

ESTUARINE MANAGEMENT PLAN FOR THE IKONGENI ESTUARY: Final Draft Situation Assessment Report

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COASTWISE CONSULTING

Image Front Page
iKongeni Estuary 2009
KwaZulu-Natal Department of Economic Development Tourism and Environmental Affairs
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EXECUTIVE SUMMARY

Overview

The National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008, as amended 2014) requires that estuaries within South Africa are managed in a co-ordinated and efficient manner, and in accordance with the National Estuarine Management Protocol via the development of an Estuarine Management Plan. The first phase in the process of developing an Estuarine Management Plan is an assessment of the *status quo* via a Situation Assessment, which explores and contextualises the iKongeni Estuary, a small temporary closed system located in the well-known coastal holiday town of Margate, in the Ray Nkonyeni Municipality on the KwaZulu-Natal south coast, relative to various environmental, social and economic aspects. The key findings of this assessment, rather than an elaborate summary of the report, are captured below in order to both prepare for the management planning process.

The Situation Assessment Report locates the iKongeni Estuary within the Ray Nkonyeni Municipality; the boundaries of the estuarine system are delineated and a description of the broader catchment, including the catchments geology, climate, runoff, and land-use, is provided. The current status of the estuary is then described through an assessment of the ecological characteristics and functioning of the system, its health status and importance, and the ecological goods and services it provides. Thereafter the broader socio-economic context of the region and the social uses and activities that it supports are described. Current and potential impacts and/or impacting activities or threats to the ecological functioning of the system are described prior to unpacking the legal instruments and related strategies and plans, which impact the management of the estuary, along with the current institutional structures governing estuarine management.

The Situation Assessment Report concludes by detailing opportunities and constraints, which should be used to develop the necessary responses or actions, and by making recommendations to address identified information gaps.

Present Ecological State and Desired Ecological State

Early assessments of the health of the iKongeni Estuary (Heydorn, 1986, Whitfield 2000 and 2013) acknowledge its heavily urbanised catchment and highly degraded state, and rated the overall condition of the system as 'Poor'. In 2015, the status of the iKongeni Estuary was reassessed through the estuaries Ecological Water Requirement study, a component of the Water Resources Classification Study for the Mvoti -Umzimkulu Water Management Area (DWS, 2015a). In this study, the health state of the estuary was downgraded to a Category D/E, i.e. highly degraded/ severely modified (DWS, 2015a). The 2018 National Biodiversity Assessment (Van Niekerk, Taljaard, *et al.*, 2019), the update to the 2011 National Biodiversity Assessment, reported on and confirmed this further degraded state.

The Recommended Ecological Category, or desired state, for the iKongeni is a Category D (DWS, 2015b). As such, management interventions should aim toward preventing further ecological degradation of the system with key interventions including restoring estuarine habitat, improving water quality and reducing base flows to the estuary to maintain the mouth state and salinity profile (DWS, 2015b). According to the Ecological Reserve study, the D Category can be achieved under the current situation by removing half the waste and flow of current discharges (DWS, 2015a, 2015b). However, this has major socio-economic implications and will be difficult to achieve. Therefore, the Target Ecological Category which considers all users of the system and is assigned by the Minister, was set to maintain the PES below a D. This is unacceptable on ecological grounds (DWA, 2011).

Goods and services or human use activities

Ecosystem goods and services are the products that emerge from the natural environment through various biological, chemical, and physical processes and functions, which are typically used by people and contribute to enhanced societal wellbeing. The types of ecosystem services include provisioning services (such as food, water and other resources), regulating services (e.g. climate regulation, as well as air and water purification), life-support services (such as nutrient cycling and soil formation) and cultural services (e.g. aesthetic, spiritual, recreational, educational and cultural benefits) (Van Niekerk and Turpie, 2012).

The level of ecosystem services provided by the iKongeni Estuary were deemed to be low, directly related to the history of human modifications to the estuary and its catchment, and the concomitant loss of ecological infrastructure. The main ecosystem services currently offered (albeit limited) relate to water quality improvement (i.e. waste treatment through dilution and assimilation), the export of nutrients and materials to the marine environment, socio-cultural services, namely recreational activities in the form of canoeing / boating, angling, as well as aesthetic appreciation (supporting tourist and residential accommodation needs). The latter was rated to be of high importance (DWA, 2013). Le Roux *et al.*, (2005) advise that both the iKongeni Estuary, as well as the previous Blue Flag status, makes a significant contribution to the perception of Margate as a favourable tourist destination. The provision of fish and crustacean nursery services, migratory corridors and protection of biodiversity is rated as medium (DWA, 2013) given the collective importance of degraded estuaries along the KZN south coast. Subsistence use of the system has been observed; however, overall usage is considered low. Other services include contribution to primary productivity, storm/wave damage control, flood attenuation and erosion control, and preservation of natural heritage (Le Roux *et al.*, 2005; Breetzke and Meyer, 2012).

