SITUATION ASSESSMENT REPORT (SAR) AS PART OF THE ESTUARY MANAGEMENT PLAN FOR St LUCIA ESTUARY WITHIN

ISIMANGALISO WETLAND PARK

COMPILED IN TERMS OF THE NATIONAL ESTUARINE MANAGEMENT PROTOCOL (2021) & THE NATIONAL ENVIRONMENTAL MANAGEMENT: INTERGRATED COASTAL MANAGEMENT ACT (ICMA, ACT 24 OF 2008)

SAR-Scoping phase

09 December 2022

Preface – Summary of the Situational Assessment Report

Anthropogenic impacts are escalating in estuaries worldwide because of increasing population growth and associated land-use alteration in adjacent coastal watersheds and the broader catchments. Establishing estuarine health and the system's response to catchment activities is complex, although many of the more extreme symptoms such as algal blooms and fish kills are by now well known. More difficulty is encountered when trying to understand the vulnerability of estuaries and the rate at which they respond to both improvements and deteriorations in catchment influences. This Estuary Management Plan (EstMP) provides a framework for coordinated conservation planning. It is anticipated that through time, most estuaries will be under increasing pressures from recreational and commercial uses, which, if not carefully managed, could lead to the degradation of the natural resources upon which many people directly or indirectly rely. This EstMP should be seen as an active working document, to be reviewed on an ongoing basis to encourage current best practise - potentially based on the precautionary principle and/or current best knowledge, adapting to changes and opportunities, and evolving day by day with the living processes of the estuary, the local community, conservation, environmental management practices and best available scientific knowledge.

In line with the National Estuarine Management Protocol published in terms of section 33(2) of the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) (ICMA), the iSimangaliso Authority has developed an EstMP for each of the three estuaries within the iSimangaliso Wetland Park. This EstMP is based on the current environmental situation (biophysical and socio-economic aspects included) of the Lake St Lucia Estuary as described in the Situation Assessment Report (MER, 2016). The iSimangaliso Wetland Park has three major estuary systems, namely Lake St Lucia, Mgobozeleni and Kosi Bay, all of which are categorised as Estuarine Lake estuary types and which fall within the boundaries of the iSimangaliso Wetland Park World Heritage Site. The Lake St Lucia Estuary is situated on the Mozambique coastal plain in the uMkhanyakude District Municipality. It is one of the rarer types being classified as an estuarine lake on the basis of its size and other physical features including the relative extent of tidal influence (Whitfield & Baliwe, 2013). The Lake St Lucia Estuary begins approximately 200 km north of Durban and stretches for a further 90 km parallel to the coastline. The upper estuary, comprised of a lake component, consisting of South Lake, North Lake and False Bay, lies to the north of a channel, generally referred to as the Narrows, which is approximately 20 km long and links the system to the sea when the mouth is open. The lake is roughly H-shaped with a maximum length of approximately 40 km and a maximum width

of approximately 20 km. The area of the Lakes and Narrows will vary with water depth but a generally accepted figure is 620 ha being the extent of the EFZ. For the purposes of this EstMP, the geographical boundaries of the Lake St Lucia Estuary are defined by the 5 m topographical contour and the area within this boundary is known as the Estuarine Functional Zone (EFZ).

The estuary falls within the sub-tropical region and this determines the nature of the plants and animals which are found within its boundaries. In addition, the geology of the area in which this estuary is situated determines the nature of its catchments. The mouth of the Lake St Lucia is dynamic and migrates northward with longshore drift. Historically, mouth dynamics in terms of closure and position between Maphelane in the south and the St Lucia high ground to the north were driven by the interaction between flow levels in the uMfolozi River and wave induced marine sediment movements. A long history of river diversion (uMfolozi River) and artificial breaching has occurred and this has influenced strongly the physical state of the estuary. The policy of diverting the uMfolozi River to sea which was initiated in 1952 was changed by the iSimangaliso Authority sixty years later in 2011/2012. An active relinking of the uMfolozi River with the St Lucia Estuary occurred in July 2012 and this began the process of restoring estuarine function. The uMfolozi River migrates naturally northwards to link with the estuary. Previously artificial breaching would pull the river back southwards by diverting it to sea in the vicinity of Maphelane. To ensure continued restoration, diversion of the uMfolozi River and artificial breaching of the estuary will be carried out in the future only in accordance with approved breaching guidelines which has to consider ecological as well as socio-economic indicators, in line with the recommendations Panel of Experts Report on the St Lucia Estuary Mouth. The active facilitation of the re-joining of the uMfolozi River with the St Lucia system has been implemented by the removal of the dredge spoil that has been deposited in the vicinity of the estuary mouth in combination with the complete cessation of mouth interference, save for situations where the ecological and socio-economic factors compel such action of artificial breaching be undertaken.

The most biologically significant water quality parameters in the Lakes, Narrows and the uMfolozi-Msunduzi complex under present conditions are salinity, turbidity and, to a lesser degree, temperature. All these parameters undergo large temporal and spatial fluctuations in response to rainfall and other environmental factors. These fluctuations move the estuary through many different states e.g., from freshwater through to very saline and it is this that drives the diversity of the biological components of the Estuary. The Lake St Lucia estuarine system is the most important nursery ground for juvenile marine fish and prawns along the sub-tropical east coast. It is also the most important estuary in terms of the numbers and diversity of water birds, which it supports. The estuary is a very important staging

area with more than 50% of all water birds in KwaZulu-Natal feeding, roosting and nesting in this estuary. Importantly, it is the breeding area for several birds, which are rare or have limited distributions in South Africa. This has contributed to it being proclaimed a protected area, a Ramsar Wetland of International Importance and then finally a World Heritage Site.

To determine overall ecosystem health, the estuary is evaluated by estimating the estuary conditions, both physical and biological characteristics, for the Reference condition and then scoring the present conditions relative to this estimated Reference state. The score derived from this assessment is the Present Ecological State (PES) score and falls into one of six categories (A-F). The steps in determining the health status and recommended state for an estuary are:

- Determination of the Present Ecological State.
- Define the Importance of the estuary (considering all scales from local to national).
- Recommend an Ecological Category (REC) for management

The information obtained above will contribute to the compilation of a Situation Analysis Report (SAR), the contents of which will align with that recommended in the National Estuarine Management Protocol (2021)" which provides guidelines on EstEMP development. The suggested chapters, as per Appendix 2 of the afore-mentioned document, will be:

The EstEMP contains eight chapters, as follows:

Chapter 1: Introduction

1.1 Background

1.2 Frame work

1.3 Purpose of Situation Assessment

1.4 Structure of Report

Chapter 2: Catchment Characteristics

2.1 Geology and geomorphology

2.2 Climate and runoff

2.3 Land-use

Chapter 3: Overview of Ecological Function and State of Estuary

3.1 Abiotic function (e.g., hydrodynamics, mouth management, sediment dynamics and water quality)

3.2 Biotic function (e.g., vegetation, fish, invertebrates, birds, etc)

3.3 Ecological health status (as per EWR study or NBA assessment)

Chapter 4: Ecosystem Services provided by Estuary

4.1 Definition of Ecosystem Services

4.2 Goods and Services provided by the St Lucia Estuary

Chapter 5: Impacts or Potential Impacts and Threats to the Estuary (incl SWOT analysis)

Chapter 6 Overview of Socio-economic Context:

6.1 Demographics

6.2 Economic profile

6.3 Social considerations

Chapter 7: Legislative Instruments and related Strategies/Programmes

7.1 Legal framework applicable to estuarine management

7.2 Management strategies/plans relevant to the estuary

7.3 Existing monitoring programmes

Chapter 8: Opportunities and Constraints for consideration in the EstMP

8.1 Opportunities

8.2 Constraints

ACRONYMS AND ABBREVIATIONS

AMSL	above mean sea level
Anthropogenic	Having to do with people, or caused by humans
Benthic Macroinvertebrates	Or benthos, refers to invertebrates attached to, living on (epifauna) or in (infauna) the substratum, that can be captured by a 500 µm net or sieve
BGIS	Biodiversity Geographic Information System (GIS) developed and managed by the South African National Biodiversity Institute and accessed at http://www.bgis.sanbi.org/
Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems
Catchment	In relation to a watercourse or watercourses or part of a watercourse, this term means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points
Community	Assemblage of organisms characterised by a distinctive combination of species that occupy a common environment and interact with one another
Community composition	All taxa, plants and animals, present in a community
Cumulative impact	Impact on the environment which results from the incremental or combined effects of one or more developmental activities in a specified area over a particular time period, which may occur simultaneously, sequentially, or in an interactive manner
CWDP	Coastal Waters Discharge Permit under the National Environmental Management: Integrated Coastal Management Act No. 24 of 2008

DAFF	Department of Agriculture, Forestry and Fisheries
DFFE	Department of Forestry, Fisheries and the Environment, previously known as the Department of Environmental Affairs (National)
DEDTEA	Department of Economic Development, Tourism and Environmental Affairs (KwaZulu- Natal)
Dilution	The reduction in concentration of a substance due to mixing with water
DWS	Department of Water and Sanitation (formerly Department of Water Affairs (DWA) and Department of Water Affairs & Forestry (DWAF))
EFZ	Estuarine Functional Zone. Low lying land adjacent to the river or estuary periodically flooded and where river borne materials are deposited, including areas adjacent to the estuary banks and below the 5 m amsl for the intermittently open estuaries along the KZN coastline, as described on BGIS
EIA	Environmental Impact Assessment in terms of the 2014 Regulations under the National Environmental Management Act No. 107 of 1998
Environmental Flows	The quantity and quality of water required to sustainably keep aquatic systems healthy and in the classified ecological management category
Environmental impact	A discrete (definable) interaction between a project activity and one or more components of the environment (biophysical and social)
Eutrophic	Rich in mineral and organic nutrients that facilitate prolific plant growth
GIS	Geographic Information System. GIS is a combination of computer software and hardware tools used for creating maps and analysing spatial data. GIS links the map and database information so that questions can be asked and answers given in map or visual form
Guidelines	Guidelines for the Development and Implementation of Estuarine Management Plans in terms of the National Estuarine Management Protocol, published by the

Department of Environmental Affairs in March 2015

Habitat	The natural home of an organism or community of organisms (this also includes the surrounding area). This includes biotic and abiotic features. Habitat loss or fragmentation is one of the primary causes of the loss of biodiversity and resilience
Hypertrophic	Conditions characterised by elevated mineral and organic nutrients in aquatic environments resulting in boom-and-bust cycles of plant growth often leading to cycles of oxygen super-saturation and oxygen depletion in the water column
IAP	Invasive Alien Plant. A plant species that does not naturally occur in a specific area and whose introduction does or is likely to cause economic or environmental harm or harm to human health
ICM Act	National Environmental Management: Integrated Coastal Management Act No.24 of 2008
Invasive alien species	A species that does not naturally occur in a specific area and whose introduction does or is likely to cause economic or environmental harm or harm to human health
IOE	Intermittently Open Estuary, also known as Temporarily Open/Closed Estuary. This is an estuarine classification that groups all estuaries that are periodically closed off from the sea by a sand bar. These systems can close for varying lengths of time, and during closure, the areas upstream from the mouth are back-flooded. The highest water level reached by KwaZulu-Natal estuaries during natural mouth closure events is approximately 5 m

above mean sea level

KZN	KwaZulu-Natal
MAR	Mean Annual Runoff
MER	Marine & Estuarine Research cc
NEMA	National Environmental Management Act No. 107 of 1998
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act No. 36 of 1998
Oligotrophic	Conditions characterised by low mineral and organic nutrients resulting in limitations to plant growth / primary production
PES	Present Ecological Status. This is a measure of the health of a water resource. The status is based on a comparison between the original / reference condition and the present state according to the reserve determination method of the Department of Water and Sanitation (DWAF 2008. Water Resource Protection and Assessment Policy Implementation Process. Resource Directed Measures for protection of water resources: Methodology for the Determination of the Ecological Water Requirements for Estuaries. Version 2). This is generally denoted by a classification that can range from an “A” being unmodified to an “F” being critically modified
Protocol	National Estuarine Management Protocol in terms of section 33 of the National Environmental Management: Integrated Coastal Management Act No. 24 of 2008; Government Notice No. 341, published in Government Gazette No. 36432 on 10th May 2013
Runoff	Runoff is the water yield from an individual catchment – the sub-catchment plus the runoff from all upstream sub-catchments. Runoff includes any seepage, environmental flow releases and overflows from the reservoirs in a catchment, if they are present
SANBI	South African National Biodiversity Institute

Special Limit Values	Department of Water Affairs and Sanitation's more stringent water quality limits / requirements that are applied when wastewater / effluent quality should be higher than General Limit Values for release to a water resource without a water use licence in accordance with GN 169 of 2013
Stormwater run-off	Stormwater run-off from paved areas, including parking lots, streets, residential subdivisions, buildings, roofs, highways, etc
TOCE	Temporarily Open/Closed Estuary. Also known as an Intermittently Open Estuary
The Authority	ISimangaliso Wetland Park Authority
The Park	ISimangaliso Wetland Park
EKZNW	Ezemvelo KwazuluNatal Wildlife
TWQR	Target Water Quality Range established by the Department of Water Affairs and Forestry in a set of guidelines published in 1996
Wastewater	Water containing solid, suspended or dissolved material (including sediment) in such volumes, composition or manner that, if spilled or deposited in the natural environment, will cause, or is reasonably likely to cause, a negative impact
WWTW	Wastewater treatment works. Facility for the treatment of domestic or industrial wastewater designed to remove biological or chemical waste products from water to ensure that water discharged downstream/to the environment is of an acceptable quality
WULA	Water Use Licence Application under the National Water Act No. 36 of 1998

Tables of contents

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The iSimangaliso Wetland Park is located in an area known as Maputaland, within the uMkhanyakude District Municipality, northern KwaZulu-Natal province, South Africa. The Park stretches across open seas, reefs, beaches, forests, savannahs, lakes, rivers and mountains to include all the natural wonders that have drawn travellers and explorers to Africa for centuries. The terrestrial component of the iSimangaliso Wetland Park is approximately 332 000 hectares in size. The Indian Ocean forms the eastern boundary of the park, which extends from the Mozambican border in the north, to Maphelane in the south and includes the uMkhuze section in the west. The Park traverses approximately one third of the KwaZulu-Natal coastline. The Park is under the management of the iSimangaliso Authority and reports to the Minister and is mandated to implement the policies and principles of the World Heritage Convention, the Act and the NEMPAA. The iSimangaliso Authority is listed as a Schedule 3a Public Entity under the PFMA and is the protected area manager in terms of the NEMPAA. The name "iSimangaliso" means miracle and wonder, which aptly describes this unique place. ISimangaliso was proclaimed a World Heritage site in December 1999 in terms of the World Heritage Convention Act, 1999 (Act 49 of 1999), an Act that incorporated the World Heritage Convention into South African legislation. With an additional 970,66.57 hectares of ocean now falling under the iSimangaliso MPA, iSimangaliso's combined terrestrial and marine area is some 1,328,900ha (or 13,289 square kilometres), also making it the second largest protected area in the country after the Kruger National Park.

It is under this ICMA Act that the iSimangaliso Wetland Park Authority has prepared this Lake St Lucia Estuary Management Plan (EstMP). The EstMP is also aligned with related legislation, notably relevant provisions of the Marine Living Resources Act, 1998 (Act 18 of 1998), the National Environmental Management: Biodiversity Act (Act 10 of 2004), National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003), National Environmental Management: Integrated Coastal Management Act 2008 (Act 24 of 2008), the Public Finance Management Act, 1999 (Act 1 of 1999) and the Disaster Management Act (Act 57 of 2002), read with the Disaster Management Amendment Act (Act 16 of 2015). Further, in terms of development planning, the EstMP also needs to be aligned with the National Development Plan, 2030, the KZN Provincial Growth and Development Strategy, 2035, Integrated development plan (IMP) and the District Municipality Integrated Development Plan.

iSimangaliso has three major estuary systems, viz. Lake St Lucia, Mgobozeleni and Kosi Bay, all

of which are categorized as estuarine coastal lakes. Estuarine coastal lakes are estuaries that have a large surface water area. These are usually drowned river valleys filled in by reworked sediments and separated from the sea by vegetated sand dune systems. These types of estuaries can be permanently open or closed for periods when the link with the sea is lost and can have large salinity fluctuations driven by fluctuations in freshwater input, evaporation, and sea condition. The tidal prism is small and marine and river input have little influence on water temperatures, which are directly related to solar heating and radiation. Estuarine, marine and freshwater organisms all occur depending on the salinity condition of the system at any given time. These are three of nine estuarine coastal lakes on the South African coast and are now the only three intact systems within the sub-tropical bioregion.

The Lake St Lucia estuarine system, the largest estuary in the country, is situated on the Mozambique coastal plain in the north of the province of KwaZulu-Natal. The estuary is a dominant feature of the iSimangaliso Wetland Park and from a biodiversity point of view is one of the country's most significant estuaries. It also plays an important socio-economic role in the region (Clark et. al., 2015) and, in terms of ecosystem services, has high tourism value. The estuary incorporates a large lake-like water body running parallel with the coastline in the north, with compartments known as North Lake, South Lake and False Bay. South of the lakes is a 20 km channel, referred to as the Narrows, which provides a physical and biological link between the lakes and the sea, allowing both water exchange and animal migration. The southern end of the Narrows links with the largest catchment to feed St Lucia, viz. the uMfolozi River, which complements the Lakes and Narrows as a source of freshwater and a driving force in terms of mouth dynamics.

This document details the Estuary Management Plan (EstMP) for the Lake St Lucia system (Figure 1) and draws on the Situation Assessment background report (iSimangaliso, 2015c) and other supporting documents. This plan provides a summary of the current situation assessment, which describes the estuary's features, health status, the activities and issues affecting estuary health, and the management objectives and programme of actions for estuary management.

