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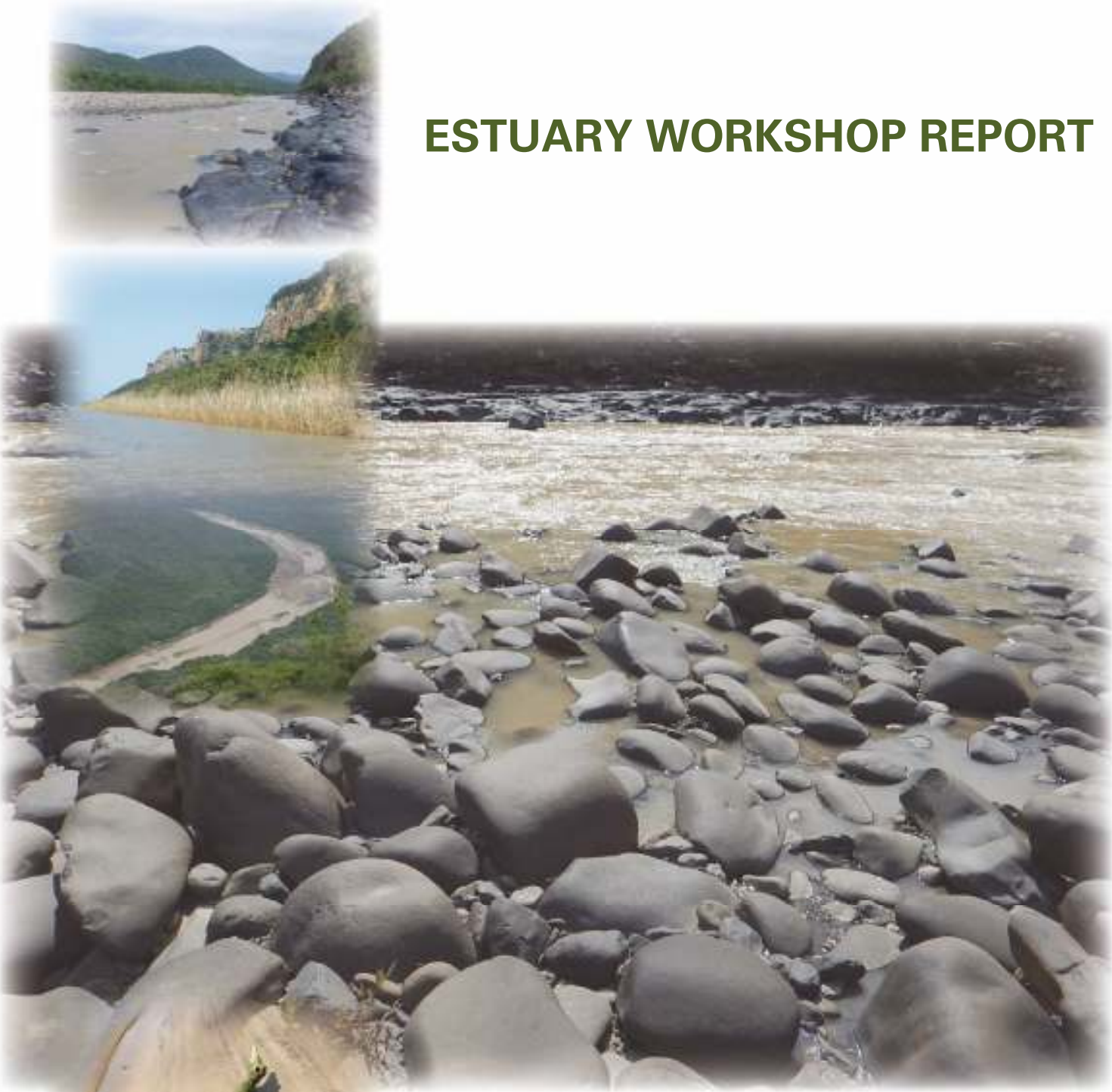
WP 11004

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



ESTUARY WORKSHOP REPORT

June 2017

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Fax: +27 (12) 323 0321

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Compiled by:
Scherman Colloty & Associates cc.
22 Somerset Street
Grahamstown
6139

