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

# Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments

## ECOLOGICAL CONSEQUENCES REPORT, VOLUME 2: ESTUARIES

**FINAL**
**August 2023**

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Department of Water and Sanitation
**Chief Directorate: Water Ecosystems Management**

PROJECT NUMBER**:** WP 11387

# Ecological Consequences Report
# Volume 2: Estuaries

# CLASSIFICATION OF SIGNIFICANT WATER RESOURCES AND DETERMINATION OF RESOURCE QUALITY OBJECTIVES FOR WATER RESOURCES IN THE USUTU TO MHLATHUZE CATCHMENTS

**August 2023**



**REFERENCE**
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# REPORT SCHEDULE

| Index Number | DWS Report Number | Report Title |
|---|---|---|
| 1 | WEM/WMA3/4/00/CON/CLA/0122 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Inception Report including Gap Analysis chapter** |
| 2 | WEM/WMA3/4/00/CON/CLA/0222 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Status Quo and Delineation of Integrated Units of Analysis and Resource Unit Report** |
| 3 | WEM/WMA3/4/00/CON/CLA/0322 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Resource Units Delineation and Prioritisation Report** |
| 4 | WEM/WMA3/4/00/CON/CLA/0422 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Hydrology Systems Analysis Report** |
| 5 | WEM/WMA3/4/00/CON/CLA/0522 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **River EWR estimates for Desktop Biophysical Nodes Report** |
| 6 | WEM/WMA3/4/00/CON/CLA/0622 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **River Survey Report** |
| 7 | WEM/WMA3/4/00/CON/CLA/0722 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Basic Human Needs Report** |
| 8 | WEM/WMA3/4/00/CON/CLA/0822 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Groundwater Report** |
| 9 | WEM/WMA3/4/00/CON/CLA/0922 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **River specialist meeting Report** |
| 10 | WEM/WMA3/4/00/CON/CLA/1022 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Estuary Survey Report** |
| 11 | WEM/WMA3/4/00/CON/CLA/1122 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Wetland Report** |
| 12 | WEM/WMA3/4/00/CON/CLA/1222 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Ecological Water Requirements Report** |
| 13 | WEM/WMA3/4/00/CON/CLA/1322 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Scenario Description Report** |

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| | WEM/WMA3/4/00/CON/CLA/0123, volume 2 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Ecological Consequences Report, Volume 2: Estuaries** |
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| 16 | WEM/WMA3/4/00/CON/CLA/0423 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Economic & User water quality Consequences Report** |
| 17 | WEM/WMA3/4/00/CON/CLA/0523 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Water Resource Classes Report** |
| 18 | WEM/WMA3/4/00/CON/CLA/0623, volume 1 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Resource Quality Objectives Report, Volume 1: Rivers** |
| | WEM/WMA3/4/00/CON/CLA/0623, volume 2 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Resource Quality Objectives Report, Volume 2: Estuaries** |
| | WEM/WMA3/4/00/CON/CLA/0623, volume 3 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Resource Quality Objectives Report, Volume 3: Wetlands and Groundwater** |
| 19 | WEM/WMA3/4/00/CON/CLA/0723 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Monitoring and Implementation Report** |
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| 21 | WEM/WMA3/4/00/CON/CLA/0224 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Issues and Responses Report** |
| 22 | WEM/WMA3/4/00/CON/CLA/0324 | Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Close out Report** |

**Shaded Grey** indicates this report.

# APPROVAL

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# EXECUTIVE SUMMARY

## BACKGROUND

Chapter 3 of the National Water Act, 1998 (NWA) (Act 36 of 1998), deals with the protection of water resources. Section 12 of the NWA requires the Minister to develop a system to classify water resources. In response to this, the Water Resource Classification System (WRCS) was gazetted on 17 September 2010 and published in the Government Gazette no. 33541 as Regulation 810. The WRCS is a step-wise process, whereby water resources are categorised according to specific classes that represent a management vision of a particular catchment. This vision takes into account, the current state of the water resource, the ecological, social, and economic aspects that are dependent on the resource. Once significant water resources have been classified through the WRCS, Resource Quality Objectives (RQOs) have to be determined to give effect to the class.

The Chief Directorate: Water Ecosystems Management (CD: WEM) of the Department of Water and Sanitation (DWS), initiated a study to determine the Water Resource Classes and RQOs for all significant water resources in the Usutu to Mhlathuze Catchment. The Usutu to Mhlathuze Catchments are amongst many water-stressed catchments in South Africa. These catchment areas are important for conservation, and contain a number of protected areas such as natural heritage sites, cultural and historic sites, as well as other conservation areas that need protection.

## STUDY AREA

The study area is the Usutu to Mhlathuze Catchment, which has been divided into six drainage areas, as well as secondary catchment areas:

- W1 catchment (main river: Mhlathuze).
- W2 catchment (main river: Umfolozi).
- W3 catchment (main river: Mkuze).
- W4 catchment (main river: Pongola) - part of this catchment area falls within Eswatini.
- W5 catchment (main river: Usutu) - much of this catchment falls within Eswatini.
- W7 catchment (Kosi Bay and Lake Sibaya).

## PURPOSE OF THIS REPORT

The purpose of this report is to update the 2015 EcoClassification and Ecological Water Requirements (EWR) results of the estuaries assessment in the Usutu to Mhlathuze Catchment. The results form part of Task 3: Quantify BHN and EWR and Task 4: Identify and evaluate scenarios within IWRM.

## APPROACH TO FUTURE SCREENINGS OF FLOW SCENARIOS RELEVANT TO THE ST LUCIA/uMFOLOZI ESTUARINE LAKE SYSTEM

The St Lucia/uMfolozi Present Ecological State (PES) was not updated as part of this study as there was no new investment in the surveying and monitoring of the Greater St Lucia Estuarine Lake system. Funds are at present being secured by iSimangaliso Wetland Park to address this critical information gaps need to guide the assessment of condition and management actions. In 2016 the St Lucia/uMfolozi PES was estimated as a D (DWS, 2016) and this will form the basis of the classification process. However, based on measurements and photographic imagery provided to the St Lucia Estuary Task Team over the last two years the various abiotic and biotic components of the system are likely varying between D and E Category due to flow reduction, reduced

connectivity, high sediment input (especially from the uMfolozi River), nutrient pollution (with a focus on the uMfolozi and Mkuze rivers), artificial breaching, illegal catches (gill netting), and significant land-use change in the flood plain of the larger system. The system is currently on a trajectory of change, i.e. condition not stable, and while the mouth have been open for an extended period, little salt water has entered the system and significant deposits of fine muds/silts have formed in The Narrows. Some of the elements of the estuary ecosystem that have been negatively affected include: physical habitat (significant increase in fine sediments in The Narrows), water quality (low salinity and high turbidity); macrophytes (die-off of mangroves), invertebrates and fish (dominated by freshwater species) (issues raised in St Lucia Task Team discussions).

The DWS (2016) overarching Recommended Ecological Category (REC) recommendation is 'Best Attainable State' of a B/C (~72) with a B Category is achievable in the long-term. The Department of Forestry and Fisheries and the Environment (DFFE) Ministerial Panel of Independent Experts also advocates for a REC of a B Category (DFFE, 2022).

DWS (2016) found that the total present flow from both the Mfolozi and the five St Lucia rivers is needed to achieve the REC of the greater St Lucia/uMfolozi Lake System, with an additional range of non-flow related activities needed to improve it to a B Category. DWS (2016) provides minimum recommend flows for a B/C Category, namely:

- Cap minimum discharge in the Mfolozi at 3 $m^3/s$ to maintain an open mouth.
- Ensure a combined Mfolozi and Mkuze drought discharge of 5 $m^3/s$ (including an additional 1.6 $m^3/s$ in Mkuze).
- Improve the water quality coming from the Mkuze catchment.

The DWS (2016) EWR report clearly states that the total present flow from both the Mfolozi and the St Lucia rivers are needed to achieve the REC, i.e. any flow scenario that would involve flow reduction from the Present will not meet the REC. Less than 1% change can be made to Mfolozi flows, but that flow needs to be reallocated to the EWR of the St Lucia Rivers to ensure that the system attains in a C category (and does not decline during droughts). In addition to ensuring the required water quantity and quality, a range of non-flow interventions is needed to improve the system to a B/C in the short term and to a B in the long term. Note, that the DWS 2016 highlights that the system is very sensitive to Climate Change and that flow and non-flow interventions are urgently needed to increase resilience to droughts.

Non-Flow interventions to address ecological concerns include (DWS, 2016):

a) St Lucia/uMfolozi should have a single mouth and with no manipulation of the mouth (artificial breaching or closing)
b) Restore low-lying areas of the uMfolozi floodplain to natural vegetation to allow for natural processes (e.g. carbon sequestration, mouth closure)
c) Remove alien vegetation around the Lake, estuaries and rivers;
d) Limit further natural deforestation such as in the Dukuduku Forest;
e) Eradicate illegal gillnetting from the system;
f) Eradicate and monitor occurrence of alien invasive species (plants, invertebrates and fish);
g) Prevent urbanization in the catchments feeding directly into the Lake and The Narrows;
h) Reduce commercial forestation in the lake catchments to increase low flows as much as possible;

i) In the uMfolozi River catchment, land care practices should focus on the most critical sub-catchment areas to limit future erosion and land degradation which could further reduce low flows; and

j) Illegal river abstractions on especially the Mkuze and uMfolozi Rivers must be eliminated. Note, ecological recommendations regarding mouth state is currently being re-evaluated by management due to social reasons at the recommendation of the (DFFE) Ministerial Panel of Independent Experts.

Future development scenarios need to be screened against these flow requirements to see if they meet the minimum set above. If they cannot meet the above, it means that the estuary cannot improve in condition, i.e. achieve REC, and may even decline further in condition over time.

## RESULTS

Five estuaries were assessed in terms of ecological consequences.

### aMATIGULU/iNYONI ESTUARY

Four flow scenarios and one non-flow scenario were evaluated for the aMatigulu/iNyoni Estuary (see table below).

**aMatigulu/iNyoni Estuary: Summary of flow scenarios**

| Scenarios | Description | MAR[1] ($X10^6$ $m^3$) | % Remaining |
|---|---|---|---|
| Reference | Natural (~1750) | 141.17 | |
| Present | Present day | 113.77 | 80.59 |
| Scenario 1 | Climate Change | 94.79 | 67.14 |
| Scenario 2 | 20% reduction | 98.97 | 70.10 |
| Scenario 3 | 30% reduction | 92.46 | 65.49 |
| Scenario 4 | 15% Increase | 125.65 | 89.00 |
| Scenario 5 | Present with non-flow restoration interventions including active restoration of the riparian area undertaken in conjunction with a reduction in harvesting and grazing pressures on the macrophytes. Fishing pressure (especially illegal gill netting) is reduced and recreational activities such as boating are controlled. Recreational activities in the lower reaches are curbed through zonation and improved compliance. | 113.77 | 80.59 |

1 Mean Annual Runoff

The **PES** of the aMatigulu/iNyoni Estuary is a **B/C** Category (see table below).

**aMatigulu/iNyoni Estuary: EHI scores and corresponding Ecological Categories under the different runoff scenarios**

| Component | PES | Scenarios | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Hydrology | 73 | 57 | 48 | 41 | 93 | 73 |
| Hydrodynamics and mouth condition | 84 | 72 | 54 | 39 | 98 | 84 |
| Water quality | 63 | 63 | 64 | 65 | 64 | 63 |
| Physical habitat alteration | 83 | 65 | 65 | 56 | 90 | 87 |

| Component | PES | Scenarios | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **Habitat health score** | **76** | **64** | **58** | **50** | **86** | **77** |
| Microalgae | 79 | 62 | 70 | 65 | 80 | 79 |
| Macrophytes | 78 | 68 | 58 | 48 | 85 | 85 |
| Invertebrates | 70 | 65 | 55 | 45 | 80 | 80 |
| Fish | 65 | 65 | 55 | 45 | 70 | 75 |
| Birds | 70 | 65 | 60 | 50 | 75 | 80 |
| **Biotic health score** | **72** | **65** | **60** | **51** | **78** | **80** |
| **ESTUARY HEALTH SCORE** | **74** | **65** | **59** | **51** | **82** | **78** |
| **ECOLOGICAL STATUS** | **B/C** | **C** | **C/D** | **D** | **B** | **B** |

The Estuary Importance Score (EIS) takes size, the rarity of the estuary type within its biographical zone, habitat, biodiversity and the functional importance of the estuary into account (DWAF 2008; Turpie *et al*. 2012a;b). Biodiversity importance, in turn, is based on the assessment of the importance of the estuary for plants, invertebrates, fish and birds, using rarity indices. The scores have been determined for all South African estuaries, apart from functional importance, which is scored by the specialists in the workshop. The Estuary Importance Score for five components and the importance rating are presented below. The **functional importance** of aMatigulu/iNyoni Estuary is **very high** with a score of 90 (see table below)

**The Functional Importance Score of the aMatigulu/iNyoni Estuary**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 40 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 90 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 80 |
| d) Roosting area for marine or coastal birds | 60 |
| e) Catchment detritus, nutrients and sediments to sea | 20 |
| **Functional importance score - Max (a to e)** | **90** |

The **EIS** for the aMatigulu/iNyoni Estuary, is 81, indicating that the estuary is rated as "**Highly Important**" (see table below).

**Estuarine Importance Score for the aMatigulu/iNyoni Estuary**

| Criterion | Weight | Score |
|---|---|---|
| Estuary Size | 15 | 90 |
| Zonal Rarity Type | 10 | 30 |
| Habitat Diversity | 25 | 80 |
| Biodiversity Importance | 25 | 89 |
| Functional Importance | 25 | 90 |
| **Estuary Importance Score** | | **81** |
| **Calculation of the functional importance score** | | **Highly important** |

The **REC** is based on the Best Attainable State (BAS) for the aMatigulu/iNyoni Estuary which is a **B** Category. The Recommended Flow Scenario is Scenario 1 (Restoration Scenario) with non-flow interventions.

### iNLABANE ESTUARY

Four flow scenarios were evaluated for the iNhlabane Estuary (see table below).

**iNhlabane Estuary: Summary of flow scenarios**

| Scenarios | Description | MAR ($X10^6$ $m^3$) | % Similarity |
|---|---|---|---|
| Reference | Natural (~1750) | 30.40 | 100.0 |
| Present | Present day | 21.31 | 70.1 |
| Scenario 1 | Climate change | 10.09 | 33.2 |
| Scenario 2 | Historical EWR (DWAF, 2000) | 21.33 | 70.2 |
| Scenario 3 | Restoration of flow (+ 15%) | 26.35 | 86.7 |
| Scenario 4 | Restoration of flow and non-flow interventions | 26.35 | 86.7 |

The **PES** of the iNhlabane Estuary is an **E** Category (see table below).

**iNhlabane Estuary: EHI scores and corresponding Ecological Categories under the different runoff scenarios**

| Component | PES | | Estuary Scenarios | | | |
|---|---|---|---|---|---|---|
| | Estuary | North & South Lakes | 1 | 2 | 3 | 4 (Sc 3 + NON-FLOW Interventions) |
| Hydrology | 33 | 75 | 32 | 33 | 56 | 56 |
| Hydrodynamics and mouth condition | 59 | 29 | 53 | 60 | 59 | 59 |
| Water quality | 32 | 25 | 34 | 32 | 32 | 32 |
| Physical habitat alteration | 30 | 10 | 20 | 30 | 30 | 30 |
| **Habitat health score** | **39** | **35** | **35** | **39** | **44** | **44** |
| Microalgae | 31 | 56 | 27 | 28 | 46 | 46 |
| Macrophytes | 50 | 20 | 45 | 50 | 55 | 60 |
| Invertebrates | 10 | 15 | 5 | 10 | 10 | 30 |
| Fish | 5 | 15 | 5 | 5 | 5 | 30 |
| Birds | 20 | 30 | 15 | 20 | 25 | 45 |
| **Biotic health score** | **23** | **27** | **19** | **23** | **28** | **42** |
| **ESTUARINE HEALTH SCORE** | **31** | **31** | **27** | **31** | **36** | **43** |
| **PRESENT ECOLOGICAL STATUS** | **E** | **E** | **E** | **E** | **E** | **D** |

*Note: PES are also provided for South and North Lake to contextualise overall ecosystem condition (Low confidence).*

The Estuary Importance Score for five components and the importance rating are presented below. The **functional importance** of iNhlabane Estuary is **high** with a score of 80 (see table below).

**The Functional Importance Score of the iNhlabane Estuarine Lake**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 40 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 80 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 80 |
| d) Roosting, foraging and/or nesting area for marine and coastal birds | 40 |
| e) Catchment detritus, nutrients and sediments to sea | 20 |
| **Functional importance score - Max (a to e)** | 80 |

The **EIS** for the iNhlabane Estuary, is 69, indicating that the estuary is rated as “Important” (see table below).

**Estuarine Importance Score for the iNhlabane Estuarine Lake**

| Estuarine Importance | Score |
|---|---|
| Estuary Size | 50 |
| Zonal Rarity Type | 70 |
| Habitat Diversity | 50 |
| Biodiversity Importance | 86 |
| Functional Importance | 80 |
| **ESTUARINE IMPORTANCE SCORE** | **69** |
| **Calculation of the functional importance score** | **Important** |

The **REC** is a **D** Category. The Recommended Flow Scenario is Scenario 3 (Restoration Scenario) coupled with interventions such as artificial breaching and dredging of the organic layer accumulated in the system.

**uMHLATUZE ESTUARY**

Four flow scenarios were evaluated for the uMhlatuze Estuary (see table below).

**uMhlatuze Estuary: Summary of flow scenarios**

| Scenarios | Description | MAR ($X10^6$ $m^3$) | % Similarity |
|---|---|---|---|
| Reference | Natural (~1750) | 470.08 | 100.0 |
| Present | Present day | 289.59 | 61.6 |
| Scenario 1 | Climate change | 219.07 | 46.6 |
| Scenario 2 | Restoration (15% increase) | 333.00 | 70.8 |
| Scenario 3 | 2030 Development | 281.44 | 59.9 |
| Scenario 4 | 2040 Development | 278.31 | 59.2 |

The **PES** of the uMhlatuze Estuary is a **D** Category. Note that PES scores are also provided for Lake Mzingazi, Richards Bay and Lake Cubhu (Low confidence) (see table below).

**uMhlatuze Estuary: EHI Score and corresponding Ecological Categories under the different runoff scenarios**

| Component | PES | | | | Scenarios for uMhlatuze Estuary | | | |
|---|---|---|---|---|---|---|---|---|
| | Lake Mzingazi | Richards Bay | uMhlatuze | Lake Chubu | 1 | 2 | 3 | 4 |
| Hydrology | 53 | 53 | 53 | 53 | 41 | 70 | 53 | 53 |
| Hydrodynamics and mouth condition | 10 | 18 | 39 | 10 | 40 | 38 | 39 | 39 |
| Water quality | 71 | 45 | 57 | 58 | 59 | 56 | 57 | 57 |
| Physical habitat alteration | 10 | 20 | 50 | 10 | 40 | 50 | 50 | 50 |
| **Habitat health score** | **36** | **34** | **50** | **33** | **45** | **53** | **50** | **50** |
| Microalgae | 31 | 41 | 55 | 30 | 50 | 54 | 55 | 55 |
| Macrophytes | 30 | 30 | 40 | 30 | 35 | 45 | 40 | 40 |
| Invertebrates | 55 | 15 | 20 | 50 | 15 | 25 | 20 | 20 |
| Fish | 25 | 25 | 40 | 35 | 35 | 45 | 40 | 40 |
| Birds | 70 | 20 | 60 | 70 | 40 | 65 | 50 | 50 |
| **Biotic health score** | **42** | **26** | **43** | **43** | **35** | **47** | **41** | **41** |
| **ESTUARINE HEALTH SCORE** | **39** | **30** | **46** | **38** | **40** | **50** | **45** | **45** |
| **PRESENT ECOLOGICAL STATUS** | **D/E** | **E** | **D** | **E** | **D/E** | **D** | **D** | **D** |

The Estuary Importance Score for five components and the importance rating are presented below. The **functional importance** of uMhlatuze Estuary is **very high** with a score of 100 (see table below).

**The Functional Importance Score of the uMhlatuze Estuary**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 90 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 100 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 90 |
| d) Roosting, foraging and/or nesting area for marine and coastal birds | 100 |
| e) Catchment detritus, nutrients and sediments to sea | 90 |
| **Functional importance score - Max (a to e)** | **100** |

The **EIS** for the uMhlatuze Estuary, is 94, indicating that the estuary is rated as "**Very high**" (see table below).

**Estuarine Importance Score for the uMhlatuze Estuary**

| Estuarine Importance | Score |
|---|---|
| Estuary Size | 100 |
| Zonal Rarity Type | 80 |
| Habitat Diversity | 100 |
| Biodiversity Importance | 85 |
| Functional Importance | 100 |
| **ESTUARINE IMPORTANCE SCORE** | **94** |
| **Calculation of the functional importance score** | **Highly important** |

The **REC** is a **D** Category as the current state of the system is largely the result of the port development and the construction of weirs/barrages that divided the system in four components – and deemed irreversible from a restoration perspective. The flow requirements for the estuary are the same as those described for Scenario 2 and are summarised in **Table 4.9**. However, Scenario 3 (2030 development) and 4 (2040 development) with the above interventions for the estuary, Richards Bay and the associated lakes implemented to offset flow impacts also meet the criteria.

**uMLALAZI ESTUARY**

Seven flow scenarios and one non-flow scenario were evaluated for the uMlalazi Estuary (see table below).

**uMlalazi Estuary: Summary of flow scenarios**

| Scenarios | Description | MAR ($X10^6$ $m^3$) | % Remaining |
|---|---|---|---|
| Natural | Natural (~1750) | 119.34 | |
| Present | Present day | 99.55 | 83.4 |
| Scenario 1 | Climate change . | 69.08 | 57.9 |
| Scenario 4 | Increased WWTW discharged. | 99.25 | 83.2 |
| Scenario 5 | Present, but includes an additional demand which is approximately 10% of the present MAR (13 $Mm^3$) supplied by the upstream dam which has an increased capacity of 15 $Mm^3$. | 95.95 | 80.4 |
| Scenario 6 | Present reduced by 10% through abstraction from lower reaches of the river. | 88.92 | 74.5 |
| Scenario 7 | Present reduced by 20% through abstraction from lower reaches of the river. | 79.12 | 66.3 |
| Scenario 8 | Same as Scenario 7 except an additional demand of 10% MAR is taken out of the upstream catchment from a dam with a capacity of 20 $Mm^3$ (over and above the 20% demand taken directly from the river). | 75.67 | 63.4 |
| Scenario 9 | Present with non-flow restoration interventions: Create interventions within the buffer zone that would improve the nutrient status and reduce sediment inputs. Reduce fishing pressure through eradicating illegal gill netting, as well as illegal seine and cast netting to improve the nursery function. Undertake active restoration of the uMlalazi estuary functional zone and reduce agriculture impacts in the supratidal area of the system, including the controlling of harvesting and grazing pressures. Restore intertidal habitat in lower reaches. Control recreational activities in the lower reaches through zonation and improved compliance. Manage disturbance to birds (e.g. closed areas, boating controls such as speed zones), including control and management of vehicle access at the mouth to minimise the disturbance to birds. Promote tourism (bird guides etc.) to reduce impacts on other activities in the system. Implement strategic planning and management of land-use in and around the EFZ. Monitor and control sand-mining in the upper reaches of the system. | 99.55 | 83.4 |

The **PES** of the uMlalazi Estuary is a **B/C** Category (see table below).

**uMlalazi Estuary: EHI scores and corresponding Ecological Categories under the different runoff scenarios**

| Component | PES | Scenarios | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 4 | 5 | 6 | 7 | 8 | 9 |
| Hydrology | 72 | 41 | 71 | 69 | 55 | 41 | 39 | 72 |
| Hydrodynamics and mouth condition | 84 | 61 | 84 | 83 | 71 | 61 | 59 | 84 |
| Water quality | 66 | 48 | 42 | 66 | 54 | 46 | 45 | 66 |
| Physical habitat alteration | 85 | 55 | 60 | 85 | 70 | 55 | 50 | 85 |
| **Habitat health score** | **77** | **51** | **64** | **76** | **62** | **51** | **48** | **77** |
| Microalgae | 72 | 55 | 34 | 72 | 70 | 65 | 63 | 72 |
| Macrophytes | 70 | 40 | 40 | 65 | 60 | 50 | 50 | 75 |
| Invertebrates | 75 | 60 | 40 | 75 | 65 | 55 | 50 | 85 |
| Fish | 80 | 50 | 55 | 75 | 75 | 55 | 55 | 85 |
| Birds | 60 | 45 | 55 | 55 | 55 | 50 | 45 | 80 |
| **Biotic health score** | **71** | **50** | **45** | **68** | **65** | **55** | **53** | **79** |
| **ESTUARY HEALTH SCORE** | **74** | **51** | **55** | **72** | **64** | **53** | **50** | **78** |
| **ECOLOGICAL CATEGORY** | **B/C** | **D** | **D** | **C** | **C** | **D** | **D** | **B** |

The Estuary Importance Score for five components and the importance rating are presented below. The **functional importance** of uMlalazi Estuary is **very high** with a score of 90 (see table below).

