DETERMINATION OF WATER RESOURCE CLASSES AND RESOURCE QUALITY OBJECTIVES FOR THE WATER RESOURCES IN THE MZIMVUBU CATCHMENT

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

BACKGROUND INFORMATION DOCUMENT (MAY 2018)

PURPOSE OF THIS DOCUMENT

The purpose of this document is to:

- Provide **progress** on the Classification of water resources and determination of Resource Quality Objectives for the water resources in the Mzimvubu catchment.
- Provide **background** on the subjects to be presented at the Project Steering Committee (PSC) Meeting to be held on **Tuesday, 15 May 2018**.

PSC members are encouraged to continue participating in the process by contributing information at meetings or by corresponding with the public participation office, the technical team or the DWS Project Manager at the addresses provided below.

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1. BACKGROUND

The Directorate: Water Resource Classification of the Department of Water and Sanitation (DWS) initiated the study in August 2016 to determine the water resource classes and Resource Quality Objectives for the water resources in the Mzimvubu Catchment.

This document is intended to provide an overview of the process to date and does not replace the technical reports which have been made available as part of the study.

According to the Project Plan for the study (**Figure 1**), the team has completed Steps 1 to 5. Step 6 is currently underway.

The PSC Meeting 4 will report on the following:

- Project progress
- An overview of finalized Water Resource Classes
- Groundwater information gathered for the study
- Wetland information gathered for the study
- **Resource Quality Objectives (RQOs)** for
  - Rivers, including user water quality
  - Estuary,
  - Groundwater, and
  - Wetlands.
- Planning for upcoming broader stakeholder meetings.

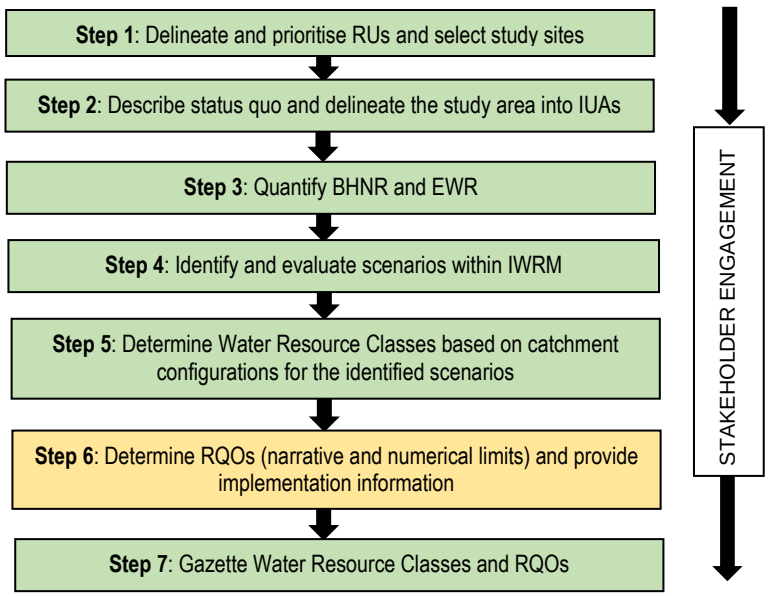

Figure 1: Project Plan for Mzimvubu Study

2. BACKGROUND TO RQOs

RQOs capture the **Water Resource Class** from the Classification System and the **ecological needs determined in the Reserve** into **measurable management goals** that give direction to resource managers as to how the resource needs to be managed. RQOs provide **numerical and/or descriptive statements** about the **biological, chemical and physical attributes that characterise a resource for the level of protection defined by its Class**. The National Water Resource Strategy 2 stipulates that "*Resource Quality Objectives might describe, among other things, the quantity, pattern and timing of instream flow; water quality; the character and condition of riparian habitat, and the characteristics and condition of the aquatic biota*".

The links between Scenarios, Water Resource Classes and RQOs are illustrated in the figure below:

As part of the Classification process, Resource Units (RUs) and biophysical nodes must be identified for different levels of Ecological Water Requirements (EWR) assessment and the setting of RQOs, during Steps 1 and 2 of the study. The RUs are described in context of the Integrated Units of Analysis (IUAs) during Step 2. This information provides context for the development of RQOs.