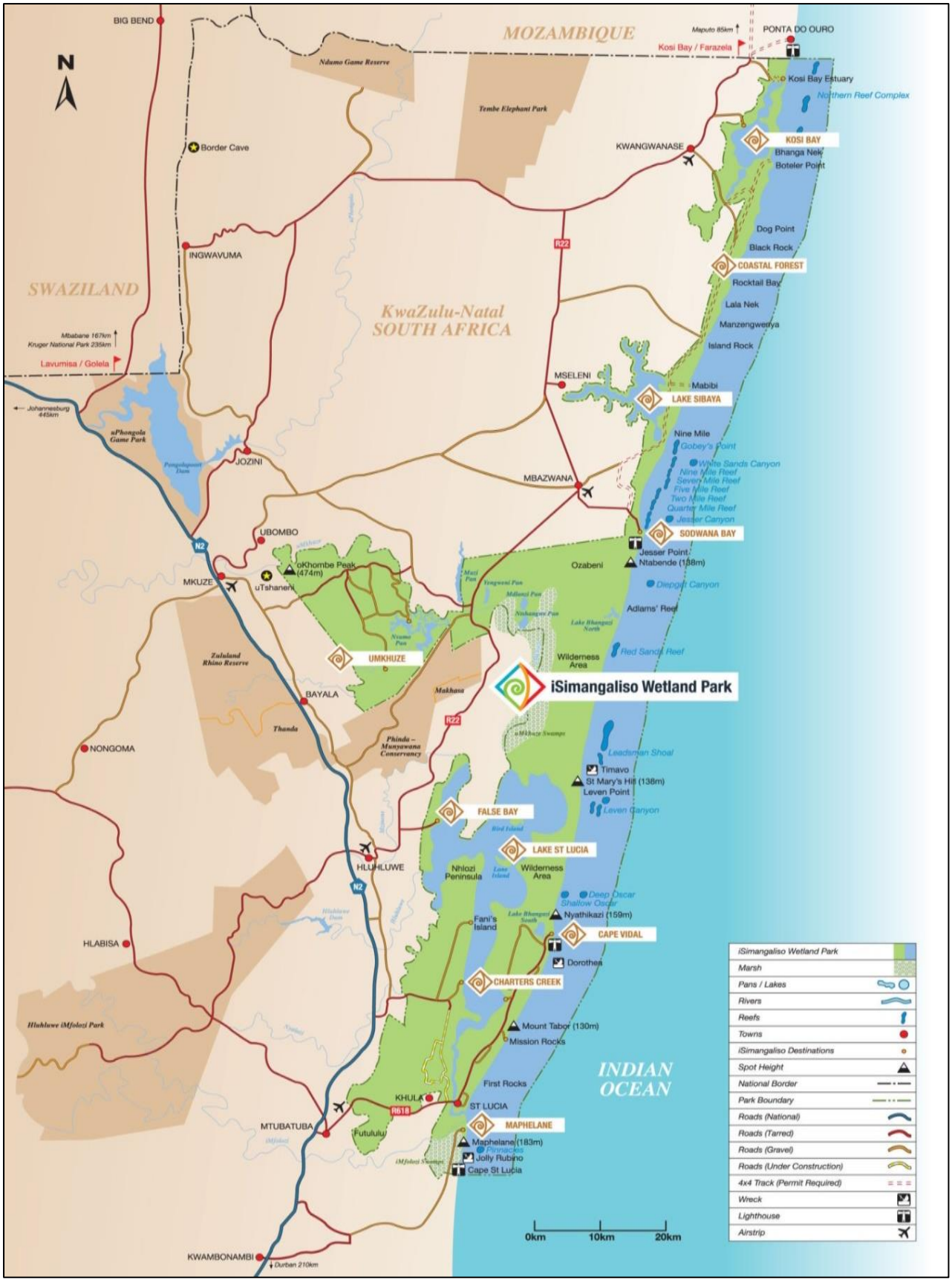

Figure 1:Image showing overview of iSimangaliso wetland park

1.1. Background

This document details the Situation Assessment Report for the Lake St Lucia system and draws on the previous Lake St Lucia Estuary Management Plan (iSimangaliso, 2016), the revised iSimangaliso Integegrated Management Plan (2022-2031) (iSimangaliso, 2021) and other supporting documents. Where information is obtained other than from the key first two listed sources, this will be duly acknowledged and referenced.

The St Lucia Estuary is located within the iSimangaliso Wetland Park, a proclaimed World Heritage Site, in an area known as Zululand or Maputaland in the northern KwaZulu-Natal province of South Africa. The Lake St Lucia Estuary begins approximately 200 km north of Durban and stretches for a further 90 km parallel to the coastline. The upper estuary, comprising of a lake component, consisting of South Lake, North Lake and False Bay, lies to the north of a channel, generally referred to as the Narrows, which is approximately 20 km long and links the system to the sea when the mouth is open. The lake is roughly H-shaped with a maximum length of approximately 40 km and a maximum width of approximately 20 km. The area of the Lakes and Narrows will vary with water depth but a generally accepted figure is 620 ha being the extent of the EFZ.

The Lake St Lucia system is situated in the southern region of the iSimangaliso Wetland Park and is the southernmost estuarine coastal lake within the subtropical region (this would have been Lake Nhlabane estuary north of Richards Bay previously but major changes to this system have resulted in the lake no longer having a connection with the sea). This estuary type is one of the rarer types of estuary, being classified in the category of ‘coastal lake’ on the basis of its size and the relative extent of tidal influence (Whitfield & Baliwe, 2013). Unlike the other two large iSimangaliso estuaries, Kosi Bay and Mgobezeleni, the Lake St Lucia system is primarily a surface water driven estuary with smaller groundwater inputs. It is served by five large tributary rivers, four of which enter the lakes, viz. the uMkhuze and uMzinene Rivers in the north, and the Hluhluwe and Nyalazi Rivers entering False Bay from the south. The fifth major river, the uMfolozi River, links with the system in the south at the lower end of the Narrows and provides a dual function as a major source of freshwater and the driver of the estuary’s mouth dynamics. The artificial separation of the uMfolozi River from the system has compromised estuarine integrity and had a significant effect on water balance and salinity. Two smaller rivers also provide surface water to the system; the relatively small Mpate River enters the Narrows about 15 km from the sea on the Western Shores and input into the lakes from the Nkazana Stream on the Eastern Shores. Some local input (6-7%) also comes to the system in the form of groundwater derived from rainfall from the immediate areas

surrounding the estuary and, in particular, the steep coastal dunes on the eastern margin. From a water resource planning perspective, the estuary is fed by five large tertiary catchments, W21, W22, W23 (uMfolozi), W31 (uMkhuze) with the remaining three rivers (Hluhluwe, Nyalazi and Mzinene) in W32. The long-term significance of changes to all these systems in terms of declines in freshwater inputs into the lake as a result of catchment modification, damming, abstraction and expanding commercial forestry cannot be overemphasised. The estuary has a diversity of important habitats including swamp forest, mangrove, reeds and sedge swamp. Despite its present fragile state, it remains a nationally critically important coastal estuarine lake by virtue of its unique size, animal and plant diversity and its role in coastal biological processes, especially as a nursery ground for both fish and invertebrates, particularly crustaceans.

Figure 2: Layout showing the St Lucia Estuary

1.2. Framework for Estuary Management Plans

Estuaries are not isolated systems. They form an interface between marine and freshwater systems and are part of regional, national and global ecosystems either directly via water flows or indirectly through the movement of fauna. In addition to the biota that estuaries support, they provide a range of goods and services (uses) to the inhabitants of the various regions. Disturbances in one estuary can influence a wide variety of habitats and organisms in the broader freshwater or marine ecosystem. Thus, the interaction between the systems and users creates a delicate balance, the sustainability of which needs to be addressed by some form of management plan. In South Africa, this is addressed in terms of Chapter 4, Section 34 of the National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008) together with the National Estuarine Management Protocol of 2021. The Act stipulates that Estuary Management Plans (EstMP) are required for all estuaries along the South African coastline, while the Protocol provides guidance for the development and implementation of EstMP. EstMP 's must be consistent with the relevant Coastal Management Programmes, while further guidance is provided by the DFFE's "Guidelines for the development and implementation of EstMP s".

According to the National Estuarine Management Protocol (2021), a detailed review of an EstMP must be conducted at least every five (5) years. A previous EstMP for the Lake St Lucia Estuary was compiled in 2016; as such, this EstMP reviews the previous EstMP and builds on this version to provide an updated and more comprehensive EstMP that follows the National Estuarine Management Protocol 2021 Protocol. This includes revising and updating the Situation Assessment Report (SAR), including the following information:

- The effectiveness of the EstMP and success with meeting the Objectives, taking into consideration information from the monitoring programmes during the preceding years (e.g., measured in terms of the performance indicators and targets)
- Environmental change (if any) at the local and wider scale that could affect the estuarine resource or the implementation of the EstMP
- Changes (if any) to legislation, land-use planning, goals and policies that may require the EstMP to be amended.

This report (SAR) forms an integral part of the development of an EstMP , providing a clear understanding of the status quo, as well as important considerations for estuarine management planning. The inputs of the Estuarine specialists will contribute towards the updating of the current EstMP 's by providing a SAR, including executive summary, for each estuary, as part of the Scoping Phase of the EstMP's. The scoping phase of all the EstMP s is collated in the form of a situation assessment report and highlights minimum

information regarding the status quo of the estuaries by ensuring they cover 7.1.1, 7.1.2, 7.1.3 & 7.1.4 of the scoping phase in accordance to the National Estuarine Management Protocol (2021).

The development of EstMP s for iSimangaliso is governed by section 34 of the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) (ICM Act) read with the National Estuarine Management Protocol 2021 (the Protocol). However, implementation is also governed by the World Heritage Convention Act (Act No. 49 of 1999) (WHC Act) read together with the ICM Act. This is because iSimangaliso is required to conduct its affairs in accordance with an Integrated Management Plan (Section 21 (2) WHC Act). The DFFE has also published Guidelines for the Development and Implementation of Estuarine Management Plans (DEA, 2015). The Protocol states that as the responsible authority, iSimangaliso must develop the EstMPs. Also, section 34 (1) (b) (i & ii) states that the EstMP must be consistent with the Protocol and the National Coastal Management Programme (NCMP). The Protocol is silent about the adoption of one or more EstMPs in the iSimangaliso circumstances. Neither a provincial management programme nor a municipal coastal programme is applicable to iSimangaliso. However, the national coastal management programme is applicable to iSimangaliso. Section 52 of the ICM Act requires consistency between coastal management programmes and other statutory plans. A statutory plan means a plan, policy or programme adopted by an organ of state. The IMP for iSimangaliso is such a statutory plan. The Minister approves the IMP and, consequently, to give effect to the purpose of the ICM Act, the EstMP must, therefore, form part of the IMP. This EstMP has taken into consideration all the requirements of the ICM Act and the Protocol. In terms of section 34(1) (d) of the ICM Act, iSimangaliso is required to submit an annual report to the Minister on the implementation of the EstMPs. iSimangaliso already reports to the Minister through the DFFE annually and will include this EstMP reporting requirement in that annual report.

The development of the EstMPs followed a three-step process that involved a scoping phase (Situation Assessment Report), objecting setting phase and the development of the implementation phase. Prior to the ICM Act and the Protocol, all the estuaries in iSimangaliso were managed in terms of the provisions of the IMP and various statutes, including:

- World Heritage Convention Act, 1999 (Act 49 of 1999).
- National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA).
- National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003).
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- National Heritage Resources Act, 1999 (Act 25 of 1999)1.

- KwaZulu-Natal Heritage Act, 1997 (Act 10 of 1997).
- National Forests Act, 1998 (Act 84 of 1998).
- National Water Act, 1998 (Act 36 of 1998).
- Marine Living Resources Act, 1998 (Act 18 of 1998).
- Seashore Act, 1935 (Act 21 of 1935).
- Maritime Zone Act, 1994 (Act 15 of 1994).

Before the proclamation of the iSimangaliso Wetland Park World Heritage Site, all the estuaries in iSimangaliso were in protected areas and were managed as part of a greater conservation area by the duly appointed conservation manager for the particular area.

The iSimangaliso Authority is accordingly the responsible authority for the development and implementation of an EstMP for St Lucia Estuary (including the five rivers that are part of this estuarine system) and any other activity that influences the system. Given the legislative and institutional complexity of coastal management in South Africa, the purpose of an EstMP is to provide for the integrated and coordinated management of activities affecting estuarine resources. The top five such activities prioritised in the National Biodiversity Assessment (van Niekerk & Turpie, 2012) were:

- Flow modification e.g., water abstraction (either directly from the system or indirectly by alien plants, timber plantations), urban stormwater runoff, etc.
- Pollution e.g., wastewater treatment works, industrial effluent, agrochemicals, etc.
- Exploitation of living resources e.g., fish, invertebrates, plants and plant-parts.
- Habitat destruction (e.g., low-lying development, bridges, mining, etc.).
- Climate change (reflected in modified rainfall patterns, temperature changes, increased storminess and sea level rise).

The EstMP Guidelines have, therefore, determined the core sectors to be addressed by the management objectives within each EstMP. These are:

- Resource use.
- Alternative livelihoods
- Conservation.
- Water quantity and quality.
- Socio-cultural values.
- Capacity building.
- Land use regulation.
- Compliance monitoring and enforcement.

- Climate change.

The EstMP for St lucia Estuary will be developed using existing and available information to:

- Develop a Situation Assessment Report.
- Set a vision and management objectives, which are aligned with iSimangaliso's IMP.

EstMPs regulate and manage human activities impacting on estuaries and in, this particular case, on the Lake St Lucia Estuarine system. This means that this EstMP will describe the current status of the estuary and the associated activities and subsequently guide future developments, if any, in relation to the dynamic forces of the estuary. Importantly, as the first EstMP published in terms of the requirements of the ICM Act and the Protocol, it provides opportunities to identify and address many of the factors identified in the Situation Assessment as impacting on the health of the system. In addition, there are opportunities to explore positive interventions to improve estuarine functioning, including rehabilitation of habitat where possible.

The development of an EstMP is a three-phase process. As illustrated in Figure 3 below comprising an initial scoping phase, followed by an objective setting phase, and finally an implementation phase. An adaptive management approach should be adopted during the latter phase with detailed reviews being conducted at five-yearly intervals

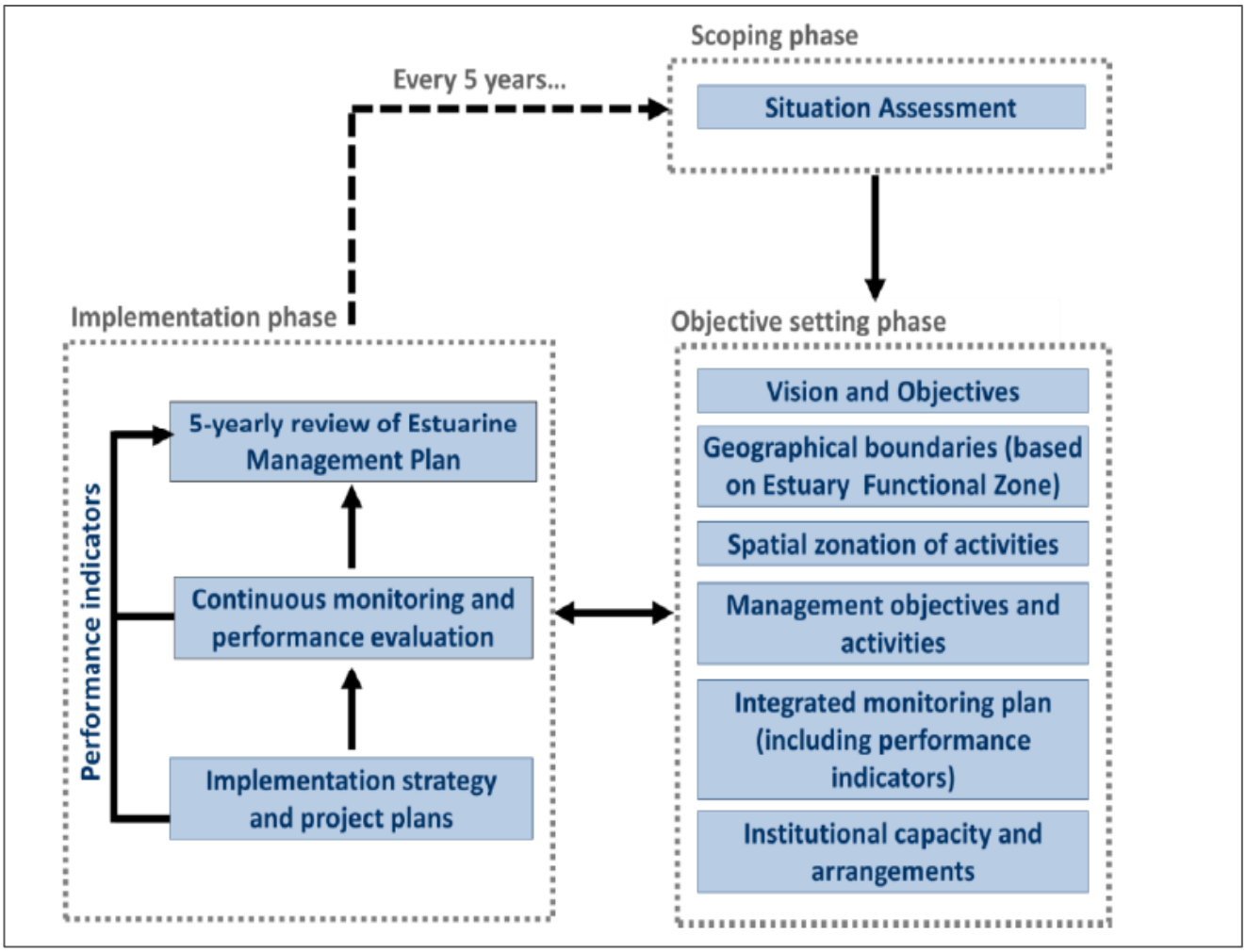

Figure 3: **Framework for Estuarine Management Plan**

Estuarine management is by definition not only focused on the Estuarine Functional Zone (EFZ) but inclusive of coastal hinterland and marine influences, shoreline status catchment management, climate change and human development impacts such as tourism, recreation and agriculture, amongst many others. This EstEMP is the primary document for use by the identified the responsible management authority to facilitate coordination of the identified management interventions to ultimately ensure the longevity of the estuarine system concerned. This is also the critical reference document for the incorporation of estuarine management into the municipal Integrated Development Planning (IDP), Spatial Development Framework (SDF) processes and relevant District Development Models.