**The Functional Importance Score of the uMlalazi Estuary**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 80 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 90 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 60 |
| d) Roosting, foraging and/or nesting area for marine and coastal birds | 60 |
| e) Catchment detritus, nutrients and sediments to sea | 20 |
| **Functional importance score - Max (a to e)** | **90** |

The **EIS** for the uMlalazi Estuary, is 85, indicating that the estuary is rated as "**Highly Important**" (see table below).

**Estuarine Importance Score for the uMlalazi Estuary**

| Criterion | Weight | Score |
|---|---|---|
| Estuary Size | 15 | 90 |
| Zonal Rarity Type | 10 | 30 |
| Habitat Diversity | 25 | 90 |
| Biodiversity Importance | 25 | 96 |
| Functional Importance | 25 | 90 |

| Criterion | Weight | Score |
|---|---|---|
| **Estuary Importance Score** | | **86** |
| **Calculation of the functional importance score** | | **Highly important** |

The **REC** is a **B** Category, and the Recommended flow scenario is Present with non-flow interventions.

**iSIYAYA ESTUARY**

Three flow scenarios were evaluated for the iSiyaya Estuary:

**iSiyaya Estuary: Summary of flow scenarios**

| Scenarios | Description | MAR ($X10^6$ $m^3$) | % Similarity |
|---|---|---|---|
| Reference | Natural (~1750) | 4.70 | 100.00 |
| Present | Present day | 3.39 | 72.0 |
| Scenario 1 | Climate change | 2.21 | 47.1 |
| Scenario 2 | Increased abstraction (-15 %) | 2.89 | 61.4 |
| Scenario 3 | Restoration of baseflows (+15%) | 3.91 | 83.0 |

The **PES** of the iSiyaya Estuary is a **D/E** Category (see table below).

**iSiyaya Estuary: EHI scores and corresponding Ecological Categories under the different runoff scenarios**

| Component | Present | Scenarios | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Hydrology | 74 | 52 | 44 | 100 |
| Hydrodynamics and mouth condition | 57 | 27 | 51 | 57 |
| Water quality | 53 | 62 | 47 | 56 |
| Physical habitat alteration | 30 | 10 | 20 | 30 |
| **Habitat health score** | **53** | **38** | **40** | **61** |
| Microalgae | 51 | 27 | 36 | 71 |
| Macrophytes | 30 | 15 | 20 | 40 |
| Invertebrates | 15 | 5 | 10 | 20 |
| Fish | 15 | 10 | 10 | 20 |
| Birds | 50 | 30 | 40 | 55 |
| **Biotic health score** | **32** | **17** | **23** | **41** |
| **ESTUARINE HEALTH SCORE** | **43** | **28** | **32** | **51** |
| **PRESENT ECOLOGICAL STATUS** | **D/E** | **E** | **E** | **D** |

The Estuary Importance Score for five components and the importance rating are presented below. The **functional importance** of iSiyaya Estuary is **low** with a score of 20 (see table below).

**The Functional Importance Score of the iSiyaya Estuary**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 10 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 20 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 20 |
| d) Roosting, foraging and/or nesting area for marine and coastal birds | 10 |
| **Functional importance score - Max (a to e)** | **20** |

The **EIS** for the iSiyaya Estuary, is 37, indicating that the estuary is rated as of "**Low to Moderate Importance**" (see table below).

**Estuarine Importance Score for the iSiyaya Estuary**

| Estuarine Importance | Score |
|---|---|
| Estuary Size | 30 |
| Zonal Rarity Type | 10 |
| Habitat Diversity | 60 |
| Biodiversity Importance | 47 |
| Functional Importance | **20** |
| **ESTUARINE IMPORTANCE SCORE** | **37** |
| **Calculation of the functional importance score** | **Low to Moderate Importance** |

The iSiyaya is a very small system and that sensitive to small increase in flows, in addition small changes in water quality would improve the system significantly. Using the degree to which non-flow interventions have modified the system and the reversibility of key impacts (i.e. removal of organic sludge and reduce high turbidity caused by mining activities), the **REC** is a **C** and the recommended flow scenario is Scenario 3 (Restoration Scenario) with additional non-flow intervention to achieve the REC.

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# TERMINOLOGY AND ACRONYMS

| | |
|---|---|
| BAS | Best Attainable State |
| CD: WEM | Chief Directorate: Water Ecosystems Management |
| DFFE | Department of Forestry, Fisheries and the Environment |
| DWA | Department of Water Affairs |
| DWAF | Department of Water Affairs and Forestry |
| DWS | Department of Water and Sanitation |
| EbA | Ecosystems-based Adaptation |
| EC | Ecological Category |
| EFZ | Estuary Functional Zone |
| EHI | Estuarine Health Index |
| EIS | Estuary Importance Score |
| EWR | Ecological Water Requirements |
| GBF | Global Biodiversity Framework |
| ICM | Integrated Coastal Management |
| IWRM | Integrated Water Resource Management |
| MAR | Mean Annual Runoff |
| MSL | Mean Sea Level |
| NWA | National Water Act |
| NWRCS | National Water Resource Classification System |
| PES | Present Ecological State |
| RDM | Resource Directed Measures |
| REC | Recommended Ecological Category |
| RQO | Resource Quality Objectives |
| Sc | Scenario |
| Sc CC | Climate Change scenario |
| WRCS | Water Resource Classification System |
| WWTW | Waste Water Treatment Works |

# SPELLING

There are multiple references to the spelling of various Rivers, Lakes, Dams and Estuaries, depending on the source of information. For the purposes of this report, the following Table presents the selected spelling of indicated water resources and places.

| Selected Spelling for this Study | Alternate spellings |
|---|---|
| Usutu River | Usuthu River |
| Mhlathuze River | Mhlatuze, uMhlatuze River |
| Pongola (river, Town & Pongolapoort Dam) | Phongola, Phongolo |
| Lake Sibaya | Lake Sibiya, Lake Sibhayi, Lake Sibhaya |
| Eswatini | eSwatini |
| Umfolozi River | Mfolozi River |
| Amatigulu River | Amatikulu, Matigulu River |
| Goedertrouw Dam | Lake Phobane |
| Mfuli River | Mefule River |
| aMatigulu/iNyoni Estuary | |
| Sibiya Estuary | |
| Mlalazi Estuary | |
| uMhlathuze /Richards Bay Estuary | |
| iNhlabane Estuary | |
| uMfolozi/uMsunduze Estuary | |
| St Lucia Estuary | |
| uMgobezeleni Estuary | |
| Kosi Estuary | |
| Hluhluwe Game Reserve | |
| iMfolozi Game Reserve | |
| Ithala Game Reserve | |
| Ndumo Game Reserve | |
| Tembe Elephant Reserve | |
| iSimangaliso Wetland Park | |
| Kosi Bay and Coastal Forest Area | |
| uMkhuze Game Reserve | |

# GLOSSARY

| | |
|---|---|
| *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. |
| *Integrated Unit of Analysis (IUAs)* | An IUA is a homogeneous area that can be managed as an entity. It is the basic unit of assessment for the Classification of water resources, and is defined by areas that can be managed together in terms of water resource operations, quality, socio-economics and ecosystem services. |
| *Resource Quality Objectives (RQOs)* | RQOs are numeric or descriptive goals or objectives that can be monitored for compliance to the Water Resource Classification, for each part of each water resource. "The purpose of setting RQOs is to establish clear goals relating to the quality of the relevant water resources" (NWA, 1998). |
| *Scenario* | Scenarios, in the context of water resource management and planning, are plausible definitions (settings) of factors (variables) that influence the water balance and water quality in a catchment and the system as a whole. Each scenario represents an alternative future condition, generally reflecting a change to the present condition. |
| *Sub-quaternary (SQ) reaches* | A finer subdivision of the quaternary catchments (the catchment areas of tributaries of main stem rivers in quaternary catchments), to a sub-quaternary reach. |
| *Target Ecological Category (TEC)* | This is the ecological category toward which a water resource will be managed once the Classification process has been completed and the Reserve has been finalised. The draft TECs are therefore related to the draft Classes and selected scenario. |
| *Water Resource Class* | The Water Resource Class (hereafter referred to as Class) is representative of those attributes that the DWS (as the custodian) and society require of different water resources. The decision-making toward a Class requires a wide range of trade-offs to be assessed and evaluated at a number of scales. Final outcome of the process is a set of desired characteristics for use and ecological condition of the water resources in a given catchment. The WRCS defines three management classes, Class I, II, and III, based on extent of use and alteration of ecological condition from the predevelopment condition. |

# 1 INTRODUCTION

## 1.1 BACKGROUND

Chapter 3 of the National Water Act, 1998 (NWA) (Act 36 of 1998), deals with the protection of water resources. Section 12 of the NWA requires the Minister develop a system to classify water resources. In response to this, the Water Resource Classification System (WRCS) was gazetted on 17 September 2010 and published in Government Gazette 33541 as Regulation 810. The WRCS is a stepwise process whereby water resources are categorised according to specific classes that represent a management vision of a particular catchment. This vision takes into account the current state of the water resource, the ecological, social and economic aspects that are dependent on the resource. Once significant water resources have been classified through the WRCS, Resource Quality Objectives (RQOs) must be determined to give effect to the class. The implementation of the WRCS therefore assesses the costs and benefits associated with utilisation versus protection of a water resource. Section 13 of the NWA requires that Water Resource Classes and RQOs be determined for all significant water resources.

Thus, the Chief Directorate: Water Ecosystems Management (CD: WEM) of the Department of Water and Sanitation (DWS) initiated a study for determining the Water Resource Classes and RQOs for all significant water resources in the Usutu to Mhlathuze Catchment. The Usutu to Mhlathuze Catchments are amongst many water-stressed catchments in South Africa. These catchment areas are important for conservation and contain a number of protected areas, natural heritage sites, cultural and historic sites as well as other conservation areas that need protection. There are five RAMSAR[1] sites within the catchment, which includes the world heritage site, St Lucia. The others are Sibaya, Kosi Bay, Ndumo Game Reserve and Turtle Beaches.

## 1.2 STUDY AREA

The study area is the Usutu to Mhlathuze Catchment that has been divided into six drainage areas and secondary catchment areas as follows (refer to the locality map provided as **Figure 1.1**):

- W1 catchment (main river: Mhlathuze).
- W2 catchment (main river: Umfolozi).
- W3 catchment (main river: Mkuze).
- W4 catchment (main river: Pongola) - part of this catchment area falls within Eswatini.
- W5 catchment (main river: Usutu) - much of this catchment falls within Eswatini.
- W7 catchment (Kosi Bay estuary and Lake Sibaya).

Note that all assessments within Eswatini are excluded apart from the hydrological modelling required to assess any downstream rivers in South Africa that either run through Eswatini or originate (source) in Eswatini.

River Ecological Water Requirements (EWR) sites are shown on **Figure 1.1**.

[1] A Ramsar site is a wetland site designated to be of international importance under the Ramsar Convention, also known as "The Convention on Wetlands", an intergovernmental environmental treaty established in 1971 by UNESCO in the Iranian city of Ramsar, which came into force in 1975.

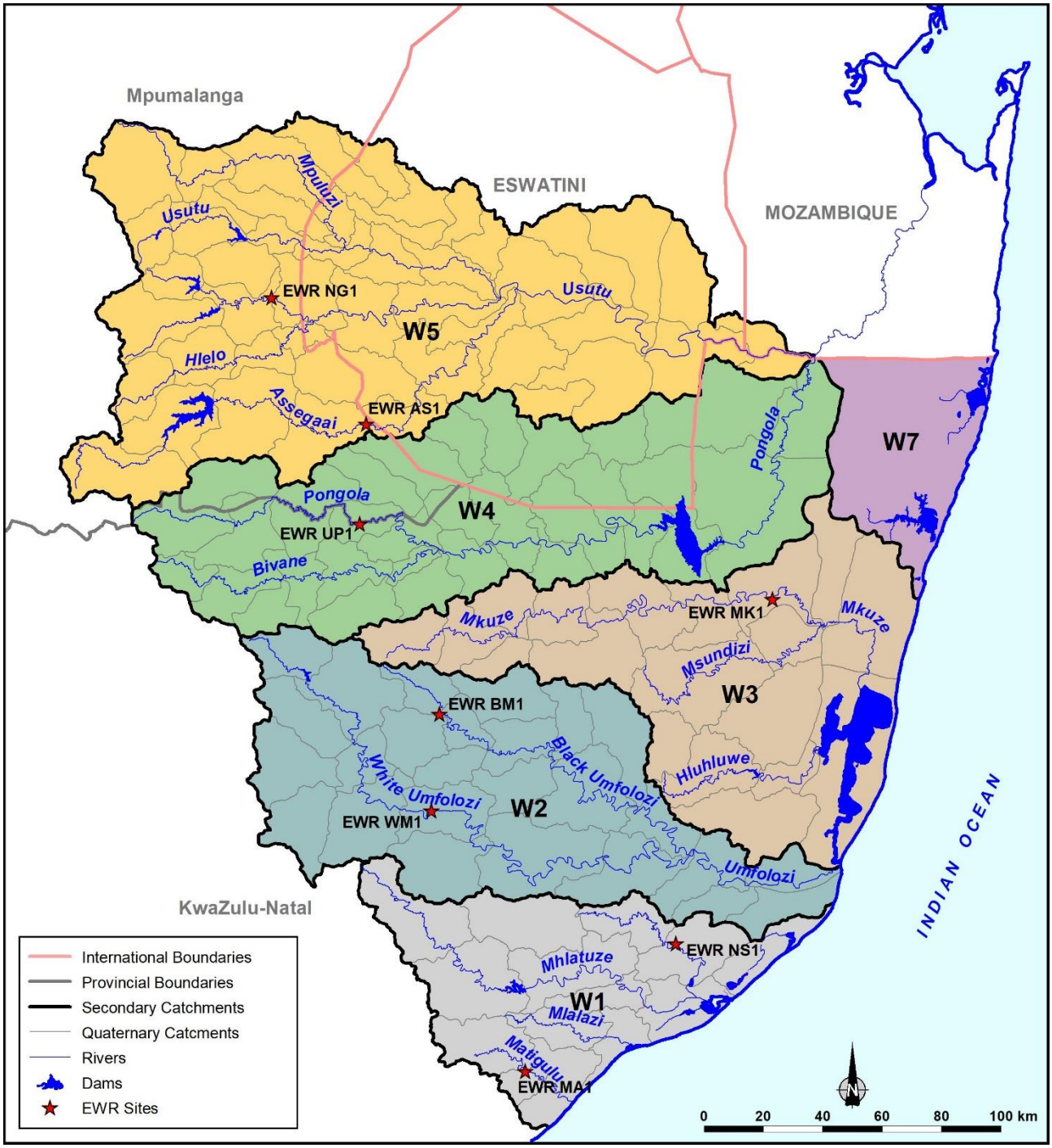


**Figure 1.1 Locality Map of the Study Area**

## 1.3 PURPOSE OF THIS REPORT

The purpose of this report is to document the findings of the estuary assessment that focused on the EcoClassification and evaluation of the consequences of the various operational scenarios in terms of their impact on the estuary ecological states. The results form part of Task 4: Identify and evaluate scenarios within Integrated Water Resources Management (IWRM) (**Figure 1.2**).

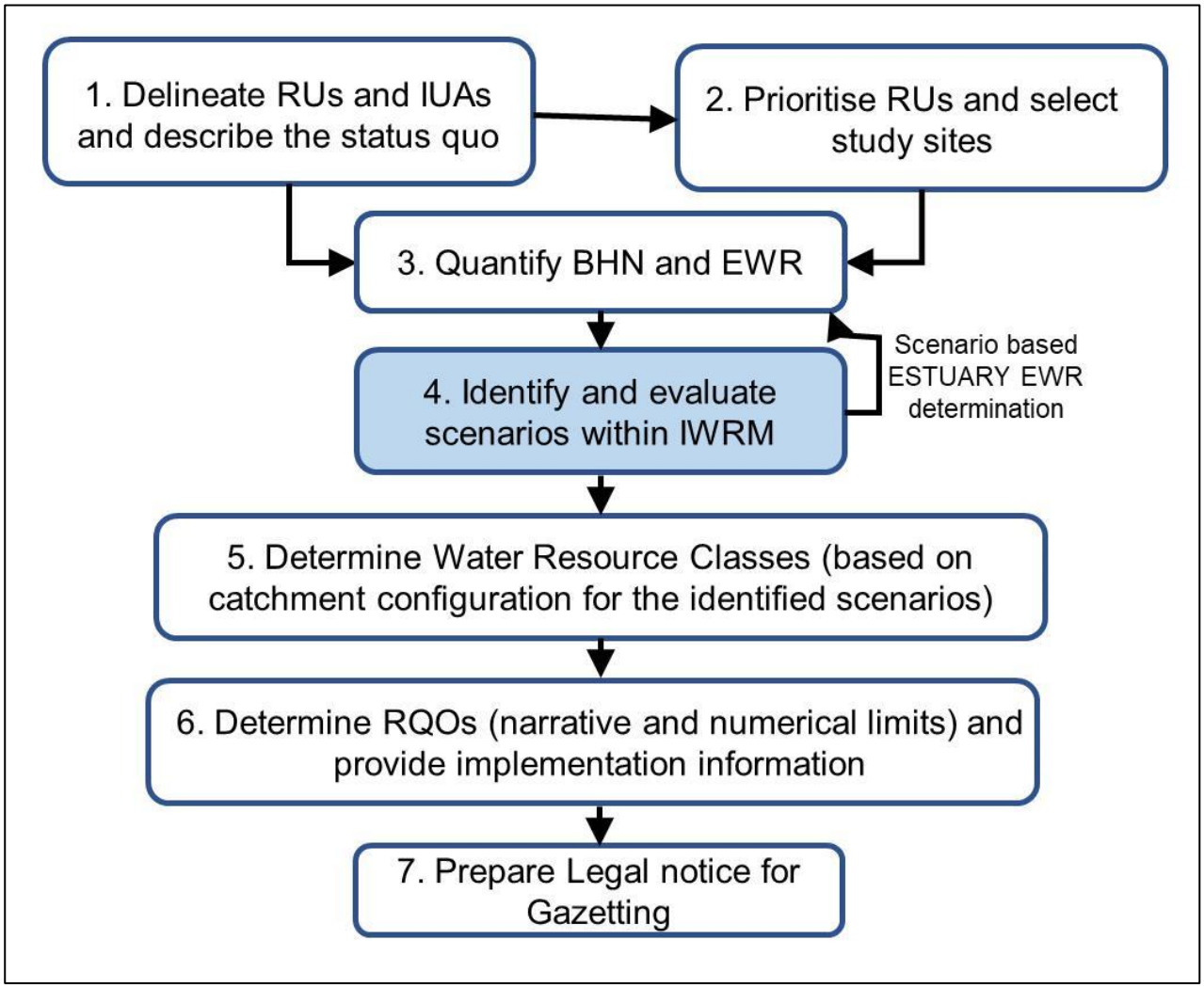


**Figure 1.2 Project Plan for the Usutu-Mhlathuze Classification study**

## 1.4 REPORT OUTLINE

The report outline is as follows:

- **Chapter 1** provides general background information on the study area and the Project Plan.
- **Chapter 2** outlines the general approach and methodology to determining ecological consequences of operational scenarios on the different estuaries.
- **Chapter 3 – 7** provides the consequences of the operational scenarios on the various estuaries.
- **Chapter 8** summarises the ecological consequences of the operational scenarios.
- **Chapter 9** lists the references used in the report.

# 2 APPROACH AND METHODOLOGY

South Africa's National Water Act (NWA) (No. 36 of 1998) requires the implementation of four types of regulatory activities to make optimal use of the country's water resources while minimising ecological damage:

1. **Resource-directed measures**, i.e. defining the desired level of protection for a water resource, and on that basis, setting environmental flows and specific goals for the quality of the resource (the Resource Quality Objectives - RQOs);
2. **Source-directed controls**, i.e. controlling impacts on the water resource through the use of regulatory measures such as registration, permits, directives and prosecution, and economic incentives such as levies and fees, to ensure that the RQOs are met;
3. **Managing demand** on water resources to keep utilisation within the limits required for protection; and
4. **Monitoring** the status of the country's water resources on a continual basis, to ensure that the Resource Quality Objectives are being met, and to enable us to modify programmes for resource management and impact control as and when necessary.

The objective of Resource Directed Measures (RDM) is to ensure the protection of water resources, in the sense of protecting ecosystem functioning and maintaining a desired state of health (integrity or condition) of aquatic and groundwater-dependent ecosystems. This objective is met through various processes, including the setting of 'environmental flows', known as the **Ecological Reserve** (the quantity and quality of water reserved to support ecosystem function). Water resources (river reaches, wetlands, estuaries, etc.) must first be classified according to a **National Water Resource Classification System** (NWRCS or "Classification System") (Dollar *et al.* 2010), to determine the future level of protection and define specific objectives for the resource (RQOs), which is then used to determine the quantity and quality of water to be allocated to the Reserve.

Recognising that it will take some time to classify all water resources in the country, provision has been made in the NWA for the determination of a **Preliminary Reserve** and hence an interim framework for issuing water use licences. Methods to determine the Preliminary Reserve were established soon after the promulgation of the NWA and have been in use since then (DWAF, 2008). These methods follow a generic methodology which can be carried out at different levels of effort to produce a determination of the ecologists' Recommended Ecological Category (REC) and the associated Ecological Reserve. The methods have been slightly modified in the development and evolution of methods for rivers, estuaries, wetlands and groundwater, but the same process is essentially followed in each. This study follows the revised generic procedure provided in **Figure 2.1** (DWAF, 2008) which shows the process for the determination of the Ecological Water Requirement in the context of the larger Resource Directed Measures process, with possible links to issues such as the stakeholder process, classification, implementation and operation, indicated as suggested ways to integrate the Reserve determination process.

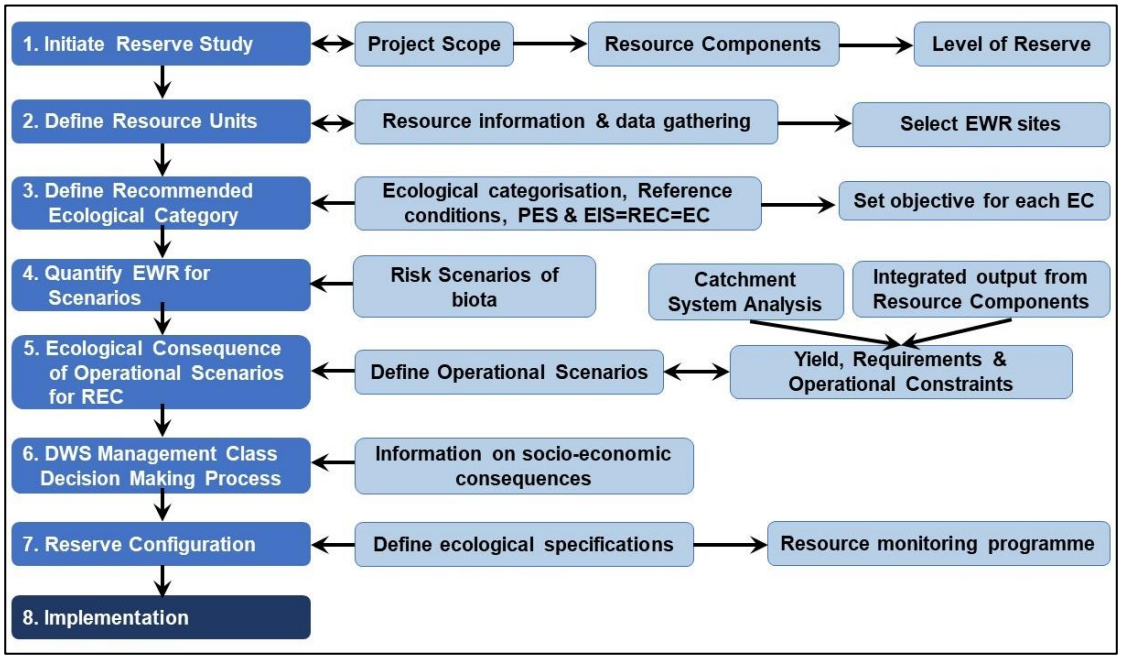


**Figure 2.1 Procedures for determination of the preliminary Reserve for estuaries (Turpie *et al*., 2012a)**

## 2.1 ECOLOGICAL WATER REQUIREMENT METHOD FOR ESTUARIES

Methods to determine the environmental flow requirement of estuaries were established soon after the promulgation of the National Water Act (NWA) in 1998. The "Preliminary Reserve Method" involves setting a REC (i.e. desired state), recommended Ecological Reserve (i.e. flow allocation to achieve the desired state) and recommended RQOs for a resource on the basis of its present health status and its ecological importance.