Geographical socio-economic context

The Situation Assessment Report unpacks the demographics of the Ray Nkonyeni Municipality detailing its geographical context, population statistics, dependency ratios and service provision. The municipalities economic profile and status as district economic driver, is then expounded noting the tourism tertiary section leading the economy and the role of environmental assets and coastal infrastructure play in making the municipality and Margate itself key tourism destinations. As such, the improvement, protection and ongoing maintenance of these aspects is vital to retaining and attracting new tourists, investment and economic development (TPS, 2018).

Margate town itself is then outlined focussing on its role as a tourism intensity / municipal development node (RNM, 2019) with the redevelopment of the Margate Beach Front as an example of a proposed catalytic project. The Margate planning scheme and scheme controls were evaluated in preparation for the proposed zonation of activities and spatial depiction of the estuaries envisaged desired state.

Three key socio-economic considerations are thereafter elaborated upon, namely, the Margate Main Beach's former Blue Flag status, secondly the municipalities, town and surrounding property owner's dependency on the state of the system and its direct and indirect impact on livelihoods. This included the current poor quality of the public space encouraging / supporting poor / unsocial behaviour with the dumping of grass cuttings and solid waste, the defacing of public and private infrastructure, illegal land reclamation and the poor maintenance of defence. The third aspect considered related to coastal vulnerability and risk, anticipated sea-level rise and the designation of coastal management lines.

Current or Potential Pressures and Impacts

The iKongeni Estuary is a highly transformed system with the level of cumulative pressure on the estuary being very high (Van Niekerk, Adams, Lamberth, Taljaard, *et al.*, 2019). The environmental processes, activities and developments that currently impact the system and pose future threats were deliberated, concentrating on: land-use and infrastructure development (urban development; road infrastructure; and bulk infrastructure); water quality and quantity issues (water quality deterioration; altered flow and invasive alien plants); exploitation of natural resources (harvesting of living resources; urban development and mouth manipulation); and environmental hazards (climate change; flooding, drought and coastal dynamics).

Opportunities and Constraints

A Strengths, Weaknesses, Opportunities and Threats analysis was conducted for the management of the iKongeni Estuary, and estuarine management in the Ray Nkonyeni Municipality in general and has been crudely divided into ecological, socio-economic and institutional spheres, however many of the recorded items are cross-cutting.

Firstly, the ecological analysis identifies the systems strengths as been that it is still worth preserving and that there is a level of community by-in. In comparison the system is highly degraded as a result of intense urban impacts, notably poor water quality, with limited, if any, assimilative capacity. Opportunities for positive change include improving the health status, undertaking research and rehabilitating degraded areas, developing standard operating procedures for emergencies and formalising both a monitoring programme and relationships with the iKongeni Conservancy and other NGO's. Threats are identified as anticipated increasing development, increased recreational pressure and pollution and continued flood risk to low-lying developments.

Secondly, from a socio-economic perspective, the estuary possesses high aesthetic and recreational value and is part of the foundation of the tourism industry, however, lack of awareness, artificial breaching and negative public perceptions need to be improved. Opportunities identified include establishing a community-based advisory forum; increasing public awareness and education on estuarine health, function and value, as well as downstream impacts of catchment activities with the resultant improved estuarine value and knock-on improvement for the local economy. Threats include continued unsustainable land-use; indiscriminate artificial breaching and continued conflict between preserving estuarine integrity versus human life and poorly located development.

Finally, from an institutional perspective, relevant institutional structures do exist and estuarine specific support is provided by provincial government, however, there appears to be poor inter-governmental cooperation, and seemingly overlapping mandates, restricted institutional resources and lack of clarity in respect to processes and implementation actions. Opportunities identified include the development of standard operating procedures in cases of emergency and clean-up operations; Public-private partnerships between various government departments, agencies and institutions (e.g. iKongeni Conservancy) and potential access to additional funding from National Government. Unfortunately, issues that could prevent the success include continued ignorance of authority roles and responsibilities; non- implementation of management actions / project plans; reallocation of funds; lack of political will and lack of communication and co-operative governance.

Information gaps to be addressed in the plan

Despite the highly degraded state of the iKongeni Estuary, it is critically important in terms of tourism that it maintains some ecological value as a coastal habitat in an otherwise urban environment. Physical, chemical and biological information on the iKongeni Estuary is either scarce or the available data is significantly outdated. As such specific recommendations are made with the view of preventing further degradation of the iKongeni Estuary: maintaining basic monitoring; undertaking co-ordinated research; establishing the contribution of the estuary to the regional estuarine nursery function; compiling an inventory of estuarine pollution sources (including volumes of discharged treated wastewater); determining the 1:100-year flood line; and updating the economic evaluation of the ecosystem goods and services provided by the iKongeni Estuary.