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Bold indicates this report

APPROVAL

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DATE:	June 2017
AUTHORS:	Taljaard, S, Van Niekerk, L, Snow, GC, Adams, JB, Forbes, N, Weerts, SP, Turpie, JK
EDITOR:	Gowans L
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Approved for Scherman Colloty & Associates cc:

_____

Dr Patsy Scherman
Study Leader

Supported by:

_____

Lawrence Mulangaphuma
Project Manager

Recommended by:

_____

Ms Lebogang Matlala
Director: Water Resource Classification

Approved for the Department of Water and Sanitation by:

_____

Ms Ndileka Mohapi
Chief Director: Water Ecosystems

ACKNOWLEDGEMENTS

Project Management Team

Matlala, L	DWS: Water Ecosystems; Classification
Mulangaphuma, L	DWS: Water Ecosystems; Classification
Scherman, P-A	Scherman Colloty & Associates cc
Sauer, J	Scherman Colloty & Associates cc
Weni, E	DWS: Eastern Cape Regional Office
Weston, B	DWS: Water Ecosystems; Surface Water Reserves
Neswiswi, T	DWS: Water Ecosystems; Surface Water Reserves
Kganetsi, M	DWS: Resource Protection and Waste
Molokomme, L	DWS: Water Ecosystems; Groundwater Reserves
Muthraparsad, N	DWS: Environment and Recreation
Thompson, I	DWS: Integrated Water Resource Planning
Matume, M	DWS: Stakeholder Engagement and Coordination
Cilliers, G	DWS: Resource Quality Information Services
Majola, S	DWS: Resource Quality Information Services

AUTHORS

The following persons contributed to this report:

Author	Company
Taljaard, S	CSIR, Stellenbosch
Van Niekerk, L	CSIR, Stellenbosch
Snow, GC	Witwatersrand University
Adams, JB	Nelson Mandela University (NMU)
Forbes, N	Marine and Estuarine Research (MER)
Weerts, SP	CSIR, Durban
Turpie, JK	Anchor Environmental Consultants

REPORT SCHEDULE

Version	Date
First draft	June 2017
Final report	

EXECUTIVE SUMMARY

BACKGROUND

The Department of Water and Sanitation (DWS) initiated a study to determine Water Resource Classes and associated Resource Quality Objectives (RQOs) for the Mzimvubu catchment in Water Management Area 7. Although Reserves are not explicitly part of the Scope of Work, Reserve data will be reviewed as part of the study. Scherman Colloty and Associates cc were appointed as the Professional Service Provider (PSP) to undertake the study.

The main aims of the project, as defined by the Terms of Reference (ToR), are to undertake the following:

- Coordinate the implementation of the Water Resources Classification System (WRCS) as required in Regulation 810 in Government Gazette 33541 dated 17 September 2010, by classifying all significant water resources in the Mzimvubu catchment,
- determine RQOs using the DWS's procedures to determine and implement RQOs for the defined classes, and
- review work previously done on Ecological Water Requirements (EWRs) and Basic Human Needs (BHN) and assess whether suitable for the purposes of Classification.

The study is currently undertaking Step 3 of the Project Plan, i.e. quantify BHN and EWRs, with the Estuary Workshop dealing with the following specific tasks related to determining Ecological Water Requirements (EWR):

- Reviewing results of the DWS 2014 Mzimvubu Estuary Reserve study and determining the Present Ecological State (PES), Ecological Importance and Recommended Ecological Category (REC).

A number of additional tasks were conducted at the workshop, which will be reported on during the study:

- Assess consequences of a selection of future development scenarios provided on the Mzimvubu Estuary as provided by the hydrologist
- Define Ecological Specification and Thresholds of Potential Concern (TPCs) for the PES and REC.
- Define monitoring requirements as pertaining to the Mzimvubu Estuary.

Results are reported in this short report for invoicing purposes.