There are four (4) main priority levels each with the broad type and detail of RQOs indicated below for the Mzimvubu system.

RU priority	RU priority level	Associated RQO
Low	**1**	Flow RQO unless situated in its total length in a conservation area (formal protected area). Habitat RQO in terms of Present Ecological State (PES) and Target Ecological Category (TEC) (EcoStatus).
Moderate	**2**	Flow RQO. Habitat and biota RQO (broad).
High	**3**	If represented by an EWR site, full suite of EcoSpecs provided at the EWR site. If not EWR site, the RQOs at the same level as for 2
	3(wq)	Water quality RQOs required as water quality is the driver at these sites. Usually high priority water quality problem areas. Habitat and biota RQO will be at a priority level 2.
Very High	**4**	If represented by an EWR site, full suite of EcoSpecs provided at the EWR site. If not EWR site, the RQOs at the same level as for 2
	4(wq)	Water quality RQOs required as water quality is the driver at these sites. Usually high priority water quality problem areas. Habitat and biota RQO will be at a priority level 2.

High Priority RUs (3 and 4): These require RQOs to be provided in as much detail as available information allows for all components. As such, no selection of RQO component indicators are required as EcoSpecs are provided for all relevant components, which are:

- Hydrology.
- Physico-chemical variables (water quality).
- Geomorphology.
- Riparian vegetation.
- Fish.
- Macroinvertebrates.

3. RIVER RQOs

Different level (in terms of detail) RQOs are set for river reaches or RUs which are represented by biophysical nodes. During this study the aspects that feed into the determination of RQOs have already been undertaken, i.e.:

- Identification of priority river RUs, wetlands and estuaries.
- Determination of EWRs (flow component of RQOs).
- Determination of Ecological categories
- Determination of water quality hotspots that provides indication of the priority areas for user specifications.

More recently, the biological indicators and driving variables for water quality have been identified, and the narrative and numerical RQOs have been determined for rivers. The recommended Classes and associated Target Ecological Categories (TEC) are available and a scenario incorporating the dams (Ntabelanga and Lalini) of the Mzimvubu Water Project has been recommended and incorporated.

The RQOs for biota and habitat for the key biophysical nodes (EWR sites) are summarised below in terms of Ecological Categories. Ecological categories represent both a numerical and narrative RQO, according to the guidelines in Table 1 *(Page 4)*.

IUA	RESOURCE UNIT (Biophysical node)	Instream Habitat Integrity	Riparian Habitat Integrity	Geomorphology	Fish	Macro-invertebrates	Riparian vegetation
T35_d	MZIMEWR1 (Tsitsa River)	**B/C**	**C**	**D***	**C**	**C**	**D***
T34_b	MZIMEWR2 (Thina River)	**C**	**C**	**C**	**B/C**	**C**	**C/D**
T33_b	MZIMEWR3 (Kinira River)	**C**	**C**	**C**	**C**	**C**	**C/D**
T36_a	MZIMEWR4 (Mzimvubu River)	**B/C**	**C**	**C**	**C**	**C**	**C/D**

D* Under recommended Scenario 69, these components show a change in PES from a C/D to a D category

Table 1: Generic numerical and narrative RQOs associated with Ecological Categories for rivers

ECOLOGICAL CATEGORY	GENERIC NARRATIVE RQO	INSTREAM AND RIPARIAN HABITAT NARRATIVE RQO	FISH, MACROINVERTEBRATE AND RIPARIAN VEGETATION NARRATIVE RQO	NUMERICAL RQO
A	Unmodified, near natural.	Very similar to natural reference conditions	Assemblage attributes as specified	≥ A (≥ 92%)
A/B				≥ A/B (≥ 88%)
B	Largely natural with few modifications.	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	Assemblage attributes as specified	≥ B (≥ 82%)
B/C				≥ B/C (≥ 78%)
C	Moderately modified.	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	Assemblage attributes as specified	≥ C (≥ 62%)
C/D				≥ C/D (≥58%)
D	Largely modified.	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	Assemblage attributes as specified	≥ D (≥ 42%)
D/E				≥ D/E (≥ 38%)
E	Seriously modified.	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	Assemblage attributes as specified	20-39%
F	Critically / Extremely modified.	Critically / 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.	Assemblage attributes as specified	0-19%