1.3. Purpose of this report

The purpose of the report is to reveal to interested and affected parties, stakeholders, partners and government agencies the proposed content of the Situation Assessment Report, compiled as part of the requirements for the Estuarine Management Plan for St Lucia Estuary, to be reviewed and updated. The objective is to review the St Lucia Estuary Management Plan (EstMP) to ensure it is up to date with current legislative requirements, National and international best practice and informed by most recent situational assessments at a local level. The development of revised Estuary Management Plans is informed by the National Estuarine Management Protocol (2021). It is understood that the overall objective is to identify and streamline estuarine activities and improve the health status of the system; and ensure integration of the roles and responsibilities of various state organs and municipalities.

This report (SAR) forms an integral part of the development of an EstMP, providing a clear understanding of the status quo, as well as important considerations for estuarine management planning. The inputs of the Estuarine specialists will contribute towards the updating of the current EstMP's by providing a SAR, including executive summary, for each estuary, as part of the Scoping Phase of the EstMP 's. The scoping phase of all the EstEMP s is collated in the form of a situation assessment report and highlights minimum information regarding the status quo of the estuaries by ensuring they cover 7.1.1, 7.1.2, 7.1.3 & 7.1.4 of the scoping phase in accordance to the National Estuarine Management Protocol (2021).

1.4. Structure of report

Key outputs include a Situation Assessment for the estuary comprising:

- A review of the legal and institutional framework
- A description of the structure (abiotic and biotic components), functioning and state of the estuary, including the underlying processes and drivers;
- An assessment of the Ecological health status;
- An overview of the socio-economic context of the estuary including the provision of goods and services and human use activities;
- An assessment of opportunities and constraints for development and conservation;
- An overview of current management practices (zoning, breaching etc.) and priority restoration actions.
- The assessment should also identify problem areas, data and information gaps, as well as potential capacity constraints in terms of EstMP implementation.
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1. CATCHMENT CHARACTERISTICS

This section provides an overview of the key features, concerns and issues of the Lake St Lucia estuary system, to provide context for the management objectives and actions.

1.1 Geology and geomorphology

The Lake St Lucia system is situated in the southern region of the iSimangaliso Wetland Park and is the southernmost estuarine coastal lake within the subtropical region. This estuary type is one of the rarer types of estuary, being classified in the category of 'coastal lake' on the basis of its size and the relative extent of tidal influence (Whitfield & Baliwe, 2013).

1.2 Catchment

The St Lucia estuarine system covers an area of up to 35 000 ha (depending on the water level), approximately 50% of South Africa's estuarine cover. Within the KwaZulu-Natal province, St Lucia makes approximately 80% of the estuarine area, (Whitfield et al. 2006). This is significant when considering the nursery function of the estuary. Although the tidal prism does not cover the entire area of the system, the St Lucia Lake forms a nursery habitat to several estuarine and marine fish (Whitfield 2021). Unlike the other two large iSimangaliso estuaries, Kosi Bay and Mgobezeleni, the Lake St Lucia system is primarily a surface water driven estuary with smaller groundwater inputs. From a water resource planning perspective, the estuary is fed by five large tertiary catchments (uMfolozi), (uMkhuze) with the remaining three rivers (Hluhluwe, Nyalazi and Mzinene).

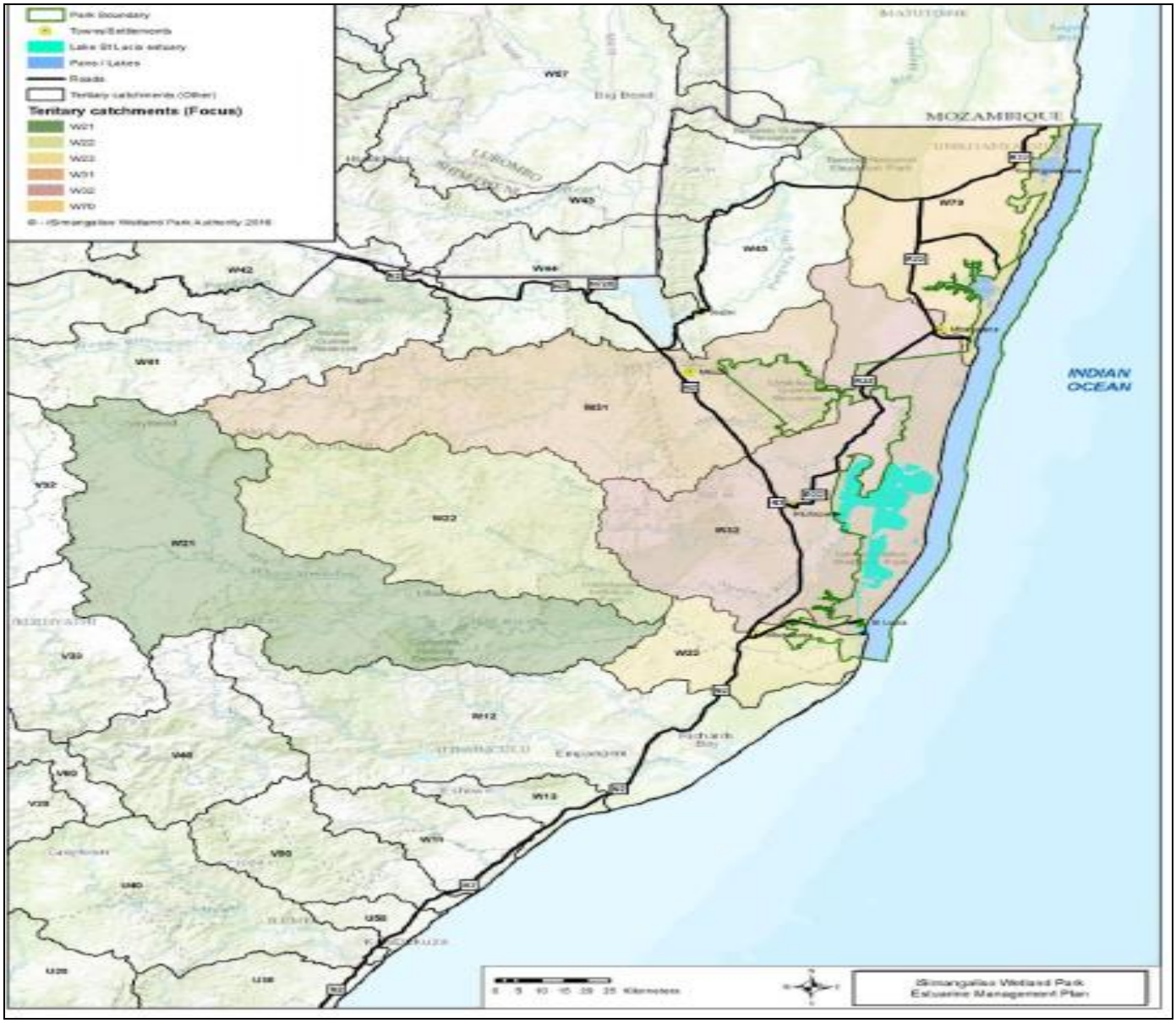

Figure 4: Catchments of the St Lucia Lake and Estuary. The catchment in the north (W70) shaded orange is not part of the St Lucia system.

The estuary incorporates a large lake-like water body running parallel with the coastline in the north, with compartments known as North Lake, South Lake and False Bay. South of the lakes is a 20 km channel, referred to as the Narrows, which provides a physical and biological link between the lakes and the sea, allowing both water exchange and animal migration. The southern end of the Narrows links with the largest catchment to feed St Lucia, the uMfolozi River, which complements the Lakes and Narrows as a source of freshwater and a driving force in terms of mouth dynamics.The St Lucia system is served by five large tributary rivers, four of which enter the lakes, viz. the uMkhuze (catchment approximately 6 000 km²) and uMzinene (catchment approximately 800 km²) Rivers in the north, and the Hluhluwe (catchment approximately 1 000 km²) and Nyalazi (catchment approximately 7 000 km²) Rivers entering False Bay from the south. The fifth major river, the uMfolozi River (catchment approximately 10 000 km²), links with

the system in the south at the lower end of the Narrows and provides a dual function as a major source of freshwater and the driver of the estuary's mouth dynamics. Two smaller rivers also provide surface water to the system; the relatively small uMphathe River enters the Narrows about 15 km from the sea on the Western Shores and input into the lakes is also provided from the kuNkazana Stream on the Eastern Shores, just north of Catalina Bay. Further, the small kwaNdonyana pan discharges from the Western Shores into the Narrows about 7 km upstream from the mouth. Some local input (6-7%) also comes to the system in the form of groundwater derived from rainfall from the immediate areas surrounding the estuary and, in particular, the steep coastal dunes on the eastern margin.

1.3 Geology

The geology underlying the Park consists of Jurassic Period (201 – 145 Ma7) lavas, followed by sediments of the Cretaceous (145 – 65 Ma), Tertiary (65 – 2.5 Ma) and Quaternary Periods (2.5 Ma – Present) covering the Makhatini Flats of the Zululand Coastal Plan. The Gondwana supercontinent began to break-up circa 184 Ma as vast out-pourings of lava (Hastie et al., 2014) and was complete by 133 Ma (Mueller and Jokat, 2019). This process gave rise to the present African continental margin and was the base on which the post-breakup Cretaceous rocks were originally deposited. The Maputaland coastline is aligned NNE-SSW and is fairly straight, apart from a series of small aeoleonite (rock formed from sediments deposited by wind) or beachrock headlands and coastal platforms, which give rise to gentle log-spiral shaped sandy bays to their north; this is in response to the predominant south-south-easterly swells and northward longshore drift. The soil groups in the St Lucia area are dominated by Arenosols followed by Fluvisols, Gleysols, Luvisols and Vertisols

1.4 Palaeontology

The area surrounding the St Lucia Lakes contains extensive Cretaceous deposits with rich marine fossil beds. Rocks underlying the Park were mainly deposited in marine, coastal and estuarine environments, hence a predominance of fossils are associated with these paleo-environments. Important geological sites include:

- The Western Shores of Lake St Lucia, which are rich in well-preserved marine fossils including giant ammonites.
- More than 100 species of marine fauna are contained in the limestones exposed at Lister's Point and Hell's Gate on the Nhlozi Peninsula. Of particular importance are the fossilized coral

forms that are preserved in their growth positions.

- A narrow band of fossil beds around the Nibela peninsula.
- Bhangazi berm between Lake Bhangazi and the Mfabeni Swamp.

1.5 Geological evolution

The evolution of the St Lucia system over geological time scales is reviewed in detail by Botha et al (2013). An essential feature of this evolution is that the main lake basin has lost any immediate connection with the ocean, and now maintains only a limited connectivity via the Narrows, a 22 km long sinuous channel that enters the sea at the town of St Lucia where there is a confluence with the Mfolozi River. Sea level changes over the past 6 000 years played a significant role in this evolution and the present shoreline morphology was attained about 1 000 years ago. The rivers that feed directly into the lake basins (Mkuze, Mzinene, Hluhluwe, and Nyalazi) are seasonal, flowing mainly during the wet summer months (November to March). The lake basins are a deposition zone for accumulated sediments from these feeder rivers.

As a result of these sedimentation processes, in terms of geological (millennial) time scales, it is generally accepted that the St Lucia Lake is on a long-term evolutionary path towards becoming a fresh-water swamp/wetland. However, this can be influenced significantly by uncertain factors such as global climate change induced sea level rise as well as other local anthropogenic factors such as land-use changes. Currently, the annual sea level rise (about 2 – 3 mm/yr is expected to accelerate e.g. Mather et al. 2013) and is similar to or exceeds current estimates of sedimentation rate in the St Lucia Lake basins. However, the issue is complex because of the interdependencies of factors such as catchment sediment yields, land-use changes, regional rainfall changes, etc. A review of some of these factors in the context of St Lucia is provided by Mather et al. (2013).

1.6 Geographical Boundaries of the Estuary and Estuarine Functional Zone (EFZ)

As per the DFFE's "Guidelines for the Development and Implementation of Estuarine Management Plans in terms of the National Estuarine Management Protocol" (DEA, 2015): "estuaries - as defined by the spatial delineation of the estuarine functional zone – are 'sensitive areas'…. Where previously the 'geographical boundaries' of an estuary was assumed to be the 'open water body', the EFZ encapsulates additional areas that support physical and biological processes and habitats necessary for that estuarine function and health (Van Niekerk and Turpie, 2012). The geographic boundary of the estuary is defined

by the 5 m amsl topographical contour. The coastal management line may also be a useful guide when defining the terrestrial extent of the estuary area.

It is important to define the boundaries of the estuary and by virtue of this, the extent of the plan. This step defines and maps the geographic boundaries of the estuary as follows:

- **Downstream boundary.** The estuary mouth, which may include the surfzone, seaward extent of the flood tide delta and/or transitional waters. This extension can be determined on salinity observations, and variations observed in historical aerial photographs or satellite imagery.
- **Upstream boundary.** The extent of tidal influence, i.e. the point up to where tidal variation in water levels can still be detected or the extent of saline intrusion or the extent of back-flooding during the closed mouth state, whichever is furthest upstream. Where no data are available to set the upper boundary, the +5 m topographical contour is used (bearing in mind that the tidal range in South Africa is microtidal [< 2 m] and sand bars at closed estuary mouths can sometimes build up as high as + 4.5 m AMSL).
- **Lateral boundaries**. The lateral boundaries include all areas below the high tide mark, all estuarine vegetation (including mangroves, swamp forest, reeds/sedges and supratidal saltmarsh), and any floodplain areas below the upstream boundary as determined by the 1:100 flood line. All the associated wetlands, intertidal mud and sand flats, beaches and foreshore environments that are affected by riverine or tidal flood events must be included. Where these boundaries have not been defined by scientific methods, they can be defined at a desktop level using the 5 m topographical contour as indicative of 5 m above Mean Sea Level (AMSL) along each bank. It should be noted that the littoral active zones adjacent to an estuary can stretch beyond the 5 m contour and should be incorporated in the estuarine functional zone in specific cases where scientific work determines these are an integral part of the estuary function.

According to the previous iSimangaliso EstEMP (2016), the EFZ is an area of about 65,000 ha. This includes a variety of natural resources that are or have the potential to be harvested included grassland areas for grazing, woody and non-woody plant resources and animal resources of the marginal habitats and water areas of the estuary. The existing EFZ for the St Lucia Lake and

Estuary is provided in Figure 5 below. This may be amended as the EstMP process unfolds and more detailed information becomes available.

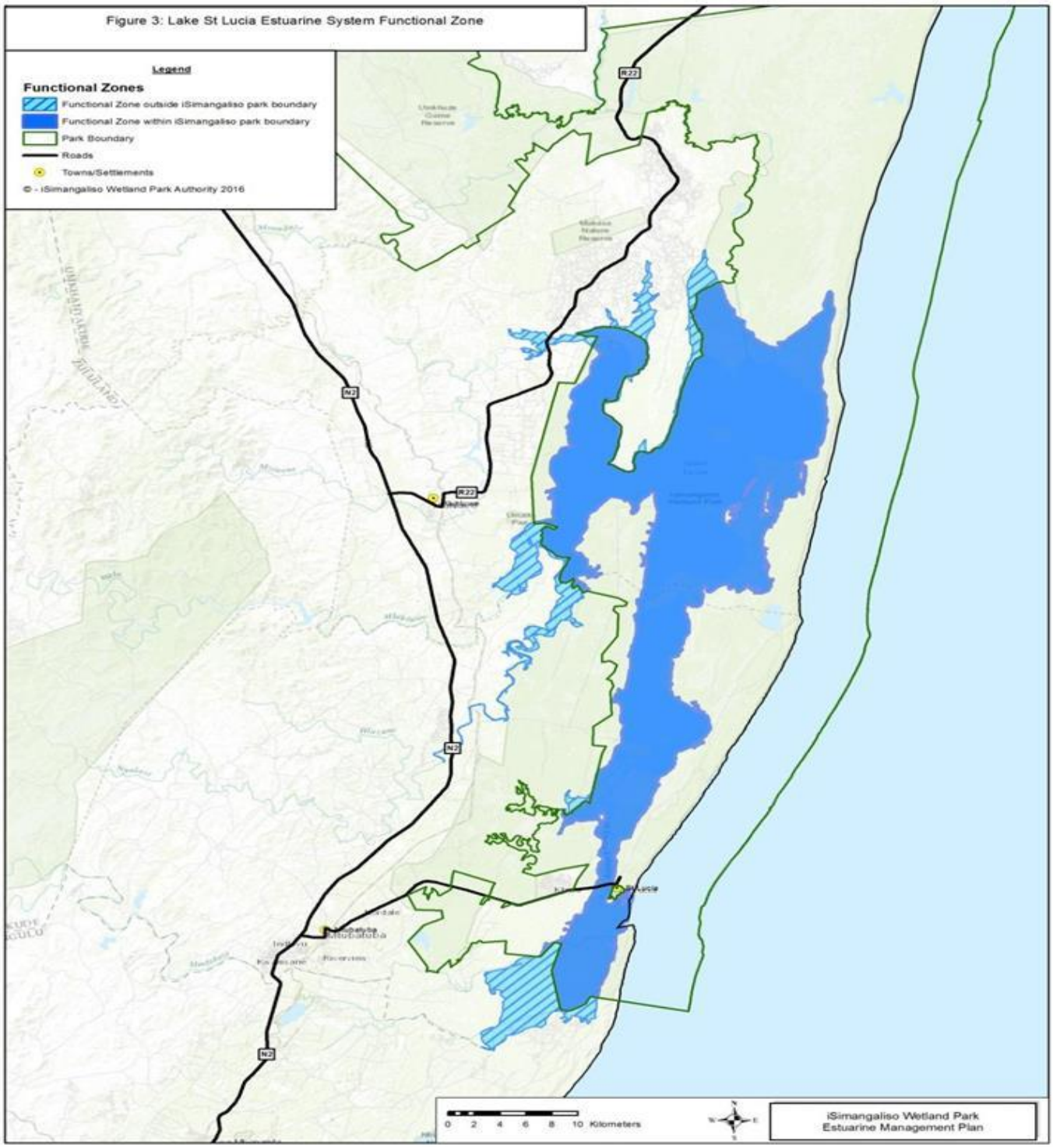

Figure 5:Estuarine functional zone

1.7 Offshore environment

The warm Agulhas Current flows offshore of the coast, from north to south. Current speeds are stronger south of Sodwana, where the current gains momentum, particularly between Cape Vidal and Cape St Lucia, where the shelf is narrowest. Inshore of this is the considerable net northward, longshore transport of sediment (shore-parallel sand-stream), in response to predominant SSE to ESE swells which, together with cross-shelf sand movements, exerts a major influence on intertidal habitats. However, prolonged north-easterly winds can impose a north-easterly to easterly swell direction, causing a reversal in the longshore drift and a phenomenon called beach rotation, manifested as a change in beach erosion and deposition patterns. A synoptic scale (i.e. over a few days, associated with passing weather systems) variability in the swells and winds is superimposed on seasonal variability, which results in dynamic changes in sediment movement along the coast. Added to this is the effect of tides; the tidal range in the area is of the order of 1.5 to 2.3 m.