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ACRONYMS AND ABBREVIATIONS

BAS	Best Attainable State
BHN	Basic Human Needs
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DIN	Dissolved Inorganic Nitrogen
DIP	Dissolved Inorganic Phosphate
DO	Dissolved Oxygen
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EC	Ecological Category
EcoSpecs	Ecological Specifications
EFZ	Estuary Functional Zone
EHI	Estuarine Health Index
EWR	Ecological Water Requirements
GPS	Global Positioning System
GRDS	Gouritz Reserve Determination Study
MAR	Mean Annual Runoff
MSL	Mean Sea Level
NMU	Nelson Mandela University
NBA 2011	National Biodiversity Assessment 2011
NTU	Nephelometric Turbidity Units
NWA	National Water Act (1998)
PES	Present Ecological Status (or State)
REC	Recommended Ecological Category
RDM	Resource Directed Measures
REI	River Estuary Interface
RQOs	Resource Quality Objectives
SA	South Africa
SANBI	South African National Biodiversity Institute
SC&A	Scherman Colloty & Associates cc
TPC	Threshold of Potential Concern
UNEP	United Nations Environmental Programme
WIO	Western Indian Ocean
WMA	Water Management Area
WQ	Water Quality
WRC	Water Research Commission
WRCS	Water Resource Classification System
WWTW	Wastewater Treatment Works
%ILE	Percentile

GLOSSARY

Abundance	The total number of individuals of an animal group in an area.
Anthropogenic	Originated from humans, e.g. storm-water is an anthropogenic source of pollution to the sea.
Benthic	Bottom-dwelling.
Benthic invertebrates	Invertebrate organisms living in or on sediments of aquatic habitats and typically retained by a 500 micron sieve.
Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems.
Biomass	The mass of living matter, including stored food, present in a species population and expressed in terms of a given area or volume of habitat.
Catchment	In relation to a watercourse or watercourses or part of a watercourse, this term means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points.
Community	Assemblage of organisms characterised by a distinctive combination of species that occupy a common environment and interact with one another.
Community	All taxa, plants and animals, present in a community composition.
Contact recreation	Refers to activities such as swimming, diving (scuba and snorkelling), water skiing, surfing, paddle skiing, windsurfing, kite-surfing, parasailing and wet biking. During these activities full body contact with the water and ingestion of water is likely to occur frequently. Tidal pools are also classified as contact recreation sites.
Crustaceans	A large class of mostly water-dwelling arthropods (as lobsters, shrimps, crabs, wood lice, water fleas, and barnacles) having an exoskeleton of chitin or chitin and a compound of calcium.
Cumulative impact	Impact on the environment which results from the incremental or combined effects of one or more developmental activities in a specified area over a particular time period, which may occur simultaneously, sequentially, or in an interactive manner.
EcoClassification	EcoClassification (or the Ecological Classification process) refers to the determination and categorisation of the Present Ecological State (PES; health or integrity) of various physical attributes of rivers relative to the natural reference condition. A range of models are used during

	EcoClassification, each of which relate to the indicators assessed.
Ecological Water Requirements (EWR)	The flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition. This term is used to refer to both the quantity and quality components.
Filter feeder	An organism that uses complex filtering mechanisms to trap food particles suspended in water, e.g. mussels and oysters.
Habitat	The natural home of an organism or community of organisms (this also includes the surrounding area).
Intertidal	Area of the shore between the highest and lowest tides.
Invasive species	A species that does not naturally occur in a specific area and whose introduction does or is likely to cause economic or environmental harm or harm to human health.
Macrophyte	Macroscopic plant life especially of a body of water.
Microalgae	Animals that are retained by a 1 mm mesh-size sieve.
Phytoplankton	Planktonic plant life.
Present Ecological State (PES)	The current state or condition of a water resource in terms of its biophysical components (drivers) such as hydrology, geomorphology and water quality and biological responses *viz*. fish, invertebrates, riparian vegetation). The degree to which ecological conditions of an area have been modified from natural (reference) conditions.
Recommended Ecological Category (REC)	The Recommended Ecological Category is the future ecological state (Ecological Categories A to D) that can be recommended for a resource unit depending on the Importance and PES. The REC is determined based on ecological criteria and considers Importance, the restoration potential of the system and attainability thereof.
Runoff	Runoff is the water yield from an individual catchment – the sub-catchment plus the runoff from all upstream sub-catchments. Runoff includes any seepage, environmental flow releases and overflows from the reservoirs in a catchment, if they are present - which is not the case in any of the simulations in this project in which baseline catchment conditions are assumed.
Submerged	Covered by water.
Sub-tidal	Area of water body always covered by water and never exposed at low tides.
Supratidal	Area above the spring high tide line on coastlines and estuaries that is regularly splashed but not submerged by ocean water.

