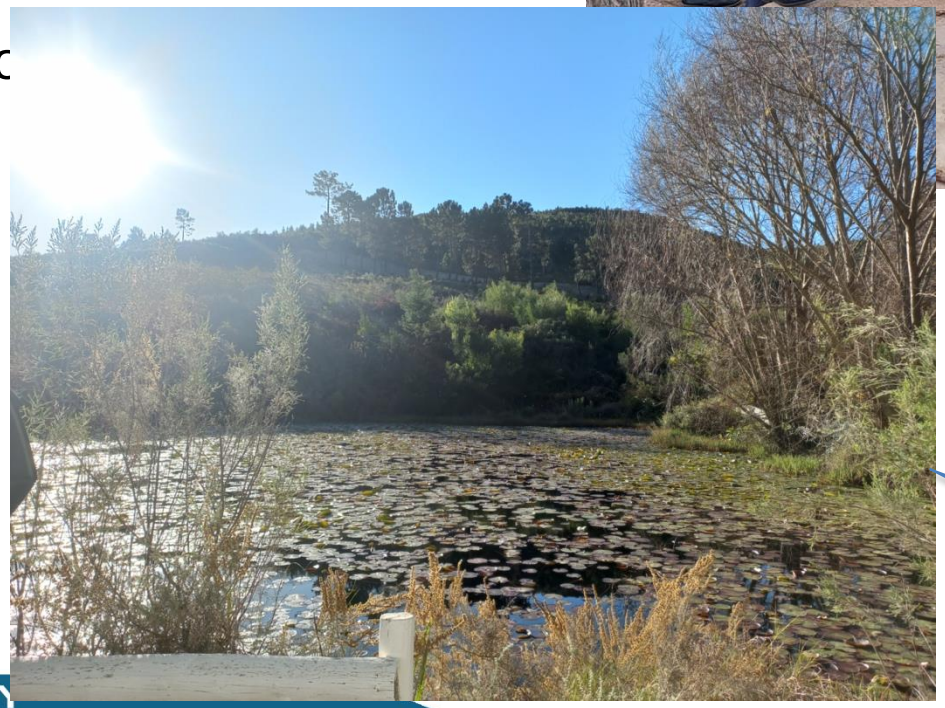
GROUNDWATER QUANTITY COMPONENT OF THE RESERVE

Parameters:

- Population
- Basic human needs
- Recharge
- Groundwater Use
- Stress Index
- Baseflow
- Groundwater contribution to baseflo
- Maintenance low flow (EWR_MLF)

Process:

- Preparatory phase
- Description of the study area
- Delineation of gw resource units
- Groundwater Resource categorization (*Stress Index*)
- Quantification of Reserve



Basic Human Needs

GW_Baseflow

Groundwater Reserve Template

Categorization

Present Status Category	Description	Stress Index (abstraction/recharge)
A	Unstressed or slightly stressed	<0.05
B		0.05 – 0.20
C	Moderately stressed	0.20 – 0.40
D		0.40 – 0.65
E	Highly stressed	0.65 – 0.95
F	Critically stressed	>0.95

Template

- Reserve (%) = $[(EWR_{gw} + BHN_{gw})/ Re] \times 100$
- $GW_{allocable} = (Re + GW_{in} – GW_{out}) – BHN - GW_{Rf}$

Catchment	Area (km^2)	Recharge (Mm^3/a)	Population	Baseflow (Mm^3/a)	EWR_MLF or GW_BF (Mm^3/a)	BHN Reserve (Mm^3/a)	EWR_MLF/ GW_BF as % of Recharge	BHN as % of Recharge
C51H	178	9.9*	13 412**	1.3***	1.41****	0.12*****	1.2	14.2