1.8 Climate and runoff

ISimangaliso falls within the humid subtropical climatic zone of Africa (Köppen classification Cwa), with the warm Agulhas Current offshore having a moderating influence. Summers are hot and humid, while winters are mild, with intermittent cold spells associated with the passage of cold fronts. About 75% of the rainfall along the coastal margin occurs during the spring to autumn months of October to April, Most summer rainfall occurs in the form of convective thunderstorms or is associated with low pressure troughs, often linked to the eastward passage of coastal lows or cold fronts to the south. Episodic floods are occasionally caused by cut-off lows and tropical cyclones or tropical depressions moving southwards from Mozambique after crossing or moving down the Mozambique Channel. Mean annual rainfall for the Maputaland Coastal Plain is approximately 1 200 mm per annum (pa) along the coastal margin. Relative Humidity is high in summer, and for much of the year it exceeds 90%, although winters are dry, particularly at inland locations. Evaporation rates are high, especially during the drier winter and early spring periods; averaging more than 1 300 mm pa near the coast; thus there is a precipitation deficit. Rainfall is an important parameter to monitor as it influences lake level, groundwater level and vegetation growth. The coastal ecosystems in Zululand are driven to a large degree by multi-year wet-dry cycles. There is a great degree of interannual variability in rainfall, with dry and wet periods linked to ENSO and PDO cycles .

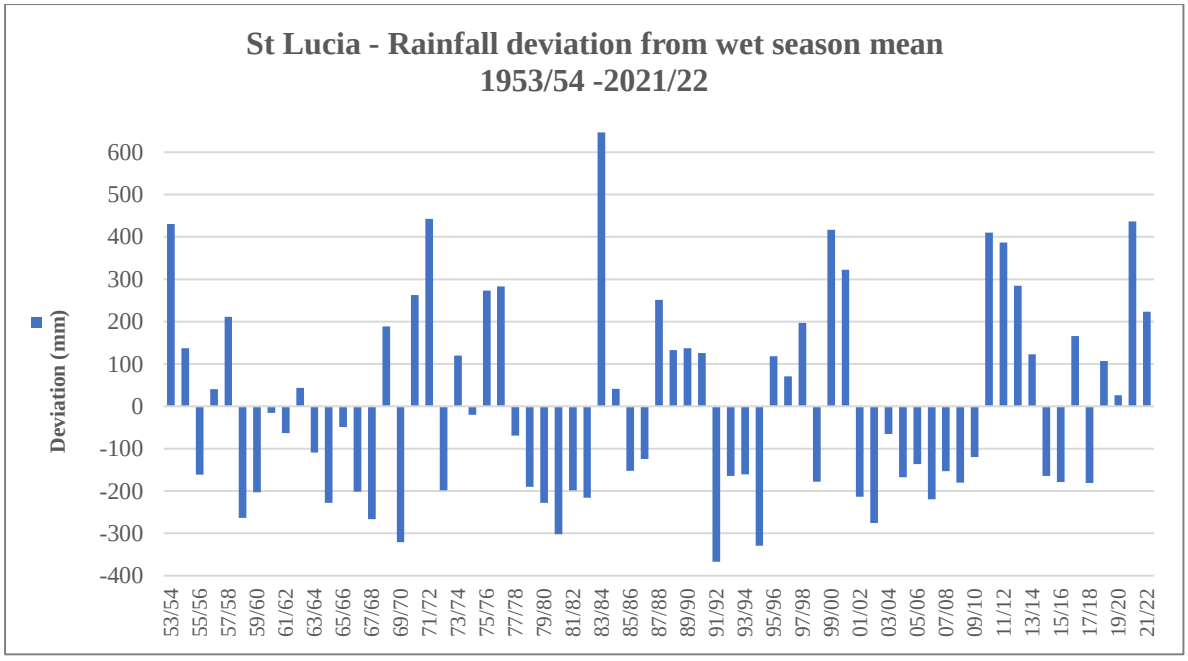

Figure 6: Rainfall deviation from the wet season mean (0 mm) recorded at St Lucia (EKZNW) main office since 1953/54 (Fox & Mfeka, 2022a).

Note that this graph was produced prior to the April-May 2022 flood events (refer Fig. B), therefore the updated 2022 figure will increase.

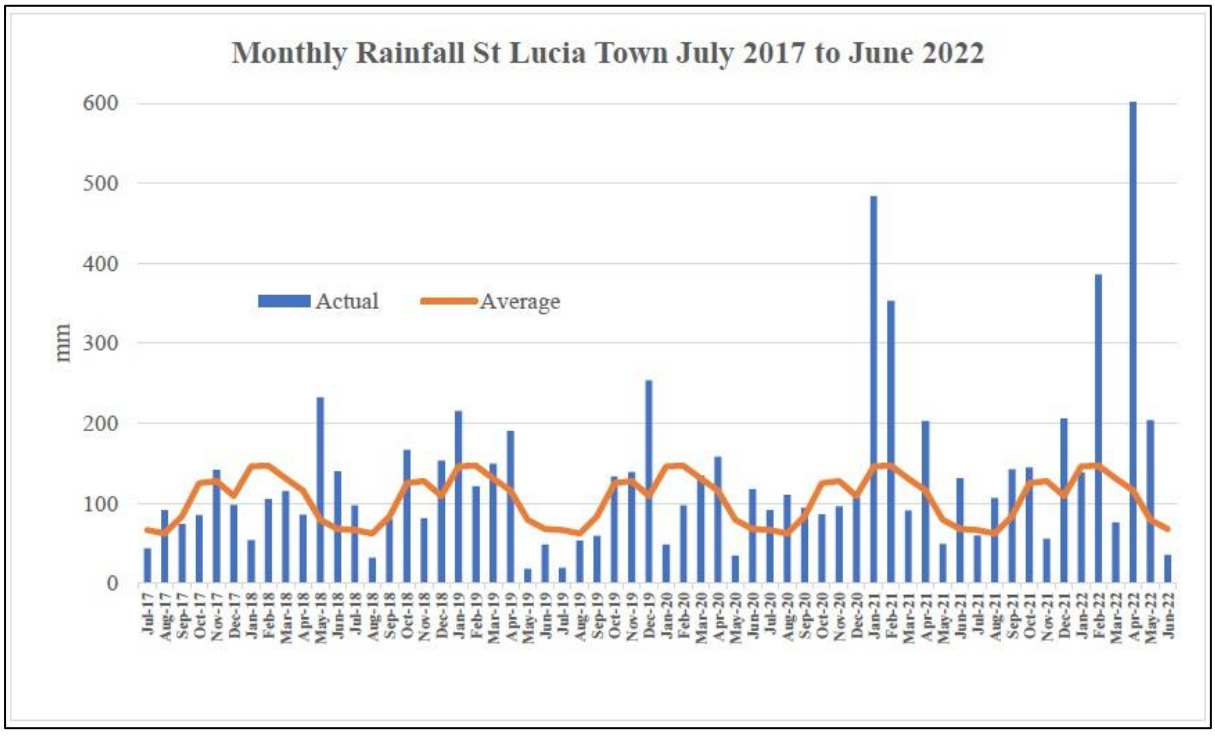

Figure 7: Total monthly rainfall measured at the St Lucia EKZNW main office (S28.382733 E32.412099) for the past five years together with the long term average rainfall (since 1971) (Fox & Mfeka, 2022b).

Winds blow predominantly from the north to north-north-east (NNE) and south to south-west, in approximately equal proportions, associated with the South-West Indian Ocean Anticyclone and passage of coastal lows and cold fronts, respectively. There are seasonal variations, with NNE winds more dominant during summer and south-west and north-west winds more prevalent during winter. There is a diurnal onshore sea-breeze effect, especially in summer. Nocturnal offshore landbreezes, draining from inland from the north to west during winter, can cause low temperatures overnight and early morning.

1.9 Land-use

The dominant land uses for the catchment are nature reserves, commercial agriculture and plantations with other significant uses including rural settlements. Several kinds of living and non-living resources are harvested for food, medicine and raw materials. Most of the value provided by the Lake St Lucia Estuary comes from the provisioning, regulating aesthetic and cultural services and in particular the nursery value which provides benefits to the marine environment.

Tourism is an important sector for this region. There are several well-known nature reserves in the Water Management Area managed by Ezemvelo KZN Wildlife as well as a number of private game reserves. Most of the tourism value in the area which was estimated at R 177 million per annum, is attributed to be associated with St Lucia Estuary (DWAF, 2010). The town of St Lucia is significantly dependent on estuary related tourism.
Detailed estimate will be provided in the phase 2 of this EstMP

Communities living around the estuary harvest a variety of plant resources mainly:

- *Juncus kraussii* or iNcema – used to make traditional sleeping mats.
- *Phragmites australis* – reeds for building.
- *Schoenoplectus scirpoides* and other sedge species – used in craftwork.
- *Hyphaene coriacea* or lala palm – leaves used in craftwork.

St. Lucia is considered to be the most important nursery ground for juvenile fish on the east coast of South Africa (Blaber, 1980). It is not only a nursery ground for fish spawned near St. Lucia, but also for those spawned along a large area of the continental shelf adjacent to the Tugela Banks and Richards Bay (Blaber, 1980). Fish larvae of 44 families and 85 species have been recorded in the St. Lucia Estuary, with 54% of the taxa being dependant on the estuary to some degree. St. Lucia is one of the most popular recreational angling destinations in the country, attracting over

150,000 anglers per year (Mann, 1993). The indirect financial benefits of this industry include tourism, tackle, boats, vehicles, and bait; however, they have not yet been evaluated (Mann, 1993). In 1989, recreational angling was reportedly increasing by 6% per annum, which raised concerns about the sustainable use of St. Lucia's fish resources.

Fishing is a significant livelihood in the area (Turpie et al., 2014) with an estimated 120 - 820 tonnes of fish and 100 tonnes of crustaceans provided by the estuary each year. These catches are estimated to be worth in the region of R 12 million. In 2009, total fish catch was estimated to be only 8 tons, worth R 240,000 (Kyle, 2010). However, the fishery would have been badly impacted by prolonged mouth closure up to this time. Some quantitative estimates of the resource utilisation exist for Lake St Lucia (DWAF, 2010) which tried to include direct and indirect utilisation, as well as non-consumptive values.

2. OVERVIEW OF ECOLOGICAL FUNCTION AND STATE OF ESTUARY

3.1 Abiotic function

Lake St Lucia and its estuary has a long history of anthropogenic intervention including canalisation of some feeder rivers, artificial breaching and maintenance of an opened mouth, water abstraction, dredging, and changes in protection status and management authorities. The historic artificial separation of the uMfolozi River from the St Lucia system compromised estuarine integrity and had a significant effect on water balance and salinity. The long-term significance of changes in terms of declines in freshwater inputs into the lake as a result of catchment modification, damming, canalisation, abstraction and expanding commercial forestry cannot be overemphasised.

3.1.1 Hydrology and geohydrology

Hydrology and geohydrology are crucial to understanding the many aquatic habitats. These habitats include major rivers and their floodplains, swamps, coastal lakes and estuaries, and smaller freshwater wetlands and pans which occur throughout the park. A number of pans and swamps occur throughout the park, some of these are part of river and lake systems, while others form as a result of the perched water table. The smaller rivers and streams entering and within the park are largely seasonal, being reduced to isolated pools during the dry months.

Lake St Lucia is the largest estuarine system in South Africa and on the African continent (Begg,

1978). Sediment accumulation from river inflow has produced a shallow lake (average depth <1 m). Fresh water inputs are derived from stream-flow, rainfall and dune seepage and these inputs determine salinities in Lake St Lucia, which are highly variable in response to variations in rainfall and run-off. Evaporative water loss exceeds inputs from direct rainfall, even in years of average or above-average precipitation. Water movement between the St Lucia Lake and the estuary is restricted by "The Narrows".

3.1.2 Groundwater

Groundwater on the Eastern and Western Shores contributes to the baseflow in rivers and is important in sustaining the ecological resilience and functioning of the lake (Perissinotto et al., 2013). The groundwater aquifer of the Maputuland coastal plain is classified as a coastal aquifer and is considered the largest primary aquifer in South Africa (Meyer et al., 2001). The base of the primary aquifer is formed by the silt- and clay-rich sediments of the Cretaceous period rocks. This terrestrial aquifer is under threat due to the risk posed by seawater intrusion, either by over-exploitation or sea level rise (Ferguson and Gleeson, 2012). There is a declining gradient in groundwater resources, and the depth thereof, from east to west, as determined by the rainfall and underlying geology. Mean annual run-off is between 200-500 mm pa in the southern coastal strip (Bailey & Pitman, 2015). Average groundwater resource potential shows that the eastern portion of the Maputuland Coastal Plain has 25 000 – 50 000 m^3/km^2 pa.

Aquifer recharge is > 100 mm pa in the east to 5 -10 mm pa in the west (Bailey and Pitman, 2015), or varying between 18% and 5% from coast to inland. (Meyer et al., 2001) Average depth to groundwater varies from < 5 m along the coastline to approximately 40 m along the Lubombo range. Generally, the hydraulic head of the coastal aquifer is seaward (Meyer et al., 2001).

The two primary porosity aquifers present on the Maputaland coastal plain, which influence the Park's aquatic habitats are:

- The shallow, unconfined aquifer or perched water table in areas of the park receiving rainfall in excess of 800 mm pa, and which is present due to the high permeability and infiltration of the KwaMbonambi sand cover of the coastal plain. Due to the high-water table (1 – 6 m) this aquifer is fairly extensively exploited.
- The deeper confined aquifer of the Uloa and Mkwelane Formations holds a significant amount of groundwater. The Uloa Formation is seen as a promising aquifer in the area but is not present everywhere on the Maputuland Coastal Plain. Little is known about how this aquifer is

recharged and it is not greatly utilised.

There is a delicate balance between the ecosystems and the groundwater regime and care must be taken to avoid over- exploitation of the coastal aquifer, as this will negatively affect the ecosystems (Meyer et al., 2001; Grundling, et al., 2014). Regional pollution from agricultural practises (which introduce nutrients) and denser settlements with inadequate sewage disposal pose a risk to aquifers. Wastewater and sewerage effluent from inappropriate systems can pollute the upper aquifer but is less of a risk to the deeper aquifers (Meyer et al., 2001).

Groundwater on the Eastern and Western Shores contributes to the baseflow in rivers and is important in sustaining the ecological resilience and functioning of the lake (Perissinotto et al). The seepage from the Nkazana stream that drains the Eastern Shores has not stopped flowing (even through the 2015/16 devasting drought) due to this groundwater seepage (Perissinotto et al). The level of groundwater is measured monthly, when possible, on the Eastern Shores in boreholes that have been in place for over twenty years. These boreholes need to be refurbished as they do clog up. The water level is measured by means of an electronic sensor attached to the end of a long tape measure (on loan from SAEON).

The level of groundwater is measured monthly, when possible, on the Eastern Shores in boreholes that have been in place for over twenty years (Fox & Mfeka, 2022). Recent data below (figure 9) shows that the groundwater level at this borehole stayed consistently high as a result of the high rainfall of early February and rose higher following the high rainfall of April and May 2022. The other boreholes on the Eastern Shores showed similar trends. The depth to groundwater is an indicator of the amount of open water in the pans of the Eastern Shores, as most of these pans are in topographic dips and hence, they intersect this groundwater level (Fox & Mfeka, 2022).