Wastewater	Water containing solid, suspended or dissolved material (including sediment) in such volumes, composition or manner that, if spilled or deposited in the natural environment, will cause, or is reasonably likely to cause, a negative impact.
Zooplankton	Plankton composed of animals.

1 INTRODUCTION

1.1 BACKGROUND

The Department of Water and Sanitation (DWS) initiated a study to determine Water Resource Classes and associated Resource Quality Objectives (RQOs) for the Mzimvubu Catchment in Water Management Area 7 (WMA 7) with the Mzimvubu Estuary as the only estuary to be considered in this study. A preliminary Reserve determination has already been done on this estuary (Intermediate level) in 2014 for the DWS Feasibility Study (DWS, 2014a and 2014b). Results from this EWR study therefore inform this Classification study. Methods were as per the official methodology for estuaries (DWAF, 2008; DWA, 2012).

The overall classification study is currently undertaking Step 3 of the Project Plan, i.e. quantify BHN and EWRs. The Estuary EWR Workshop was held on 25 and 26 May 2017 in Port Elizabeth (see Agenda in Appendix A). The purpose of the workshop was to:

- confirm or re-assess the PES and REC building on the results from the previous EWR study (DWS, 2014a and 2014b);
- assess consequences of a selection of future development scenarios provided on the Mzimvubu Estuary as provided by the hydrologist;
- define Ecological Specification and Thresholds of Potential concern (TPCs) for the PES and REC; and
- define monitoring requirements as pertaining to the Mzimvubu Estuary.

This report contains a brief summary of the workshop outputs. Final results will the available in the Estuary EWR Report, RQO and Monitoring reports for the study.

1.2 STUDY AREA

The boundary of South Africa's estuaries incorporates an area known as the estuarine functional zone (EFZ) (Van Niekerk and Turpie, 2012). The estuarine functional zone is defined by the 5m topographical contour (as indicative of 5m above mean sea level). The official EFZ boundary of the Mzimvubu Estuary as per the national requirement is indicated in **Figure 1.1** (blue), defined by:

Downstream boundary:	31°37'52" S, 29°32'59" E (Estuary mouth)
Upstream boundary:	31°29'7.15"S, 29°22'59.66"E
Lateral boundaries:	5 m contour above Mean Sea Level (MSL) along each bank

Historical references (Day, 1981) suggest an upper boundary of the estuary about 14.5 km upstream from the mouth. It should be noted that the Mzimvubu Estuary mouth may be prone to closure if the river inflow decreases below ~ 1.0 m^3/s.

However, given the conditions (freshwater dominated and minimal saline intrusion) within the system during the survey, the upper limit 5m contour was not applied. Instead, a modified boundary of the system was applied for the purposes of this assessment which encompasses the major estuarine habitats and estuarine support habitats which are found within the estuarine functional zone (**Figure 1.1**, green) which is closely aligned with the historical references.

Figure 1.1 Geographical boundaries of the Mzimvubu Estuary based on the official EFZ (blue) and boundaries used in this EWR study (lower part in green)

NOTE: The official EFZ should be adhered to as a development setback line.

For the purposes of this study, the Mzimvubu Estuary is sub-divided into three distinct zones primarily based on bathymetry (**Figure 1.2**):

- Lower Zone: From mouth to 4 km upstream (34% of volume)
- Middle Zone: From 4 - 10 km upstream (33% of volume)
- Upper Zone: From 10 - 14 km upstream (33 % of volume).

Figure 1.2 Zones identified for the Mzimvubu Estuary as part of this EWR study

1.3 WORKSHOP PARTICIPANTS

The following people participated in the Workshop:

Specialist	Affiliation	Area of responsibility
Dr S Taljaard	CSIR, Stellenbosch	Coordinator/Water quality
Ms L van Niekerk	CSIR, Stellenbosch	Physical dynamics
Dr G Snow	University of Witwatersrand (Wits)	Microalgae
Prof J Adams	Nelson Mandela University (NMU)	Macrophytes
Ms Nicky Forbes	Marine and Estuarine Research (MER)	Invertebrates
Mr S Weerts	DAFF	Fish
Dr J Turpie	Anchor Environmental Consultants	Birds

The signed attendance register is attached as Appendix B.