The approach follows a generic methodology that can be carried out at different levels of effort (e.g. rapid, intermediate or comprehensive). The official method for estuaries (Version 2), is documented in DWA (2008). In 2013, an unofficial Version 3 of the method was published, as part of a Water Research Commission study (Turpie *et al*., 2012a). The study uses Version 2 of the methodology (DWA, 2008), but with consideration of obvious improvements proposed in Version 3 (Turpie *et al*., 2012a) and Taljaard *et al*. (2022).

The generic steps of the official "Ecological Reserve Method" for estuaries were applied as follows:

Step 1: Initiate study defining the study area, project team and level of study (confirmed in the **inception report** of this study).

Step 2: Delineate the geographical boundaries of the resource units (confirmed in the **delineation report** of this study).

Step 3a: Determine the **Present Ecological State** (PES) of resource health (water quantity, water quality, habitat and biota) assessed in terms of the degree of similarity to the reference condition (referring to natural, unimpacted characteristics of a water resource, and must represent a stable baseline based on expert judgement in conjunction with local knowledge and historical data). An Estuarine Health Index (EHI) is used to evaluate the current condition of the estuary (**Table 2.1**). The fact that the physical conditions in estuarine systems are more dynamic than those of other

aquatic ecosystems means that severe degradation of an estuary may involve a shift from a dynamic to a more stable, or unidirectional, system. This means that the loss of dynamic function *per se* is an important indication of declining estuarine health (DWAF, 2008). Thus, in an estuarine health assessment, measures of these different states need to be sufficiently robust so that different practitioners/disciplines will arrive at the same categorisation.

**Table 2.1 Estuarine Health Index scoring system**

| Variable | Score | Weight | Weighted score |
|---|---|---|---|
| Hydrology | … | 25 | … |
| Hydrodynamics and mouth condition | … | 25 | … |
| Water quality | … | 25 | … |
| Physical habitat alteration | … | 25 | … |
| **Habitat health score** | | | **…** |
| Microalgae | … | 20 | … |
| Macrophytes | … | 20 | … |
| Invertebrates | … | 20 | … |
| Fish | … | 20 | … |
| Birds | … | 20 | … |
| **Biotic health score** | | | **…** |
| **Estuary Health Score Mean (Habitat health, Biological health)** | | | **…** |

In the case of this assessment the EHI scoring of the various variables is based on a review of historical data, as well as data collected during a field monitoring programme in 2022. The assessment was undertaken by a multidisciplinary group of estuarine scientists in a workshop setting, based on their collective understanding of the likely impacts affecting each system. Expert knowledge and available information were all used to build up a “picture” of the probable pristine state of each estuary and the changes under current conditions. The EHI is applied to all levels of ecological water requirement studies (comprehensive, intermediate or rapid), with only the level of information supporting the study and level of confidence varying. For each variable the conditions are estimated as a percentage (0 – 100%) of the pristine health. Scores are then weighted and aggregated so that the final score reflects the present health of the estuary as a percentage of the pristine state (**Figure 2.1**). Both abiotic and biotic variables are included as the relationships between the abiotic and biotic variables are often not well understood and because the biotic response to certain abiotic variables can be lagging.

For comparative reasons (with previous assessments) the individual health scores were aggregated as illustrated in **Figure 2.2** and **Table 2.2**. In estuaries, unlike in the terrestrial environment, degradation or loss of habitat seldom means a complete loss of an estuary. This can only happen if an estuary becomes completely degraded, e.g. changed into a parking lot or golf course. In most cases, degradation means loss of processes or loss of biological functionality, e.g. the estuarine space is filled with a different salinity condition or different species composition. This loss of functionality happens on a continuum, with estuaries which retain more than 90% of their natural processes and pattern being rated as Excellent and estuaries degraded to less than 40% of natural functionality rated as Poor.

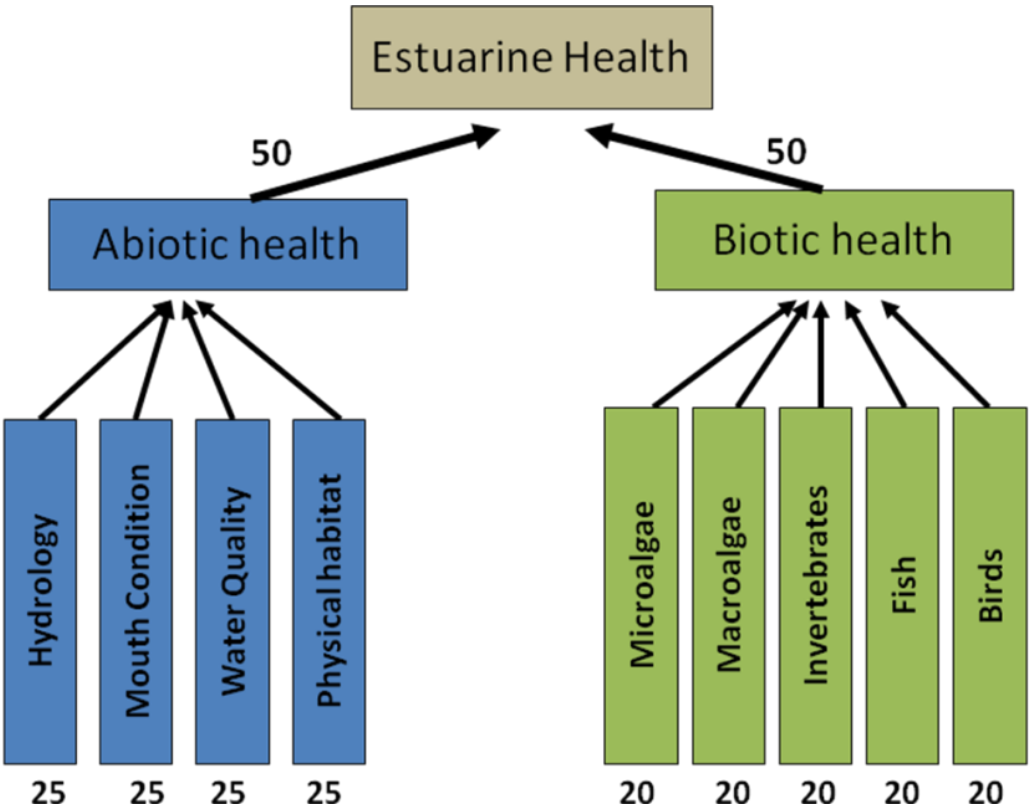


**Figure 2.2 Components and weightings of the Estuarine Health Index (DWAF, 2008)**

**Table 2.2 Schematic illustration of the relationship between loss of ecosystem condition and functionality**

| Condition | ≥91% | 90-75 | 75 - 61 | 60 - 41 | 40-21 | ≤20 |
|---|---|---|---|---|---|---|
| Category | A Natural | B Largely natural with few changes | C Moderately modified | D Largely modified | E Highly degraded | F Extremely degraded |
| State | Excellent | Good | Fair | | Poor | |
| Functionality | Retain Process & Pattern (representation) | | Loss of Process or Pattern | | No Process & Pattern | |

The estuarine health score is translated into one of six Ecological Categories (ECs) provided below in **Table 2.3**.

**Table 2.3 Translation of EHI score into Ecological Categories**

| EHI score | PES | General Description |
|---|---|---|
| 91 – 100 | A | Unmodified, or approximates natural condition; the natural abiotic template should not be modified. The characteristics of the resource should be determined by unmodified natural disturbance regimes. There should be no human induced risks to the abiotic and biotic maintenance of the resource. The supply capacity of the resource will not be used. |
| 76 – 90 | B | Largely natural with few modifications. A small change in natural habitats and biota may have taken place, but the ecosystem functions are essentially unchanged. Only a small risk of modifying the natural abiotic template and exceeding the resource base should not be allowed. Although the risk to the well-being and survival of especially intolerant biota (depending on the nature of the disturbance) 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. The impact of acute disturbances must be totally mitigated by the presence of sufficient refuge areas. |
| 61 – 75 | C | Moderately modified. A loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. A moderate risk of modifying the abiotic template and exceeding the resource base may be allowed. Risks to the wellbeing and survival of intolerant biota (depending on the nature of the disturbance) may generally be increased with some reduction of resilience and adaptability at a small number of localities. However, the impact of local and acute disturbances must at least partly be mitigated by the presence of sufficient refuge areas. |
| 41 – 60 | D | Largely modified. A 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. However, the associated increase in the abundance of tolerant species must not be allowed to assume pest proportions. The impact of local and acute disturbances must at least to some extent be mitigated by refuge areas. |
| 21 – 40 | E | Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive. |
| 0 – 20 | F | Critically modified. Modifications have reached a critical level and the lotic 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. |

Step 3b: Determine the **Estuary Importance Score (EIS[2])** that takes account the size, the rarity of the estuary type within its biographical zone, habitat, biodiversity and functional importance of the estuary into account (**Table 2.4** and **Table 2.5**).

[2] Note that EIS does not have the same meaning as EIS for rivers, which refer to Ecological Importance and Sensitivity. The estuaries approach do not consider sensitivity.

**Table 2.4 Estuary Importance scoring system**

| Criterion | Score | Weight | Weighted Score |
|---|---|---|---|
| Estuary Size | … | 15 | **…** |
| Zonal Rarity Type | … | 10 | **…** |
| Habitat Diversity | … | 25 | **…** |
| Biodiversity Importance | … | 25 | **…** |
| Functional Importance | … | 25 | **…** |
| **Weighted Estuary Importance Score** | | | **…** |

**Table 2.5 Estuarine Importance rating system**

| EIS | Importance rating |
|---|---|
| 81 – 100 | Highly important |
| 61 – 80 | Important |
| 0 – 60 | Of low to average importance |

Step 3c: Set the **Recommended Ecological Category (REC)** which is derived from the PES and EIS (or the protection status allocated to a specific estuary) flowing the guidelines listed in **Table 2.6**.

**Table 2.6 Guidelines to assign REC, based on protection status and importance, and PES of an estuary**

| Protection Status and Importance | REC | Policy basis |
|---|---|---|
| Protected area | A or BAS* | Protected and desired protected areas should be restored to and maintained in the best possible state of health. |
| Desired Protected Area (based on complementarity) | | |
| Highly important | PES + 1, min B | Highly important estuaries should be in an A or B Category. |
| Important | PES + 1, min C | Important estuaries should be in an A, B or C Category. |
| Of low to average importance | PES, min D | The remaining estuaries can be allowed to remain in a D Category. |

* Best Attainable State

An estuary cannot be allocated a REC below a Category “D”. Therefore systems with a PES in Categories ‘E’ or ‘F’ needs to be managed towards achieving at least a REC of “D”.

Step 4: **Quantify the ecological consequences of various runoff scenarios** (including proposed operational scenarios) where the predicted future condition of the estuary is assessed under each scenario. As with the determination of the PES, the EHI is used to assess the predicted condition in terms of the degree of similarity to the reference condition.

Step 5: Quantify the (recommended) **Ecological Water Requirements (EWR)**, which represent the lowest flow scenario that will maintain the resource in the REC.

Step 6: Estimate (recommended) **Resource Quality Objectives (Ecological Specification)** for the REC, as well as future **monitoring requirements** to improve the confidence of the EWR.

## 2.2 DEFINITION OF CONFIDENCE LEVELS

The level of available historical data in combination with the level of effort expended during the assessment determines the level of confidence of the study. Three levels of study have been recognised in the past in terms of the effort expended during the assessment – rapid, intermediate and comprehensive. In this study, effort lay somewhere between a rapid and intermediate study, in that some field data collection was carried out, but overall would be classed as a 'Rapid' study. Nevertheless, the paucity of historical data on the system meant that we expected the confidence of the study to be low. This is a situation that can only be remedied with some comprehensive and long-term data collection on the system. Criteria for the confidence limits attached to statements in this study are shown in **Table 2.7**.

**Table 2.7 Confidence levels for an Estuarine EWR study**

| Confidence level | Situation | Expressed as percentage |
|---|---|---|
| Very Low | No data available for the estuary or similar estuaries | (i.e. < 40% certain) |
| Low | Limited data available | 40 - 60% certainty |
| Medium | Reasonable data available | 60 – 80% certainty |
| High | Good data available | > 80% certainty |

## 2.3 APPROACH TO FUTURE SCREENINGS OF FLOW SCENARIOS RELEVANT TO THE ST LUCIA/uMFOLOZI ESTUARINE LAKE SYSTEM

The St Lucia/uMfolozi Present Ecological State (PES) was not updated as part of this study as there was no new investment in the surveying and monitoring of the Greater St Lucia Estuarine Lake system. Funds are at present being secured by iSimangaliso Wetland Park to address critical information gaps need to guide the assessment of condition and management actions. In 2016 the St Lucia/uMfolozi PES was estimated as a D (D.W.S., 2016) and this will form the basis of the classification process. However, based on measurements and photographic imagery provided to the St Lucia Estuary Task Team over the last two years the various abiotic and biotic components of the system are likely varying between D and E Category depending mouth state due to flow reduction, reduced connectivity, high sediment input (especially from the uMfolozi River), nutrient pollution (with a focus on the uMfolozi and Mkuze rivers), artificial breaching, illegal catches (gill netting), and significant land-use change in the flood plain of the larger system. The system is currently on a trajectory of change, i.e. ecological condition not stable, and while the mouth have been open for an extended period, little salt water has entered the system and significant deposits of fine muds/silts have formed in The Narrows near the mouth of the system. Some of the elements of the estuary ecosystem that have been negatively affected include: physical habitat (significant increase in fine sediments in The Narrows), water quality (low salinity and high turbidity); macrophytes (die-off of mangroves), invertebrates and fish (dominated by freshwater species) (Issues raised in St Lucia Task Team discussions).

The DWS (2016) overarching REC recommendation is 'Best Attainable State' of a B/C (~72) with a B Category achievable in the long-term. The Department of Forestry and Fisheries and Environment (DFFE) Ministerial Panel of Independent Experts also advocate for a REC of a B Category (DFFE, 2022).

DWS (2016) found that the total present flow from both the Mfolozi and St Lucia rivers is needed to achieve the REC, with an additional range of non-flow related activities needed to improve it to a B Category. DWS (2016) provides minimum recommend flows for a B/C Category (report use B- term), namely:

- Cap minimum discharge in the Mfolozi at 3 $m^3/s$ to maintain an open mouth.
- Ensure a combined Mfolozi and Mkuze drought discharge of 5 $m^3/s$ (including an additional 1.6 $m^3/s$ in Mkuze).
- Improve the water quality coming from the Mkuze catchment.

The DWS (2016) EWR report clearly states that the total present flow from both the Mfolozi and the St Lucia rivers are needed to achieve the REC, i.e. any flow scenario that would involve flow reduction from the Present will not meet the REC. Less than 1% change can be made to Mfolozi flows, but that flow needs to be reallocated to the EWR of the St Lucia Rivers to ensure that the system attains in a C category (and does not decline during droughts). In addition to ensuring the required water quantity and quality, a range of non-flow interventions is needed to improve the system to a B/C in the short term and to a B in the long term. Note, that the DWS (2016) highlights that the system is very sensitive to Climate Change and that flow and non-flow interventions are urgently needed to increase resilience to droughts.

Non-Flow interventions include to address ecological concerns include (DWS, 2016):

a) St Lucia/uMfolozi should have a single mouth and with no manipulation of the mouth (artificial breaching or closing);
b) Restore low-lying areas of the uMfolozi floodplain to natural vegetation to allow for natural processes (e.g. carbon sequestration, mouth closure)
c) Remove alien vegetation around the Lake, estuaries and rivers;
d) Limit further natural deforestation such as in the Dukuduku Forest;
e) Eradicate illegal gillnetting from the system;
f) Eradicate and monitor occurrence of alien invasive species (plants, invertebrates and fish);
g) Prevent urbanization in the catchments feeding directly into the Lake and The Narrows;
h) Reduce commercial forestation in the lake catchments to increase low flows as much as possible;
i) In the uMfolozi River catchment, land care practices should focus on the most critical sub-catchment areas to limit future erosion and land degradation which could further reduce low flows; and
j) Illegal river abstractions on especially the Mkuze and uMfolozi rivers must be eliminated.

Note, ecological recommendations regarding mouth state are currently be re-evaluated by management due to social reasons at the recommendation of the (DFFE) Ministerial Panel of Independent Experts.

Future development scenarios need to be screened against these flow requirements to see if they meet the minimum set above. If they cannot meet the above, it means that the estuary cannot improve in condition, i.e. achieve REC, and may even decline further in condition over time.

# 3 aMATIGULU/iNYONI ESTUARY

## 3.1 ESTUARY DELINEATION

The mouth of the aMatigulu/iNyoni Estuary is approximately 100 km north east of Durban and 56 km south of Richards Bay. The system comprises two separate estuaries that join at the mouth. The combined estuary mouth closes from time to time, i.e. it is a “temporarily open/closed” estuary.

For the purposes of this EWR study, the geographical boundaries of the aMatigulu/iNyoni Estuary are defined as follows (**Figure 3.1**):

| | |
|---|---|
| Downstream boundary: | Estuary mouth 29° 4'1.43"S 31°39'49.38"E (but can move to 29° 6'44.54"S 31°37'5.89"E)<br>*Note: New mouth location further north from DWS (2015).* |
| Upstream boundary: | aMatigulu arm: 29° 4'1.12"S 31°33'20.90"E<br>iNyoni Arm: 29° 8'1.17"S 31°35'45.33"E |
| Lateral boundaries: | 5 m contour above Mean Sea Level (MSL) along each bank. |


**Figure 3.1 Geographical boundaries of the aMatigulu/iNyoni Estuary based on the Estuary Functional Zone**

## 3.2 PRESENT ECOLOGICAL STATUS

The aMatigulu/iNyoni Estuary in its present state is estimated to be 74% similar to natural conditions, which translates into a PES of a B/C Category. This is mostly attributed to the following factors:

- Flow reduction;
- A decline in water quality;
- Over-exploitation of living resources (e.g. poaching and line fishing);
- Agricultural activities in the Estuary Functional Zone (EFZ) cause loss of estuarine habitat; and
- Recreational activities in the lower reaches, particularly along the shoreline on the sea side effect bird abundance.

The overall current Estuarine Health Index (EHI) score as well as the score with non-flow related pressures removed is given in **Error! Reference source not found.** below.

**Table 3.1 Estuarine Health score for the aMatigulu/iNyoni Estuary**

| Variable | Estuarine health score | | |
|---|---|---|---|
| | Overall | % attributed to non-flow related impacts | Confidence |
| Hydrology | **73** | 0 % | L |
| Hydrodynamics and mouth condition | **84** | 0 % | L |
| Water quality | **63** | 0 % | L |
| Physical habitat alteration | **83** | 10 % | M |
| **Habitat health score** | **76** | | |
| Microalgae | **79** | 0 % | M |
| Macrophytes | **78** | 60 % | L |
| Invertebrates | **70** | 5 % | M |
| Fish | **65** | 15 % | M |
| Birds | **70** | 60 % | L |
| **Biotic health score** | **72** | | |
| **ESTUARY HEALTH SCORE** | **74** | **78** | **L** |
| **PRESENT ECOLOGICAL STATUS (PES)** | **B/C** | **B** | |

1 Confidence levels – Low (L), Medium (M), High (H)

Estimates of the contribution of non-flow related impacts on the level of degradation of each component led to an increase in the health score from a PES of 74 to 78, which would raise the health score to a B. This suggests that non-flow related impacts have played some role in the degradation of the estuary to a B/C, but that some flow-related impacts are also driving degradation.

Confidence levels for three of the four abiotic components were rated as Low. Only three of the five biotic components had enough data to yield Medium Confidence assessments. The overall confidence assessment for this study is Low due to lack of long-term datasets.

## 3.3 RECOMMENDED ECOLOGICAL CATEGORY

### 3.3.1 Importance of the Amatigulu/iNyoni Estuary

The Estuary Importance Score (EIS) takes size, the rarity of the estuary type within its biographical zone, habitat, biodiversity and functional importance of the estuary into account (**Table 3.1**) (Turpie *et al*., 2002). Biodiversity importance, in turn, is based on the assessment of the importance of the estuary for plants, invertebrates, fish and birds, using rarity indices. The scores have been determined for all South African estuaries (DWAF 2008, Turpie *et. al.,* 2012b), apart from functional importance, which is scored by the specialists during the workshop (**Table 3.2**). The Estuary Importance Score for five components and the importance rating are presented in **Tables 3.2** and **3.3**, respectively.

The functional importance of aMatigulu/iNyoni Estuary is very high with a score of 90.

**Table 3.2 Estimation of the functional importance score of the aMatigulu/iNyoni Estuary**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 40 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 90 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 80 |
| d) Roosting area for marine or coastal birds | 60 |
| e) Catchment detritus, nutrients and sediments to sea | 20 |
| **Functional importance score - Max (a to e)** | **90** |

The EIS for the aMatigulu/iNyoni Estuary, is 81 (**Table 3.3**), indicating that the estuary is rated as "High Important" **(Table 3.4**). Much of this is due to the ecological contributions made by the size of the system and the fact that the biodiversity is high. Field studies also indicated that habitat diversity is much higher than listed in the national rating. There is a wide range of vegetation types present in the system including the rare submerged seagrass (e.g. *Zostera capensis*). In addition, the physical habitat comprises fine to medium sands in mouth area which is a very special habitat in KwaZulu-Natal and important for a wide range of invertebrate species.

**Table 3.3 Estuarine Importance Score for the aMatigulu/iNyoni Estuary**

| Criterion | Weight | Score |
|---|---|---|
| Estuary Size | 15 | 90 |
| Zonal Rarity Type | 10 | 30 |
| Habitat Diversity | 25 | 80 |
| Biodiversity Importance | 25 | 89 |
| Functional Importance | 25 | 90 |
| **Estuary Importance Score** | | **81** |
| **Calculation of the functional importance score** | | **Highly important** |

**Table 3.4 Estuarine Importance Score and significance**

| Importance score | Description |
|---|---|
| 81 – 100 | Highly important |
| 61 – 80 | Important |
| 0 – 60 | Of low to average importance |

The aMatigulu/iNyoni Estuary is in a formally protected area, the Umlalazi Nature Reserve, managed by Ezemvelo KwaZulu-Natal Wildlife. The estuary thus also forms part of the core set of priority estuaries in need of protection to achieve biodiversity targets in the 2011 National Estuaries Biodiversity Plan (Turpie *et al*., 2012c). The NBA 2011 (van Niekerk and Turpie, 2012) recommended that the minimum Category for the aMatigulu/iNyoni be an A, that the system be granted partial no-take protection, and that 50 % of the estuary margin be undeveloped (**Table 3.5**).

**Table 3.5 National Estuary Biodiversity Plan requirements for the aMatigulu/iNyoni Estuary**

| Estuary Requirements | aMatigulu/iNyoni |
|---|---|
| Current health category | B |
| National and/or Regional Priority set | SA |
| Recommended extent of protection | Partial |
| Recommended extent of undeveloped margin | 50% |
| Provisional estimate of Recommended Ecological Category | A |

### 3.3.2 Recommended Ecological Category

The Recommended Ecological Category (REC) represents the level of protection assigned to an estuary. The Present Ecological State (PES) sets the minimum REC below which the system should not decline in condition. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary. The PES for the aMatigulu/iNyoni Estuary is a B and the Estuary is rated as “Important” from a biodiversity perspective.

Thus, taking into account the current conditions (PES = B/C), the reversibility of the impacts, the ecological importance and the conservation requirements of the aMatigulu/iNyoni Estuary, the REC for the system is a B Category. This recommendation is also based on the fact that the aMatigulu/iNyoni is sensitive to mouth closure and declines in oxygen levels and at the same time it needs floods to be able to take out accumulated sediments. At the same time, both the Estuarine and Functional Importance of the system are high.

The Recommended Ecological Category represents the level of protection assigned to an estuary. The first step is to determine the 'minimum' Ecological Category based on its PES. The relationship between Estuary Health Index (EHI) Score, PES and minimum REC is set out in **Table 3.6**.