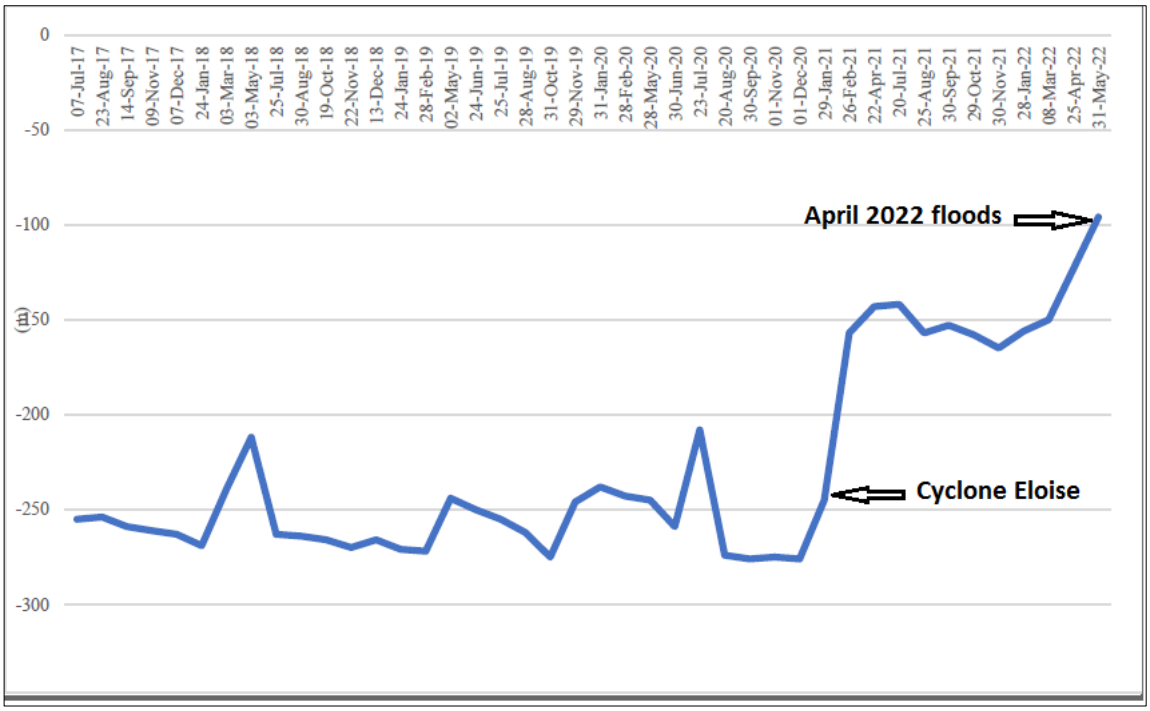

Figure 8: The depth of the groundwater table below the surface for well number D4b (old) (in centimetres) in the raised area of the Ezibomvini area of the Eastern Shores for the past 5 years (adapted from Fox & Mfeka, 2022b).

3.1.3 Lake levels

Water level in St Lucia provides a measure of the volume of water contained in the Lake, as well as the area of water surface. At present it is important to understand the effects high water levels are having on vegetation in the periphery of St Lucia as well as the flooding of grazing and the impacts on people and land-uses beyond the lake. The lake levels are currently extremely high as a result of substantial rainfall and input from sustained flows from all the rivers entering Lake St Lucia.

Figure 9: Water levels at the St Lucia Bridge (S28.369954, E32.409939) over the past five years. (The data is not calibrated to mean sea level). The yellow line indicates that the level has been above 2 m since late Dec 2021

3.1.4 Water quality

The most biologically significant water quality parameters in the Lakes, Narrows and the uMfolozi-Msunduzi complex under present conditions are salinity, turbidity and, to a lesser degree, temperature. All these parameters undergo large temporal and spatial fluctuations in response to rainfall and other environmental factors. These fluctuations move the estuary through many different states e.g., from freshwater through to very saline and it is this that drives the diversity of the biological components of the Estuary.

Salinity indicates the ecological state of the lake system. Salinity is one of the most important factors in estuarine ecosystems, as it determines the composition of animal and plant life there (Fox & Mfeka, 2022). Sea water salinity is 35 ppt (parts per thousand, i.e.,35 grams of salt per 1000 grams of saltwater), while that of fresh water is measured at 0 ppt. Table 1 provides the different salinity states that can be found at Lake St Lucia.

Table 1: Salinity states in Lake St Lucia

State	Salinity range	Description
1	0-4	Fresh
2	4-12	Brackish
3	12-25	Low marine state
4	25-45	Medium marine state
5	45-65	High marine state
6	>65	Hypersaline

Figure 10 below illustrates the salinity measured during the past five years. A ‘reversed’ salinity pattern is evident, where the northern parts of the lake were more saline than the southern area. This higher salinity in the north is largely due to the residual salt in the system after the drought conditions of a few years ago. After the mouth breached in mid-April 2022, seawater was able to penetrate only to a small degree into the St Lucia Bay and lower portions of the Narrows. The southern half of Lake St Lucia has effectively been a freshwater lake for the past four years (Fox & Mfeka, 2022b).

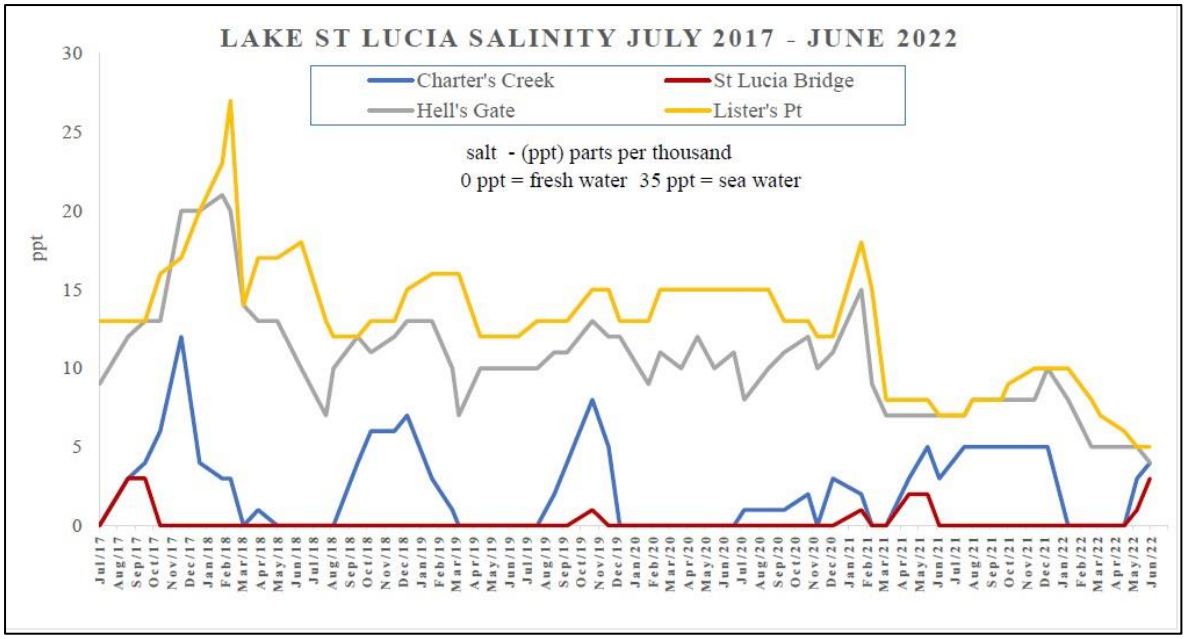

Figure 10: Track of salinity concentrations over the past five years for North Lake (Lister's Point & Hell's Gate), South Lake (Charter's Creek) and the Narrows (St Lucia Bridge).

No water quality data (e.g. e. coli, pH, dissolved Oxygen, etc) is available, but it is known that there have previously been concerns about water quality of the uMphathe River and the KwaNdonyana stream, which discharges into the western shores of the Narrows, is currently polluted, the probable source being Khula village.

3.1.5 Mouth dynamics

The mouth of the Lake St Lucia is dynamic and migrates northward with longshore drift (refer Fig. 11). Historically, mouth dynamics in terms of closure and position between Maphelane in the south and the St Lucia high ground to the north were driven by the interaction between flow levels in the uMfolozi River and wave induced marine sediment movements. A long history of river diversion (uMfolozi River) and artificial breaching has occurred and this has influenced strongly the physical state of the estuary. The policy of diverting the uMfolozi River to sea which was initiated in 1952 was changed by the iSimangaliso Authority sixty years later in 2011/2012. An active relinking of the uMfolozi River with the St Lucia Estuary occurred in July 2012 and this began the process of restoring estuarine function. The uMfolozi River migrates naturally northwards to link with the estuary. Previously artificial breaching would pull the river back southwards by diverting it to sea in the vicinity of Maphelane. The active facilitation of the re-joining of the uMfolozi River with the St Lucia system is currently being implemented by the removal of the dredge spoil that has been deposited in the vicinity of the estuary

mouth in combination with the complete cessation of mouth interference. The uMfolozi transports large volumes of mud and, prior to the GEF rehabilitation project, used to enter the sea to the south of St Lucia town at Maphelane. Although artificially separated from Lake St Lucia since 1952 to prevent the inflow of suspended sediment into the main St Lucia system, the link between the uMfolozi River and Lake St Lucia was re-established under a new management approach in 2012 and Lake St Lucia and the uMfolozi River mouth have since been managed as one system.

The St Lucia/Umfolozi mouth was artificially breached in January 2021, following concerns about high rainfall, backflooding and siltation of the estuary. The mouth had been closed to the marine environment since 2014 and a large sand berm and establishment of sand dunes prevented a natural breach. The main objectives for this breach, among others, were to restore the nursery function of the system and to flush out the accumulated silt load originating from the uMfolozi and its catchments (DFFE, 2022). The breach was carried out by iSimangaliso Wetland Park Authority with the advice of a scientific and technical task team. This process was subsequently taken under review (DFFE, 2022) by an Independent Panel of Experts appointed by the Minister.

Summary and recommendations as per the report 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

The findings of the panel outline the impact of the breach, stakeholder perceptions, and the alignment of the breach to authoritative reports. Its states that the breach did not contravene the recommendations in the Maintenance Management Plan, however it does go against the GEF report recommendations (Independent panel experts-DFFE, 2022). The breach did not appear to have a significant ecological impact and it was found that the circumstances necessitating a breach were largely undefined. The findings form the panel report further highlights a gap in the socio-economic context regarding management plans and modelling of management scenarios. Although hydrological and ecological data provide useful insight into the environmental reality of managing estuarine systems, social actors are important ecosystem components and to exclude social or economic realities from management plans will only further exacerbate conflict between management and related stakeholders ((Independent panel experts-DFFE, 2022). Lastly, the panel provides key recommendations for the ongoing monitoring and management of the system along with potential directions for future investigation. The panel concludes that the increased attention around the St Lucia system heralds optimism for its ecological well-being and for the subsequent well-being of all interested and affected stakeholders. With careful planning, ongoing monitoring and improved multi-stakeholder

liaison, there is opportunity for collaboration and co-production of knowledge so that varied inputs can be included in policy decision making and all may benefit equitably from the ecosystem services of this system (Independent panel experts-DFFE, 2022).

The mouth closed again during June 2021 and built up an approximate 1.2 m high sand berm, but was naturally forced open again, at the same location, following the April 2022 floods and remains open at the time of writing. The mouth has now migrated some 300 m northwards since October 2022, most likely following the impact of equinoctial tides, south-easterly swells and longshore drift. This mouth movement is to be expected; the mouth has historically previously migrated north of the ski-boat ramp

Figure 11: Movement of the St Lucia/Mfolozi mouth (imagery: Google Earth)

3.2 Biotic function

The estuary has a diversity of important habitats including swamp forest, mangrove, reeds and sedge swamp. Despite its present fragile state, it remains a nationally critically important coastal estuarine lake by virtue of its unique size, animal and plant diversity and its role in coastal biological processes, especially as nursery ground for both fish and invertebrates, particularly crustaceans.

The Lake St Lucia Estuary complex has been the subject of more research, scientific publications and controversy than any other estuary in the country. It is clear from the large body of information that the high variability of the physical and chemical parameters of the system is natural, and that this is an important driver of spatial and temporal biotic diversity. However, the removal of the uMfolozi River from the system has resulted in the variability being pushed to extremes as low water levels and extremely high salinities were experienced during the drought. The estuary was described in the National Biodiversity Assessment (van Niekerk & Turpie, 2012) as being in poor condition generally but largely as a result of the historical separation of the uMfolozi River combined with prolonged drought conditions. At that time, the estimates of estuary health suggested a Present Ecological Status of E, being “highly modified”

The estuarine system hosts several habitat types in terms of vegetation. These include mangrove systems, salt marsh area, sedges and reeds, swamp forests, submerged vegetation and macroalgae, sand- and mud-flats (Lück-Vogel et al. 2016). Each of these habitats is characterized by a unique set of flora and fauna and each contributes to the functions of the estuary. Mangroves and the water column are well-known nursery habitats; salt marsh, mangroves, and submerged macrophytes all have high carbon sequestration capacity; and all these habitat types provide important food sources for the overall estuarine trophic web. Each habitat has a different tolerance to the fluctuation between freshwater and hyper salinity, the varying connectivity to the sea, the silt load and the inflow of nutrients and water.

3.2.1 Invertebrates

Invertebrate species which have been observed to occur within the St Lucia estuary include shellfish such as Solen, penaeid prawns, and Melanoides snails. Many of these species have succumb to the pressures facing the estuary and have declined or completely collapsed. The once extensive bed of Solen species has disappeared as a result of the estuary mouth closures and freshwater conditions (Van Niekerk et al., 2019). Likewise, the migratory crab *Veruna litterata* has long been unable to complete its migration into the estuary due to its closed mouth state. However, in 2022, following the mouth breaching,

post-larvae *V. litterata* were observed along the edges of the mouth and were attempting to enter the estuary (Fox and Mfeka, 2022). Hundreds of freshwater prawns, *Macrobrachium equidens*, were also found stranded along the St Lucia beach suggesting its widespread population numbers within the estuary (Fox and Mfeka, 2022). Phytoplankton community composition has shifted from predominantly marine based groups to freshwater and eutropic groups, a consequence of the silt laden inflow from the uMfolozi River and overall freshwater conditions (Van Niekerk et al., 2019).

Terrestrial invertebrates include 282 butterflies, 52 fruit chafer beetles, 38 dragonflies and damselflies, 228 spiders, 5 scorpions and 41 terrestrial molluscs as well as millipedes. There is a high diversity of marine molluscs on the coral reefs, in rock pools and off the shore platforms, with 812 species recorded. Extensive beds of Pinna bicolour occur in the bioclastic dune troughs near Sodwana Bay (Ramsay et al., 1996). The coral reefs host 129 hard and soft coral species and 20 species of sponges as well as species typical of inshore and coral reef environments, e.g., sea anemones, hydroids, crustaceans, etc. Coral reefs in South Africa are solely confined to the iSimangaliso Marine Protected Area (northern KwaZulu-Natal).

3.2.2 Fish

Estuaries are highly productive, are often less turbulent, have higher water temperatures, provide more shelter, and have fewer predators than the marine environment (Whitfield, 2019). As such, these environments are highly attractive to fish, providing suitable nursery habitats for juveniles of many species (Wallace et al., 1984; Vorsatz et al., 2021) and supporting resident and migratory species (Elliott et al., 2007). The St Lucia estuary is an important nursery ground for juvenile marine fish, prawns and crabs. The warm, clear offshore marine environment hosts a variety of demersal and pelagic fish species (Guastella, 2002). The highest species diversity of fishes along the South African coast is found within the (then) St Lucia and Maputaland marine reserves (Beckley & Pradevand 1999). Most fish species are of the Indo-Pacific ichthyofauna and are typically West Indian Ocean in character, however, a number of fish species of Atlantic Ocean origin are also present.

Figure 12: **Alien Tarebia granifera snails stranded by the sinking water levels in the lake. Indigenous snails interspersed within image, b) Stranded Macrobrachium equidens,, c) Veruna litterata along the edges of the estuary mouth, d) freshwater Tilapia within the estuary.** All images adapted from Fox, C & Mfeka, S. (2022) Current physical & biological **conditions of Lake St Lucía & the Mfolozi/Msunduzi Estuary, Jan to Mar 2022 and Fox, C & Mfeka, S. (2022) Current physical & biological conditions of Lake St Lucía & the Mfolozi/Msunduzi Estuary, April to June 2022**

The fish species richness of the St Lucia estuary has declined drastically over the years in response to mouth closures, increased freshening and hypersalinity. Earlier surveys recorded a total of 82 species of fish with commonly caught species being *P. commersonnii*, *A. hololepidotus*, *A. berda*, and *R sarba*. These species were largely of marine origin, making use of the estuarine system to various degrees (Begg, 1978). A more recent survey conducted in 2008 to 2011 revealed a decrease in the number of species from 51 in 2008 to 27 in 2011(Schutte et al., 2020). This decrease was likely a result of the closed state of the system preventing the recruitment of 22 marine species which had previous occurred. In 2014, an almost complete absence of marine migrants were observed with the estuary being dominated by two freshwater species, namely the sharp tooth catfish and the Mozambique Tilapia (Forbes et al., 2020). Obvious declines from the earlier survey in 1978 also highlight the impacts of recreational and subsistence fisheries in the system (Whitfield, 2019). A total of 55 freshwater fish and 212 estuarine fish are listed within the Park area. The St Lucia and Kosi estuaries are important nursery grounds for juvenile marine fish, prawns and crabs. The warm, clear offshore marine environment hosts a variety of demersal and pelagic fish species (Guastella, 2002). The highest species diversity of fishes along the South African coast is found within the (then) St Lucia and Maputaland marine reserves (Beckley & Pradevand 1999).