2 KEY WORKSHOP OUTPUTS

2.1 PRESENT ECOLOGICAL STATE AND ECOLOGICAL IMPORTANCE

Estuarine specialists used the revised Reference and Present flow scenarios to re-assess the PES for the Mzimvubu Estuary at the workshop. Results are presented in **Table 2.1.**

	Wt	Score	Wt score
Hydrology	0.25	89	22
Hydrodynamics and mouth condition	0.25	98	24
Water quality	0.25	75	19
Physical habitat alteration	0.25	94	23
Habitat health score			89
	Wt	**Score**	**Wt score**
Microalgae	0.2	65	13
Macrophytes	0.2	63	13
Inverts	0.2	95	19
Fish	0.2	77	15
Birds	0.2	61	12
Biotic health score			72
ESTUARINE HEALTH SCORE			81
PRESENT ECOLOGICAL STATUS			B
Estuarine importance	**Wt**	**Score**	**Wt score**
Size	0.15	90	14
Zonal Type Rarity	0.10	30	3
Habitat diversity	0.25	90	23
Biodiversity importance	0.25	73	18
Functional importance	0.25	100	25
ESTUARINE IMPORTANCE SCORE			82

a. Estuary: Input of detritus and nutrients generated in estuary	40
b. Nursery function for marine-living fish	100
c. Movement corridor for river invertebrates and fish breeding in sea	80
d. Migratory stopover for coastal birds	60
e. Catchment detritus, nutrients and sediments to sea	100

RECOMMENDED ECOLOGICAL CATEGORY	B

Figure 2.1 Workshop results on PES, Importance and REC for the Mzimvubu Estuary

As in the 2014 study (DWS, 2014a), the Present Ecological Status of the Mzimvubu Estuary came to an **Ecological Category B**.

Specialists also confirmed the ecological importance rating score of 82, which classify this estuary as **highly important.**

2.2 CONSEQUENCES OF OPERATIONAL SCENARIOS

The various development scenarios provided to the estuary team are summarised in **Table 2.1.** In *order to ensure align between reference and present day flow scenarios, and the future development scenari*os, the hydrologist on the team re-ran reference and present scenarios. Except for a few minor differences the original and re-run Reference and Present flow simulations, mostly compared favourably.

Table 2.1 Description of Mzimvubu present and future scenarios

Scenario	Updated Water Demands (2040)		EWRs			Development Options*		MAR (10^6 m^3)	% of nMAR
	Realistic Projection (a)	Ultimate Development Projection (b)	EWR4	EWR1	Lalini EWR (scaled)	MWP (Ntabelanga & Lalini Dams with Hydropower)	Port St Johns Proposed WWTW		
Ref								2 737.0	100.0
Pres								2 613.5	95.5
S2a	Yes	No	No	No	No	Yes	No	2 577.3	94.2
S2b	No	Yes	No	No	No	Yes	No	2 536.8	92.7
S32	No	Yes	REC tot	No	REC tot	Yes	No	2 537.4	92.7
S33	No	Yes	REC low	No	REC low	Yes	No	2 537.2	92.7
S41	No	Yes	REC low	REC low	No	Yes	No	2 536.7	92.7
S42	No	Yes	REC low	REC low	REC low	Yes	No	2 537.2	92.7
S51	No	Yes	REC low	REC low	No	Yes – Reduced Hydro in dry months	No	2 536.6	92.7
S52	No	Yes	REC low	REC low	REC low	Yes – Reduced Hydro in dry months	No	2 537.0	92.7
S53	Yes	Yes	REC low	REC low	No	Yes – further reduced Hydro in dry months	No	2536.1	92.7
PresW1	Present river inflow, including 3.5Ml per day WWTW inflow						Yes	2 614.8	95.5
PresW2	Present inflow, including 4.5Ml per day WWTW inflow						Yes	2 615.1	95.5
Dam (1.5 MAR)	Large dam 1.5 MAR (Ntabelanga) (previous study's Scenario 3 – DWS, 2014a)						No	2427.8	91

The chemical composition of the proposed Port St Johns Wastewater Treatment Works (WWTW) discharge in PresW1 and W2 (see **Figure 1.2** for proposed position entering the estuary via a small tributary outside the EFZ) is expected to comply with general standards (DWA, 2013) as follows:

Parameter	General Standards
Estimated flow (Mℓ/day	3.5
Estimated flow (m^3/s)	0.04
Total NH_4-N (µg/ℓ)	6 000
NO_x-N (µg/ℓ)	15 000
Dissolved inorganic nitrogen (DIN) (µg/ℓ)	**21 000**
Dissolved inorganic phosphate (DIP) (µg/ℓ)	**10 000**
Suspended solids (mg/ℓ)	**25**

Applying the same Estuarine Health Index (EHI) as was applied to obtain the PES, the consequences of each of the future development scenarios are presented in **Table 2.2**.