GROUNDWATER QUALITY COMPONENT OF THE RESERVE

Guidelines

Chemical Parameter	Target Water Quality Ranges per Water Quality Class			
	Class 0	Class I	Class II	Class III
pH	6 – 9	5 – 6 & 9 – 9.5	4 – 5 & > 9.5 – 10	<4 & >10
Electrical Conductivity	< 70	70 - 150	150 – 370	> 370
Calcium as Ca	< 80	80 - 150	150-300	> 300
Magnesium as Mg	< 70	70 - 100	100 – 200	> 200
Sodium as Na	< 100	100 - 200	200 – 400	> 400
Chloride as Cl	< 100	100 - 200	200 – 600	> 600
Sulphate as SO_4	< 200	200 - 400	400 – 600	> 600
Nitrate as NO_x-N	< 6	6 - 10	10 – 20	> 20
Fluoride as F	<0.7	0.7 – 1.0	1.0-1.5	> 1.5

Process

Water Quality Class (WRC, 1998)	Ca mg/l	Cl mg/l	EC mS/m	F mg/l	Mg mg/l	NO_3 mg/l	Na mg/l	SO_4 mg/l	pH	
Class 0	80	100	70	0.7	70	6	100	200	6-9	
Class I	150	200	150	1	100	10	200	400	5-6 & 9-9.5	
Class II	300	600	370	1.5	200	20	400	600	4-5 & 9.5-10	
Class III	>300	>600	>370	>1.5	>200	>20	>400	>600	<4 & >10	
No of samples	81	81	81	81	81	81	81	81	81	Study Area Water Quality Class
Median	36.50	187.40	103.80	0.28	14.90	3.24	164.00	27.20	8.10	
Average	43.63	263.32	123.73	0.35	20.09	5.14	187.44	39.93	8.05	
95th percentile	107.70	588.90	251.00	0.72	51.10	18.26	402.80	87.80	8.50	
5th percentile	8.10	57.10	42.10	0.13	1.80	0.02	61.80	6.20	7.30	
Reserve Limits (Median + 10%; provided the sum does not exceed Class I limits)	40.15	187.40	114.18	0.31	16.39	3.56	180.40	29.92	8.00 – 8.91	Class I

Example

GENERAL CHEMISTRY

Parameter	Ambient Ground Water Quality[1)]	Basic Human Needs Reserve[2)]	Ground Water Quality Reserve[3)]
Calcium (mg/l)	73.84	<150	81.22
Magnesium (mg/l)	38.10	<100	41.91
Sodium (mg/l)	**516.08**	<200	**516.08**
Chloride (mg/l)	**675.64**	<200	**675.64**
Sulphate (mg/l)	136.08	<400	149.68
Nitrate (mg/l)	2.16	<10	2.38
Fluoride (mg/l)	0.61	<1.0	0.67

PHYSICAL WATER QUALITY

Parameter	Ambient Ground Water Quality[1)]	Basic Human Needs Reserve[2)]	Ground Water Quality Reserve[3)]
pH	7.91	5.0 – 9.5	8.70
Electrical Conductivity (mS/m)	**284.00**	< 150	**284.00**