Most fish species are of the Indo-Pacific ichthyofauna and are typically West Indian Ocean in character, however, a number of fish species of Atlantic Ocean origin are also present. A total of 992 marine fish species have been recorded offshore of iSimangaliso, of which 399 are reef species. Approximately 16% of fish species are endemic to the area (Smith, 1980). The most notable fish is the Coelacanth, which is found in the deep marine canyons. Another important species is the Brindle Bass, the largest reef-dwelling fish in the world. On the other end of the scale, the smallest fish species is most likely the Sodwana Bay pygmy seahorse, which was recently (May 2020) discovered off Sodwana Bay. Migratory pelagic gamefish utilising the offshore Agulhas Current are common in summer, including six marlin species. The inshore areas are also occasionally visited by whale sharks during summer and a number of shark species are known to frequent inshore and offshore areas, including aggregations of the Ragged Tooth Shark at certain locations

3.2.3 Reptiles

The St Lucia estuarine system is home to the second largest breeding population of Nile Crocodile in South Africa, one of the last two remaining viable breeding populations in the country. Crocodiles frequent the rivers, lakes and estuaries, in particular the lower reaches of the uMfolozi, St Lucia Lake and Lake Bhangazi and breed during summer. There are an estimated 1 500 crocodiles of greater than 2 m length in the St Lucia estuarine system alone. Other reptiles include water monitors and 42 species of lizards, skinks, agamas, geckos and chameleons, including the endemic Setaro Dwarf chameleon.

162 reptiles have been recorded in the Park, including 53 snake species. iSimangaliso is the only protected area where Gaboon Adders are found and Black Rock is the only known location of the Bouton's snake eyed skink in South Africa. There are 12 species of Testunids, i.e., turtles and tortoises (five marine, four freshwater and three terrestrial species). The northern section of the park provides nesting beaches for loggerhead turtles and the critically endangered leatherback turtles; these are the only turtle nesting beaches in the country. Turtle nesting and hatching takes place at night during the summer months. In addition, green, olive ridley and hawksbill turtles are occasional visitors to subtidal habitats in the park. iSimangaliso also provides habitat for the southernmost-recorded breeding population of the yellow-bellied hinge terrapin. Crocodiles frequent the rivers, lakes and estuaries, in particular the lower reaches of the uMfolozi, St Lucia Lake and Lake Bhangazi and breed during summer. There are an estimated 1 500 crocodiles of greater than 2 m length in the St Lucia estuarine system alone. Other reptiles include water monitors and 42 species of lizards, skinks, agamas, geckos and chameleons, including the endemic Setaro Dwarf chameleon.

3.2.4 Birds

Lake St Lucia is a highly important staging area with more than 50% of all water birds in KwaZulu-Natal feeding, roosting and nesting in this estuary. It is the breeding area for several birds, which are rare or have limited distributions in South Africa (iSimangaliso Wetland Park Authority, 2016). Waterfowl include flamingos, pelicans, and waders, along with breeding colonies of pelicans, yellow-billed storks, herons, Caspian terns, spoonbills, red-winged pratincoles, and the African fish eagle have been observed here. According to the 2021 and 2022 Ezemvelo Monitoring report, the vast majority of recorded waterbirds were observed in the northern areas of the Lake (False Bay and near the uMkhuze river mouth). This was largely attributed to a reduction in shallow water areas including islands and mudflats which serve as feeding grounds for the birds (Fox and Mfeka, 2022).

A total of 525 terrestrial and water bird species have been recorded in the park area. There are 47 subspecies of birds that are endemic to the Maputaland region and four South African endemic species. It is one of the principal avifaunal breeding areas in South Africa as 339 bird species (62% of the total list) are known to, or are considered to breed, in the park. Lake St Lucia is the most important estuary in terms of the numbers and diversity of water birds, which it supports. The estuary is a very important staging area with more than 50% of all water birds in KwaZulu-Natal feeding, roosting and nesting in this estuary. It is the breeding area for several birds, which are rare or have limited distributions in South Africa (iSimangaliso Wetland Park Authority, 2016). Waterfowl include flamingos, pelicans, and waders, along with breeding colonies of pelicans, yellow-billed storks, herons, Caspian terns, spoonbills and red-winged pratincoles, as well as the African fish eagle.

3.2.5 Vegetation

The St Lucia Estuary harbours the second highest mangrove area cover of all estuaries in South Africa. However, pressures such as relinking to the uMfolozi catchment, mouth closures, freshening and siltation has resulted in a loss in mangrove area from 331 ha to 288 ha since the 1960s (Adams and Rajkaran, 2021). Reed swamps occur along the edges of most of St Lucia although the greatest extent can be found in the Mkuze swamps in the extreme north of the estuary. Other previously recorded vegetation types include two species of submerged macrophystes (*Potamogeton pectinatus* and *Zostera capensis*), swamp forests (*Ficus, Barringtonia, Voacanga and Syzygium*, sedges (*Scirpus, Juncus*) and hydrophilous grasses (*Sporobolus* and *Paspalum*). Recent data has confirmed that *Zostera capensis* is now absent from the lake and will not return if freshwater conditions persist (Van Niekerk et al., 2019). The main terrestrial vegetation surrounding the estuarine area are of the savannah biome and coastal

dune vegetation at the estuary mouth. Extensive forestry plantations in the form of pine and eucalyptus still occupy an extensive area inland of the system (Begg, 1978).

The Park is located at the southern end of the Maputaland Centre11 of Plant Endemism, part of the Maputaland-Pondoland-Albany biodiversity hotspot. The vegetation types and sub types recognised according to the classification system of Mucina and Rutherford (2006) are listed hereunder. Map 16 provides the biomes and Map 17 the vegetation types.

Savannah Biome

Southern Lubombo Bushveld
- Tembe Sandy Bushveld
- Western Maputaland Sandy Bushveld
- Western Maputaland Clay Bushveld

Indian Ocean Coastal Belt Forest
- Northern Coastal Forest
- Sand Forest
- Lowveld Riverine Forest
- Swamp Forest
- Mangrove Forest

Azonal Vegetation
- Subtropical Seashore
- Vegetation
- Subtropical
- Dune Thicket
- Subtropical
- Freshwater Wetlands
- subtropical
- Salt Pans

The iSimangaliso Wetland Park Rare, Threatened & Endemic Species Project lists 2,185 vascular plants within the park, representing 736 genera. 46 species are endemic. For many plants, this is the southernmost extent of their distribution range. The area provides the ideal habitat for mangrove swamps and 6 species of mangrove tree have been recorded. The Futululu area in the south is reportedly the best remaining example of coastal lowland forests. There is also a high diversity of marine vegetation: 325 seaweed species have been recorded, representing more than 78% of the total seaweed species for the KwaZulu-Natal coastline.

Mangroves

The stands of mangroves continue to stress and die off as their roots remain inundated with water

Alien vegetation

Alien plants includes Casuarina equisetifolia., or “beefwood”, in the coastal areas. Casuarina is regarded as an effective stabiliser of mobile sediments and was historically planted to maintain access routes across dunes, establish windbreaks and shade, and to alleviate concern over the impact of mobile dunes on water resources (Bundy, 2015). The pine and eucalyptus plantations that occupied the Eastern shores have been removed and replaced with grassland and wetland, whilst restoration of the Western shores is ongoing . Other alien vegetation species typically found in KZN such as Lantana camara, Chromolaena odorata bugweed, castor oil bush, etc are present in some areas, as well as aquatic species such as water hyacinth Eichhornia crassipes and Pistia stratiotes. A few of the large Casuarinas have been chopped down and left on the dunes at the St Lucia Beach – this is part of the alien plant removal programme.

The marine Biome

Characterised by a warm sea and includes dune, rocky shore, rocky reef, coral reef and pelagic ecosystems. Importantly, iSimangaliso houses the southernmost extension of coral reefs in Africa, submarine canyons that host the Coelacanth and long sandy beaches utilised by Loggerhead and Leatherback turtles for nesting. Two distinct marine biogeographic regions are represented in the Park, with an important break at Cape Vidal:

- Maputaland Sub-province of the Tropical Indo-West Pacific Province (Cape Vidal Point northwards to Ponta do Oura). Many of the species in this region are not found elsewhere in South Africa.
- Natal Sub-province of the Sub-tropical East Coast Province (South of Cape Vidal Point to Cape St Lucia), with many endemic marine species.

The terrestrial biome

Includes savannah, sand forest, coastal forest and grassland ecosystems. On the eastern shores sub-tropical forests and grasslands dominate. On the western shores ancient shoreline terraces and dry savannah woodlands, thickets and sand forests occur on the higher lying ground between the coastal plain and the Lubombo Mountains.

The aquatic biome

Includes wetland, riverine, and freshwater lake systems. The freshwater lake systems consist of three lakes (Sibaya, Bhangazi North and Bhangazi South). The uMkhuze River supports swamp forest and the uMfolozi floodplain contains extensive reed and papyrus wetlands. Three distinct ecosystems, viz. beaches, estuaries and swamp forest, cannot be classed as discrete biomes, but are strongly influenced by the dominant features or processes of two or more biomes. The estuaries (Kosi Bay, Mgobozeleni and Lake St Lucia) are shaped by a combination of terrestrial, freshwater, aquatic and marine processes and communities; while beaches and swamp forests are a product of land-sea and land-water interactions, respectively. The many ecological linkages between these ecosystems have attracted research interest in a number of geomorphological and biological processes.

3. ECOLOGICAL HEALTH STATUS (AS PER EWR STUDY OR NBA ASSESSMENT)

3.1 Estuary Type

In South Africa, estuaries are generally classified on the basis of physiographic (tidal prism and size), hydrographic (mouth state and mixing process) and salinity characteristics (Whitfield, 1992). Of the five generally recognised estuary types, the St Lucia Lake complex is classified as an estuarine lake system (Whitfield & Baliwe, 2013). Estuarine coastal lakes are estuaries that have a large surface area. The estuaries have been formed over time with changes in sea level creating drowned river valleys which are then filled in by reworked sediments and separated from the sea by vegetated sand dune systems. These types of estuaries can be permanently open or closed for periods when the link with the sea is lost and can have large salinity fluctuations, driven by fluctuations in freshwater input, evaporation and sea condition. The tidal prism is small and marine and river input have little influence on water temperatures, which are directly related to solar heating and radiation. Estuarine, marine and freshwater organisms all occur depending on the salinity condition of the system. These are three of nine coastal lake estuaries on the South African coast and are now the only three intact systems within the sub- tropical bioregion.

3.2 Estuary Health Status

The health status of an estuary is determined using the Estuary Health Index (EHI). The EHI is a standardised metric for use in estuary management and the determination of ecological water requirements. To determine overall health, the estuary is evaluated by estimating the estuary conditions, both physical and biological characteristics, for the Reference Condition and then

scoring the present conditions relative to this estimated Reference Condition. The score derived from this assessment is the Present Ecological State (PES) score and falls into one of six categories (A-F) detailed in the table overleaf.

The Lake St Lucia Estuary was described in the National Biodiversity Assessment (van Niekerk & Turpie, 2012) as being in poor condition generally but largely as a result of the historical separation of the uMfolozi River combined with prolonged drought conditions. At that time, the estimates of estuary health suggested a Present Ecological State of 'E', being "highly degraded" (van Niekerk & Turpie, 2012). Since the NBA, a more detailed re-evaluation of estuary health concluded that as a result of the relinkage of the uMfolozi River, the ecological health score is now a low 'C' category "Modified" (Clark et. al., 2014). A preliminary Recommended Ecological Category has been generated for all estuaries and for the Lake St Lucia system, this has been determined to be 'A or Best Attainable State' given that the estuary is:

- Located within a proclaimed protected area and World Heritage Site.
- Within the St Lucia Ramsar Site .
- Listed as a national priority for estuary conservation (van Niekerk & Turpie, 2012).
- In relatively good condition considering the current state of the collective estuarine resource in KwaZulu-Natal and South Africa (van Niekerk & Turpie, 2012; Whitfield & Baliwe, 2013).
- By far the largest estuary in the country, comprising approximately 60% of the national estuarine area, 80% of the sub-tropical estuarine area and 90% of the protected estuarine area.
- Recognised as one of the three most important nursery habitats for estuary-dependant marine fauna in the country.
- Known to support a number of rare and threatened species, being situated within a transition zone between the tropical and subtropical bioregions (iSimangaliso Wetland Park Authority, 2011).

The Lake St Lucia Estuary was described in the National Biodiversity Assessment, 2019 (Van Niekerk et al., 2019) as being in poor condition generally but largely as a result of the historical separation of the uMfolozi River combined with prolonged drought conditions. At that time, the estimates of estuary health suggested a Present Ecological State of 'E', being "highly degraded" (van Niekerk & Turpie, 2012). Since the NBA(2019), a more detailed re-evaluation of estuary health

concluded that as a result of the relinkage of the uMfolozi River, the ecological health score is now a 'D' category "Modified" (Van Niekerk et al., 2019). The St Lucia Estuary ranks within the top 50 South African estuaries of conservation importance and has been given an importance rating of 96.6 % (highly important) (Turpie et al., 2002). The estuary is also regarded as an Important Bird Area (IBA), Ramsar sites and is given a "high priority" with regards to Important Fish nursery. The recommended Ecological Reserve Category (REC) represents the level of protection which should be assigned to an estuary. The recommended REC for the St Lucia Estuary was previously rated as a category "A", however according to the National Biodiversity Assessment (2019), the estuary has been designated as category D.

Estuary Health Index Score	Present Ecological State	Description
100 - 91	A	Unmodified, natural
76 – 90	B	Largely natural with few modifications
61 – 75	C	Moderately modified
41 – 60	D	Largely modified
21 – 40	E	Highly degraded
0 – 20	F	Extremely degraded

A detailed and current estuary health status with latest scoring will be provided as phase 2 of this EstEMP.

3.3 Key Features

St Lucia is the world's oldest protected estuary (1895) and one of Africa's largest estuarine systems. It is also the centre piece of South Africa's first UNESCO World Heritage Site, the iSimangaliso Wetland Park, and has been a Ramsar Wetland of International Importance since 1986. Its importance as a functioning ecosystem is also confirmed by its selection as a priority estuary to satisfy the biodiversity targets of the country. This is an obvious choice as the estuary supports high levels of biodiversity and viable populations of threatened species, which are of international and national importance, including feeding and breeding areas for endangered and endemic species. The interaction of these environments with major floods and coastal storms in the Park's transitional location has resulted in continuing speciation and exceptional species diversity. Its vivid natural spectacles include nesting turtles and large aggregations of flamingos and other waterfowl.

Estuaries play a unique role in coastal functioning. They are critical habitats for many species of fish, shellfish, birds and marine mammals. They are nursery areas for many species of fish that return to and are harvested in the open sea. As many as 75% of all commercially important marine fish depend upon estuaries at some stage in their life cycle. Estuaries, therefore, play a critical role

in the generation of protein-rich fish and shellfish. In many parts of the world, communities living near estuaries depend upon them for their food and livelihoods. Lake St Lucia is no different and is an important system for neighbouring communities, recreational and commercial fisheries, and local and international tourists.

Despite their importance as nursery areas for a large number of important recreational and commercial fish species, estuaries have not been well protected from impacting activities. This elevates the importance of Lake St Lucia for the prawns and fish of the sub-region making it one of the most important nursery grounds for juvenile marine fish and prawns along the sub-tropical east coast. It is also the most important estuary in terms of the numbers and diversity of waterbirds, which it supports. The estuary is a very important staging area with more than 50% of all waterbirds in KwaZulu-Natal feeding, roosting and nesting in this estuary. Importantly, it is the breeding area for several birds, which are rare or have limited distributions in South Africa. This has contributed to it being proclaimed a protected area, a Ramsar Wetland of International Importance and then finally a World Heritage Site.

Crocodiles are internationally recognized as important keystone predators in aquatic and terrestrial food webs, tourist attractions, good indicators of ecosystem health and flagship conservation species. The Lake St Lucia estuarine system is the most important protected area for the conservation of the Nile crocodile in South Africa. In terms of large aquatic mammals, the hippopotamus is an iconic animal for Lake St Lucia and contributes significantly to the 'brand recognition' of many of the businesses associated with the St Lucia Village. It is listed as 'Vulnerable' on the IUCN Red List and Lake St Lucia is recognized as having the largest viable population in South Africa. This provides significant conservation value to this already important system

4. ECOSYSTEM SERVICES PROVIDED BY ESTUARY

4.1 Definition of Ecosystem Services

Traditional definitions of ecosystem services are the conditions and processes through which natural ecosystems sustain and fulfil life. Ecosystem goods refers to material products that are obtained from natural systems for human use (Wilson et al., 2005). Ecosystem goods and services can be grouped into four broad categories namely, regulating, habitat, production and information services. Regulating

services relates to an ecosystems natural ability to regulate essential ecological process through bio-geochemical cycles. These may include climate regulation, storage of carbon in plants, the control of pest populations and water purification. Habitat services refer to the natural habitats which are available and provide refuge and reproduction areas for plants and animals. This contributes to the conservation of the genetic diversity of biological organisms. Productional services refer to any goods which are available for human consumption or raw material usage, including biofuels, foods, ornamental products or medicines. Information services contribute to the maintenance of human health by providing opportunities for reflection, spiritual enrichment, cognitive development or recreational experiences (de Groot et al., 2002).

In many instances, the human population requires monetary values to be added to intangible objects in order to appreciate its overall value. This is termed ecosystem accounting and it provides natural resource managers and policy makers with an overview of how changes in ecosystem extent and condition can affect economic outputs and human welfare (Van Niekerk et al., 2020). The ecosystem accounting approach redefined this definition to "contributions that ecosystems make to benefit human activities and the economy" (Van Niekerk et al., 2020). Estuarine services in South Africa are valued at ZAR 972 million per annum ,contributing substantially to the economy (Turpie et al., 2017).

4.2 Goods and Services provided by the St Lucia Estuary

The role of the St Lucia estuary in providing ecosystem goods and services has development into one which is largely tourism based, falling into the information services category. The number of accommodation establishments along with concession activities within the St Lucia Town has increased progressively over the years. Likewise, the type of tourists visiting this world heritage site has shifted from fishermen based to ecotourism based, with visitors more interested in the natural beauty and educational activities (IDP, 2020). The town receives approximately 460 000 visitors annually with annual expenditure equating to R917 million (Forbes et al., 2020).