Table 2.2 Workshop results on consequences of future development scenarios on the Mzimvubu Estuary

	S2a		S2b		S32		S33		S41		S42		S51		S52		S53		PRESW1		PRESW2		Dam (1.5MAR)	
	Score		Score		Score		Score		Score		Score		Score		Score		Score		Score		Score		Score	
Hydrology	85	21	86	22	85	21	85	21	86	22	85	21	87	22	86	21	97	24	90	22	90	22	84	21
Hydrodynamics/Mouth condition	97	24	97	24	97	24	97	24	97	24	97	24	97	24	97	24	99	25	98	24	98	24	98	24
Water quality	67	17	67	17	66	17	66	17	67	17	66	17	67	17	66	17	77	19	64	16	61	15	70	18
Physical habitat alteration	93	23	90	23	80	20	85	21	90	23	85	21	90	23	80	20	89	22	93	23	94	23	89	22
Habitat health score		85		85		82		83		85		83		85		82		90		86		86		85
Microalgae	74	15	73	15	68	14	73	15	75	15	73	15	75	15	68	14	68	14	60	12	58	12	63	13
Macrophytes	63	13	62	12	58	12	59	12	62	12	59	12	62	12	58	12	62	12	60	12	58	12	62	12
Invertebrates	75	15	75	15	70	14	75	15	75	15	75	15	75	15	70	14	93	19	85	17	80	16	92	18
Fish	64	13	64	13	62	12	64	13	64	13	62	12	64	13	62	12	72	14	72	14	68	14	73	15
Birds	62	12	62	12	62	12	62	12	62	12	62	12	62	12	62	12	62	12	62	12	62	12	62	12
Biotic health score		68		67		64		67		68		66		68		64		71		68		65		70
ESTUARINE HEALTH SCORE		76		76		73		75		76		75		76		73		81		77		75		78
ECOLOGICAL CATEGORY		B/C		B/C		B/C		B/C		B/C		B/C		B/C		B/C		B		B/C		B/C		B/C

2.3 RECOMMENDATIONS

As for the previous EWR study (DWS, 2014a), specialists confirmed that the REC for this system should be a category B.

The EWR methods for estuaries (DWAF, 2008; DWA, 2012) set the following as a guideline for the Ecological Flow Requirement Scenario: *"The recommended Ecological Flow Requirement scenario is defined as the flow scenario (or a slight modification thereof) that represents the highest change in river inflow that will maintain the estuary in the Recommended Ecological Category".* **Scenario S53** (i.e. maintaining the system in an Ecological Category B) was therefore selected as the recommended EWR flow scenario for the estuary.

Specialists will set Ecological Specification and TPCs for a **Category B** (i.e. PES and REC) to be captured in the detailed Estuary EWR Report. Also, the EWR report will details recommendations regarding additional baseline studies that are important for the improvement of the confidence of the EWR results. A recommended long-term monitoring programme will be outlined in the Monitoring Report - the purpose of which will be to test for compliance with EcoSpecs and TPCs (or RQOs, as outlined in the RQO report) and to continuously improve understanding of ecosystem function.

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4 APPENDIX A: WORKSHOP AGENDA

water & sanitation
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REPUBLIC OF SOUTH AFRICA

DETERMINATION OF WATER RESOURCE CLASSES AND RESOURCE QUALITY OBJECTIVES FOR THE WATER RESOURCES IN THE MZIMVUBU CATCHMENT: ESTUARY SPECIALIST WORKSHOP

QUANTIFY ECOLOGICAL WATER REQUIREMENTS FOR THE MZIMVUBU ESTUARY - 25 and 26 MAY 2017

25/26 May 2017	Specialist Workshop
VENUE	Sir Roy's Guesthouse in Walmer, Port Elizabeth
OBJECTIVES	A 2-day specialist workshop to confirm the PES and REC for the Mzimvubu Estuary (as allocated in the EWR study conducted on the estuary in 2014), and to assess the consequences of future scenarios as presented to the estuarine team by the study yield modelling team. The Estuary Templates (as per the official DWS methodology) will be completed by all specialist. In addition this workshop will produce the monitoring programme templates for the Mzimvubu Estuary and EcoSpecs for the PES and REC.