4. WATER QUALITY RQOs

These are generated as EcoSpecs for the EWR sites as part of the Reserve process (i.e. objectives for aquatic ecosystems), and User-Specs for the following users, where represented. Where objectives for aquatic ecosystems were not available from a Reserve study, water quality guidelines for the protection of aquatic ecosystems are used.

- Domestic use; assumes primary treatment
- Agriculture - Stock watering and Irrigation
- Aquaculture
- Industrial - Category 3
- Recreation - Intermediate or full-contact

To summarize, user water quality state per relevant RU and IUA is evaluated by determining the driving water quality variables linked to the primary water quality role player(s). Note that although the aquatic ecosystem is the **resource**

base rather than a "user", it is grouped and evaluated with other users for purposes of this step of the Classification process. The driving user and set of variables is then identified and the water quality RQOs set accordingly. An example of a **narrative and numerical** water quality RQO is shown below:

Narrative RQO	Numerical RQO
Ensure that nutrient levels are within Acceptable limits.	50th percentile of the data must be less than or equal to 0.015 mg/L PO_4-P (Aquatic ecosystems: driver).
Ensure that electrical conductivity (salt) levels are within Acceptable limits.	95th percentile of the data must be less than or equal to 55 mS/m (Domestic use: driver).

5. ESTUARY RQOs

As per the DWS methodology, estuaries are sufficiently different in terms of state, functioning and management to form individual RUs. RQOs are set for the short-to medium term (5 to 10-year period) for the following components:

- Quantity, pattern and timing of instream flow (hydrology).
- Mouth state (hydrodynamics).
- Water quality.
- Characteristics and condition of primary producers (e.g. macrophytes).
- Characteristics and condition of biota (e.g. fish).

In the case of the Mzimvubu Estuary, RQOs for the TEC (linked to Scenario 69) were derived from the EcoSpecs and Thresholds of Potential Concern (TPCs) as set for the REC in the EWR study, as the TEC is similar to the REC. In terms of RQOs for recreational use (water quality), the recommended targets proposed for South Africa's coastal marine waters were applied as summarised in Table 2.

Table 2: RQOs for recreational use in Mzimvubu Estuary specified as risk-based ranges for intestinal enterococci and E. coli (microbiological indicator organisms) (DEA, 2012)

CATEGORY	ESTIMATED RISK PER EXPOSURE	ENTEROCOCCI (Count per 100 ml)	*E. coli* (Count per 100 ml)
Excellent	2.9% gastrointestinal (GI) illness risk	≤ 100 (95 percentile)	≤ 250 (95 percentile)
Good	5% GI illness risk	≤ 200 (95percentile)	≤ 500 (95 percentile)
Sufficient or Fair (minimum requirement)	**8.5% GI illness risk**	**≤ 185 (90 percentile)**	**≤ 500 (90 percentile)**
Poor (unacceptable)	>8.5% GI illness risk	> 185 (90 percentile)	> 500 (90 percentile)

In South Africa, the minimum requirement for recreational use is the "Sufficient or Fair" category, thus also representative of the RQOs for estuaries used for full-contact recreation. For estuaries where the Blue Flag status has been awarded, or for estuaries immediately adjacent to beaches awarded Blue Flag status, the ROQ for recreation in the "Excellent" category was awarded.

Ecological Categories represent both a numerical and narrative RQO, according to the guidelines in Table 3 (as per DWS estuarine methods).