The St Lucia system makes up about 80% of the estuarine area in Kwa-Zulu-Natal making it an important nursery habitat for estuarine and marine species. The presence of these estuarine and marine species has been the source of recreational fisher visitors in the past. However the systems dominate closed mouth state has reduced the system's ability to provide this service, and subsequently recreational fishing, although still present, has decreased (Cyrus et al., 2020).

St Lucia is rich in cultural heritage and has the potential for the development of archaeotourism. Some examples of cultural services and history which this estuary offers is listed below:

- The system is rich in artefacts and other remains of Early Iron Age (250 – 1000 AD) and Late Iron Age (1000 – 1840 AD) settlements (Maggs, 1984). These settlements exploited the peat bog iron ore deposits that occur in the vicinity of Lake St Lucia and other wetlands.
- Chief Somkhele of the Mphukonyoni, supporting King Cetswayo, fought against Zibhebhu kaMaphita, with the help of John Dunn in August 1883. Chief Somkhele lost the battle and fled to the swamps of Lake St Lucia (Dominy 1994).
- World War II remnants include the Catalina Jetty at Catalina Bay on Lake St Lucia, which was used as a base for the Royal Air Force (RAF) 262 Squadron between 1943 and 1944 (NCS 1995; Dominy, 1994), to supply air cover for allied shipping in the area. Currently the Catalina Jetty consists of several foundation structures, the jetty itself, and some concrete structures, which are currently under vegetation and not clearly visible.
- The establishment of an active military site in a conservation area on the Nhlozi Peninsula.

The estuary is also recognised for its “sense of place”. People of different backgrounds, locals, learners and conservationists have described their relationship with the estuary as spiritual, healing, calming and holding social value (Draft IMP 2022-2030).

Goods and Services provided by the St Lucia Estuary

- Utilization of natural resources (e.g., fisheries)
- Nursery function
- Boating and recreational facilities
- Tourism
- Cultural services
- Regulating services, such as carbon sequestration and water purification.
- Threats to the estuarine function
- Historical disasters and/or environmental emergencies/incidents and fish kills
- Opportunities and constraints for development and conservation, and dependence of local communities on the estuary
- Consideration of potential carrying capacity for activities

5. IMPACTS OR POTENTIAL IMPACTS AND THREATS TO THE ESTUARY (SWOT)

Estuaries and the adjacent marine environments are affected by direct and indirect anthropogenic impacts from their catchments, Given the role that estuaries play in the broader coastal environment and their sensitivity to human impacts (DEAT, 2000); a focused and coordinated approach to sustainable use of these ecosystems is essential to the continued delivery of ecosystem values, goods and services.

According to the most recent National Biodiversity Assessment,2019 six key categories of pressures on South African estuaries were identified. These included: flow modification, pollution, exploitation of resources, land use-development, estuary mouth manipulation and biological invasive species (Van Niekerk et al., 2019). Similarly, the current pressures facing the St Lucia estuary abide by these broader categories with the greatest pressure currently being fishing effort (very high), habitat loss (medium), pollution (medium), invasive plant species (medium), artificial breaching (low) and flow modifications (low) (Van Niekerk et al., 2019).

5.1 Fishing pressure

For decades St Lucia was referred to as a fisher's paradise. However, a lack of fishing control combined with mouth manipulation in earlier years has resulted in overfishing and subsequent stock declines of many well represented estuarine fish species, such as spotted grunter, perch and tropical stumpnose (Forbes et al., 2020). The total fish catches for the St Lucia estuary are currently at 296 tons per year (Van Niekerk et al., 2019).

Illegal gill netting has been a persistent concern within the St Lucia estuary for over 60 years. Efforts to legalise this process with the objective of providing sustainable subsistence fisheries for rural communities was unsuccessful, with fishermen reverting to commercial loads to maximise profits (Forbes et al., 2020). This fishery was therefore terminated, however reports from 2017 to 2019 indicated that illegal fishing is still occurring within the lower and upper Narrows, as well as within the North Lake off the Nibela peninsula (Forbes et al., 2020).

5.2 Mouth Manipulation

Historically, the St Lucia estuary and the uMfolozi estuary shared the same estuary mouth. During periods of drought, when the estuary mouth would close, water from the uMfolozi estuary would

flow into the St Lucia estuary preventing hypersaline conditions. The estuaries combined mouth would breach naturally when summer flow from the uMfolozi would cause water levels in the St Lucia to rise. However, habitat destruction from farming activities in the 1930s prevented the system's ability to trap sediment loads resulting in the siltation of the estuary mouth. The estuary mouths were eventually artificially separated to prevent sediment from the uMfolozi reaching St Lucia, however this resulted in additional mouth closures from a lack of water supply (Cyrus et al., 2020). A series of dredging projects commenced over the years in efforts to provide St Lucia with continued flow and to maintain marine fish migration during mouth closures. These efforts however have not been successful, with the almost continued closure of the estuary from 2002 to 2011 resulting in substantial declines in species richness, and abundance. Although the St Lucia mouth is currently open, the possibility of future closures should be considered and may require a new strategy to address freshwater deprivation and hyper salinity (Cyrus et al., 2020).

5.3 Sedimentation and Reed Encroachment

The continued struggle with mouth management has also resulted in additional impacts to the system such as sedimentation and reed encroachment. Catchment development and natural habitat removal has resulted in increased impervious surfaces which are not effective in sediment trapping. Sediments are therefore washed downstream and settle within the estuarine reaches. These additional sediments promote the growth of reeds such as *Phragmites australis*, which naturally occur in estuaries. However excessive sedimentation can result in the uncontrolled spread of these reeds which results in the narrowing of channels and smothering of other vegetation types. The lack of catchment rehabilitation combined with freshwater inflows has also resulted in the increased flooding of the mangrove areas. In response to this inundation mangrove diebacks have been recorded (Adams and Rajkaran, 2021).

5.4 Alien vegetation

Several alien plant species occur around the system. The tree *Casuarina equisetifolia* alters dune dynamics with the potential to influence estuary mouth behaviours. Casuarinas were removed from the vicinity of the mouth but seed bank re-establishment needs to be controlled. Aquatic alien invasive animal species also occur such as the snail, *Tarebia granifera.*

Estuaries and the adjacent marine environments are affected by direct and indirect anthropogenic impacts from their catchments and they are used by people for consumptive and non-consumptive purposes. Given the role that estuaries play in the broader coastal environment and their sensitivity to human impacts (DEAT, 2000); a focused and coordinated approach to sustainable use of these ecosystems is essential to the continued delivery of ecosystem values, goods and services.

5.5 Disruption of Terrestrial and Wetland Processes

- The disruption of terrestrial and wetland processes by various forms of land use around the park and land tenure is a major threat to the natural heritage values of iSimangaliso and, thus, to long-term biodiversity conservation in the park.
- In addition, inappropriate land use within the park, such as illegal developments, has led to the fragmentation of areas that are in a natural or near-natural condition, with the potential to hinder the important free movement and migration of indigenous plants and animals in the short to medium-term, and the flow of genetic material in the longer-term. Such movement is essential for species survival and the conservation of biodiversity in general.
- Furthermore, the integrity of the Park's terrestrial ecosystems is threatened by ongoing environmental degradation in areas adjacent to the park.

5.6 Fishing Offtake

- Recreational fishing is permitted in- and off-shore in designated areas as well as in Kosi and Lake St Lucia. Offshore ski-boat and spear fishing is limited to migratory gamefish species. There is generally good compliance by this sector. There are challenges related to the safety of launching craft at St Lucia.
- There is also recreational and subsistence harvesting of invertebrates (mainly mussels and crayfish) in sections of the northern and southern parts of the park. Small scale subsistence harvesting of mussels occurs in parts of the Coastal Forest Reserve section of the Park and at Maphelane and the adjoining shoreline. There is a threat of potential overexploitation along the park intertidal zone related to increased population and unemployment.
- Harvesting is beyond that intended for this small scale, sustainable fishing.
- The Whilst the expansion of the iSimangaliso MPA is welcomed, as the designated management authority for this area, this presents a challenge for the Park Authority to enforce the regulations

over the expanded offshore areas. There is also a threat from offshore illegal long-liners and gill netters, mostly from the Far East. A shortcoming is that there are insufficient state resources (i.e., Navy or DFFE patrol boats) to support the Park Authority and adequately control the offshore areas.

The continued offtake of these resources from a protected area and World Heritage site needs to be carefully managed to promote the sustainable use of these resources and, in particular, the protection and conservation of species of conservation concern.

A vast number of migratory wading birds stop in St Lucia to feed and rest during migration. Staging areas are where migratory birds stop and are vital stepping stones in migratory routes

- The limited water inflows from the uMfolozi River due to its partial separation from the estuary as a result of human manipulation to mitigate damage from upstream agricultural practices.
- Direct abstraction from tributary rivers and indirect abstraction of the groundwater feeds affecting the freshwater volumes reaching the estuary (activities such as Eucalyptus spp. plantations affecting ground water recharge). Changes in water volume have resulted in a loss of connectivity between the different parts of the Lakes and Narrows while the historical separation of the uMfolozi River has had a major impact on mouth status. Ensuring that the environmental (ecological) flow requirement is determined and adequate flow is maintained to preserve water quantity/volume or flow is a major priority. The flow requirement for the estuary has not yet been determined but is the subject of a Department of Water and Sanitation study due to be completed during 2016/2017.
- Water quality in tributary rivers.
- Alien species. Several alien plant species occur around the system. The tree Casuarina equisetifolia alters dune dynamics with the potential to influence estuary mouth behaviours. Casuarinas were removed from the vicinity of the mouth but seed bank re-establishment needs to be controlled. Aquatic alien invasive animal species also occur such as the snail, Tarebia granifera.
- Climate change – rainfall, sea level rise and temperature changes.

6. KEY IMPACTING ACTIVITIES THAT AFFECT THE ABILITY OF THE ST LUCIA LAKE ESTUARY TO CONTINUE TO DELIVER ECOSYSTEM GOODS AND SERVICES ARE DESCRIBED IN MORE DETAIL BELOW.

6.1 Artificial Breaching and Mouth Manipulation

Breaching is the term for the opening of an estuary mouth and is a natural response to rainfall and sea conditions. An estuary may be temporarily cut off from the sea by the development of a sand barrier across the inlet or mouth. When rainfall increases and freshwater outflow is strong enough to remove the sand, the estuary will break through or breach the sand barrier. Sand is constantly deposited in the open mouth of an estuary by the sea during high tide and if river flow is not strong enough will ultimately close. It is an important natural and highly seasonal process in the life-cycle of an estuary as it establishes the connection of an estuary with the sea. This allows for the immigration and emigration of fish and invertebrates, tidal exchanges, flushing and the re-establishment of salinity gradients along the estuary which is one of the drivers of estuarine diversity and productivity.

Artificial breaching is the active removal of the sandbar from an estuary by human manipulation. This is usually done in response to rising water levels that rise behind the sand barrier once the estuary is cut off from the sea. A variety of fish species and invertebrates have life histories geared to the natural cycles of opening and closing, and along with many plants and birds are dependent on these natural cycles. Once estuaries close, habitat, nutrients and food availability increase dramatically thereby providing ideal conditions for growth and survival.

Artificial breaching in KwaZulu-Natal is most often carried out during winter or when rainfall is low. Unseasonal flushing of these systems as a result of artificial breaching reduces the nursery function for many fish and invertebrates by the removal of food resources and premature flushing of juvenile fish and prawns out into a hostile marine environment while they are still too young to cope. Thus, artificial breaching disrupts the natural cycle and, therefore, has a negative effect on the plants and animals within estuaries (which in one study showed a twentyfold decrease in biomass). Artificial breaching is a convenient, but ecologically disruptive, means of altering the natural processes of an estuary. This is often done for the benefit of a few individuals but at the expense of the ecological health and services that these important systems provide and, in this way, having a ripple effect through many other lives. It is recognised and has been shown in the literature to be a highly damaging activity for estuaries.

Historically, the uMfolozi River flowed into the Lake St Lucia system. The mouth of the system opened to the sea at any point on the approximately 3 km of sandy beach between the Maphelane dunes to the south and the higher ground to the north at St Lucia village. Patterns of mouth closure, breaching and migration were driven by the interactions of river flow, wave driven sand movement, wave direction, and mouth bank scour and erosion during tidal ebb and flow. Under natural conditions the system would have behaved like any other intermittently open system on the KwaZulu-Natal coast whereby mouth closure would have resulted in backflooding onto both the uMfolozi floodplain and the low-lying margins of the Lakes. However, in 1952 the uMfolozi River was partially separated from the system by artificially breaching the river in the south and conducting extensive dredging. Breaching was always carried out as far south as possible in order to maximise the separation of the systems.

The iSimangaliso Authority's strategy announced in 2011/2012 saw the uMfolozi River returning along its natural pathway into the system, thus, beginning the process of restoring estuarine function. This policy of minimum interference in the estuarine system to facilitate as much natural functioning as possible, limiting artificial breaching and then only for exceptional reasons with ecological and socio-economic indicators, in line with the recommendations of the Panel of Experts report on the St Lucia Mouth, be implemented.

6.2 Mfolozi/ Msunduzi and St Lucia Estuary mouths

Changes in estuarine waters are measured to record how human activities and natural events affect Lake St Lucia. One of the key features to Lake St Lucia is its link to the sea (Perissinotto et al). Since St Lucia has been effectively closed off from the sea for much of the past two decades this has resulted in fresh swamp-like conditions persisting causing changes to peripheral vegetation and to the fish and microorganism populations in the lake. As a result of the heavy rainfalls in and around the catchment of the lake in April, the high lake levels continued to rise and together with high storm waves seawater overtopped into the estuary causing the estuary to breach in the same position as last year's breach. The north bank of the mouth has moved approximately 100m (1,3m daily) northwards at its outlet since it breached. It is following the same pattern as last year. On the 29th June 2022, the width of the mouth was approximately 42m at its inlet and 200m at its outlet.

6.3 Water Quality

Although turbidity of the water is a significant feature of the St Lucia Estuary, influencing light penetration and the distribution of visual versus tactile predatory fish, the over-riding feature of the water quality in the St Lucia Lake Estuary is salinity which can vary between fresh throughout, as existed in the mid-1970s, and up to 300 as has been recorded during 2015. A combination of freshwater and low temperatures can be lethal to migrant estuarine fish and fish kills under such conditions have been recorded (Blaber & Whitfield, 1976). Seawater has a salinity of 35 and once the salinity exceeds ca. 70, differential solubility of different ions results in proportional changes and the solution is no longer simply concentrated seawater. The typical estuarine invertebrate fauna broadly cannot tolerate salinities greater than 55-60 (Forbes, A.T. pers. comm.) although many estuarine fish can tolerate 80-90 (Whitfield, Blaber & Cyrus, 1981)

Figure 13: two images showing darker water from Mfolozi to Msunduzi

At this time there is no evidence of bacterial or nutrient contamination in the Lakes and Narrows although some nutrient enrichment has been recorded in the uMsunduzi River (Nondoda, Adams, Bate & Taylor, 2011). The darker water identified within the Msunduzi River is from Mfolozi river as shown in the above photo. It also represents water 'seeping' from the sediments along the respective banks and this water has low silt levels (hence the 'darker' coloration). The higher turbidity 'channel' water is more recent Mfolozi River flood water that still has high levels of suspended silt particles being carried through the system. (Pers com Prof Alan Whitfield).

6.4 Casuarina equisetifolia

Casuarina equisetifolia was historically planted on the south bank of the lower reaches of the Narrows to stabilize sand movement (Begg, 1978). This stabilization acts against the normal sediment movement patterns of the highly dynamic estuary and beaches, and once stands of the tree have established, they tend to accelerate dune and beach erosion (Digiamberardino, 1986). In addition to influencing dune morphology, C. equisetifolia alters dune and beach vegetation structure and species composition (Avis, 1995; Kraus et al., 2003), decreasing biological diversity and compromising beach integrity (Awale & Phillott, 2014). This tree has since been identified as an invasive alien (Conservation of Agricultural Resources Act No. 43 of 1983; National Environmental Management: Biodiversity Act No. 10 of 2004; Invasive Species South Africa, 2014) particularly in the province of KwaZulu-Natal.

6.5 Tourism and Recreation

The St Lucia Village is a highly popular tourism node within the iSimangaliso Wetland Park, with high numbers of visitors accessing and using the beaches. Tourists are catered for by a variety of accommodation types, restaurants and craft shops. Various activities are offered by concession holders, which enable tourists to take boat trips on the Narrows, go on a game drive on the Eastern and Western Shores, whale watching, deep-sea fishing or swim and snorkel at Cape Vidal. Guided night drives are available on the Eastern and Western Shores that provide opportunities to observe nocturnal animals. The area is rich in birdlife and bird watching, which is catered for by knowledgeable local guides, and is a popular activity.

Tourism is the largest source of foreign exchange to St Lucia and has a substantial direct and indirect impact on economic activity. Tourism is Saint Lucia's main economic sector. The area of St Lucia was primarily known for its abundance of fish species that could be bagged both from the beach as well as venturing into the Indian Ocean. The growth in eco-tourism has also been accompanied by a growth in beach tourism. St Lucia is aa small town with approximately 550 permanent residents. All of which are involved directly or indirectly in the Tourism sector. Hippos are the main attraction that promotes this fantastic place of wonder. The Indian Ocean offers the perfect setting for lazying about, fishing, snorkeling and exploring its pristine beaches as far as the eye can see.

6.6 Invasive Alien Species

The Lake St Lucia system is known to have populations of the invasive alien freshwater snail Tarebia granifera (Appleton et al., 2009; Miranda et al., 2011). This parthenogenetic snail has proved to be a very successful invader of estuaries and lake systems on the KwaZulu-Natal coast, although the significance of possible ecological impacts on these habitats remains unknown (Miranda et al., 2011).