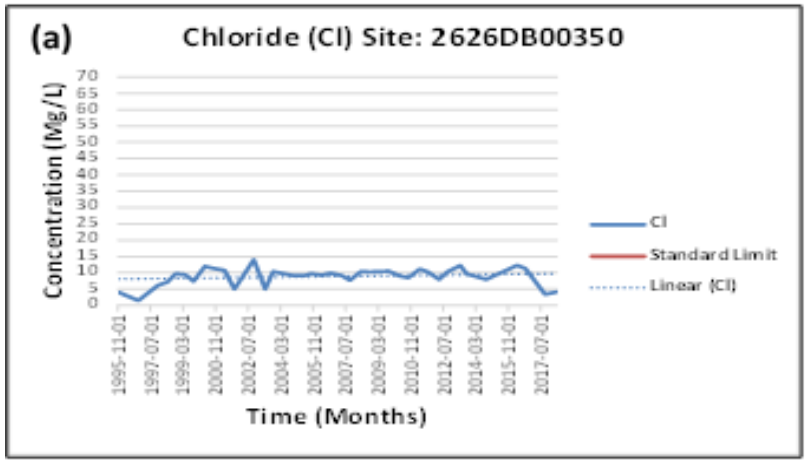
To Note

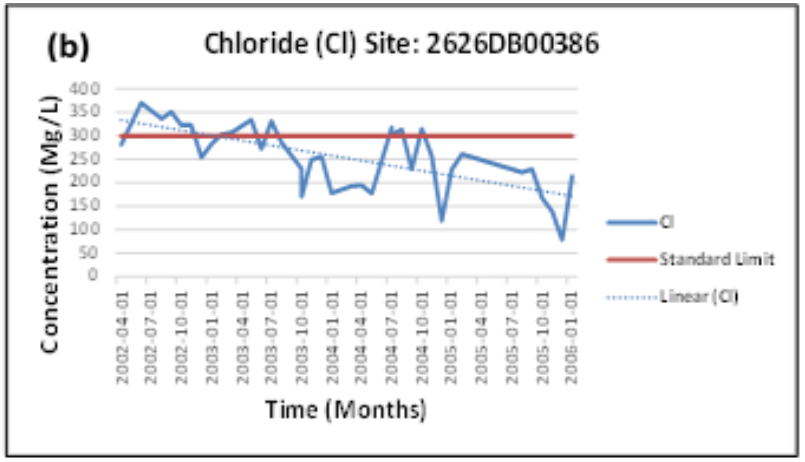
- Groundwater Reserve is determined for a quaternary catchment or Groundwater Resource Unit, not for a water user/applicant.
- Reserve limits/threshold (quality) are applicable to the catchment or Groundwater Resource Unit as water resource conditions, not Water Use License Conditions.
- Reserve limits/threshold should be based on all water quality data from the study area.
- Submission of all relevant documents & all existing water quality data for Reserve determination is crucial.

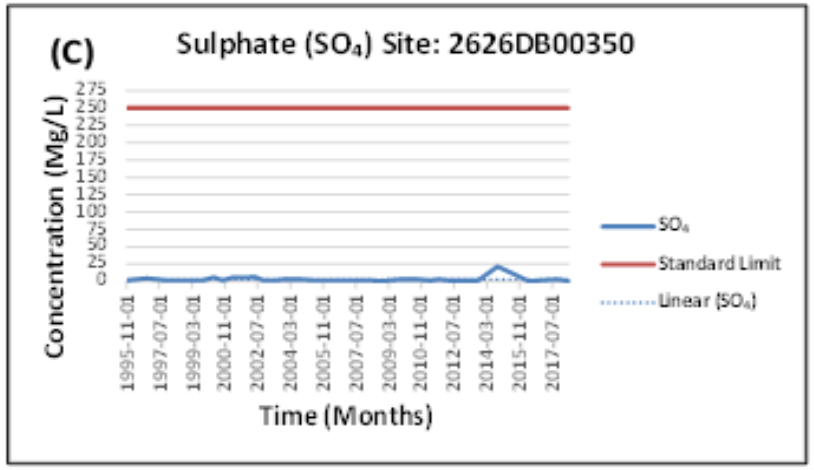
itoring F	Drainage R	Date	Ca	Cl	EC	F	Mg-Diss	NO3+NO2	Na	SO4	TAL	pH	Data Source
6260	W12H	2017/11/15	15,5	57,1	54,5	0,125	8,5	15,274	87,5	20	101,5	8,5	
6261	W12H	2017/09/13	14,5	44,7	51,3	0,154	7,7	18,255	76,8	17,7	86,2	8,2	Water User-1
6265	W12H	2017/09/13	13,6	122,2	61,7	0,123	10,4	14,432	89,8	24,1	71	8,3	
6265	W12H	2017/11/15	15,2	106	63,2	0,146	11,2	10,304	88,9	28,3	72,1	8,2	
6269	W12H	2017/09/13	10	91,4	71,9	0,26	12,8	9,453	119,8	19,3	163,1	8,6	Water User-2
196431	W12G	2017/11/14	50,8	93,6	74,3	0,531	30,5	0,787	58,5	26,9	260	8,5	
196432	W12H	2017/11/14	33,9	98,5	89,1	0,311	28,4	14,248	30,4	45	250,5	7,9	
196433	W12H	2017/11/15	5,9	113	65,8	0,126	11,1	12,536	97,5	5,5	109,4	8,4	New Applicant
196434	W12H	2017/11/14	36,6	187,4	132,9	0,349	33,2	20,733	203,1	60,4	307	8,7	
196435	W12H	2017/11/14	14,4	280,7	127,4	0,224	15,2	0,193	234,5	5,9	201,8	8,5	
196436	W12H	2017/11/14	76,5	255,3	157,8	0,383	59,7	8,705	173,4	83,8	380,1	8,4	
196438	W12H	2017/11/14	32,2	170,5	124,2	0,368	23,3	18,681	204,1	48,1	301,5	8,4	WMS
196439	W12H	2017/11/15	26,9	59,3	57,4	0,257	8,6	6,127	71,4	54,2	133,6	8,5	
196453	W12H	2017/11/16	5,6	59,1	34,1	0,242	6,6	3,581	101,4	5,1	45,5	7	