25 May 2017	Duration (min)	Item	Presenters
10:00 - 10:15	15 min	Purpose and overview of workshop	Susan Taljaard
10:15 - 10:45	30 min	Overview of Hydrological Scenarios provided to estuarine team	Lara van Niekerk
10:45 - 11:30	45 min	Hydrodynamic/Sediment Component (confirmation of PES and Future Scenarios)	Lara van Niekerk
11:30 - 12:00	30 min	Water Quality component (confirmation PES and Future Scenarios)	Susan Taljaard
12:00 - 12:30	30 min	Microalgae component (confirmation of PES and Future Scenarios)	Gavin Snow
12:30 - 13:00	30 min	Macrophyte (confirmation of PES and Future Scenarios)	Janine Adams
13:00 - 14:00		**LUNCH**	
14:30 - 14:30	30 min	Invertebrate component (confirmation of PES and Future Scenarios)	Nicky Forbes
14:30 - 15:00	30 min	Fish component (confirmation of PES and Future Scenarios)	Steven Weerts
15:00 - 15:30	30 min	Birds component (confirmation of PES and Future Scenarios)	Jane Turpie
15:30 - 16:00		**TEA/COFFEE BREAK**	
16:00 - 16:30	30 min	Confirmation of overall PES, Importance and REC	All
16:30		**CLOSURE FOR DAY**	

26 May 2017	Duration (min)	Item	Presenters
8:30 - 9:00	30 min	Selection and agreement on REC Flow Scenario	Lara van Niekerk
9:00 - 9:30	30 min	Overview of requirements for EcoSpecs and monitoring templates	Susan Taljaard
9:30 - 10:30	60 min	Specialists work on individual EcoSpec templates for PES and REC	All
10:30 - 11:00		**TEA/COFFEE BREAK**	
11:00 - 12:00	60 min	Specialists work on individual Monitoring templates	All
12:00 - 13:00	60 min	Feeb-back on EcoSpec and Monitoring templates (plenary)	All
13:00 - 14:00		**LUNCH**	
14:00 - 15:00	60 min	Finalisation of Templates/Due dates for outstanding Deliverables	Susan Taljaard
15:00		**CLOSURE OF WORKSHOP**	

5 APPENDIX B: ATTENDANCE REGISTER

ATTENDANCE REGISTER: MZIMVUBU CLASSIFICATION AND RQO STUDY – ESTUARY SPECIALIST WORKSHOP

THURSDAY, 25 May 2017

Name and Surname	Organisation	Email Address	Signature
Susan Taljaard	CSIR	staljaar@csir.co.za	S. Taljaard
Janine Adams	NMMU	janine.adams@nmmu.ac.za	
Steven Weerts	CSIR	sweerts@csir.co.za	
Gavin Snow	WITS	GAVIN.SNOW@WITS.AC.ZA	
Nicolette Forbes	MER	nicolette@mer.co.za	
Jane Turpie	Anchor		
Lara van Niekerk	CSIR	lvniekerk@csir.co.za	

ATTENDANCE REGISTER: MZIMVUBU CLASSIFICATION AND RQO STUDY – ESTUARY SPECIALIST WORKSHOP

FRIDAY, 26 May 2017

Name and Surname	Organisation	Email Address	Signature
Susan Taljaard	CSIR	staljaar@csir.co.za	S. Taljaard
Gavin Snow	WITS	GAVIN.SNOW@WITS.AC.ZA	
Steven Weerts	CSIR	sweerts@csir.co.za	
Janine Adams	NMMU	janine.adams@nmmu.ac.za	
Nicolette Forbes	MER	nicolette@mer.co.za	
Jane Turpie	Anchor	jane@anchorenvironmental.co.za	
Lara van Niekerk	CSIR	lvniekerk@csir.co.za	