**Table 3.6 Relationship between the EHI, PES and minimum REC**

| EHI score | PES | Description | Minimum Ecological Category |
|---|---|---|---|
| 91 – 100 | A | Unmodified, natural | A |
| **76 – 90** | **B** | **Largely natural with few modifications** | **B** |
| 61 – 75 | C | Moderately modified | C |
| 41 – 60 | D | Largely modified | D |
| 21 – 40 | E | Highly degraded | - |
| 0 – 20 | F | Extremely degraded | - |

The PES sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary (**Table 3.6**). The PES for the aMatigulu/iNyoni Estuary is a B/C. The Estuary is rated as "Highly Important" from a biodiversity perspective and the target recommended by the National Estuaries Biodiversity Plan for the National Biodiversity Assessment (Turpie *et al*., 2012c) indicates it should be in an A or B Category. However, as some of the changes are seen as irreversible the Best Attainable State (BAS) is a B.

**Based on this study, the National Biodiversity targets and the reversibility of current impacts DWS (2015), the REC for the aMatigulu/iNyoni Estuary is a B Category.**

## 3.4 OPERATIONAL AND ECOLOGICAL RESERVE SCENARIOS

### 3.4.1 Description of the Scenarios

**Table 3.7** provides a summary of a range of water resource development scenarios (Sc) that could affect the aMatigulu/iNyoni Estuary.

**Table 3.7 Summary of flow scenarios**

| Scenarios | Description | MAR[1] ( $X10^6$ $m^3$) | % Remaining |
|---|---|---|---|
| Reference | Natural (~1750) | 141.17 | |
| Present | Present day | 113.77 | 80.59 |
| Scenario 1 | Climate Change | 94.79 | 67.14 |
| Scenario 2 | 20% reduction | 98.97 | 70.10 |
| Scenario 3 | 30% reduction | 92.46 | 65.49 |
| Scenario 4 | 15% Increase | 125.65 | 89.00 |
| Scenario 5 | Present with non-flow restoration interventions including active restoration of the riparian area undertaken in conjunction with a reduction in harvesting and grazing pressures on the macrophytes. Fishing pressure (especially illegal gill netting) is reduced and recreational activities such as boating are controlled. Recreational activities in the lower reaches are curbed through zonation and improved compliance. | 113.77 | 80.59 |

1 Mean Annual Runoff

### 3.4.2 Ecological Categories associated with runoff scenarios

The REC represents the level of protection assigned to an estuary. The PES sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of

importance and level of protection or desired protection of a particular estuary. The PES for the aMatigulu/iNyoni Estuary is a B/C, but the Estuary is rated as "Highly Important" from a size and biodiversity perspective and should therefore be in a B Category. In addition, the system also forms part of the core set of priority estuaries in need of protection to achieve biodiversity targets in the National Estuaries Biodiversity Plan for the National Biodiversity Assessment (Turpie *et al.,* 2012c). The NBA 2011 (van Niekerk & Turpie, 2012) recommends that the minimum Category for the aMatigulu/iNyoni is Category A, and that it should be granted full no-take protection, and that 50% of the estuary margin be undeveloped.

Taking the current conditions (PES = B/C), the reversibility of the impacts, the ecological importance and the conservation requirements of the aMatigulu/iNyoni Estuary into account, the REC for the system is a B Category.

The individual EHI scores, as well as the corresponding ecological category under different scenarios, are provided below in **NON-FLOW Sc** 5 represents a restoration scenario in which no effort is made to improve baseflows or water quality, but active restoration of the riparian area is undertaken in conjunction with a reduction in harvesting and grazing pressures on the macrophytes. Fishing pressure (especially illegal gill netting) is reduced and recreational activities such as boating are controlled. These, in turn, result in a significant gain in ecological health lifting the system into a low category B. The small improvement in baseflows and water quality would assist further in restoring this system even more.
Table 3.8. Scenario 1, Climate change, will result in deterioration by 9% from the PES causing the estuary to degrade to a C Category. Under Sc 2 the Estuary will rapidly decline by 15% to a C/D Category, while there will be an additional 8% decline under Scenario 3 to a D Category. Scenarios 1 to 3 will have a major impact on the cueing effect as the signal to the marine environment will be substantially reduced. Under Scenario 5 the estuary will improve by 8% to a Category B.

NON-FLOW Sc 5 represents a restoration scenario in which no effort is made to improve baseflows or water quality, but active restoration of the riparian area is undertaken in conjunction with a reduction in harvesting and grazing pressures on the macrophytes. Fishing pressure (especially illegal gill netting) is reduced and recreational activities such as boating are controlled. These, in turn, result in a significant gain in ecological health lifting the system into a low category B. The small improvement in baseflows and water quality would assist further in restoring this system even more.

**Table 3.8 EHI score and corresponding Ecological Categories under the different runoff scenarios**

| Component | Weight | Present | Scenario | | | | | Confidence[1] |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | |
| Hydrology | 25 | 73 | 57 | 48 | 41 | 93 | 73 | L |
| Hydrodynamics and mouth condition | 25 | 84 | 72 | 54 | 39 | 98 | 84 | M |
| Water quality | 25 | 63 | 63 | 64 | 65 | 64 | 63 | L |
| Physical habitat alteration | 25 | 83 | 65 | 65 | 56 | 90 | 87 | L |
| **Habitat health score** | | **76** | **64** | **58** | **50** | **86** | **77** | **L** |
| Microalgae | 20 | 79 | 62 | 70 | 65 | 80 | 79 | L |

| Component | Weight | Present | Scenario | | | | | Confidence[1] |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | |
| Macrophytes | 20 | 78 | 68 | 58 | 48 | 85 | 85 | M |
| Invertebrates | 20 | 70 | 65 | 55 | 45 | 80 | 80 | L |
| Fish | 20 | 65 | 65 | 55 | 45 | 70 | 75 | M |
| Birds | 20 | 70 | 65 | 60 | 50 | 75 | 80 | L |
| **Biotic health score** | | **72** | **65** | **60** | **51** | **78** | **80** | **L** |
| **ESTUARY HEALTH SCORE** | | **74** | **65** | **59** | **51** | **82** | **78** | L |
| **ECOLOGICAL STATUS** | | **B/C** | **C** | **C/D** | **D** | **B** | **B** | |

1 Confidence levels – Low (L), Medium (M), High (H)

Under Sc 2 to 4 increased/extended mouth closures will result in salinities gradually decreasing from the open marine phase. Consequently, lower salinities will become distributed almost throughout the system and this will have major impacts on the marine and estuarine fauna within the estuary. There will be a loss of ecosystem services such as nursery function in this important system for fish and prawns species. An additional impact related to this situation is that alien invasive species such as the freshwater snail *Tarebia granifera* would have an increased invasive potential. Decreased salinities would also impact on the breeding success of freshwater *Macrobrachium* prawns which require a certain minimum salinity for successful larval development.

**Economic Issues Related to extended Mouth Closure**

Increased closure will have an impact on the offshore Thukela Banks prawn fishery which recently collapsed due to the extended mouth closure of the St Lucia System. There has also been a knock on effect in the fish populations where it has been found that offshore breeding stocks of *Rhabdosargus sarba* have declined drastically and aged due to the loss of estuarine nursery facilities (Mann & Pradarvand, 2007). Extended closures of other important estuaries which have an important nursery function, such as aMatigulu/iNyoni, could further impact on the declining stocks. Increased closure of the mouth also has economic implications due to the fact that some rural 'block' sugar farming is taking place on the flood plain within the 5m mean sea level. contour. This will result in pressure being placed to breach the mouth once back flooding starts.

For the aMatigulu/iNyoni Estuary, Sc 4 and Sc 5 achieved the REC of a B Category. However, as Sc 4 results in improved estuary connectivity, Sc 4 in conjunction with several management interventions is the recommended ecological flow scenario. Flows can be restored from any of the catchments through evaluating current lawful use, a reduction in forestry and removal of aliens. The following management interventions could all contribute to the aMatigulu/iNyoni achieving a REC of a B:

- Increase base flows to prevent mouth closure for periods longer than six to eight weeks and also prevent the water levels from going beyond 4 m MSL (indicative of a long term closure and significant build-up of berm). .
- Create interventions within the catchment and institute a buffer zone that would improve the nutrient status and help with sedimentation issues.
- Undertake restoration of the aMatigulu/iNyoni flood plain up to the 5m MSL contour and reduce agriculture impacts in the supratidal area of the system.
- Implement controlled harvesting of *Juncus* and *Phragmities.*

- Curb illegal gill netting of targeted species, as well as illegal seine and cast netting. This has an impact on the nursery function and impacts on prawns, which form part of the bycatch.
- Curb recreational activities in the lower reaches through zonation and improved compliance (e.g. through the development of an Estuary Management Plan).
- Improve protection levels through Contracted Conservation on the North Bank. This will reduce grazing pressure and lead to an improvement in the ecology.
- Promote tourism (bird guides etc.) to reduce impacts on other components in the system.

## 3.5 RECOMMENDED ECOLOGICAL FLOW REQUIREMENTS FOR THE aMATIGULU/iNYONI ESTUARY

The 'recommended Ecological Flow Requirement' scenario, is defined as the flow scenario (or a slight modification thereof to address low-scoring components) that represents the highest change in river inflow that will still maintain the estuary in the REC. Where any component of the health score is less than 40, then modifications to flow and measures to address anthropogenic impacts must be found that will rectify this. The REC for the aMatigulu/iNyoni Estuary is a Category B.

The flow requirements for the estuary are the same as those described for Sc 4 and are summarised in **Table 3.9**.

**Table 3.9 A summary of the monthly flow (in $m^3/s$) distribution under Scenario 4**

| %ile | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99.9 | 52.4 | 34.5 | 41.0 | 39.0 | 74.5 | 153.9 | 58.8 | 58.5 | 70.1 | 32.4 | 21.3 | 139.6 |
| 99 | 23.4 | 33.7 | 38.9 | 20.4 | 50.1 | 83.0 | 40.7 | 41.5 | 33.9 | 26.7 | 20.9 | 44.3 |
| 95 | 13.0 | 15.9 | 20.4 | 9.4 | 25.0 | 22.8 | 16.5 | 15.6 | 9.4 | 8.9 | 7.0 | 10.1 |
| 90 | 7.1 | 8.4 | 8.5 | 7.1 | 8.7 | 13.8 | 7.4 | 8.6 | 5.4 | 3.3 | 3.6 | 4.8 |
| 85 | 5.3 | 6.6 | 5.4 | 4.4 | 4.7 | 7.3 | 5.9 | 4.2 | 3.1 | 2.7 | 2.6 | 3.3 |
| 80 | 3.8 | 5.6 | 3.9 | 2.1 | 3.4 | 4.7 | 4.0 | 2.4 | 2.8 | 2.2 | 2.1 | 2.3 |
| 70 | 2.6 | 4.2 | 2.4 | 1.8 | 2.0 | 2.4 | 2.0 | 1.8 | 1.9 | 1.7 | 1.8 | 2.0 |
| 60 | 2.1 | 2.9 | 1.8 | 1.6 | 1.7 | 1.9 | 1.7 | 1.6 | 1.7 | 1.6 | 1.7 | 1.9 |
| 50 | 1.8 | 2.0 | 1.6 | 1.4 | 1.5 | 1.7 | 1.5 | 1.4 | 1.5 | 1.5 | 1.5 | 1.8 |
| 40 | 1.8 | 1.8 | 1.5 | 1.2 | 1.4 | 1.4 | 1.4 | 1.2 | 1.4 | 1.4 | 1.4 | 1.7 |
| 30 | 1.6 | 1.6 | 1.3 | 1.0 | 1.2 | 1.2 | 1.2 | 1.1 | 1.2 | 1.2 | 1.3 | 1.5 |
| 20 | 1.5 | 1.4 | 1.0 | 0.7 | 0.8 | 0.9 | 1.1 | 0.8 | 1.1 | 1.1 | 1.1 | 1.4 |
| 10 | 1.3 | 1.1 | 0.8 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.9 | 1.0 | 1.0 | 1.2 |
| 5 | 1.2 | 0.9 | 0.6 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.8 | 0.8 | 0.8 | 1.0 |
| 1 | 0.9 | 0.5 | 0.2 | 0.3 | 0.3 | 0.5 | 0.4 | 0.3 | 0.4 | 0.6 | 0.8 | 0.6 |
| 0.1 | 0.9 | 0.5 | 0.2 | 0.1 | 0.2 | 0.4 | 0.3 | 0.3 | 0.2 | 0.6 | 0.5 | 0.2 |

# 4 uMHLATUZE ESTUARY

## 4.1 ESTUARY DELINEATION

The uMhlatuze Estuary is situated near Richards Bay on the Zululand North Coast. It forms an integral part of the uMhlatuze Sanctuary. The system is classified as a "Predominantly open" estuary (van Niekerk *et al*. 2020). The original uMhlatuze estuarine lake system comprised a single large bay connected to a tidal estuary and channel. Port development in the mid-1970's saw the system artificially divided into two estuarine bays, the uMlathuze and Richards Bay estuaries. Originally these estuarine water bodies were also tidally connected with two other lakes in the lower Umhlathuze catchment, namely Lakes Cubhu and Mzingazi. These two systems are relict estuarine lakes that were created when dune formation closed off the mouth of their estuaries. However, these two systems are regulated at their outflows by weirs in order to provide a great (freshwater) water storage capacity, thus presently they largely function as freshwater lakes. However, Lakes Cubhu and Mzingazi presently function as freshwater lakes as a result of their disconnection from the uMhlathuze/Richards Bay estuarine water bodies. For the purposes of this EWR study, the geographical boundaries of the uMhlatuze Estuary are defined as follows (**Figure 4.1**):

| | |
|---|---|
| Downstream boundary: | Richards Bay mouth 28°48'40.93"S 32° 5'26.07"E<br>uMhlatuze mouth 28°50'40.66"S 32° 3'6.06"E |
| Upstream boundary: | Mzingazi arm: 28°42'0.82"S 32°10'10.21"E<br>Cubhu Arm: 28°53'2.92"S 31°53'0.08"E<br>uMhlatuze Upper: 28°46'32.22"S 31°57'35.09"E |
| Lateral boundaries: | 5 m contour above MSL along each bank. |

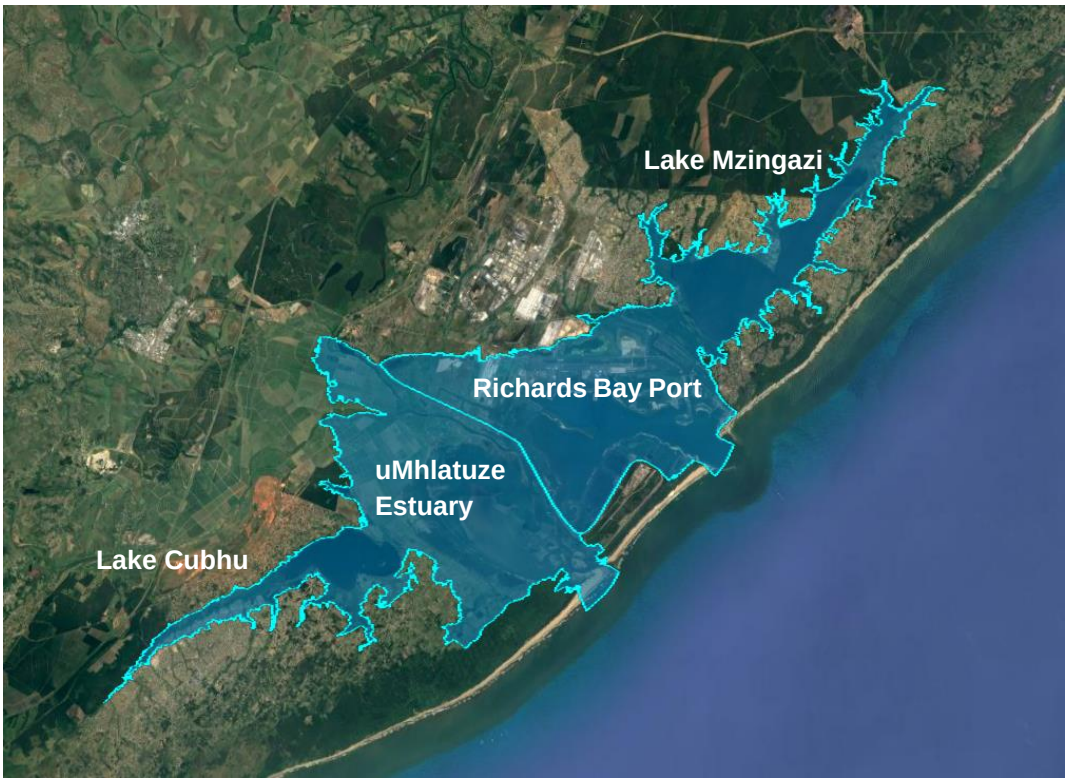


**Figure 4.1 Geographical boundaries of the uMhlatuze Estuary based on the Estuary Functional Zone**

## 4.2 PRESENT ECOLOGICAL STATUS

The uMhlatuze Estuary in its present state is estimated to be 46% similar to natural condition, which translates into a PES of a D Category. This is mostly attributed to the following factors:

- Significant flow reduction, especially in the baseflows that maintain salinity profile;

A decline in water quality due to runoff from urban areas (many of which is not on formal reticulation) and agriculture in flood plain and catchment (nutrient enrichment);

- Large-scale change in land-use change in the EFZ causing loss of estuarine habitat;
- Severe over-exploitation of living resources (e.g. large scale illegal gillnetting); and
- Loss of connectivity between the different four parts of the system, Lake Mzingazi, Lake Chubu, Richards Bay and uMhlatuze Estuary.

Lake Mzingazi, Lake Chubu and Richards Bay are estimated at 39% (Category D/E), 38% (Category E) and 30% (Category E) respectively. The overall current EHI, as well as the score with non-flow related pressures removed, is given in **Table 4.1** below.

**Table 4.1 Estuarine Health Score for the uMhlatuze Estuary**

| Component | PES | | | | | |
|---|---|---|---|---|---|---|
| | Lake Mzingazi | Richards Bay | uMhlatuze Estuary | Lake Chubu | % attributed to non-flow related impacts | Confidence |
| Hydrology | 53 | 53 | **53** | 53 | - | L |
| Hydrodynamics | 10 | 18 | **39** | 10 | 100% | L |
| Water quality | 71 | 45 | **57** | 58 | - | L |
| Physical habitat alteration | 10 | 20 | **50** | 10 | 95 – 100% | M |
| Habitat health score | 36 | 34 | **50** | 33 | | |
| Microalgae | 31 | 41 | **55** | 30 | 60 - 90% | L |
| Macrophytes | 30 | 30 | **40** | 30 | 90% | M |
| Invertebrates | 55 | 15 | **20** | 50 | 65 - 95% | L |
| Fish | 25 | 25 | **40** | 35 | 80 - 95% | M |
| Birds | 70 | 20 | **60** | 70 | 20 - 70% | L |
| Biotic health score | 42 | 26 | **43** | 43 | | |
| **ESTUARINE HEALTH SCORE** | **39** | **30** | **46** | **38** | **73** | **L** |
| **PRESENT ECOLOGICAL STATUS** | **D/E** | **E** | **D** | **E** | **B/C** | |

Estimates of the contribution of non-flow related impacts on the level of degradation of each component led to an increase in the health score from a PES of 46 to 84, which would raise the health score to a B/C. This suggests that non-flow related impacts have played a major role in the degradation of the estuary to a D, but that some flow-related impacts are also driving degradation.

Confidence levels for three of the four abiotic components were rated as Low. Only two of the five biotic components had enough data to yield Medium Confidence assessments. The overall confidence assessment for this study is Low. Due to lack of long-term monitoring data and access.

## 4.3 RECOMMENDED ECOLOGICAL CATEGORY

### 4.3.1 Importance of the uMhlatuze Estuary

The EIS for five components and the importance rating are presented in **Tables 4.2** and **4.3**, respectively.

The functional importance of uMhlatuze Estuary is very high with a score of 100. The two main reasons for this high functional importance were that it served as an important nursery fish and crustacean (marine /riverine) species, as well as being a very important stopover point for migratory birds, supporting several red data species with important nesting sites scattered throughout the system. The system also serves as a movement corridor between the estuary and the coastal lakes and surrounding wetlands.

**Table 4.2 Estimation of the functional importance score of the uMhlatuze Estuary**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 90 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 100 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 90 |
| d) Roosting, foraging and/or nesting area for marine and coastal birds | 100 |
| e) Catchment detritus, nutrients and sediments to sea | 90 |
| **Functional importance score - Max (a to e)** | **100** |

The EIS for the uMhlatuze Estuary, is 94 (**Table 4.3**), indicating that the estuary is rated as of “Highly Important” (**Table 4.4**). This very high rating is related to the very large size of the system, its high habitat diversity and its overall high functional importance.

**Table 4.3 Estuarine Importance Score for the uMhlatuze Estuary**

| Estuarine Importance | Score |
|---|---|
| Estuary Size | 100 |
| Zonal Rarity Type | 80 |
| Habitat Diversity | 100 |
| Biodiversity Importance | 85 |
| Functional Importance | 100 |
| **ESTUARINE IMPORTANCE SCORE** | **94** |
| **Calculation of the functional importance score** | **Highly important** |

**Table 4.4 Estuarine Importance Score and significance**

| Importance score | Description |
|---|---|
| 81 – 100 | Highly important |
| 61 – 80 | Important |
| 0 – 60 | Of low to average importance |

The uMhlatuze Estuary is in a formally protected area, the uMhlatuze Sanctuary Reserve, managed by Ezemvelo KwaZulu-Natal Wildlife. The estuary thus also forms part of the core set of priority estuaries in need of protection to achieve national and global biodiversity targets (Turpie *et al*., 2012c). The NBA 2011 (van Niekerk and Turpie, 2012) recommended that the minimum Category for the uMhlatuze be an A or BAS, that the system be granted partial no-take protection, and that 50% of the estuary margin be undeveloped (**Table 4.5**).

**Table 4.5 National Estuary Biodiversity Plan requirements for the uMhlatuze Estuary**

| Estuary Requirements | uMhlathuze |
|---|---|
| Current health category | D |
| National and/or Regional Priority set | SA |
| Recommended extent of protection | Partial |
| Recommended extent of undeveloped margin | 50% |
| Provisional estimate of Recommended Ecological Category | A or BAS |

### 4.3.2 Recommended ecological category

The REC represents the level of protection assigned to an estuary. The PES sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary. The PES for the uMhlatuze Estuary is a D/E and the Estuary is in a protected area.

The REC represents the level of protection assigned to an estuary. The first step is to determine the 'minimum' Ecological Category based on its PES as it sets a value below which the system should not decline. The relationship between EHI score, PES and minimum REC is set out in **Table 4.6**.

**Table 4.6 Relationship between the EHI, PES and minimum REC**

| EHI score | PES | Description | Minimum Ecological Category |
|---|---|---|---|
| 91 – 100 | A | Unmodified, natural | A |
| 76 – 90 | B | Largely natural with few modifications | B |
| 61 – 75 | C | Moderately modified | C |
| **41 – 60** | **D** | **Largely modified** | **D** |
| **21 – 40** | **E** | **Highly degraded** | **-** |
| 0 – 20 | F | Extremely degraded | - |

The PES sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary (**Table 4.6**). The PES for the uMhlatuze Estuary is a D. However, as the estuary is in a formally protected area that should contribute to meeting South Africa's national and global

biodiversity targets it should be in an A or a B Category. However, as some of the changes are seen as irreversible the BAS is a D.

**Taking into account the current conditions, the reversibility of the impacts, the ecological importance and the conservation requirements of the uMhlatuze Estuary, the REC for the system is a D Category.**

## 4.4 OPERATIONAL AND ECOLOGICAL RESERVE SCENARIOS

### 4.4.1 Description of flow scenarios

**Table 4.7** provides a summary of a range of water resource development scenarios that could affect the uMhlatuze Estuary.

**Table 4.7 Summary of flow scenarios**

| Scenarios | Description | MAR ($X10^6$ $m^3$) | % Similarity |
|---|---|---|---|
| Reference | Natural (~1750) | 470.08 | 100.0 |
| Present | Present day | 289.59 | 61.6 |
| Scenario 1 | Climate change | 219.07 | 46.6 |
| Scenario 2 | Restoration (15% increase) | 333.00 | 70.8 |
| Scenario 3 | 2030 Development | 281.44 | 59.9 |
| Scenario 4 | 2040 Development | 278.31 | 59.2 |

### 4.4.2 Ecological Categories associated with runoff scenarios

The REC represents the level of protection assigned to an estuary. The PES sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary. The PES for the uMhlatuze Estuary is a D, however, as the estuary is in a formally protected area it should be in an A or a B Category.