Table 3: Generic numerical and narrative RQOs associated with Ecological categories for Estuaries

ECOLOGICAL CATEGORY	GENERIC NARRATIVE RQO	NARRATIVE RQO	NUMERICAL RQO (expressed as similarity to reference condition)
A	Unmodified, or approximates natural condition	Characteristics of resource should be determined by unmodified natural disturbance regimes. No human induced risks to abiotic and biotic maintenance of resource. The supply capacity of resource not to be used.	> 92%
A/B			> 87%
B	Largely natural with few modifications.	Small change in natural habitats and biota may have taken place, but ecosystem functions are essentially unchanged. Only a small risk of modifying natural abiotic template and exceeding resource base should not be allowed. Although risk to well-being and survival of especially intolerant biota at a very limited number of localities may be slightly higher than expected under natural conditions, the resilience and adaptability of biota must not be compromised. Impact of acute disturbances must be totally mitigated by presence of sufficient refuge areas.	>78%
B/C			>72%
C	Moderately modified.	Loss and change of natural habitat and biota have occurred, but basic ecosystem functions still predominantly unchanged. A moderate risk of modifying the abiotic template and exceeding the resource base may be allowed. Risks to the well-being and survival of intolerant biota may generally be increased with some reduction of resilience and adaptability at a small number of localities. Impact of local and acute disturbances must at least partly be mitigated by the presence of sufficient refuge areas.	>63%
C/D			>57%
D	Largely modified	Large loss of natural habitat, biota and basic ecosystem functions has occurred. Large risk of modifying the abiotic template and exceeding the resource base may be allowed. Risk to the well-being and survival of intolerant biota depending on (the nature of the disturbance) may be allowed to generally increase substantially with resulting low abundances and frequency of occurrence, and a reduction of resilience and adaptability at a large number of localities. Associated increase in abundance of tolerant species must not be allowed to assume pest proportions. Impact of local and acute disturbances must at least to some extent be mitigated by refuge areas.	>43
D/E			≥37%
E	Seriously modified	Loss of natural habitat, biota and basic ecosystem functions is extensive	>23%
E/F			>17%
F	Critically modified	Modifications have reached a critical level and ecosystem modified completely with an almost complete loss of natural habitat and biota. In worst instances basic ecosystem functions have been destroyed and changes are irreversible	≤ 17%

6. WETLAND RQOs

Due to the high number of wetlands within the T3 primary catchment, and following the recommendations and method guidelines by DWS, specific RQOs were only determined for priority wetlands of High or Very High importance, although the detail of these were constrained by the availability of existing data. Broad-scale catchment and sub-catchment RQOs were determined for all other wetlands. Broad level narrative RQOs for wetlands across the WMA were determined at the quaternary catchment scale and focused on averages of PES and Ecological Importance and Sensitivity (EIS) categories, mostly taken from DWS's PESEIS database of 2014. These narrative RQOs specify that the average quaternary level PES and EIS should be maintained and not permitted to deteriorate, and have been developed so that all wetlands, even those of low priority, have some measure of protection.

Catchment level RQOs were developed at the sub-quaternary (SQ) scale. These specify more detail and are at a finer scale than the broad level RQOs and should be used in preference to them. Catchment level RQOs rely on PESEIS data (DWS) for low or moderate priority wetlands (an improvement from broad-scale RQOs only due to finer scale and not a quaternary average) and verified data using a similar but expanded (so as to include all wetlands within a sub-quaternary catchment) method of the PESEIS rationale.

More detailed RQOs were developed for wetlands of High or Very High priority. These were highlighted as priority during the EcoStatus and EWR determination for wetlands process. As detailed data of these very high priority individual wetlands were limited, Google Earth © was used to conduct level 1 Wet-Health assessments for floodplains and to verify PES ratings and wetland metrics in the PESEIS database for channelled valley bottom wetlands. Updated metrics were applicable to all wetlands within a SQ and included wetland habitat modification and wetland continuity (fragmentation and connectivity) modification.