6.7 Development Pressures

The St Lucia Village tourism node is located immediately north of the mouth of the St Lucia Estuary with a secondary development node further north at Cape Vidal. The village has a remarkably high concentration of tourist accommodation and supporting infrastructure such as restaurants, supermarkets, craft shops and booking centres for tourism activities. Delineation of the estuary, a setback line to ensure a buffer and zonation of the estuary to protect sensitive habitats and species will serve to mitigate the impact of development pressures.

7. OVERVIEW OF SOCIO-ECONOMIC CONTEXT

7.1 Demographics

Mtubatuba is one of the five municipalities within Umkhanyakude District Municipality in KwaZulu Natal. It is situated on the north-east coast of the province, and was home to 175 425 people. Covering an area of approximately 1970km² Mtubatuba Municipality was one of the most urbanised municipality within the district, with 15% of the municipality falling under urban areas.The two main town areas are Mtubatuba and St Lucia. The vast majority of the municipality was under traditional authority – almost 80% – indicating a high proportion of peopleresiding in scattered, rural villages under the jurisdiction of traditional authorities. The Isimangaliso Wetland Park World Heritage Site falls under Matubatuba. . Detail and latest information on the socio-economic environment will be provided in this section after a thorough and intense public participation process

7.2 Economic profile

Detailed economic profile of St Lucia will be provided in the phase 2 of the EstMP

7.2.1 Agricultural Sector

Detailed information will be provided in the phase 2 of the EstMP regarding the status quo of agriculture in St Lucia.

8. LEGISLATIVE INSTRUMENTS AND RELATED STRATEGIES/PROGRAMMES

The key relevant legislation applicable to the EstMP includes the following, but not limited to:

8.1 National Estuarine Management Protocol and Section 53 of the NEM: ICMA.

The National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) ("the ICM Act") which was promulgated in December 2009, requires estuaries of the Republic to be managed in a coordinated and efficient manner, in accordance with a National Estuarine Management Protocol ("the Protocol"). Section 33(2) of the ICM Act empowers the Minister responsible for Environmental Affairs with the concurrence of the Minister responsible for Water Affairs to publish a Protocol that will provide guidance for the management of estuaries through the development and implementation of estuarine management plans (EstEMPs). The EstEMPs seek to achieve greater harmony between ecological processes and human activities while accommodating orderly and balanced estuarine resource utilization

8.2 National Water act (1998)

The purpose of this Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors –

- meeting the basic human needs of present and future generations;
- promoting equitable access to water;
- redressing the results of past racial and gender discrimination
- promoting the efficient, sustainable and beneficial use of water in the public interest;
- facilitating social and economic development; providing for growing demand for water use;
- protecting aquatic and associated ecosystems and their biological diversity;
- reducing and preventing pollution and degradation of water resources
- meeting international obligations;
- promoting dam safety;
- managing floods and droughts.

8.3 World Heritage Convention Act, 1999 (Act 49 of 1999) (WHCA) and associated operational guidelines.

In 2000, iSimangaliso was proclaimed a World Heritage site in terms of the World Heritage Convention Act, 1999 (Act 49 of 1999), an Act that incorporated the World Heritage Convention into South African legislation. The World Heritage Convention Act provides a fundamental commitment to the protection, conservation, preservation and presentation of World Heritage values, with a strong emphasis on local economic development. This balance is appropriate in the South African context in which high levels of poverty necessitate an approach that optimises the economic potential of World Heritage sites without compromising their natural and cultural integrity.

8.4 National Environmental Management: Biodiversity Act,2004 (Act 10 of 2004) (NEM:BA)

The National Biodiversity Act, 2004 (Act 10 of 2004) provides for the management and conservation of South Africa's biodiversity. This includes the protection of specific ecosystems and species, equitable and sustainable use of indigenous biological resources

8.5 National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003) (NEM:PA).

As a World Heritage site and protected area, the iSimangaliso Wetland Park is also governed by the National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003) which affords additional protection and makes provision for management and management plans in support of what is provided for in the World Heritage Convention Act. Regulations promulgated under the National Environmental Management: Protected Areas Act also contain provisions regarding Management Plans

8.6 National Environmental Management: Integrated Coastal Management Act, 2008 (Act 24 of 2008) (NEM: ICMA)

The National Environmental Management: Integrated Coastal Management Act 24 of 2008 aims to establish a system of integrated coastal and estuarine management in the Republic, including norms, standards and policies, in order to promote the conservation of the coastal environment, and maintain the natural attributes of coastal landscapes and seascapes, and to ensure that development and the use of natural resources within the coastal zone is socially and economically justifiable and ecologically sustainable; to define rights and duties in relation to coastal areas; to determine the responsibilities of

organs of state in relation to coastal areas; to prohibit incineration at sea; to control dumping at sea, pollution in the coastal zone, inappropriate development of the coastal environment and other adverse effects on the coastal environment to give effect to South Africa's international obligations in relation to coastal matters; and to provide for matters connected therewith.

8.7 National Environmental Management Act, 1998 (Act No 107 of 1998) (as amended) and relevant Regulations there under, including the EIA Regulations (2017)

The National Environmental Management Act 107 of 1998 intends to provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state; and to provide for matters connected therewith.

8.8 National Forests Act, 1998 (Act No. 84 of 1998).

The purposes of this Act are to

- promote the sustainable management and development of forests for the 10
- benefit of all;
- create the conditions necessary to restructure forestry in State forests;
- provide special measures for the protection of certain forests and trees:
- promote the sustainable use of forests for environmental, economic.
- educational. recreational, cultural, health and spiritual purposes: 15
- promote community forestry;
- promote greater participation in all aspects of forestry and the forest products industry by persons disadvantaged by unfair discrimination

8.9 ISimangaliso Wetland Park integrated management plan (2017-2021)

The iSimangaliso Wetland Park occupies an area of approximately 358,534 ha comprising fifteen ecosystems and a number of notable and diverse landscapes. In 2000, iSimangaliso was proclaimed a World Heritage site in terms of the World Heritage Convention Act, 1999 (Act 49 of 1999), an Act that incorporated the World Heritage Convention into South African legislation. It is under this Act that the iSimangaliso Wetland Park Authority has prepared an Integrated Management Plan (IMP). The IMP is aligned with related legislation, notably relevant provisions of the Marine Living Resources Act, 1998 (Act

18 of 1998), the National Environmental Management: Biodiversity Act (Act 10 of 2004), National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003) and the Public Finance Management Act, 1999 (Act 1 of 1999). The objective of the IMP is to provide measures to protect and manage the World Heritage site in a manner that is consistent with the objectives and principles of the governing Acts. The IMP document is, therefore, the statutory decision-making framework that the iSimangaliso Authority uses to develop and manage the Park. Currently the 2022 iteration has not yet been approved by the Ministry of the DFFE but will be mentioned and not yet fully considered as this is a draft at this stage and has not yet been adopted/ approved.

8.10 Marine Living Resources Act, 1998 (Act 18 of 1998) (MLRA).

The entire coastline of the iSimangaliso Wetland Park is a proclaimed World Heritage site under the World Heritage Convention Act. Approximately three quarters of this coastline (from Kosi Bay to 1 km south of Cape Vidal) is also proclaimed as two Marine Protected Areas (MPAs) (St Lucia and Maputaland) through Government Notice3 under the Marine Living Resources Act, 1998 (Act 18 of 1998), which provides specific protection to the marine environment.

9. OPPORTUNITIES AND CONSTRAINTS FOR CONSIDERATION IN THE EstEMP

9.1 Opportunities

Estuary management brings about various opportunities in terms of ecological biodiversity habitats in terms of fauna and flora species habitat benefit etc. while creating market opportunities for the locals since the estuary is a tourist attraction after all. Therefore, tourism creates great markets for the locals as locals sell various craft work to them for economic gain. Subsequently estuary surroundings become a significant economic location for locals and thus create economic opportunities.

9.2 Constraints

- Land-use change (transformation and fragmentation), both lawful and unlawful, is one of the most serious threats to biodiversity and conservation, the implications of landuse change include:Poor Planning / Decision making
- Poor Land Management

- Alien plant invasion
- Poaching
- Insecticides / Herbicides and Pesticides
- Water, Land and Air Pollution (incl. fertilisers)
- Climate Change
- Fish traps(kraals)
- Estuary infrastructure management

The intention of this Situation Assessment Report was to provide the current status quo as the baseline of the development of the St Lucia Estuarine Management Plan. This will be critical in providing the I&APs as well as relevant stakeholders a vision into the current status quo and hopefully allow stakeholders to also provide inputs into their views of the current status quo and issues they feel need to be considered in the development of the review process of the St Lucia Estuary Management Plan.

9.3 Way Forward and next steps

Once the Situation Assessment Report phase has been completed we will be developing the objective setting phase which will include the development of the public participation plan where we will be going into detail in elaborating to our I&APs and affected neighbouring communities, the communities living within the Park and stakeholders at large how and when we will be engaging with them (as well as through which platforms) to begin jointly working through the development of the revised St Lucia Estuary Management Plan.

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APPENDICES

Appendix 1: Expertise of professional team

Park Authority and Environmental Assessment Practitioner (Eap)

Table 1: Contact details of isimangaliso wetland park Authority:

Contact Person	**Siboniso Mbhense**
Address	**Private Bag X05** **St Lucia** **3936**
Telephone	**035 5901633**
Email	**siboniso@isimangaliso.com**

3.1 Role and Competence of the Project team

It is the responsibility of the project team to perform all work relating to the iSimangaliso Wetland Park in an objective, appropriate and responsible manner.

Table 2: Name and contact details of the lead EAP for the project:

Business name of EAP:	**ICEBO ENVIRO PROJECTS**		
Physical address:	**SUITE 2B, NO: 8 OLD MAIN ROAD, HILLCREST, 3650**		
Postal address:	**P.O. BOX 29156, HILLCREST**		
Postal code:	**3650**	**Cell:**	**079 307 3282**
Telephone:	**0317654129**	**Fax:**	**086 549 8430**
E-mail:	**shangen@iceboenviro.co.za**		

3.2 Names and expertise of representatives involved in the preparation of the EstMP

Names and details of the expertise of each representative involved in the preparation of this EstMP:

Table 3: Expertise of representatives of the project team

Role	Name	Responsibilities	Experience at environmental assessments (yrs.)
Project Principal And senior Environmentalist	**Monica Shange**	Monitoring project progress as per set timeframes. Project quality control and progress monitoring. Client and project team liaison. Draft all EstMPs and reviews all EstMP reports and applicable legislations. Principle presenter for public participation process – stakeholder engagement of the EstMPs	16 Years' experience as a qualified and registered environmentalist and registered natural scientist with EAPASA and SACNASP
Senior ecological specialist	**Andrew Husted**	Assist in drafting of report relating to aquatic advise, review reports, GIS / Spatial mapping of EMps	12 years' experience as an environmental specialist
Hydrologist & Spatial Mapping	**Brian Mafela**	Hydrology study with GIS Mapping and Zoning of EstMPs	10 Years' Experience as a Hydrologist
Oceanographer	**Anitha Van Schoor**	Assist with River Fish samples and GIS mapping of EstMPs	3 Years' experience as an oceanographic
Terrestrial Ecologist	**Brian Paul**	Assist with Terrestrial Ecologist, and Spatial Mapping (GIS)	10 years as a Terrestrial Ecologist
Coastal and Estuarine/riverine specialist	**Dr Alan Mitchell Smith**	Assist with coastal and estuarine (GIS Mapping and Zoning) of EstMPs	27 years as coastal and estuarine specialist
Meteorologist, air quality specialist, oceanographer, coastal expert and climate change specialist	**Lisa Anne-Marrie Guastella**	Meteorologist, air quality specialist, oceanographer, GIS Mapping, coastal expert and climate change specialist	41 years as Meteorologist, air quality specialist, oceanographer, GIS Mapping, coastal expert and climate change specialist
Project Assistant	**Noluvuyo Masango**	Assistance with project where required Facilitator for public participation process – stakeholder engagement of the EstMPs	1-year as a Project assistant
Junior Environmental Consultant	**Thakasani Mthembu**	Assists with drafting of EstMP reports Assist Facilitator for public participation process –stakeholder engagement of the EstMPs	1 year experience

Appendix 2: Methodology

1 APPROACH AND METHODOLOGY

The consultants together with estuarine specialist have formed together as a team to contribute to a Situation Assessment, based on the Protocol and DEA Guidelines. It will include an analysis of existing information- quantitative and qualitative - from both published and unpublished literature, data from existing monitoring programmes (to be obtained from relevant competent authorities and volunteer initiatives), and information obtained through consultations with relevant organs of state, Municipalities, tribal authorities, local interest groups and selected experts, as necessary. The assessment will also identify data and information gaps, as well as potential capacity constraints in terms of EstMP implementation. The Situation Assessment will exclude GIS maps of the estuary.

1.1 DESKTOP ASSESSMENT

To correctly classify the site according to the most recent available data, a literature review and desktop assessment is required. It is important to have a good understanding of the physical environment as this is what controls the environment and determines the biological response, i.e., the underlying processes and drivers. Desktop assessments are based on available information for the area, and several databases and datasets are checked. These include the following:

- Familiarization of site and literature review
- Review of legal context and institutional framework
- Reference to available historical imagery
- Reference to available Coastal Vulnerability Index (CVI) information
- Analysis of satellite imagery (interannual and seasonal variability to determine high water mark change and estuary migration)
- Consideration of river catchment (link to GIS expert) and DWS Reserve determination/ Ecological Water Requirement (EWR), if available/ any catchment management forums
- Analysis of land use, physical infrastructure, stormwater drains, wastewater (as this will affect run-off, i.e., water quality and quantity)
- Climatic description, with detailed rainfall analysis – as this determines the water quantity
- Consideration of riverine input

- Wave data analysis using available information, as this (in addition to rainfall) can be a contributor to mouth breaching and migration
- Biological responses and biodiversity reports, ecological function
- Breaching protocol/mouth management (applies to St Lucia) and review of panel decision, in this regard.
- Consideration of threats to the estuaries (e.g., DDT, water pollution, water abstraction, human use and resource consumption)
- Historical disasters (natural and anthropogenic)
- Future scenarios considering climate change and sea-level rise
- Gap analysis – a statement of research needs

1.2 GIS Mapping

In South Africa, the Estuarine Functional Zone (EFZ) is defined as the area that not only encapsulates the estuary waterbody, but also the supporting physical and biological processes necessary for estuarine function and health. It includes all dynamic areas influenced by long-term estuarine sedimentary processes, i.e., sediment stored or eroded during floods, changes in channel configuration, aeolian transport processes, and/or changes due to coastal storms. It also encompasses the multiple ecotones of floodplain and estuarine vegetation that contribute detritus (food source) to the estuary and/or provide refuge during high flow events.

QGIS will be used to produce fine scale maps for each estuary which detail:

- Geographical description and map of the estuary should be developed identifying different habitats and potential and existing management zones.
- A geographical description and a map of the estuary based on the Estuarine Functional Zone (EFZ) clearly identifying the boundaries of the system
- Details of intended spatial zonation of the estuary specifying activities that may or may not take place in different sections of the estuary, and indicating: (1) which organs of state will need to be consulted given the type of zonation that is proposed; and (2) which organs of state will need to enact the relevant laws to implement the proposed zonation.

Conservation Planning Tools such as National Wetlands (NFEPA), National estuaries, Marine National Biodiversity Assessment (2011), National threatened ecosystems, Estuarine Ecosystem Maps, and other datasets will be utilised to produce these maps.

1.3 SITUATION ANALYSIS REPORT

The information obtained above will contribute to the compilation of a SAR, the contents of which will align with that recommended in the "Guidelines for the Development terms of the National Estuarine Management Protocol". The suggested chapters, as per Appendix 1 of the afore-mentioned document, will be:

Chapter 1: Introduction

1.1 Background

1.2 Purpose of Situation Assessment

1.3 Structure of Report

Chapter 2: Catchment Characteristics

2.1 Geology and geomorphology

2.2 Climate and runoff

2.3 Land-use

Chapter 3: Overview of Ecological Function and State of Estuary

3.1 Abiotic function (e.g., hydrodynamics, sediment dynamics and water quality)

3.2 Biotic function

3.3 Ecological health status (as per EWR study or NBA assessment)

Chapter 4: Important Good and Services (or Ecosystem Services) provided by Estuary

Chapter 5: Impacts or Potential Impacts to Estuary

Chapter 6: Overview of Socio-economic Context

6.1 Demographics

6.2 Economic profile

6.3 Social considerations (e.g., level/s of dependence of local communities)

Chapter 7: Legislative Instruments and related Strategies/programmes

7.1 Legal framework applicable to estuarine management

7.2 Management strategies/plans relevant to estuary

7.3 Existing monitoring programmes

Chapter 8: Opportunities and Constraints for consideration in EstMP

Chapter 9: Recommendations to address Major Information Gaps (relevant to EstMP process) and Implementation of Estuarine Management Plan

1.4 FIELD ASSESSMENT

A site visit will be undertaken to familiarize with each of the estuaries. This will include a physical assessment of the site and surrounds, including visual inspection and assessment of estuary mouth dynamics and previous flood levels. From the site inspection and desktop findings, the behaviour of the outlets can be assessed. Consideration of the EFZ, biodiversity, zonation, resource use and socio-economic context for each estuary.

1.5 Present ecological state

Using the information obtained above, determine the present ecological state using the Estuarine Health Index.

1.6 Goods and services provided by the estuary

Contribute to a review of the resource use and various goods and services provided by the estuary including:

- Utilization of natural resources (e.g., fisheries)
- Nursery function
- Boating and recreational facilities
- Tourism
- Cultural services
- Regulating services, such as carbon sequestration and water purification.
- Threats to the estuarine function
- Historical disasters and/or environmental emergencies/incidents and fish kills
- Opportunities and constraints for development and conservation, and dependence of local communities on the estuary
- Consideration of potential carrying capacity for activities