Taking the current conditions, the reversibility of the impacts, the ecological importance and the conservation requirements of the uMhlatuze Estuary into account, the REC for the system is a C Category.

The individual EHI scores, as well as the corresponding ecological category under different scenarios are provided below in **Table 4.8**. Under Sc 1, the Climate Change scenario, the condition of the system will degrade by a further 6% to Category D/E. Under Sc 2, the Restoration scenario, the estuary will improve by 4% but remain in a D Category. While under Sc 3 (2030 development scenario) and 4 (2040 development scenario), the system will further decline in condition by 1% but also still remains in a Category D.

**Table 4.8 uMhlatuze: EHI scores and corresponding Ecological Categories under the different runoff scenarios**

| Component | uMhlatuze Estuary PES | Scenarios for uMhlatuze Estuary | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| Hydrology | 53 | 41 | 70 | 53 | 53 |
| Hydrodynamics and mouth condition | 39 | 40 | 38 | 39 | 39 |
| Water quality | 57 | 59 | 56 | 57 | 57 |
| Physical habitat alteration | 50 | 40 | 50 | 50 | 50 |
| **Habitat health score** | 50 | **45** | **53** | **50** | **51** |
| Microalgae | 55 | 50 | 54 | 55 | 55 |
| Macrophytes | 40 | 35 | 45 | 40 | 40 |
| Invertebrates | 20 | 15 | 25 | 20 | 20 |
| Fish | 40 | 35 | 45 | 40 | 40 |
| Birds | 60 | 40 | 65 | 50 | 50 |
| **Biotic health score** | 43 | **35** | **47** | **41** | **41** |
| **ESTUARINE HEALTH SCORE** | 46 | **40** | **50** | **45** | **45** |
| **PRESENT ECOLOGICAL STATUS** | **D** | **D/E** | **D** | **D** | **D** |

Focussing on the uMhlatuze Estuary, Sc 2 to 4 achieved the REC of a D Category. However, it is also recommended several management interventions are instituted to improve the overall resilience of the system to future pressures, including climate change. Ecosystem-based adaptation restoration project is needed to offset and restore the impacts of port development and flow reduction.

In the short term, several key interventions can yield immediate results in this important nursery area (e.g., sharks, rays and economically important fish species):

- Reduce very high fishing pressure (i.e. control poaching and illegal gillnetting) by increasing compliance.
- Increase connectivity between lakes and downstream waters by reinstalling/installing functional fishways.
- Identify and protect areas in which the seagrass *Zostera capensis* reestablishment is occurring and re-establish/restore this important habitat near the yacht terminal.
- Access to uMhlatuze Estuary is currently highly restricted for legal users as permission is needed to travel through the Port of Richards Bay. Improve access to uMhlatuze Estuary through an alternative road or an improved permitting system will allow for increased compliance, monitoring and research. Lack of access leads to no oversight and results in no awareness of the high level of illegal activities in the system or its general ecological importance
- Ensure that there is no leakage of contaminated water (e.g. oil slicks) through the tidal gates between the uMhlathuze estuary and the Port of Richards Bay.

In the long term, the uMhlatuze Estuary presents opportunities for bird tourism if access was to improve. This could provide livelihoods for local communities instead of illegal activities that benefit a few. Birding tourism is also known for spin-off benefits such as generating the need for accommodation. BirdLife SA could assist with training field guides - Zululand Birding Route.

Declining water quality, especially in Mzingazi and Chubu and uMhlatuze River catchment, is a growing concern and needs urgent interventions in the form of formal reticulation for urban development and implementing agricultural best practices to reduce nutrient enrichment to all parts of the system.

Overall it is important to improve research and understanding of the uMhlatuze Estuary to better understand the changes this important system has experienced over the past five decades.

To compliment uMhlatuze Estuary functionality, the Port of Richards Bay should initiate projects that retain and restore estuarine ecosystem services, for example:

- The National Port Authority must acknowledge the importance of the Blue Carbon Ecosystems its supports in the port and be given credit for protecting such habitats (e.g. to offset the Port's Carbon footprint).
- Given how important the system is as a fish nursery (e.g. hammerhead sharks) the port should look for bio-enhancement opportunities in support of nursery function as part of its port plan.

## 4.5 RECOMMENDED ECOLOGICAL FLOW REQUIREMENTS FOR THE uMHLATUZE ESTUARY

The REC for the uMhlatuze Estuary is Category D. The flow requirements for the estuary are the same as those described for Scenario 2 and are summarised in **Table 4.9**. However, Sc 3 (2030 development) and 4 (2040 development) with the above interventions for the estuary, Richards Bay and the associated lakes implemented to offset flow impacts also meet the criteria.

**Table 4.9 A summary of the monthly flow (in $m^3/s$) distribution under Scenario 2**

| %tile | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99 | 112.4 | 77.9 | 125.3 | 74.1 | 207.9 | 175.1 | 101.6 | 68.0 | 40.0 | 43.6 | 31.5 | 153.0 |
| 95 | 31.1 | 32.2 | 28.3 | 31.8 | 66.7 | 40.9 | 37.8 | 27.1 | 21.2 | 18.6 | 12.7 | 18.7 |
| 90 | 12.6 | 26.5 | 21.1 | 15.1 | 34.7 | 29.7 | 18.1 | 16.3 | 9.4 | 9.7 | 8.4 | 10.8 |
| 85 | 11.2 | 19.6 | 14.5 | 11.6 | 27.2 | 26.3 | 12.9 | 11.9 | 8.7 | 8.3 | 5.6 | 8.5 |
| 80 | 9.3 | 10.9 | 9.0 | 8.6 | 23.2 | 23.4 | 10.6 | 7.5 | 8.1 | 5.8 | 4.6 | 6.5 |
| 70 | 6.9 | 7.8 | 6.7 | 6.9 | 11.7 | 9.1 | 7.7 | 5.1 | 5.1 | 4.3 | 3.7 | 5.3 |
| 60 | 5.6 | 5.9 | 5.2 | 5.7 | 9.5 | 7.2 | 5.6 | 4.1 | 3.9 | 3.4 | 3.3 | 4.4 |
| 50 | 4.5 | 5.0 | 4.5 | 4.2 | 7.7 | 5.5 | 4.8 | 3.6 | 3.4 | 3.1 | 3.1 | 3.9 |
| 40 | 4.1 | 4.0 | 3.8 | 3.9 | 6.5 | 4.6 | 4.2 | 3.2 | 3.1 | 2.8 | 2.8 | 3.4 |
| 30 | 3.3 | 3.6 | 3.5 | 3.4 | 5.6 | 4.1 | 3.6 | 3.0 | 2.8 | 2.5 | 2.5 | 3.1 |
| 20 | 2.9 | 3.3 | 3.1 | 3.0 | 4.5 | 3.3 | 3.0 | 2.7 | 2.6 | 2.4 | 2.3 | 2.7 |
| 10 | 2.4 | 2.4 | 2.6 | 2.6 | 3.4 | 2.8 | 2.7 | 2.4 | 2.4 | 2.2 | 2.2 | 2.3 |
| 5 | 2.3 | 2.4 | 2.4 | 2.3 | 3.0 | 2.6 | 2.4 | 2.3 | 2.2 | 2.1 | 2.1 | 2.2 |
| 1 | 2.2 | 2.3 | 2.2 | 2.2 | 2.7 | 2.5 | 2.4 | 2.2 | 2.1 | 2.0 | 1.9 | 2.1 |

# 5 iNHLABANE ESTUARY

## 5.1 ESTUARY DELINEATION

The iNhlabane Estuary used to be part of an estuarine coastal lake system, linking the lake areas with the sea. In the past, the lakes consisted of two basins with large stretches of open water mostly in excess of 1 m deep. The maximum depth recorded in the main basin was 5 m. The system is classified as a transformed "Estuarine Lake" (van Niekerk *et al*., 2020). In 1977 a barrage was constructed across the upper reaches of the estuary, approximately 3 km from the mouth. This divided the system into Lake iNhlabane (North lake and South lake), which is now a large freshwater lake, and the smaller iNhlabane Estuary, which is periodically open to the sea for short periods. A fishway was constructed re-establish migration of fish and other fauna but is non-functional. For the purposes of this EWR study, the geographical boundaries of the iNhlabane Estuary are defined as follows (**Figure 5.1**):

| | |
|---|---|
| Downstream boundary: | 28°39'49.34"S 32°15'23.80"E |
| Upstream boundary: | 28°34'19.04"S 32°18'11.36"E |
| Lateral boundaries: | 5 m contour above MSL along each bank |


**Figure 5.1 Geographical boundaries of the iNhlabane Estuary based on the Estuary Functional Zone**

## 5.2 PRESENT ECOLOGICAL STATUS

The iNhlabane Estuary in its present state is estimated to be 31% similar to a natural condition, which translates into a PES of an E Category. This is mostly attributed to the following factors:

- Significant flow reduction as a result of impoundment by weir – preventing connectivity with the sea for years and disrupting the salinity profile.
- The build-up of a large 10 m high dune at the mouth prevents breaching opportunities.
- A severe decline in water quality due to runoff from urban areas (many of which is not on formal reticulation), mining activities and poor agricultural agriculture practices in flood plain and catchment.
- Large-scale change in land-use in the EFZ causing loss of estuarine habitat (e.g. afforestation).
- Large-scale change in land-use change in the EFZ causing loss of estuarine habitat.
- Severe over-exploitation of living resources (e.g. large-scale illegal gillnetting), at present, confined to lakes as the estuary is non-functional.
- Loss of connectivity between the different three parts of the system, namely the estuary and South and North Lake.

Similarly, both South and North Lake are estimated at 31% (Category E). The overall current Estuarine Health Score, as well as the score with non-flow related pressures removed, is given in **Table 5.1** below.

**Table 5.1 Estuarine Health score for the iNhlabane Estuary**

| Component | PES | | % attributed to non-flow related impacts | Confidence |
|---|---|---|---|---|
| | Estuary | North & South Lakes | | |
| Hydrology | **33** | 75 | 0% | L |
| Hydrodynamics | **59** | 29 | 0 - 90% | L |
| Water quality | **32** | 25 | 0% | L |
| Physical habitat alteration | **30** | 10 | 0-90% | L |
| **Habitat health score** | **39** | **35** | | |
| Microalgae | **31** | 56 | 0 – 70% | L |
| Macrophytes | **50** | 20 | 60 - 100% | M |
| Invertebrates | **10** | 15 | 20 - 90% | L |
| Fish | **5** | 15 | 5 - 20% | M |
| Birds | **20** | 30 | 20% | L |
| **Biotic health score** | **23** | **27** | | |
| **ESTUARINE HEALTH SCORE** | **31** | **31** | **45** | **L** |
| **PRESENT ECOLOGICAL STATUS** | **E** | **E** | **D** | |

Estimates of the contribution of non-flow related impacts on the level of degradation of each component led to an increase in the health score from a PES of 31 to 45, which would raise the health score to a D. This suggests that non-flow related impacts have played the major role in the degradation of the estuary to an E, but that flow-related impacts are also driving degradation.

Confidence levels for four of the four abiotic components were rated as Low. Only two of the five biotic components had enough data to yield Medium Confidence assessments. The overall confidence assessment for this study is Low due to lack of long-term data sets.

## 5.3 RECOMMENDED ECOLOGICAL CATEGORY

### 5.3.1 Importance of the iNhlabane Estuary

The Estuary Importance Score for five components and the importance rating are presented in **Tables 5.2** and **5.3**, respectively.

The functional importance of iNhlabane Estuarine Lake was high with a score of 80. The two main reasons for this high functional importance were that it served as an important nursery for fish and freshwater invertebrates, as well as a movement corridor for eels, fish and selected invertebrates species between the sea and the coastal lakes and surrounding wetlands.

**Table 5.2 The functional importance score of the iNhlabane Estuarine Lake**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 40 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 80 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 80 |
| d) Roosting, foraging and/or nesting area for marine and coastal birds | 40 |
| e) Catchment detritus, nutrients and sediments to sea | 20 |
| **Functional importance score - Max (a to e)** | 80 |

The EIS for the iNhlabane Estuary, is 69 (**Table 5.3**), indicating that the estuary is rated as “Important” (**Table 5.4**). This rating is related to the relatively large historical extent of the system, its Biodiversity Importance and its overall high functional importance.

**Table 5.3 Estuarine Importance Score for the iNhlabane Estuary**

| Estuarine Importance | Score |
|---|---|
| Estuary Size | 50 |
| Zonal Rarity Type | 70 |
| Habitat Diversity | 50 |
| Biodiversity Importance | 86 |
| Functional Importance | 80 |
| **ESTUARINE IMPORTANCE SCORE** | **69** |
| **Calculation of the functional importance score** | **Important** |

**Table 5.4 Estuarine Importance Score and significance**

| Importance score | Description |
|---|---|
| 81 – 100 | Highly important |
| 61 – 80 | Important |
| 0 – 60 | Of low to average importance |

The iNhlabane Estuary does not form part of the core set of priority estuaries in need of protection to achieve national and global biodiversity targets (Turpie *et al*., 2012c).

### 5.3.2 Recommended Ecological Category

The REC represents the level of protection assigned to an estuary. The PES sets the minimum REC below which an estuary should not decline in condition. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary (**Table 2.6**). The PES for the iNhlabane Estuary is an E.

The relationship between EHI score, PES and minimum REC is set out in **Table 5.5**.

**Table 5.5 Relationship between the EHI, PES and minimum REC**

| EHI score | PES | Description | Minimum Ecological Category |
|---|---|---|---|
| 91 – 100 | A | Unmodified, natural | A |
| 76 – 90 | B | Largely natural with few modifications | B |
| 61 – 75 | C | Moderately modified | C |
| **41 – 60** | **D** | **Largely modified** | **D** |
| **21 – 40** | **E** | **Highly degraded** | **-** |
| 0 – 20 | F | Extremely degraded | - |

The PES for the iNhlabane Estuary is an E. However, as the estuary is rated as Important, it should be in a C Category. However, as some of the changes are seen as irreversible the BAS is a D.

**Taking into account the current conditions, the reversibility of the impacts, the ecological importance and the conservation requirements of the iNhlabane Estuary, the REC for the system is a D Category.**

## 5.4 OPERATIONAL AND ECOLOGICAL RESERVE SCENARIOS

### 5.4.1 Description of flow scenarios

**Table 5.6** provides a summary of a range of water resource development scenarios that could affect the iNhlabane Estuary.

**Table 5.6 Summary of flow scenarios**

| Scenarios | Description | MAR ($X10^6$ $m^3$) | % Similarity |
|---|---|---|---|
| Reference | Natural (~1750) | 30.40 | 100.0 |
| Present | Present day | 21.31 | 70.1 |
| Scenario 1 | Climate change | 10.09 | 33.2 |
| Scenario 2 | Historical EWR (DWAF, 2000) | 21.33 | 70.2 |
| Scenario 3 | Restoration of flow (+ 15%) | 26.35 | 86.7 |

### 5.4.2 Ecological Categories associated with runoff scenarios

The PES for the iNhlabane Estuary is an E Category, however, as the estuary is severely degraded it should be in a D Category.

Focussing on the iNhlabane Estuary, none of the future scenarios Sc 1 to 3 achieved the REC of a D Category. Sc 3, the Restoration scenario, could only increase the PES by 5%, while Sc 2, the historical EWR scenario, showed less than 1% change. Under Sc 1, the Climate Change scenario, the estuary declined by an additional 4%. Scenario 4, increased flows (represented by Sc 3 flow conditions) coupled with interventions such as artificial breaching and dredging of the organic layer accumulated in the system, is required to elevate the estuary condition to a D.

The individual EHI scores, as well as the corresponding ecological category under different scenarios, are provided below in **Table 5.7**.

**Table 5.7 iNhlabane: EHI scores and corresponding Ecological Categories under the different runoff scenarios**

| Component | Estuary | Estuary Scenarios | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 (Sc 3 + NON-FLOW Interventions) |
| Hydrology | 33 | 32 | 33 | 56 | 56 |
| Hydrodynamics | 59 | 53 | 60 | 59 | 59 |
| Water quality | 32 | 34 | 32 | 32 | 32 |
| Physical habitat alteration | 30 | 20 | 30 | 30 | 30 |
| **Habitat health score** | **39** | **35** | **39** | **44** | **44** |
| Microalgae | 31 | 27 | 28 | 46 | 46 |
| Macrophytes | 50 | 45 | 50 | 55 | 60 |
| Invertebrates | 10 | 5 | 10 | 10 | 30 |
| Fish | 5 | 5 | 5 | 5 | 30 |
| Birds | 20 | 15 | 20 | 25 | 45 |
| **Biotic health score** | **23** | **19** | **23** | **28** | **42** |
| **ESTUARINE HEALTH SCORE** | **31** | **27** | **31** | **36** | **43** |
| **PRESENT ECOLOGICAL STATUS** | **E** | **E** | **E** | **E** | **D** |

An ecosystem-based adaptation restoration project is needed to restore the iNhlabane Estuarine Lake System's functionality to a Category D.

Key interventions required to improve the condition of the iNhlabane Estuary include:

- Develop an Estuary Management Plan for the iNhlabane Estuarine Lake System to identify key actions and coordinate restoration efforts.
- Develop an Estuary Mouth Management Plan (including an approved Maintenance Management Plan as required under the Environmental Impact Assessment regulations under the National Environmental Management Act (No. 107 of 1998) to facilitate artificial breaching of the 10 m high berm at the mouth with earth-moving equipment.
- Remove accumulated organic sludge with earth-moving equipment/dredging from the bottom strata to improve water quality (i.e. oxygen levels) in the system. This intervention will result in multiple benefits to the ecology.
- The current fishways are not functional. Increase connectivity between the estuary and various parts of the lakes by flow releases from the weir and possible reengineering of the fishway. Such flow release will result in variable lake levels which will also benefit water birds in the lakes.
- Prevent disturbance of riparian vegetation, including trampling, cattle, fire, and removal of alien vegetation.

Key interventions required to improve the condition of the Lakes include:

- Control/reduce severe fishing efforts (i.e. illegal and legal fishing) in the lakes through increased compliance.
- Ensure connectivity between the estuary and the various parts of the lakes. For example, draw down of the lakes should not be at levels that could separate North and South Lakes.
- Proactive strategic planning is needed in the area to reduce the impact of future developments - for example, the disposal of waste is a key issue. Waste cannot run into estuaries and lakes.
- Deteriorating water quality represents a significant threat to the ecological functioning of the system, the risk is especially high during the closed state. No wastewater should be discharged into the system and agricultural best practices should be implemented to reduce nutrient-rich agriculture return flow. There is also a need to address diffuse runoff from housing not on formal reticulation systems. Look into innovative ways to manage wastewater in this area, e.g. artificial reed beds.
- Prevent disturbance of riparian vegetation, including trampling, cattle, fire, and removal of alien vegetation.
- Increase freshwater runoff through management/removal of wood lots. This needs a study to verify the benefits and development of a management plan for the associated impacts and/or removal.

## 5.5 RECOMMENDED ECOLOGICAL FLOW REQUIREMENTS FOR THE iNhlabane ESTUARY

The REC for the iNhlabane Estuary is Category D. The Recommended Flow Scenario is Scenario 3 (Restoration Scenario) coupled with interventions such as artificial breaching and dredging of the organic layer accumulated in the system.

The flow requirements for the estuary are the same as those described for Scenario 3 and are summarised in **Table 5.8**.

**Table 5.8 A summary of the monthly flow (in $m^3/s$) distribution under Scenario 3**

| %tile | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99 | 6.6 | 6.5 | 9.1 | 9.7 | 13.1 | 12.4 | 11.5 | 8.1 | 6.5 | 6.4 | 3.1 | 8.8 |
| 95 | 3.8 | 3.8 | 2.8 | 1.9 | 8.6 | 7.0 | 6.4 | 4.1 | 3.1 | 3.2 | 1.5 | 1.7 |
| 90 | 1.2 | 1.5 | 1.0 | 0.9 | 3.7 | 3.6 | 3.3 | 2.8 | 1.4 | 1.6 | 0.7 | 1.0 |
| 80 | 0.3 | 0.3 | 0.3 | 0.3 | 0.8 | 1.5 | 1.0 | 0.6 | 0.4 | 0.4 | 0.3 | 0.3 |
| 70 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| 60 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| 50 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| 40 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| 30 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.3 | 0.2 | 0.1 |
| 20 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 10 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

# 6 uMLALAZI ESTUARY

## 6.1 ESTUARY DELINEATION

The mouth of the uMlalazi Estuary is approximately 105 km northeast of Durban and 56 km south of Richards Bay. The mouth of the uMlalazi Estuary is approximately 50 km south of Richards Bay. The uMlalazi Estuary estuary mouth closes about 4% of the time, i.e. it is a “Predominantly Open” estuary (van Niekerk *et al*., 2020).

For the purposes of this EWR study, the geographical boundaries of the uMlalazi Estuary are defined as follows (**Figure 6.1**):

| | |
|---|---|
| Downstream boundary: | Estuary mouth 28°56'43.60"S 31°49'7.43"E |
| Upstream boundary: | Left tributary: 28°55'50.71"S 31°42'32.15"E |
| Lateral boundaries: | Centre tributary: 28°55'9.89"S 31°42'21.14"E |

**Figure 6.1 Geographical boundaries of the uMlalazi Estuary based on the Estuary Functional Zone**

## 6.2 PRESENT ECOLOGICAL STATUS

The uMlalazi Estuary in its present state is estimated to be 74% similar to natural condition, which translates into a PES of a B/C Category. This is mostly attributed to the following factors:

- Reduction in river inflow, especially baseflows that maintain the open mouth state and salinity regime in the system.
- Over-exploitation of living resources (e.g. poaching and line fishing).
- Land use change in the EFZ resulted in 956 ha of transformed habitat as a result of agriculture and development.
- Nutrient pollution from agricultural activities and urban settlements (wastewater and stormwater inputs).
- Recreational activities (e.g., boat launching) in the lower reaches affect bird's abundance.
- Past disposed spoil from dredging in the 1960’s as well as berm construction near the mouth.

- Artificial breaching that can result in loss of back flooding and sedimentation is not done appropriately.
- Artificial berms and levees along banks reduce estuary-land connectivity.

The overall current Estuarine Health Score as well as the score with non-flow related pressures removed is given in **Table 6.1** below.

**Table 6.1 Estuarine Health score for the uMlalazi Estuary**

| Variable | Estuarine health score | | |
|---|---|---|---|
| | Overall | % of impact non-flow related | Confidence |
| Hydrology | 72 | 0% | L |
| Hydrodynamics and mouth condition | 84 | 5% | L |
| Water quality | 66 | 90% | M |
| Physical habitat alteration | 85 | 10% | M |
| **Habitat health score** | **77** | | |
| Microalgae | 72 | 0% | L |
| Macrophytes | 70 | 60% | L |
| Invertebrates | 75 | 15% | M |
| Fish | 80 | 15% | M |
| Birds | 60 | 80% | L |
| **Biotic health score** | **71** | | |
| **ESTUARY HEALTH SCORE** | **74** | 84 | |
| **PRESENT ECOLOGICAL STATUS (PES)** | **B/C** | **B** | **L - M** |

Confidence levels for two of the four abiotic components were rated as Low. Only two of the five biotic components had enough data to yield Medium Confidence assessments. The overall confidence assessment for this study is Low due to low confidence in the hydrology.

Estimates of the contribution of non-flow related impacts on the level of degradation of each component led to an increase in the health score from a PES of 74 to 84, which would raise the health score to a B. This suggests that non-flow related impacts have played some role in the degradation of the estuary to a B/C, but that flow-related impacts are also driving degradation.

Of the non-flow related impacts, habitat loss to sugar farming within the 5 m contour and the vegetation integrity of those areas along with potential water quality problems associated with agricultural activities, Mtunzini Waste Water Treatment Works (WWTW) and the Aquaculture Kob Farm and historical dredging and berm construction were identified important factors currently influencing ecological health of the system. A full list of items that could improve estuarine health are given under **Section 5.4.2** - **Ecological Categories associated with scenarios**.

**Potential Impacts of Mariculture**

The National Biodiversity Assessment: 2011 (Driver *et. al.,* 2012) identified aquaculture as an emerging pressure in the marine and coastal environment. The NBA stated that although mariculture can sometimes provide options for easing pressure on over-exploited marine resources, it can also have serious negative impacts if not appropriately undertaken and managed, for example causing

declines in water quality through nutrient enrichment and pollution, incubation of parasites and pathogens which may then transfer to wild stocks, introduction and spread of invasive alien species, and degradation of marine habitats.