It should be stressed that although RQOs at different levels have been determined, all should be taken into consideration in a tiered fashion. To clarify this approach an example of SQ T35G-06099 is given: The wetlands in this SQ occur in the T35G quaternary catchment and therefore have broad level RQOs that specify that the average PES of a B/C category and EIS of "High" be maintained. In addition, the catchment level RQOs specify narrative measures for other criteria of the SQ T35G-06099. These RQOs pertain to measures for water quantity, water quality, habitat, biota and ecosystem services for the SQ. One of the habitat RQOs related to integrity and condition specifies that the PES category of wetlands within this SQ must be maintained according to those listed, which in this case is a category B. Since this is a better measure than the quaternary average of B/C it will take precedence. Similarly, the RQO related to EIS, as a measure of ecosystem services, will be "Very High", rather than the quaternary average of "High". However, this SQ also belongs to one of the high priority floodplains – Gatberg Floodplains – and will therefore also have more detailed RQOs as specified. These will be in addition to those already given, and where overlap exists, precedence should be given to more detailed RQOs that are based on higher quality data.

7. GROUNDWATER RQOs

Groundwater RQOs were developed to maintain the required groundwater contribution (groundwater baseflow) to the Ecological Reserve, which is assumed to equal the required maintenance low flow. The relevance of the groundwater RQOs to protect groundwater is twofold; 1) to maintain and support the ecological requirements of the receiving surface water bodies; and 2) to protect groundwater resources for the direct and indirect users of groundwater.

The reduction of groundwater baseflow can occur due to abstraction by the interception of groundwater flow which would normally discharge into rivers, or by abstraction near rivers, which creates drawdown and reverses groundwater gradients so that flow in the river is induced into the aquifer. Therefore, possible RQOs may stipulate the volume of abstraction that would cause an undesirable reduction in baseflow, or specific distances from a river, or specified distances from the surface water body where abstraction can take place.

Baseflow can also be impacted by afforestation and Alien Invasive Plants (AIPs), which can increase evaporation from groundwater if they occur in areas of shallow water table or reduce interflow from high lying areas. Selected indicators to monitor groundwater can be based on existing monitoring data, on simulated data if available, or extrapolation from other areas of similar hydrogeological conditions.

a) Abstraction

To calculate the available groundwater resources, the stress index was first calculated as the ratio of groundwater use to aquifer recharge. This step determines the existing stress on the aquifer. Once a stress index was calculated, each Quaternary was assigned a groundwater (GW) present status based on the volume of groundwater abstracted compared to the volume recharged (stress index). The following categories were used to determine the present status:

GW present status	Description	Guide	Stress index
A	Unmodified, pristine conditions	Very limited use (GW use is less than 5% of recharge)	≤ 0.05
B	Low volume GW usage, largely natural conditions, no negative impacts apparent	Stock watering, farm domestic water supply, rural water supply (use ranges between 5% and 20% of recharge)	0.05 – 0.2
C	Moderate volumes of GW usage, little or no negative impacts apparent	Small-scale irrigation, rural water supply, water supply for villages and small towns (use ranges between 20% and 40% of recharge)	0.2 – 0.4
D	High volumes of GW usage, but with little apparent negative impact	Water supply for large rural communities, medium to large towns, large-scale irrigation (use ranges between 40% and 65% of recharge)	0.4 – 0.65
E	Stressed system due to over-abstraction of GW or inappropriate land-use	High volume of major groundwater users (use range between 65% and 95% of recharge)	0.65 – 0.95
F	Critical over-abstraction of GW or highly sensitive hydrological environment	Very high volume of major groundwater users (GW use is in excess of 95% of recharge)	> 0.95

Note that the GW present status categories are NOT directly linked to Ecological Categories used for rivers and estuaries.

b) Baseflow

In Groundwater Resource Units (GRUs) where baseflow reduction is greater than 30%, whether due to afforestation, AIPs or groundwater abstraction, it is considered necessary to monitor baseflow due to the potential impacts on the ecology. Monitoring baseflow can take the form on monitoring dry season flows at gauging stations and comparing flows to natural flows utilising flow duration curves, or via simulation of impacts on low flows by model simulation of changes in land or water use.

c) Water Level

Setting water levels as an RQO is problematic since water levels vary by borehole location in terms of topography, pumping rates and aquifer hydraulic parameters. Hence water level below surface is a very site-specific variable which cannot be stipulated for an entire catchment.