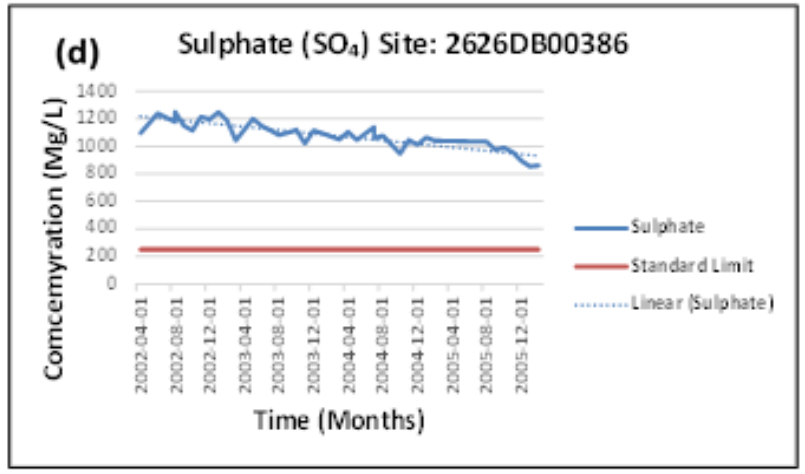
Classes	Ca (mg/l)	Cl (mg/l)	EC (mS/m	F (mg/l)	Mg (mg/l)	NO3+NO2-	Na (mg/l)	SO4 (mg/l	TAL (mg/l	pH (pH uni	Catchment Class
Class 0	80	100	70	0,7	70	6	100	200		6-9	
Class I	150	200	150	1	100	10	200	400		5-6 & 9-9.5	
Class II	300	600	370	3,5	200	20	400	600		4-5 & 9.5-10	
Class III	>300	>600	>370	>3.5	>200	>20	>400	>600		<4 & >10	
No of samples	16	16	16	16	16	16	16	16	16	16	
Median	15,35	102,25	68,85	0,23	12,00	9,88	99,45	27,05	170,45	8,45	Class I
Average	24,11	121,45	82,46	0,25	18,50	9,94	117,33	32,69	178,59	8,32	
95,00	57,23	261,65	139,13	0,42	39,83	19,19	211,70	66,25	325,28	8,63	
5,00	5,83	54,00	47,00	0,12	7,43	0,16	51,48	5,40	64,63	7,68	
Reserve	**16,89**	**112,48**	**75,74**	**0,26**	**13,20**	**10,87**	**109,40**	**29,76**	**187,50**	**9,30**	

Monitoring for the Reserve limits









THANK YOU!

https://www.dws.gov.za/wem/currentstudies/