***Source: DWS (2015)***

## 6.3 RECOMMENDED ECOLOGICAL CATEGORY

### 6.3.1 Importance of the uMlalazi Estuary

The Estuary Importance Score for five components and the importance rating are presented in **Tables 6.2** and **6.3**, respectively.

The functional importance of uMlalazi Estuary is very high with a score of 90, with much of it contributing to the very nursery importance of the system for fish and invertebrates.

**Table 6.2 Estimation of the functional importance score of the uMlalazi Estuary**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 80 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 90 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 60 |
| d) Roosting, foraging and/or nesting area for marine and coastal birds | 60 |
| e) Catchment detritus, nutrients and sediments to sea | 20 |
| **Functional importance score - Max (a to e)** | **90** |

The EIS for the uMlalazi Estuary, is 86 (**Table 6.3**), indicating that the estuary is rated as “Highly Important” (**Table 6.4**). Much of this is due to the ecological contributions made by the system and the fact that the biodiversity is high, there are several iconic as well as red data bird species present in the system. Furthermore, the uMlalazi is important from an economic perspective due to the regional tourism value attached to it.

**Table 6.3 Estuarine Importance Score for the uMlalazi Estuary**

| Criterion | Weight | Score |
|---|---|---|
| Estuary Size | 15 | 90 |
| Zonal Rarity Type | 10 | 30 |
| Habitat Diversity | 25 | 90 |
| Biodiversity Importance | 25 | 96 |
| Functional Importance | 25 | 90 |
| **Estuary Importance Score** | | **86** |
| **Calculation of the functional importance score** | | **Highly important** |

**Table 6.4 Estuarine Importance Score and significance**

| Importance score | Description |
|---|---|
| 81 – 100 | Highly important |
| 61 – 80 | Important |
| 0 – 60 | Of low to average importance |

The uMlalazi Estuary is partially in a formally protected area, the Umlalazi Nature Reserve, managed by Ezemvelo KwaZulu-Natal Wildlife. The estuary thus also forms part of the core set of priority estuaries in need of protection to achieve biodiversity targets in the 2011 National Estuaries Biodiversity Plan (Turpie *et al*., 2012c). The NBA 2011 (van Niekerk and Turpie 2012) recommended that the minimum Category for the uMlalazi be an A, that the system be granted partial no-take protection, and that 75% of the estuary margin be undeveloped (**Table 6.5**).

**Table 6.5 National Estuary Biodiversity Plan requirements for the uMlalazi Estuary**

| Estuary Requirements | uMlalazi |
|---|---|
| Current health category | B |
| National and/or Regional Priority set | SA |
| Recommended extent of protection | Full |
| Recommended extent of undeveloped margin | 75% |
| Provisional estimate of Recommended Ecological Category | A |

### 6.3.2 Recommended Ecological Category

The REC represents the level of protection assigned to an estuary. The PES sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary. The PES for the uMlalazi Estuary is a B/C and the Estuary is rated as “Highly Important” from a biodiversity perspective.

The REC represents the level of protection assigned to an estuary. The first step is to determine the 'minimum' Ecological Category based on its PES. The relationship between EHI score, PES and minimum REC is set out in **Table 6.6**.

**Table 6.6 Relationship between the EHI, PES and minimum REC**

| EHI score | PES | Description | Minimum Ecological Category |
|---|---|---|---|
| 91 – 100 | A | Unmodified, natural | A |
| **76 – 90** | **B** | **Largely natural with few modifications** | **B** |
| 61 – 75 | C | Moderately modified | C |
| 41 – 60 | D | Largely modified | D |
| 21 – 40 | E | Highly degraded | - |
| 0 – 20 | F | Extremely degraded | - |

The PES sets the minimum ecological condition. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary (**Table 2.6**). Taking into account the current conditions (PES = B/C), the

reversibility of the impacts, the ecological importance and the conservation requirements of the uMlalazi Estuary, the REC for the system is a B Category. The Estuary is rated as "Highly Important" from a biodiversity perspective and the target recommended by the National Estuaries Biodiversity Plan for the National Biodiversity Assessment (Turpie *et al*., 2012c) indicates it should be in an A Category. However, as some of the changes are seen as irreversible the BAS is a B.

It should be noted that the uMlalazi is sensitive to mouth closure and declines in oxygen levels, needing baseflows to maintain open mouth conditions and floods to scour accumulated sediments. A decline in these important processes will result in a further decline in condition.

**Based on this study, DWS (2015), the National Biodiversity targets and the reversibility of current impacts, the REC for the uMlalazi Estuary is a B Category.**

## 6.4 OPERATIONAL AND ECOLOGICAL RESERVE SCENARIOS

### 6.4.1 Description of the Scenarios

**Table 6.7** provides a summary of a range of water resource development scenarios that could affect the uMlalazi Estuary.

**Table 6.7 Summary of flow evaluated for the uMlalazi Estuary**

| Scenarios | Description | MAR ($X10^6$ $m^3$) | % Remaining |
|---|---|---|---|
| Natural | Natural (~1750) | 119.34 | |
| Present | Present day | 99.55 | 83.4 |
| Scenario 1 | Climate change | 69.08 | 57.9 |
| Scenario 4 | Increased WWTW discharged. | 99.25 | 83.2 |
| Scenario 5 | Present, but includes an additional demand which is approximately 10% of the present MAR (13 $Mm^3$) supplied by the upstream dam which has an increased capacity of 15 Mm3. | 95.95 | 80.4 |
| Scenario 6 | Present reduced by 10% through abstraction from lower reaches of the river | 88.92 | 74.5 |
| Scenario 7 | Present reduced by 20% through abstraction from lower reaches of the river | 79.12 | 66.3 |
| Scenario 8 | Same as Scenario 7 except an additional demand of 10% MAR is taken out of the upstream catchment from a dam with a capacity of 20 $Mm^3$ (over and above the 20% demand taken directly from the river). | 75.67 | 63.4 |
| Scenario 9 | Present with non-flow restoration interventions: Create interventions within the buffer zone that would improve the nutrient status and reduce sediment inputs. Reduce fishing pressure through eradicating illegal gill netting, as well as illegal seine & cast netting to improve the nursery function. Undertake active restoration of the uMlalazi estuary functional zone and reduce agriculture impacts in the supratidal area of the system, including the controlling of harvesting and grazing pressures. Restore intertidal habitat in lower reaches. Control recreational activities in the lower reaches through zonation and improved compliance. Manage disturbance to birds (e.g. closed areas, boating controls such as speed zones), including control and management of vehicle access at the mouth to minimise the disturbance to birds. Promote tourism (bird guides etc.) to reduce impacts on other activities in the system. Implement strategic planning and management of land-use in | 99.55 | 83.4 |

| Scenarios | Description | MAR ($X10^6$ $m^3$) | % Remaining |
|---|---|---|---|
| | and around the EFZ. Monitor and control sand-mining in the upper reaches of the system. | | |

### 6.4.2 Ecological Categories associated with runoff scenarios

The individual EHI scores, as well as the corresponding ecological category under different scenarios are provided below in **Table 6.8**. The estuary is currently in a B/C Category.

Scenario 1, the Climate Change scenario will result in a 23% decline in condition to a Category D. While under Sc 4, the WWTW option, it will degrade by 19% resulting in Category D, however under this scenario much of the ecology will be in a highly degraded state and most ecosystem services are severely compromised. Under Sc 5 the estuary will decline by 2% to a C Category. There will be an additional 10% decline under Sc 6, but the estuary will remain in a Category C state. Scenarios 7 and 8 will result in severe further deterioration by 21% and 24% respectively from the PES causing the uMlalazi Estuary to degrade to a D Category. Development Sc 6 to 8 will also have major impacts on the cueing effect as the signal to the marine environment will be substantially reduced. Under most future scenarios increased/extended mouth closures will result in salinities gradually decreasing from the open marine phase. Consequently, lower salinities will become distributed almost throughout the system and this will have major impacts on the marine and estuarine fauna within the estuary. An additional impact related to this situation is that alien invasive species such as the freshwater snail *Tarebia granifera* would have increased invasive potential. Decreased salinities would also impact the breeding success of freshwater *Macrobrachium* prawns which require a certain minimum salinity for successful larval development.

The NON-FLOW Scenario 9, represents a restoration scenario in which no effort is made to improve baseflows or water quality, but active restoration of the EFZ is undertaken in conjunction with a reduction in harvesting, grazing and fishing pressure (especially illegal gill netting). Recreational activities such as boating are controlled. These in turn result in a significant gain in ecological health lifting the system into a low category B. Note, while not a requirement of Scenario 9, a small improvement in baseflows (e.g. removal of aliens) and water quality (restoring buffer zones) would assist further in restoring this system even more.

**Economic Issues related to extended Mouth Closure**

Increased mouth closure will have an impact on the offshore Thukela Banks prawn fishery which recently collapsed due to the extended mouth closure of the St Lucia System. There has also been a knock-on effect in the fish populations where it has been found that offshore breeding stocks of *Rhabdosargus sarba* have declined drastically and aged due to the loss of estuarine nursery facilities. Extended closures of other important estuaries which have an important nursery function, such as uMlalazi Estuary, could further impact the declining stocks. Increased closure of the mouth also has economic implications because some rural 'block' sugar farming is taking place on the flood plain within the 5 m MSL contour. This will result in pressure being placed to breach the mouth once back flooding starts.

**Table 6.8 EHI scores and corresponding Ecological Categories under the different runoff scenarios**

| Component | Weight | PES | Scenario | | | | | | | Confidence |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 4 | 5 | 6 | 7 | 8 | 9 | |
| Hydrology | 25 | **72** | 41 | 71 | 69 | 55 | 41 | 39 | 72 | L |
| Hydrodynamics and mouth condition | 25 | **84** | 61 | 84 | 83 | 71 | 61 | 59 | 84 | L |
| Water quality | 25 | **66** | 48 | 42 | 66 | 54 | 46 | 45 | 66 | L |
| Physical habitat alteration | 25 | **85** | 55 | 60 | 85 | 70 | 55 | 50 | 85 | M |
| **Habitat health score** | | **77** | **51** | **64** | **76** | **62** | **51** | **48** | **77** | **L** |
| Microalgae | 20 | **72** | 55 | 34 | 72 | 70 | 65 | 63 | 72 | L |
| Macrophytes | 20 | **70** | 40 | 40 | 65 | 60 | 50 | 50 | 75 | M |
| Invertebrates | 20 | **75** | 60 | 40 | 75 | 65 | 55 | 50 | 85 | L |
| Fish | 20 | **80** | 50 | 55 | 75 | 75 | 55 | 55 | 85 | M |
| Birds | 20 | **60** | 45 | 55 | 55 | 55 | 50 | 45 | 80 | L |
| **Biotic health score** | | **71** | **50** | **45** | **68** | **65** | **55** | **53** | **79** | **L** |
| **ESTUARY HEALTH SCORE** | | **74** | **51** | **55** | **72** | **64** | **53** | **50** | **78** | |
| **ECOLOGICAL CATEGORY** | | **B/C** | **D** | **D** | **C** | **C** | **D** | **D** | **B** | |

For the uMlalazi Estuary, none of the flow scenarios without non-flow interventions achieved the REC of a B Category. The Present State flow in conjunction with several management interventions is the recommended ecological flow scenario. The following management interventions could all contribute to the uMlalazi achieving a REC of a B:

- Remove invasive alien plants in the catchment to increase base flows to prevent mouth closure for periods longer than six to eight weeks and also prevent the water levels from going beyond 4 m MSL (indicative of a long closed mouth state).
- Deteriorating water quality represents a significant threat to the ecological functioning of the system, the risk is especially high during the closed state. No wastewater should be discharged into the system and agricultural best practices should be implemented to reduce nutrient-rich agriculture return flow. There is also a need to address diffuse runoff from housing not on reticulation.
- Create interventions within the buffer zone that would improve the nutrient status and reduce sediment inputs.
- Curb illegal gill netting of targeted species, as well as illegal seine and cast netting. This has an impact on the nursery function and impacts on prawns, which form part of the bycatch.
- Undertake restoration of the uMlalazi EFZ and reduce agriculture impacts in the supratidal area of the system.
- Ensure controlled harvesting of *Juncus* and *Phragmities* (plan currently in place).
- Curb recreational activities in the lower reaches through zonation and improved compliance (e.g. through the development of an Estuary Management Plan).
- Realign the protected area delineation with the EFZ to increase protection levels. Including options for Stewardship/Contracted Conservation being undertaken on the North Bank. This will reduce grazing pressure and lead to an improvement in the ecology.

- Develop a plan to manage disturbance to birds (e.g. closed areas, boating controls such as speed zones), including control and management of vehicle access to the north of the mouth to minimise the disturbance to birds.
- Promote tourism (bird guides etc.) to reduce impacts on other activities in the system.
- Implement strategic planning and management of land-use in and around the EFZ. For example, limit industrial scale agriculture changes to residential development.
- Investigate options to remove hard structures of aquaculture facilities and investigate opportunities to rewild banks and restore gentle slopes where possible along the banks of the estuary.
- Monitor and control sand-mining in the upper reaches of the system.
- Maintain hydrological connectivity by ensuring that roads and bridges do not impact tidal and river flows.
- Manage and control fires of riparian vegetation to protect mangroves (once-off accidental ignited the boardwalk and spread to the mangroves).

## 6.5 RECOMMENDED ECOLOGICAL FLOW REQUIREMENTS FOR THE UMLALAZI ESTUARY

Where any component of the health score is less than 40, then modifications to flow and measures to address anthropogenic impacts must be found that will rectify this. The REC for the uMlalazi Estuary is Category B.

The flow requirements for the estuary are the same as those described for the Present State **(Table 6.9**), but it should be noted that even a small increase in the baseflows (baseflows increase to > 0.3) through the removal of aliens vegetations in the catchment will ensure more open mouth conditions moving forward.

**Table 6.9 A summary of the monthly flow (in $m^3/s$) distribution under the Present State**

| %ile | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99 | 22.4 | 19.5 | 37.0 | 18.9 | 41.3 | 40.2 | 28.8 | 20.0 | 20.4 | 18.9 | 9.4 | 29.2 |
| 95 | 12.4 | 12.6 | 12.0 | 11.1 | 21.4 | 15.3 | 18.3 | 9.2 | 10.8 | 6.0 | 5.7 | 9.7 |
| 90 | 5.6 | 7.1 | 7.9 | 4.5 | 9.8 | 11.6 | 9.2 | 7.2 | 4.6 | 4.3 | 2.8 | 3.1 |
| 85 | 4.5 | 6.2 | 5.1 | 3.8 | 8.5 | 9.5 | 6.4 | 5.0 | 3.4 | 2.6 | 2.3 | 2.8 |
| 80 | 3.5 | 4.3 | 3.1 | 3.3 | 6.5 | 5.8 | 3.9 | 3.8 | 2.6 | 2.3 | 2.1 | 2.4 |
| 70 | 2.7 | 3.0 | 2.0 | 1.7 | 2.9 | 3.2 | 2.4 | 2.0 | 1.7 | 1.7 | 1.7 | 1.8 |
| 60 | 2.0 | 2.6 | 1.6 | 1.4 | 1.9 | 2.2 | 1.9 | 1.4 | 1.3 | 1.2 | 1.2 | 1.5 |
| 50 | 1.6 | 2.1 | 1.4 | 1.2 | 1.6 | 1.6 | 1.5 | 1.3 | 1.1 | 1.1 | 1.0 | 1.2 |
| 40 | 1.3 | 1.6 | 1.2 | 0.9 | 1.3 | 1.2 | 1.3 | 1.0 | 1.0 | 0.9 | 0.9 | 1.1 |
| 30 | 1.2 | 1.3 | 1.0 | 0.7 | 0.9 | 1.0 | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 1.0 |
| 20 | 1.0 | 1.0 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 | 0.6 | 0.7 | 0.6 | 0.6 | 0.8 |
| 10 | 0.7 | 0.8 | 0.6 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.6 |
| 5 | 0.6 | 0.6 | 0.5 | 0.4 | 0.4 | 0.2 | 0.3 | 0.2 | 0.2 | 0.3 | 0.3 | 0.5 |
| 1 | 0.3 | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.1 | 0.3 |

# 7 iSIYAYA ESTUARY

## 7.1 ESTUARY DELINEATION

The iSiyaya Estuary is situated near Mtunzini on the Zululand North Coast. It forms an integral part of the Umlalazi Nature Reserve and has had a pivotal role in the local community. It is used extensively by the local community as a recreation facility and many years ago it was the venue for such events as the local school gala (before loss of water column depth). The system is classified as a "temporarily closed" estuary (van Niekerk *et al*., 2020).

For the purposes of this EWR study, the geographical boundaries of the iSiyaya Estuary are defined as follows (**Figure 7.1**):

| | |
|---|---|
| Downstream boundary: | Estuary mouth 28°57'48.78"S 31°46'5.05"E (but can move). |
| Upstream boundary: | iSiyaya arm: 28°58'40.77"S 31°44'1.80"E<br>aManzamanyana Arm: 28°58'59.11"S 31°43'52.99"E |
| Lateral boundaries: | 5 m contour above MSL along each bank. |


**Figure 7.1 Geographical boundaries of the iSiyaya Estuary based on the Estuary Functional Zone**

## 7.2 PRESENT ECOLOGICAL STATUS

The iSiyaya Estuary in its present state is estimated to be 43% similar to natural condition, which translates into a PES of a D/E Category. This is mostly attributed to the following factors:

- Significant flow reduction, especially in the baseflows that is needed to maintain water levels under closed conditions.
- Loss of marine connectivity due to flow reduction resulting in the development of stagnant freshwater conditions.

- Accumulation of organic matter in the bottom substrate of the system leading to high oxygen demand and low dissolved oxygen levels.
- A decline in water quality (due to runoff from mining sites (turbidity) and agriculture (nutrient enrichment.
- Land-use change in the EFZ causing loss of estuarine habitat.
- Disturbance of birds near the mouth due to beach driving.
- Some over-exploitation of living resources (e.g. poaching and line fishing).

Overall there has been a major catastrophic shift in the state from a functional estuary to a stagnant swamp. There is a near complete loss of the estuarine invertebrate and fish communities where once there was a thriving and rich community present. There is also a human health risk, i.e. Lung flukes, associated with the invasive species in Zone B.

The overall current Estuarine Health Score as well as the score with non-flow related pressures removed is given in **Table 7.1** below.

**Table 7.1 Estuarine Health score for the iSiyaya Estuary**

| Variable | Estuarine health score | | |
|---|---|---|---|
| | PES | % of impact non-flow related | Confidence |
| Hydrology | 78 | - | L |
| Hydrodynamics and mouth condition | 57 | 0% | L |
| Water quality | 53 | 80% | L |
| Physical habitat alteration | 30 | 70% | M |
| **Habitat health score** | **54** | | |
| Microalgae | 51 | 0% | L |
| Macrophytes | 30 | 60% | M |
| Invertebrates | 15 | 65% | L |
| Fish | 15 | 20% | L |
| Birds | 50 | 40% | L |
| **Biotic health score** | 32 | | |
| **ESTUARY HEALTH SCORE** | **43** | **67** | **L** |
| **PRESENT ECOLOGICAL STATUS (PES)** | **D/E** | **C** | |

Estimates of the contribution of non-flow related impacts on the level of degradation of each component led to an increase in the health score from a PES of 43 to 67, which would raise the health score to a C. This suggests that non-flow related impacts have played a major role in the degradation of the estuary to a D/E, but that some flow-related impacts are also driving degradation.

Confidence levels for three of the four abiotic components were rated as Low. Only one of the five biotic components had enough data to yield Medium Confidence assessments. The overall confidence assessment for this study is Low.

## 7.3 RECOMMENDED ECOLOGICAL CATEGORY

### 7.3.1 Importance of the iSiyaya Estuary

The Estuary Importance Score for five components and the importance rating are presented in **Tables 7.3** and **7.3**, respectively.

The functional importance of iSiyaya Estuary is very high with a score of 20.

**Table 7.2 Estimation of the functional importance score of the iSiyaya Estuary**

| Calculation of the functional importance score | Score |
|---|---|
| a) Export of organic material generated in the estuary (regional scale) | 10 |
| b) Nursery function for fish and crustaceans (marine /riverine) | 20 |
| c) Movement corridor for river invertebrates and fish breeding in sea | 20 |
| d) Roosting, foraging and/or nesting area for marine and coastal birds | 10 |
| **Functional importance score - Max (a to e)** | **20** |

The EIS for the iSiyaya Estuary, is 37 (**Table 7.3**), indicating that the estuary is rated as of "Low to Average Importance" (**Table 7.4**). Much of this is due to small size.

**Table 7.3 Estuarine Importance Score for the iSiyaya Estuary**

| Estuarine Importance | Score |
|---|---|
| Estuary Size | 30 |
| Zonal Rarity Type | 10 |
| Habitat Diversity | 60 |
| Biodiversity Importance | 47 |
| Functional Importance | **20** |
| **ESTUARINE IMPORTANCE SCORE** | **37** |
| **Calculation of the functional importance score** | **Low to Average Importance** |

**Table 7.4 Estuarine Importance Score and significance**

| Importance score | Description |
|---|---|
| 81 – 100 | Highly important |
| 61 – 80 | Important |
| 0 – 60 | Of low to average importance |

The iSiyaya Estuary is in a formally protected area, the Umlalazi Nature Reserve, managed by Ezemvelo KwaZulu-Natal Wildlife. The estuary thus also forms part of the core set of priority estuaries in need of protection to achieve biodiversity targets in the 2011 National Estuaries Biodiversity Plan (Turpie *et al*., 2012c). The NBA 2011 (van Niekerk and Turpie, 2012) recommended that the minimum Category for the iSiyaya be a B, that the system be granted partial no-take protection, and that 50% of the estuary margin be undeveloped (**Table 7.5**).

**Table 7.5 National Estuary Biodiversity Plan requirements for the iSiyaya Estuary**

| Estuary Requirements | iSiyaya |
|---|---|
| Current health category | D/E |
| National and/or Regional Priority set | SA |
| Recommended extent of protection | Partial |
| Recommended extent of undeveloped margin | 50% |
| Provisional estimate of Recommended Ecological Category | B |

### 7.3.2 Recommended Ecological Category

The REC represents the level of protection assigned to an estuary. The PES sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary. The PES for the iSiyaya Estuary is a D/E and the Estuary is in a protected area.

The REC represents the level of protection assigned to an estuary. The first step is to determine the 'minimum' Ecological Category based on its PES. The relationship between EHI score, PES and minimum REC is set out in **Table 7.6**.

**Table 7.6 Relationship between the EHI, PES and minimum REC.**

| EHI score | PES | Description | Minimum Ecological Category |
|---|---|---|---|
| 91 – 100 | A | Unmodified, natural | A |
| 76 – 90 | B | Largely natural with few modifications | B |
| 61 – 75 | C | Moderately modified | C |
| **41 – 60** | **D** | **Largely modified** | **D** |
| **21 – 40** | **E** | **Highly degraded** | **-** |
| 0 – 20 | F | Extremely degraded | - |

The PES sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary (**Table 2.6**). The PES for the iSiyaya Estuary is a D/E. However, as the estuary is in a formally protected area that should contribute to meeting South Africa's national and global biodiversity targets it should be in an A or a B Category. However, as some of the changes are seen as irreversible, the BAS is a C.

**Taking into account the current conditions, the reversibility of the impacts, the ecological importance and the conservation requirements of the iSiyaya Estuary, the REC for the system is a C Category.**

## 7.4 OPERATIONAL AND ECOLOGICAL RESERVE SCENARIOS

### 7.4.1 Description of flow scenarios

**Table 7.7** provides a summary of a range of water resource development scenarios that could affect the iSiyaya Estuary.

**Table 7.7 Summary of flow scenarios**

| Scenarios | Description | MAR ($X10^6$ $m^3$) | % Similarity |
|---|---|---|---|
| Reference | Natural (~1750) | 4.70 | 100.00 |
| Present | Present day | 3.39 | 72.0 |
| Scenario 1 | Climate change | 2.21 | 47.1 |
| Scenario 2 | Increased abstraction (-15 %) | 2.89 | 61.4 |
| Scenario 3 | Restoration of baseflows (+15%) | 3.91 | 83.0 |

### 7.4.2 Ecological Categories associated with runoff scenarios

The REC represents the level of protection assigned to an estuary. The PES sets the minimum REC. The degree to which the REC needs to be elevated above the PES depends on the level of importance and level of protection or desired protection of a particular estuary. The PES for the iSiyaya Estuary is a D/E, however, as the estuary is in a formally protected area it should be in an A or a B Category.

Taking the current conditions, the degree to which non-flow intervention have impacted the system (Table 7.1), the reversibility of many of the impacts (e.g. impact of high turbidity runoff from mining site and removal of organic sludge), the ecological importance and the conservation requirements of the iSiyaya Estuary into account, the REC for the system is a C Category.