In addition, monitoring water level provides only localised information, and monitoring water level 'within 50 m of a river to ensure water levels do not drop more than 0.5 m' requires having a dense network of boreholes within 50 m of a river and being monitored; otherwise only point data is being gathered. It is not a feasible monitoring action at catchment scale. Monitoring baseflow in catchments where groundwater is linked to rivers provides an integrated response of processes within the entire catchment, and where gauging weirs exist this data is already being collected.

Monitoring water levels is not necessary where baseflow reduction occurs due to afforestation and AIPs, which reduce interflow from high lying areas. Monitoring of water levels should be prioritised in areas where the stress index is greater than 0.2, especially where the abstraction has had a significant impact on baseflow.

d) Water Quality

The number of samples available for water quality for many quaternaries is very limited, hence it is not possible to derive meaningful statistics such as range, median etc. The number of samples in each DWS water quality class (shown below) is listed per catchment as a percentage. Where boreholes of a quality worse than class II are present, monitoring is recommended.

Groundwater quality classes were allocated according to the following criteria:

- Quality Class I: 95% of samples of water quality class 0 and 1
- Quality Class II: 75% of samples of water quality class 0-2
- Quality Class III: <75% of samples class 0-2.

8. STAKEHOLDER ENGAGEMENT

The upcoming PSC Meeting 4 (15 May 2018) will be the final PSC Meeting for this study. All stakeholders will be invited to attend stakeholder meetings where the proposed Water Resource Classes and RQOs as per the requirements of the National Water Act (Act No 36 of 1998) will be presented.

Upon conclusion of the stakeholder meetings, the Department will initiate the gazetting process whereby a 60-day comment period will be provided for stakeholders.

PSC members are encouraged to participate in the stakeholder meetings. Personalised invitation letters will be distributed to all registered stakeholders. These meetings will also be published in the local and regional newspapers. More information on the project is available on **http://www.dwa.gov.za/rdm/WRCS/default.aspx**

9. LIST OF ACRONYMS

AIPs	Alien Invasive Plants		PMC	Project Management Committee
EC	Ecological Category		PSC	Project Steering Committee
EIS	Ecological Importance and Sensitivity		REC	Recommended Ecological Category
EWR	Ecological Water Requirements		RU	Resource Units
GRUs	Groundwater Resource Units		RQO	Resource Quality Objectives
IUA	Integrated Unit of Analysis		TEC	Target Ecological Category
PES	Present Ecological State		TPC	Thresholds of Potential Concern

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DETERMINATION OF WATER RESOURCE CLASSES AND RESOURCE QUALITY OBJECTIVES FOR THE WATER RESOURCES IN THE MZIMVUBU CATCHMENT

COMMENT SHEET

Title:			
First Name:			
Surname:			
Organisation:			
Position:			
Email:			
Cell:			
Tel:		**Fax:**	
Postal Address:			

I would like to make the following comments in response to the Mzimvubu Study:

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We thank you for your participation. Please use separate or additional sheets if you wish.

Please complete and return to: Bongi Shinga,
Wakhiwe Group: Stakeholder Engagement Specialists, Postnet Suite 382, P/Bag x 0001, Ballito, 4420
Tel: 079 953 8371 Fax: 086 613 2745 E-mail: mzimvubu@wakhiwe.co.za

MY NOTES

THE DEPARTMENT OF WATER AND SANITATION
AND THE STUDY TEAM
WISHES TO THANK YOU FOR YOUR PARTICIPATION

……✂ ***Please cut and place on your notice board or fridge***

REMINDER			
All PSC members are requested to participate in the broader stakeholder meetings where the proposed Water Resource Classes and RQOs as per the requirements of the National Water Act (Act No 36 of 1998) will be presented. These meetings will be held as follows:			
Area	**Venue and Address**	**Date**	**Time**
Mthatha	Mayfair Hotel 35 Errol Spring Avenue	Tuesday, 05 June 2018	10h00 – 13h30
East London	East London Golf Club 22 Gleneagles, Bunkers Hill	Wednesday, 06 June 2018	10h00 – 13h30
Upon conclusion of the stakeholder meetings, the Department will initiate the gazetting process whereby a 60-day comment period will be provided for stakeholders.			