The individual EHI scores, as well as the corresponding ecological category under different scenarios are provided below in **Table 7.8**. The estuary is currently in a D/E Category. Under Sc 1 (Climate Change) and 2 (flow reduction) the estuary will further decline in condition by 15% and 9% respectively to a Category E. These scenarios will have a major impact on the average water levels in the system and overall marine connectivity. While under Sc 3, the Restoration scenario, the estuary will improve by 7% to a D Category. None of the flow scenarios achieve the REC.

**Table 7.8 EHI scores and corresponding Ecological Categories under the different runoff scenarios**

| Component | Present | Scenarios | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Hydrology | 74 | 52 | 44 | 100 |
| Hydrodynamics and mouth condition | 57 | 27 | 51 | 57 |
| Water quality | 53 | 62 | 47 | 56 |
| Physical habitat alteration | 30 | 10 | 20 | 30 |
| **Habitat health score** | **53** | **38** | **40** | **61** |
| Microalgae | 51 | 27 | 36 | 71 |
| Macrophytes | 30 | 15 | 20 | 40 |
| Invertebrates | 15 | 5 | 10 | 20 |
| Fish | 15 | 10 | 10 | 20 |
| Birds | 50 | 30 | 40 | 55 |
| **Biotic health score** | **32** | **17** | **23** | **41** |
| **ESTUARINE HEALTH SCORE** | **43** | **28** | **32** | **51** |

| Component | Present | Scenarios | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| **PRESENT ECOLOGICAL STATUS** | **D/E** | **E** | **E** | **D** |

For the iSiyaya Estuary, only Sc 3 ensured a significant improvement towards achieving the REC of a D Category. It is thus recommended that in addition to restoring baseflows, several non-flow management interventions are instituted to improve the overall resilience of the system.

Ecosystem-based adaptation restoration project is needed to restore the iSiyaya Estuary's functionality to a Category D, with the possibility of improving it to a C overtime:

1. In the short term several mechanical interventions are needed to restore estuarine functionality:
    - Remove accumulated organic sludge through dredging of bottom substrate to improve water quality, i.e. increase oxygen in water column;
    - Mechanical removal of reeds in lower reaches to increase open water area;
    - Revegetate the dune at the mouth; and
    - Develop a Estuary Mouth Management Plan, that consider mechanical removal of sediment that build-up at the mouth to allow for overwash recruitment when the system has been closed for long periods. This may also require deepening the estuarine channel and /or bringing the openwater area forward by removing marine sand at the mouth. Such Estuary Mouth Management Plan should also consider the natural northwards migration of the mouth and the risk this entail for the submarine communications cables near the mouth as stabilising the mouth may have ecological consequences and reduce estuarine open water area overtime.

In the long-term, a "catchment-to-coast" approach needs to be taken given this small river basin including:

- Mitigate the impacts of mining by ensuring a buffer zone of riparian vegetation around the estuary to reduce the turbidity signal and sediment input from mining. Note: Forestry in and around the EFZ has removed the natural buffer capacity riparian vegetation provides.
- Reduce the direct impact of forestry on the estuary by instituting buffer zones around the estuary (e.g. 1 km zone), while over longer time scales baseflows should be restored by an overall reduction in forested areas in the catchment.
- Pioneer different footpaths to the beach further north to reduce the disturbance of birds.
- Increase fishing compliance as fishing pressure will escalate if fish communities recover under restoration actions.
- Restore the upstream riparian zone and remove alien vegetation to assist with restoring baseflows and act as turbidity and nutrient filters.

## 7.5 RECOMMENDED ECOLOGICAL FLOW REQUIREMENTS FOR THE ISIYAYA ESTUARY

The REC for the iSiyaya Estuary is Category C.

The flow requirements for the estuary are the same as those described for Sc 3 and are summarised in **Table 7.9**.

**Table 7.9 A summary of the monthly flow (in $m^3/s$) distribution under Scenario 3**

| %ile | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99 | 0.789 | 0.569 | 1.368 | 0.484 | 1.041 | 1.378 | 1.032 | 0.733 | 0.820 | 0.740 | 0.327 | 1.085 | 1.033 |
| 95 | 0.374 | 0.372 | 0.417 | 0.335 | 0.544 | 0.537 | 0.520 | 0.367 | 0.365 | 0.287 | 0.231 | 0.321 | 0.404 |
| 90 | 0.229 | 0.228 | 0.248 | 0.149 | 0.339 | 0.401 | 0.276 | 0.238 | 0.135 | 0.170 | 0.121 | 0.145 | 0.231 |
| 85 | 0.165 | 0.165 | 0.183 | 0.111 | 0.298 | 0.233 | 0.175 | 0.161 | 0.123 | 0.117 | 0.111 | 0.121 | 0.149 |
| 80 | 0.119 | 0.140 | 0.120 | 0.100 | 0.163 | 0.140 | 0.130 | 0.132 | 0.111 | 0.108 | 0.104 | 0.116 | 0.119 |
| 70 | 0.097 | 0.114 | 0.098 | 0.069 | 0.079 | 0.106 | 0.093 | 0.070 | 0.071 | 0.072 | 0.084 | 0.075 | 0.089 |
| 60 | 0.070 | 0.104 | 0.075 | 0.067 | 0.073 | 0.073 | 0.069 | 0.067 | 0.068 | 0.068 | 0.068 | 0.070 | 0.070 |
| 50 | 0.068 | 0.074 | 0.067 | 0.063 | 0.068 | 0.066 | 0.065 | 0.065 | 0.066 | 0.066 | 0.065 | 0.069 | 0.067 |
| 40 | 0.066 | 0.069 | 0.065 | 0.061 | 0.065 | 0.062 | 0.063 | 0.062 | 0.065 | 0.064 | 0.064 | 0.065 | 0.064 |
| 30 | 0.062 | 0.064 | 0.060 | 0.060 | 0.062 | 0.060 | 0.060 | 0.059 | 0.061 | 0.060 | 0.060 | 0.061 | 0.060 |
| 20 | 0.059 | 0.061 | 0.056 | 0.056 | 0.058 | 0.055 | 0.056 | 0.056 | 0.057 | 0.057 | 0.056 | 0.058 | 0.057 |
| 10 | 0.053 | 0.055 | 0.053 | 0.051 | 0.050 | 0.048 | 0.045 | 0.049 | 0.051 | 0.050 | 0.049 | 0.051 | 0.050 |
| 5 | 0.050 | 0.050 | 0.050 | 0.046 | 0.041 | 0.043 | 0.039 | 0.040 | 0.040 | 0.041 | 0.043 | 0.048 | 0.043 |
| 1 | 0.038 | 0.044 | 0.041 | 0.038 | 0.033 | 0.033 | 0.024 | 0.032 | 0.034 | 0.035 | 0.037 | 0.043 | 0.033 |

# 8 CONCLUSIONS

A key concern is the level of degradation noted in the estuaries of the Usutu to Mhlathuze Catchment. Given their importance and the poor quality of the estuaries further south this is a worrisome trend and immediate action is required to halt further decline in the region.

There are a very high number of critical important estuaries in the Usutu to Mhlathuze Catchment. Despite this most of these systems show a severe decline in ecological health and require a significant commitment from the government at all levels, the private sector and communities, to address this ongoing decline and restore estuarine functionality.

The Kunming-Montreal Global Biodiversity Framework (GBF) was signed by 196 nations on 19 December 2022 to "take urgent action to halt and reverse biodiversity loss" by 2030. The GBF consists of four overarching global goals to protect nature, including: halting human-induced extinction of threatened species; sustainable use and management of biodiversity; fair sharing of the benefits from the utilization of genetic resources; and that adequate means of implementing the GBF be accessible to all Parties. The GBF targets include: Effective conservation and management of at least 30% of the world's land, coastal areas and oceans (Target 3); and Restoration of 30 % of terrestrial and marine ecosystems (Target 2); and Climate change mitigation and adaptation including a focus on Blue Carbon (Target 8). **South Africa have committed to demonstrating progress towards meeting the 23 GBF targets by 2030, with key estuaries in the region activity contributing towards these targets if they can be managed in a natural or near natural state (i.e. Category A or B) (DFFE Reaching Target 3 of the Global Biodiversity Framework national workshop proceedings, 6 – 8 June 2023).**

It will take efforts from national departments (DWS and DFFE), provincial authorities (Ezemvelo KwaZulu-Natal Wildlife and KwaZulu-Natal Department of Economic Development and Environmental Affairs) and local municipalities to achieve the overarching biodiversity commitments. It is not in the ambit of a single department to achieve this. The Estuary Management Planning Protocol under the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) (ICM Act) is the platform for achieving this. However, this will only be possible if all parties agree on the need for estuary improvement and commit to restoration, e.g., from restoration of baseflows to improved compliance with living resources. It will require not only compliance with legislation, but also implementation of best practices, and education and awareness among communities and stakeholders.

The United Nations Decade of Ecosystems Restoration 2021 - 2030 makes restoration and protection of critical ecosystems such as estuaries imperative at a global scale. This call to arms, aims to scale up the restoration of degraded ecosystems to combat the climate crisis and enhance food security and biodiversity. It also presents a host of funding opportunities through climate finances instruments (e.g. Blue Carbon trading), Ecosystems-based Adaptation (EbA) global funds, and national debt restructuring mechanisms which will be highly supportive of a South African Strategic Estuarine Management Framework.

**If South Africa cannot commit to restoring estuaries currently under formal protection this needs to be formally communicated, and agreed upon by relevant lead agencies as policy; so general guidelines and planning frameworks such as the National Estuaries Protocol can be adapted to reflect this.**

# 9 REFERENCES

Department of Forestry and Fisheries and Environment (DFFE). 2022. Review of the Scientific Basis for Breaching the Mouth of Lake St Lucia Estuary. Compiled by the Independent Panel of Experts as appointed by the Honourable Minister, Ms Barbara Creecy, Department of Forestry and Fisheries and Environment 1 Oct 2021 – 31 March 2022.

Department of Water Affairs and Forestry (DWAF). 2000. Mhlathuze System Ecological Reserve (Quantity) Study. Report on Estuary Freshwater Requirements Nhlabane Estuary. Supporting Report No 4. September 2000. Department Of Water Affairs and Forestry, Directorate Project Planning. Report No: W120-00-1599

Department of Water Affairs and Forestry (DWAF). 2008. Resource Directed Measures for Protection of Water Resources: Methodologies for the determination of ecological water requirements for estuaries. Version 2. Pretoria.

Department of Water and Sanitation (DWS). 2015. Resource Directed Measures: Reserve determination study of selected surface water and groundwater resources in the Usutu/Mhlathuze Water Management Area. Amatikulu-Nyoni Estuary Rapid Environmental Water Requirements Determination. Report produced by CRUZ Environmental on behalf of Tlou Consulting (Pty) Ltd. Report no: RDM/WMA6/CON/COMP/1413. 1-160 pp.

Department of Water and Sanitation (DWS). 2016. Chief Directorate – Water Ecosystems: Reserve determination study of selected surface water and groundwater resources in the Usuthu/Mhlathuze Water Management Area. Lake St Lucia Intermediate EWR Assessment Report – Volume 1: Ecoclassification and EWR Assessment. Prepared by Tlou Consulting (Pty) Ltd and Anchor Environmental Consultants (Pty) Ltd. Report no: RDM/WMA6/CON/COMP/2213.

Dollar, E.S.J., Nicolson, C.R., Brown, C.A., Turpie, J.K., Joubert, A.R., Turton, A.R., Grobler, D.F., Pienaar, H.H., Ewart-Smith, J. and Manyaka S.M. 2010. Development of the South African Water Resource Classification System (WRCS): a tool towards the sustainable, equitable and efficient use of water resources in a developing country. *Water Polic.* **12** 479-499. https://doi.org/10.2166/wp.2009.213.

Driver, A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. and Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria.

Mann, B.Q. and Pradervand, P. 2007. Declining catch per unit effort of an estuarine-dependant fish, *Rhabdosargus sarba* (Teleostei: Sparidae), in the marine environment following closure of the St Lucia Estuarine System, South Africa. *African Journal of Aquatic Sciences*, **32(2)**, 133-138.

Taljaard, S., Lemley, D.A. and Van Niekerk, L. 2022. A method to quantify water quality change in data limiting estuaries. *Estuarine Coastal and Shelf Science* **272**: 107888.

Turpie, J.K., Taljaard, S., Adams, J.B., Van Niekerk, L., Forbes, N., Weston, B., Huizinga, P., and Whitfield, A. 2012a. Methods for the determination of the Ecological Reserve for estuaries. Version

3. Water Research Commission and Department of Water Affairs, Pretoria. WRC Report No. 1930/2/14.

Turpie, J.K., Taljaard, S., Van Niekerk, L., Adams, J.B., Wooldridge, T., Cyrus, D.P., Clarke, B., and Forbes, N., 2012b. The Estuary Health Index: a standardised metric for use in estuary management and determination of ecological water requirements. WRC Report No. 1930/1/12.

Turpie, J.K., Wilson, G. and Van Niekerk, L. 2012c. National Biodiversity Assessment 2011: National Estuary Biodiversity Plan for South Africa. Anchor Environmental Consulting, Cape Town. Report produced for the Council for Scientific and Industrial Research and the South African National Biodiversity Institute.

Van Niekerk, L. and Turpie, J.K. (eds). 2012. National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research, Stellenbosch. Available at: http://bgis.sanbi.org/nba/project.asp.

Van Niekerk, L., Adams, J.B., James, N., Lamberth, S., Mackay, .F, Rajkaran, A., Turpie, J., Weerts, S., Whitfield, A.K. 2020. An estuary ecosystem classification that encompasses biogeography and a high diversity of types in support of protection and management. *African Journal of Aquatic Science* **45**, 199-216.

# 10 APPENDIX A: COMMENTS AND RESPONSE REGISTER

| No. | Section | Comment | From | Addressed? |
|---|---|---|---|---|
| 1. | Sec. 5.3.2 Pg 5-4 | **iNhlabane Estuary: The Estuary is in a protected area** - This protected area has been deproclaimed in the late '90's i.e. this is no longer a protected area. | S Bachoo | Noted and statement removed. |
| 2. | Sec. 6.3.1 Pg 6-5 | The uMlalazi Estuary is **partially** in a formally protected area | S Bachoo | Noted and captured as such in report. |
| 3. | Sec. 6.4.2 Pg 6-8 | **Implement controlled harvesting of *Juncus* and *Phragmites*** - his is already in place and is managed quite well. | S Bachoo | Noted and captured as such in report as intervention already instituted. |
| 4. | | … management of vehicle access at the mouth to minimise the disturbance to birds - This is extremely well-managed south of the estuary mouth - vehicle tracks there are primarily from management patrols. At the north bank (Port Durnford) outside oof the protected area - beach driving is an issue but there is a DFFE compliance presence managing this. | S Bachoo | Vehicles were seen disturbing birds during field visit. Indicated North Bank for management action. |
| 5. | | Manage and control fires of riparian vegetation to protect mangroves - This was a single isolated incident where a fisherman's fire ignited the polywood boardwalk and spread to the mangroves. The site is being monitored and mangrove regrowth is anticipated there. | S Bachoo | Text added to indicate that it was a once-off event. |
| 6. | Sec 7.4.2 Pg 7-5 | For this system, in particular it is important to include an assessment on mouth behaviour under different scenarios. The mouth (like the others in the area) has been tracking northwards along the beach. The concern here is that this will block off the only beach access available to residents and visitors along the entire Umlalazi Local Municipality. In addition - this site has the only operational boat launch site left - the ones at uThukela and aMatikulu have been closed down due to the mouth behaviour affecting those sites.<br>A mouth management plan may also have to be developed to manage the mouth migrating to the north. | S Bachoo | Text added to indicate that a Mouth Management Plan is needed and that it should include recommendations regarding submarine communication cable (which could impact on the open water area over time). |
| 7. | Exec sum Pg vi<br>Sec 2.3 Pg 2-7 | **However, based on anecdotal evidence and photographic imagery the various abiotic and biotic components of the system is estimated to be between D and E Category due to flow reduction** - In my opinion, this sentence is subjective in a view that the classification for the estuary has been determined based on anecdotal evidence. If this is the case, then it creates precedence to classify estuaries in the future. And poor support for scientific evaluation of the ecological consequences to determine the correct category for the system e.g., uMlalazi Estuary, but this approach is rather unsystematic to classify St Lucia estuary where anecdotal evidence seems to be sufficient to classify a reserve. | R Cedras | Agreed. Text reworded to indicate that the primary source for the Classification study would be DWS 2016 which states that the estuary is in a D.<br><br>The St Lucia/uMfolozi Present Ecological State (PES) was not updated as part of this study as there was no new investment in the surveying and monitoring of the Greater St Lucia Estuarine Lake system. Funds are at present being secured by iSimangaliso Wetland Park to address critical information gaps need to guide the assessment of condition and management actions. In 2016 the St Lucia/uMfolozi PES was estimated as a D (DWS 2016) and this will form the basis of the classification process. However, based on measurements and photographic imagery provided to the St Lucia Estuary Task Team over the last two years the various abiotic and biotic components of the |

| No. | Section | Comment | From | Addressed? |
|---|---|---|---|---|
| | | | | system are likely varying between D and E Category depending mouth state due to flow reduction, reduced connectivity, high sediment input (especially from the uMfolozi river), nutrient pollution (with a focus on the uMfolozi and Mkuze rivers), artificial breaching, illegal catches (gill netting), and significant land-use change in the flood plain of the larger system. The system is currently on a trajectory of change, i.e. ecological condition not stable, and while the mouth have been open for an extended period, little salt water has entered the system and significant deposits of fine muds/silts have formed in The Narrows near the mouth of the system. Some of the elements of the estuary ecosystem that have been negatively affected include: physical habitat (significant increase in fine sediments in The Narrows), water quality (low salinity and high turbidity); macrophytes (die-off of mangroves), invertebrates and fish (dominated by freshwater species) (Issues raised in St Lucia Task Team discussions). |
| 8. | Exec sum Pg vi<br>Sec 2.3 Pg 2-7 | Funds are at present being secured - That is not the reason that was given to DWS initially why these systems were not addressed. it was stated by L v Niekerk that additional work was not done since no changes from the previous scenarios and status of the system was evident? To which DWS expressed their concern at the last PMC meeting. Refer to the minutes. A PES of a D to E Is a matter of great concern especially in the proclaimed Ramsar and heritage sites. This study is also to advise a ministerial study related to the operational plan for managing the St Lucia and Umfolozi estuarine mouth. It was stated that some investigation is going to be done by the specialists to work in some additional work/results etc and that some recommendation related to the future operations and management of the systems will be proposed. **NOLU WORK THAT PEACE IN THAT WAS STATED IN THE MINUTES OF THE PMC** ...**B Category is achievable in the long-term** - See comment above what was the PES then?? The system has definitely been significantly degraded since the 2016 study. | B Weston | Text reworded (see above).<br><br>It was indicated in the meetings that the PES could not be updated as no new field data have been collected on St Lucia since the GEF study.<br><br>Text was included to reflect concerns raised by St Lucia Task team regarding trajectory. |
| 9. | | **The DWS (2016) overarching Recommended Ecological Category (REC) recommendation is 'Best Attainable State' of a B/C (~72) with a B Category is achievable in the long-term** - For what overall or are you referring to the St Lucia Mouth define since there are a number of ecological system involved here (i.e. rivers, swamps, Lakes, wetlands, groundwater, estuaries. | B Weston | DWS (2016) clearly refers to the Greater St Lucia/ uMfolozi system. This document also refers to the The St Lucia/uMfolozi system as one. |
| 10. | | **Future development scenarios need to be screened against these flow requirements** - and this is what I thought that this current study is going to do, is to evaluate additional scenarios taking the ministerial advisory panels comments into consideration. | B Weston | As indicated in the proposal and inception report, scenarios for St Lucia falls outside of the scope of this study due to it being addressed through a wider forum consisting of various government departments. The Consultant can only use the information in terms of the REC as recommended by the DFFE task team and provide broad RQOs for this. Furthermore, a scenario selection process was followed with DWS and the |

| No. | Section | Comment | From | Addressed? |
|---|---|---|---|---|
| | | | | PSC in 2022. No scenarios were raised for the estuary, probably due to DFFE task team deliberations and planning underway. |
| 11. | | The Ramsar fact sheet should also be taken into consideration as to what the requirements are of the St Lucia as a Ramsar site, and those should be quantified in terms of RQO's or targets against which monitoring, compliance and enforcement should take place. The latter should be built into the St Lucia Estuarine Management Plan. | B Weston | Ramsar requirements can be included in RQO report. DWS 2016 requirements are higher. |
| 12. | | **In addition to ensuring the required water quantity and quality, a range of non-flow interventions is needed to improve the system to a B Category over time** - The latter should be specified as part of this study, and the action plan to be drafted by the DFFE minister's specialist task team for managing the St Lucia mouth. | B Weston | Non-flow interventions now included:<br><br>Non-Flow interventions include to address ecological concerns include (D.W.S., 2016): a) St Lucia/uMfolozi should have a single mouth and with no manipulation of the mouth (artificial breaching or closing); b) Restore low-lying areas of the uMfolozi floodplain to natural vegetation to allow for natural processes (e.g. carbon sequestration, mouth closure) c) Remove alien vegetation around the Lake, estuaries and rivers; d) Limit further natural deforestation such as in the Dukuduku Forest; e) Eradicate illegal gillnetting from the system; f) Eradicate and monitor occurrence of alien invasive species (plants, invertebrates and fish); g) Prevent urbanization in the catchments feeding directly into the Lake and the Narrows; h) Reduce commercial forestation in the lake catchments to increase low flows as much as possible; i) In the uMfolozi River catchment, land care practices should focus on the most critical sub-catchment areas to limit future erosion and land degradation which could further reduce low flows; j) Illegal river abstractions on especially the Mkuze and uMfolozi Rivers must be eliminated. Note, ecological recommendations regarding mouth state is currently be reevaluated by management due to social reasons at the recommendation of the (DFFE) Ministerial Panel of Independent Experts. |
| 13. | Exec sum Results Pg v | Link al the estuarine descriptions below to a figure pls so that the location in context of the study area is provided. | B Weston | Text added to maps to indicate locations. |
| 14. | Exec sum Pg xiii | uMlalazi Sc descriptions:<br>Sc1: You need to clarify what is taken into account when you refer to climate changes as a scenario, what does it mean/ what are the implications?<br>Sc4: From where and with how much?<br>Sc 5: Is the word demand understood correctly here? is the demand referring to the additional water that is required from the system to fill up the dam first pls clarify this scenario and the impact on the system?<br>Sc 8: Are these actual demands and realistic scenarios? | B Weston | Scenario detail provided in Scenario report. |

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| 15. | Exec sum Pg xiv Sec 7.3 | iSiyaya Estuary:<br>How is a C possible if the PES is a D/E and the importance is low then the REC is a D and this would most likely also be the BAS due the current bad state of the system?<br>There is a difference between the logic of allocating the REC to the estuary or the BAS. Often the BAS is not the same as the REC of PES it could be inbetween or it can be the minimum which is a D. | B Weston | iSiyaya Estuary is a small system and highly responsive to interventions. Taking the current conditions, the degree to which non-flow intervention have impacted the system (Table 7.1), the reversibility of the many of the impacts (e.g. impact of high turbidity runoff from mining site and removal of organic sludge), the ecological importance and the conservation requirements of the iSiyaya Estuary into account, the REC for the system is a C Category.<br>Table 7.1 shows that the system can increase by 20% with non-flow interventions. |
| 16. | Exec sum Pg x | uMhlatuze Estuary Sc description:<br>2030 Development - Are these realistic did you speak to Kobus Bester? | B Weston | Scenario detail provided in Scenario report. |
| 17. | General | I suggest that the results of the St Lucia estuary should also be included in this report as we don't have a choice since this water resource is currently under the magnifying glass. The estuarine specialist did indicate that they will use the 2016 results and run some current scenarios and assess the risk and impacts to allow for management recommendation and eco specs to be set that would be gazetted. There is NO WAY that due to the significant importance of this water resource the Umzidozi, Umfolozi and the St Lucia can be skimmed over. | B Weston | Text added to clarify.<br><br>RQO report will reflect St Lucia requirements as stated in DWS (2016).<br><br>See previous response to comment 10. To reiterate, St Lucia is not being glossed over. As stated in the inception report (and therefore contract), information supplied by the ministerial committee will be used in terms of providing a TEC for St Lucia that matches the aspirations of the work being undertaken by various government departments. The TEC (as a phased approach as requested by DWS) has been set (see next report) and broad RQOs will be set to achieve this. The reason for broad RQOs is that detail required to set management plans is outside of our contractual obligations and would require detail studies involving a range of government departments. |
| 18. | Sec 2.3 Pg 2-7 | **The St Lucia/uMfolozi PES was not updated as part of this study as there was no new investment in the surveying and monitoring of the Great St Lucia Estuarine Lake system** - What was the PES from the 2016 study? Why was that not utilised as is if a new study could not be done? Or, why not update using the methods that were utilised for the NBA national assessment?<br>Anecdotal - What does this mean? It does not sound right for the determination of a PES, and if cannot be referenced. | N. Jafta | Text rephrased to clearly show that DWS (2016) Study results will form the basis of the Classification. The NBA 2018 maintained the D Category for the system.<br><br>Text has also been added to clearly indicated where trajectory of change has occurred.<br><br>'The system is currently on a trajectory of change, i.e. condition not stable, and while the mouth have been open for an extended period, little salt water has entered system and significant deposits of fine muds/silts have formed in The Narrows. Some of the elements of the estuary ecosystem that have been negatively affected include: physical habitat (significant increase in fine sediments in The Narrows), water quality (low salinity and high turbidity); macrophytes (die-off of |

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| | | | | mangroves), invertebrates and fish (dominated by freshwater species). |
| 19. | | ...various abiotic and biotic components of the system is estimated to be between D and E Category - Various? Can these not be presented maybe in table form? What is the combined PES? | N. Jafta | Text has also been added to clearly indicated where trajectory of change has occurred. |
| 20. | | ▪ Cap minimum discharge in the Mfolozi at 3 $m^3/s$ to maintain an open mouth.<br>▪ Ensure a **combined Mfolozi/Mkuze** drought discharge of 5 $m^3/s$ (including an additional 1.6 $m^3/s$ in Mkuze).<br>Should these not have been converted to scenarios?<br>**combined Mfolozi/Mkuze** - So no indication of how much should come from where? Or will it be up to the implementers? | N. Jafta | As the REC has been established, operational scenarios would not be applicable. A management plan to achieve these scenarios must be established and that is the work of a range of government scenarios. The consultant's role is limited to providing RQO indicators of the changes required to components of the estuary that will need to be addressed to achieve the REC. |
| 21. | Sec 2.3<br>Pg 2-8 | C category - Is this the REC or PES? | N. Jafta | REC = C<br><br>Text added to clarify:<br><br>The DWS (2016) EWR report clearly states that the total present flow from both the Mfolozi and the St Lucia rivers are needed to achieve the REC, i.e. any flow scenario that would involve flow reduction from the Present will not meet the REC. Less than 1% change can be made to Mfolozi flows, but that flow needs to be reallocated to the EWR of the St Lucia Rivers to ensure that the system attains in a C category (and does not decline during droughts). In addition to ensuring the required water quantity and quality, a range of non-flow interventions is needed to improve the system to a B/C in the short term and to a B in the long term. Note, that the DWS (2016) highlights that the system is very sensitive to Climate Change and that flow and non-flow interventions are urgently needed to increase resilience to droughts. |
| 22. | | Future development scenarios need to be screened against these flow requirements to see if they meet the minimum set above - So this was not done? And there was no linkage done with the river parts?<br>Should there not have been a present day vs possible future scenarios? They don't need to be reduction of water scenarios. It could be to show the climate change if things are left as they are. Other examples, it could be increased releases or something from Mfolozi, or a combination of Mfolozi, Mkhuze, Hluhluwe (if there is a slight possibility). It could be, for example, big companies implementing buffers for afforestation, removing strips of the plants, (I don't even know if this is possible, it's an example, but if it has been quantified then maybe it can assist Isimangaliso to go negotiate with the Sappis and Mondis). Just thoughts. | N. Jafta | No Scenarios were assessed as part of the estuary assessment. The recommendations to achieve the required flows will be provided in the Implementation Report.<br><br>DWS (2016) indicate that the estuary is very sensitive to Climate Change. Text has been added to reflect this and why it is needed to increase the drought flows. Text also clearly reflect that St Lucia needs all flow – no further reduction can occur. Implementation plan needs to reflect what flows are needed to meet baseflow requirements.<br><br>Studies have been undertaken by Isimangaliso regarding links to the rivers. Due to the lack of large dams, St Lucia cannot be operated by dams or dam releases. Changes required to St |

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| | | | | Lucia are physical interventions in the estuary and then very broad catchment issues such as sedimentation. We have various RUs which have been included as part of the St Lucia IUA. These are all small rivers - some drainage lines and no operation is possible, and therefore, no scenarios are possible. It has been clearly stated that these rivers' requirements (as well as the lower section of the larger rivers) will be based on St Lucia's requirements as it overrides those of the lower rivers in terms of importance. |
| 23. | | In addition to ensuring the required water quantity and quality, a range of non-flow interventions is needed to improve the system to a B Category over time - Could these not have been unpacked? Similar to the other estuaries in this report? | N. Jafta | Non-flow interventions have been listed (see above). |
| 24. | Sec 3.4.2 Pg 3-7 | **Sc 1 in conjunction with several management interventions is the recommended ecological flow scenario**.<br>Are there any practical suggestions on how the increase in baseflows could be done? Looking at the catchment, the land use is mainly rural and sugarcane, with scattered pockets of afforestation. DWS does not have legal authority to regulate dryland sugarcane (it would have to be voluntary). Similarly, if the forestry occurred before the National Water Act (1998), it could be an existing lawful use, if after, it could be licenced. And looking at WARMS it seems there's quite a lot of registered HDI plantations?<br>Also, which arm/tributary of the Amatigulu/Nyoni could possibly be targeted to bring improvement to the baseflows? Matigulu, Nyoni, Nyezane? | N. Jafta | Text added to show: Flows can be restored from any of the catchments through evaluating current lawful use, a reduction in forestry and removal of aliens. |
| 25. | | **Increase base flows to prevent mouth closure for periods longer than six to eight weeks and also prevent the water levels from going beyond 4 m MSL.**<br>Present day is 113.77 $Mm^3$, scenario 1 requires 125.65 $Mm^3$. Which interventions could assist in availing the additional 11.8 8$Mm^3$? Also considering the CC?<br>Is the idea that there should be dredging if levels go beyond 4 m? | N. Jafta | No dredging is not recommended in a protected area. Text added to clarify that high berm levels are also an indication of long closures. |
| 26. | | Other recommendations - Would these contribute to biota, habitat, water quality improvements as well as bring in the required baseflows? Or something else needs to be done in the catchment? | N. Jafta | Other recommendation relates to water quality and reducing sediment input as indicated in text. |
| 27. | Sec 5.4 Pg 5-6 | Increase freshwater runoff through management/removal of wood lots - Are these unlawful? Are these HDIs? | N. Jafta | Specialist team do not know the extent to which the smaller wood lots are lawful. Hence the need for a research project/investigation. |
| 28. | | The 'recommended Ecological Flow Requirement' scenario, is defined as the flow scenario (or a slight modification thereof to address low-scoring components) that represents the highest change in river inflow that will still maintain the estuary in the REC. Where any component of the health score is less than 40, then modifications to flow and measures to address anthropogenic | N. Jafta | Repetition deleted from document. |

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| | | impacts must be found that will rectify this - This could have been said once, under methods. It is repeated under every estuary. | | |
| 29. | Table 5.6 Pg 5-5 | Sc 3 – Restoration of flow – How much? | N. Jafta | Added (+15%). |
| 30. | Sec 6.1 Pg 6-1 | 50 km south of Durban - South? And are the km correct? Or this should be Richard's Bay? | N. Jafta | Text changed to Richards Bay. |
| 31. | Sec 6.3.1 Pg 6-3 | red data species - Critically endangered? Vulnerable? Etc. Is it fish or? | N. Jafta | Text added to indicate Bird species. |
| 32. | Sec 6.4.2 Pg 6-6 | The **small improvement in baseflows and water quality** - So this small improvement will be from implementing the above? And thus not in contrast to the statement that said "no effort is made to improve baseflows or water quality"? Maybe this no effort vs. small improvement should be elaborated on a bit. E.g. "Even though there will be no effort but the habitat interventions will yield an increase in baseflows". | N. Jafta | Text added to indicate that while not a requirement of the scenario, removal of alien vegetation could benefit baseflows and thus assist with decreasing occurrence of mouth closure. |
| 33. | Sec 7.4.2 Pg 7-5 | For the iSiyaya Estuary, only Sc 3 ensured a significant improvement towards achieving the REC of a C Category:<br>But the table indicates a D Category? | N. Jafta | iSiyaya Estuary is a small system and highly responsive to interventions. Taking the current conditions, the degree to which non-flow intervention have impacted the system (Table 7.1), the reversibility of the many of the impacts (e.g. impact of high turbidity runoff from mining site and removal of organic sludge), the ecological importance and the conservation requirements of the iSiyaya Estuary into account, the REC for the system is a C Category.<br><br>Table 7.1 show that the system can increase by 20% with non-flow interventions. |
| 34. | | Ecosystem-based adaptation restoration project is needed to restore the iSiyaya Estuary's functionality to a Category C - It looks like there needs to be another scenario. | N. Jafta | |
| 35. | General | There is a lot of repetition of information that could have formed part of the approach/method once. Please streamline. | N. Jafta | Repetition removed. |
| 36. | Sec 2.1 Pg 2-2 | In 2013, an unofficial Version 3 - Why is this version unofficial? | M. Sekoele | Version 3 was never signed off by DWS. Thus, not official. The scoring system for biology was never tested on small KZN systems and thus not supported by wider EWR community of practice. Elements of the Version 3 approach, e.g. WQ, has been refined and published in scientific peer review journals to validate. |
| 37. | Sec 2.3 Pg 2-7 | Funds are at present being secured to address this critical gap - In which study is the gap going to be addressed? | M. Sekoele | Funds being secured to address gap in monitoring and baseline information to evaluate state. |
| 38. | Chapter 3 | Amatigulu/iNyoni estuary – Scenario 1 calls for an increase in the MAR by 15%. This may be a challenge for the Region to implement a full 15% increase in MAR, especially if this would require a curtailment of allocated water. What other actions, other than curtailment of water use could be implemented to bring about the 15% increase in MAR bearing in mind that the climate change scenario further reduces the Present Day MAR from 113.77 X $10^6$ $m^3$ to 94.79 X $10^6$ $m^3$. Climate change will impact the study area and the climate change | R. Pillay | This report only provides consequences. The decision on whether the REC is achievable forms part of the next report – the Water Resources Classes report: Classification of Significant Water Resources and Determination of Resource Quality Objectives for Water Resources in the Usutu to Mhlathuze Catchments: **Water Resource Classes Report.** |

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| | | scenario can change over time as more information is made available and depending on the greenhouse gas emission scenarios. Scenario 5 relates to non-flow interventions which would maintain the Present Day MAR. The REC of a B category would be a challenge (especially as it involves increasing MAR which may be a challenge considering climate change) and cannot be achieved in the short to medium term. A B/C category with a longer term goal of improving the system to a B category is feasible and would allow for better planning and collaboration with other Departments and institutions to achieve this. Achieving an REC of a B category in the next 5 or so years will be very challenging. | | Prepared by: WRP Consulting Engineers (Pty) Ltd. DWS Report: WEM/WMA3/4/00/CON/CLA/0523. |
| 39. | Chapter 4 | uMhlatuze estuary – It is understood from the Report that the REC for this estuary is a D category. | R. Pillay | Correct – it has been divided in half. Cannot improve it to a C or B. |
| 40. | Chapter 5 | Inhlabane estuary – It is acknowledged that the REC for this estuary is a D category and is based upon a restoration scenario. It is further noted that a combination of non-flow and flow related impacts have degraded this system. It is noted in the report that significant flow reduction arising from the impoundment by the weir has prevented connectivity of the estuary with the marine environment. Is Scenario 1 (restoration of flow) based solely on maintaining the weir so that there is connectivity of the estuary with the sea or does this include an increase in flow? One of the interventions proposed is to *"Increase freshwater runoff through the management/removal of wood lots"* - This will need further investigation by the Regional office as to whether this could be achieved. Some of the interventions identified requires collaboration with other Departments and institutions and as such improvement from the PES of an E category to the REC of a D category is dependent on institutions/departments outside of the Department and commitment would have to be sought from these organisations. | R. Pillay | Refer to comment 38. |
| 41. | Chapter 6 | Umlalazi estuary – removal of sugarcane within the 5 m contour would have to investigated by the Region going forward to establish if this was authorized or not. If it is authorized then it would provide additional challenges in terms of its removal but this would have to be investigated further. Scenario 7 is based on non-flow related interventions which again requires commitment from other Departments/institutions including the Department to improve the PES from a B/C category to a B category. To further improve from a low B to a higher B category, the specialist has recommended that no further wastewater be discharged to the system – this will require engagement with the municipality to explore alternate wastewater options as well as increasing baseflows to prevent mouth closure (of at least > 0.3$m^3$/s). | R. Pillay | Agree. |
| 42. | Chapter 7 | Isiyaya estuary – The PES is a D/E category, and the specialist has proposed an REC of a C category. The REC of a C category would be a challenge (especially as it involves increasing the baseflows) and is likely not possible to achieve in the short to medium term. A D category with a longer-term goal of improving the system to a C category is preferred. This would require extension planning and collaboration with other Departments and institutions to achieve | R. Pillay | Comment noted on 'D category with a longer-term goal of improving the system to a C category is preferred' for **Water Resource Classes Report** – refer to comment 38 for report reference. |

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| | | this. If baseflows could not be achieved, would the implementation of the Ecosystem-based adaptation only as highlighted under point 1 (page 7-6) be able to improve the system to a category C. The longer term-catchment to coast approach especially around removing forestry around the estuary would need further investigation and would be a much longer process to implement. | | |
| 43. | | Lake St Lucia – the approach of incremental improvement from a D to C to B category is supported and would allow for long term planning amongst institutions and Departments to secure funds, etc. to improve the ecological category. | R. Pillay | Comment noted for **Water Resource Classes Report** – refer to comment 38 for report reference. |
| 44. | | For the improvement of baseflows and increases in MAR, even incremental measures taken may not yield the required results in view of climate change impacts. The climate change scenarios presented show a reduction in MAR. | M. Maharaj | Climate Change Impacts are a concern. Baseflows need to ensure mouth state and estuary flushing. |
| 45. | | For St. Lucia, the DWS (2016) EWR Report states that the "Total Present flow from both the Mfolozi and St Lucia rivers are needed to achieve the REC and that any flow scenario that involves a flow reduction from the Present will not meet the REC.". The implications of this being that DWS can no longer authorize further allocations from this system? Will this system have to be prioritized for compulsory licencing? Doe the combined Mfolozi/Mkuze drought discharge of 5 $m^3/s$ inclusive of the 1.6 $m^3/s$ in the Mkuze? Has this information been shared with the Richards Bay Recon study team? | M. Maharaj | Comments noted for Implementation Report.<br><br>DWS (2016) in public domain and departmental report. |
| 46. | Chapter 3 | aMatigulu/Inyoni estuary: Due to the uncertainty around climate change and runoff, it is proposed to sustain the ecological category of a B/C supported through Scenario 5. Based on the climate change scenario, MAR is set to further reduce from 113.77 x $10^6$ m3 to 94.79 x $10^6$ $m^3$. There are also existing demands in this catchment where water has already been allocated. The report refers to restoration being required in the floodplain up to the 5m MSL contour – please delineate the extent. | M. Maharaj | Comment noted for **Water Resource Classes Report** – refer to comment 38 for report reference. |
| 47. | Chapter 4 | uMhlatuze estuary: DWS are able to regulate activities however, the proposal to increase MAR by 15% is concerning. In order to meet current demands, water is pumped from the Tugela to Goedertrouw Dam. There is no room to release additional water (except under storm events) to meet the required flows as this water is used by the users in the catchment. | M. Maharaj | Recommended scenario from an ecological perspective is increased flow by 15%. However, both 2030 and 2040 development scenarios will maintain Category D.<br><br>Comment noted for **Water Resource Classes Report** – refer to comment 38 for report reference. |
| 48. | Chapter 5 | iHnhlabane estuary: Who is the owner of the weir? Is it possible to quantify the extent of the woodlots that need to be removed and how significant would their removal be on the hydrology of the system. Are these woodlots community-based woodlots? Community based woodlots are a source of income and removal would be a sensitive matter. | M. Maharaj | Awaiting feedback from DWS on weir. Operations and ownership.<br><br>Uncertainty around wood lots, thus the recommendation that a small study be conducted on their extend impact and control. |
| 49. | Chapter 6 | uMlalazi estuary: Scenario 7 (non-flow interventions) is supported. It is understood that the implementation of these interventions would boost the system to a low category B. This can be enhanced with relatively small improvement to baseflows and an improvement in the water quality. | M. Maharaj | Comment noted for **Water Resource Classes Report** – refer to comment 38 for report reference. |

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| 50. | Chapter 7 | iSiyaya estuary: Climate change (scenario 3) has shown a likely decrease in MAR. Even if interventions are in place improve baseflows this would be off-set by climate change scenarios. The implementation of measures to improve baseflow will need to be looked at against the potential reduction in MAR under the climate change scenario. The forestry in the Estuary Functional Zone will need to be investigated further by the region. Please geolocate and demarcate the extent of the forestry. | M. Maharaj | Baseflows need to be elevated and protected to ensure resilience against climate change. Users and estuary should carry the burden of climate change. |
| 51. | Exec sum Pg iv | St Lucia - …connectivity, high sediment input, pollution, artificial breaching, illegal catches (gill netting), and... - Except for the illegal gill netting, what is the state of the ichthyofauna in the system? | M. Dopolo | Ichthyofauna at present largely comprise freshwater species of fish as system is currently fresh. |
| 52. | Sec 4.4.2 Pg 4-6 | Reduce **very high fishing pressure** (poaching and **illegal gillnetting**) by increasing compliance.<br>It would be helpful to know the current state of fishing, be explicit about the desired state; and establish if that is sound and resonate with stakeholders. Can we not conduct a study to explore possible zonation within the system to allow gillnet fishing in areas less sensitive (limited bycatch). We don't need another Dwesa-Cwebe scenario of antagonism between rangers and fishermen | M. Dopolo | The system under very high fishing pressure as a result of illegal gillnetting. Information on confiscated nets and what they catch shared by Ezemvelo KZN Wildlife and SAPS with DFFE Branch: Fisheries. No recreational fishing as a result of no access through the port and high level of illegal activity.<br><br>Request for increase compliance was raises by the management authority of the protected area. To protect nursery function gill netting is not allowed in any estuary in South Africa accept Olifants to protect biodiversity but also assist with stock recovery of economic species fished in the sea. Unlike recreational fishing which is selective, gill netting is not selective and take out all types of fish, e.g. Zambezi's and Sawfish (that used to frequent this estuary but are now extinct from SA waters). Gillnetting also impacts on birds, reptiles and even mammals. It is not compatible with management objectives of a PA. This is why study recommends bird guides as alternative livelihoods project. |
| 53. | Sec 4.4.2 Pg 4-7 | Declining water quality, especially in **Mzingazi** and…<br>Regular maintenance and servicing of Lakes Chubu and Mzingazi is critical in ensuring freshwater flows reach the estuary. | Y. Galada | Agree. |
| 54. | Sec 6.3.1 Pg 6-3 | in turn, is based on the assessment of the importance of the estuary for plants, invertebrates, fish and birds, using rarity indices. The scores have been determined for all South African estuaries (DWAF 2008; Turpie *et. al.,* 2012b… Study might need to be updated. 2012 is about 10 years ago, esp in light of rapid changing environment. | M. Dopolo | Agree, Importance rating needs update. Best available information was used for this study. Botanical importance data updated using National Blue Carbon study. |
| 55. | Exec sum Sec 2.3 Pg 2-7 | Funds are at present being secured to address this critical **gap**. Addressed by who, DWS or a combination? | B. Madikizela | The consultant is not in the position to query funding sources. |
| 56. | | Ensure a combined Mfolozi/**Mkuze** drought discharge of 5 $m^3/s$ (including an additional 1.6 $m^3/s$ in Mkuze). Mkuze or uMsunduzi? | B. Madikizela | Mkuze. |
| 57. | Sec 2.1 Pg 2-5 | Step 3b: Determine the **Estuary Importance Score (EIS) –** with reference to the footnote - Is this related to the table above and acronyms or an error? | B. Madikizela | Not related to the table above. See foot note. |

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| 58. | Sec 2.1<br>Pg 2-6 | Nevertheless, the paucity of historical data on the system meant that we expected the confidence of the study to be **low**. While this is true (DFFE, Panel report, most recent, perhaps?), when are we ging to include data sampling in a study to build up confidence, we cannot continue spending on undecisive reports, what's the value of such reports? | B. Madikizela | The statement on the relationship between lack of data and confidence is an overarching statement applicable to all EWR studies. If no investment has been made in the collection of long-term data sets, estuary scientist cannot grantee that once-off, or even winter/summer, sampling will result in a high/medium confidence if the system is complex. Critical national estuary datasets are more than 30 years old. The EWR process requires specialists to indicate how confident they are in the assessment. |
| 59. | Sec 2.3, par 3<br>Pg 2-7 | Most important system to mention is uMsunduzi and court ruling favouring its reunion with St Lucia. This system's water flow cut (before court ruling) is massive! | B. Madikizela | Noted. The EWR study combines the flows from all the St Lucia rivers (5) and all the flow into uMfolozi. The uMsunduzi does not get its own PES. It is integrated into the larger system as it a small flow input. Comment will be added to the RQO Report. |
| 60. | Fig 3.1<br>Pg 3-1 | Which River is Nyoni and which is Matigulu. Pls label Figure 3.1. | B. Madikizela | Map modified to show locations. |
| 61. | Table 3.1<br>Pg 3-2 | For all these tables, pls provide that data to the DWS. This must apply to all NWRCS, etc. | B. Madikizela | Assumptions and data will be provided. |
| 62. | Section 3.3.1<br>Pg 3-4 | that 50 % of the estuary margin be undeveloped - There is a Buffer zone determination/maintenance set of guidelines, one can scientifically base the buffering from that report-TT715: Part 1&2. | B. Madikizela | Recommendations taken from NBA 2012 report. It does not state a buffer, but that 50% of margin not be developed with the Estuary Management Plan to determine the practical extent trough stakeholder consultation. |
| 63. | Section 3.3.2<br>Pg 3-4 | The Present Ecological State (PES) sets the minimum **REC** - These are two separate concepts, really. It creates confusion when PES is equal to REC at some undefined level. PES is just PES, while REC is the desired, therefore futuristic. | B. Madikizela | Text added to clarify that the PES sets the minimum category. The Chapter 2: Approach and Method explains the steps. |
| 64. | Section 4.1<br>Pg 4-1 | Same comment as earlier, please add labelling to help the reader. | B. Madikizela | Map modified to show locations. |
| 65. | Section 4.1<br>Pg 4-2 | Loss of connectivity between the different four parts of the system, Lake Mzingazi, Lake Chubu, Richards Bay and uMhlatuze Estuary. - Please show on figure 4.1. | B. Madikizela | Map modified to show locations. |
| 66. | Section 4.3.2<br>Pg 4-4 | The first step is to determine the **'minimum** ' Ecological Category based on its PES - These brackets say something? | B. Madikizela | Text added to clarify that is the minimum condition below which the system should not decline. |
| 67. | Section 5.4.2<br>Pg 5-6 | ecosystem-based adaptation - Can you add examples of this? | B. Madikizela | Text below indicates what actions this will entail for this system. We do not have a good example for estuaries. |
| 68. | Figure 7.1<br>Pg 7-1 | Labelling on figure please. | B. Madikizela | Map modified to show locations. |
| 69. | Sec 8, par 2<br>Pg 8-1 | **the government** … - Gov must lead the Partnership with Pvt Sector and Society, then you have a sustainable Restoration efforts/future! | B. Madikizela | Text added to reflect this.<br><br>However, this will only be possible if all parties agree on the need for estuary improvement and commit to restoration, e.g., from restoration of baseflows to improved compliance with living resources. It will require not only compliance with legislation, |

| No. | Section | Comment | From | Addressed? |
|---|---|---|---|---|
| | | | | but also implementation of best practices, and education and awareness among communities and stakeholders. |
| 70. | Sec 8, par 3 Pg 8-1 | …halting human-induced extinction of threatened species - True, but should go as say find alternative food security options for livelihood of marginalized communities. | B. Madikizela | Noted. |
| 71. | Sec 8, par 6 Pg 8-1 | If South Africa cannot commit to restoring estuaries currently under formal protection this needs to be formally communicated and agreed upon by relevant lead agencies as policy; so general guidelines and planning frameworks such as the National Estuaries Protocol can be adapted to reflect this. - True, but politically flawed. | B. Madikizela | Noted. |