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LIST OF ACRONYMS

BSP	Biodiversity Spatial Plan
CBA	Critical Biodiversity Area
CBD	Central Business District
cfu	Colony forming units
CML	Coastal Management Line
CMP	Coastal Management Programme
COGTA	Department of Cooperative Governance and Traditional Affairs
CPI	Consumer Price Index
CVI	Coastal Vulnerability
DALR&RD	Department of Agriculture, Land Reform and Rural Development
DEFF	Department of Environment, Forestry and Fisheries
DFFE	Department of Forestry, Fisheries and the Environment (formerly DEFF)
DM	District Municipality
DO	Dissolved Oxygen
DWS	Department of Water and Sanitation
EDC	Estuarine Dependence Category
EDTEA	KZN Department of Economic Development, Tourism and Environmental Affairs
EEW-EPRG	Estuary Early Warning - Emergency Preparedness and Response Guide
EFZ	Estuarine Functional Zone
EHi	Estuarine Health Index
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Estuarine Management Plan
EMPr	Environmental Management Programme
EMZ	Environmental Management Zone
ESA	Ecological Support Area
GDP	Gross Domestic Product
GRAP	Generally Recognised Accounting Practice
HCM	Hibiscus Coast Municipality (now Ray Nkonyeni)
ICM Act	Integrated Coastal Management Act (No. 24 of 2008)
IDP	Integrated Development Plan
KPA	Key Performance Area
KZN	KwaZulu-Natal
LED	Local Economic Development
LM	Local Municipality
MAR	Mean Annual Run-off
MIG	Municipal Grant Funding
MMP	Mouth Management Plan
MPA	Marine Protected Area
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act (No. 107 of 1998)
NGOs	Non-governmental Organisations
p.a.	Per annum
PAHs	Polyaromatic Hydrocarbons
PCC	Provincial Coastal Committee
PES	Present Ecological State
PGDS	Provincial Growth and Development Strategy
PPP	Purchasing Power Parity
[the] Protocol	National Estuarine Management Protocol
PSDF	Provincial Spatial Development Framework
REC	Recommended Ecological State
RMA	Responsible Management Authority
RNM	Ray Nkonyeni Municipality

RQO	Resource Quality Objective(s)
SAR	Situation Assessment Report
SAWQG	South African Water Quality Guidelines
SDF	Spatial Development Framework
SoC	State of the Coast
SWOT	Strengths, Weaknesses, Opportunities and Threats analysis
SZ	Special Zonation
TDS	Total Dissolved Solids
TEC	Target Ecological State
TPC	Threshold of Potential Concern
TWQR	Target Water Quality Range
WftC	Working for the Coast
WMA	Water Management Area
WSMP	Water Services Master Plan
WWTW	Waste Water Treatment Works

DISCLAIMER, ASSUMPTIONS AND LIMITATIONS

This report has been prepared by Coastwise Consulting, with all reasonable skill, care and diligence within the terms of the contract with the client. The findings in this report are based on the author/s' professional knowledge, data and resources available at the time and relevant information provided by the client. The nature of the study, and detail of assessment undertaken are dependent on the human and time resources committed to the study in agreement with the client prior to the assessment.

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1. INTRODUCTION

1.1. Background

Estuaries are among the most productive and biological diverse ecosystems in the world and they also provide a variety of valuable ecosystem services that benefit society. However, they are under increasing threat of degradation, transformation, misuse and overexploitation. The iKongeni Estuary, also known as the Kongweni, iNkongweni or Margate 'lagoon', located in the well-known coastal holiday town of Margate in the Ray Nkonyeni Municipality (RNM) on the KwaZulu-Natal (KZN) south coast, is a case in point. Due to urban development impacts and human interference, the structure, functioning and provision of ecosystem services of this system are largely impaired. Furthermore, inappropriately located urban development adjacent coastline has been subject to major erosion events warranting engineering intervention, while ongoing water pollution and the position of the mouth periodically hampers the usability of the main beach, which supports the tourism-dependent local economy. The poor water quality in the system has also prevented the beach from maintaining its former Blue Flag status.

Integrated management of the iKongeni Estuary is urgently required to stave these negative impacts and the downward trajectory of the system's health, and develop effective strategies in pursuit of the protection of estuarine natural resources, whilst increasing economic potential as well as ensuring sustainable use and development.

The National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008, as amended 2014) (ICM Act), requires that estuaries within South Africa are managed in a co-ordinated and efficient manner, and in accordance with the National Estuarine Management Protocol (hereafter referred to as 'the Protocol') as well as the National Coastal Management Programme (CMP), which lays out specific objectives for management of South African coastline, including estuaries and the relevant Provincial CMP. The identified vehicle to manage estuaries is the estuarine management plan (EMP).

In light of the above directive and the degradation of the iKongeni Estuary, the KZN Department of Economic Development, Tourism and Environmental Affairs (EDTEA) prioritised the development of an EMP for this estuarine system.

1.2. Purpose of the Situation Assessment

This report constitutes the first phase of the estuarine management planning process, namely the Situation Assessment, after which the second phase, the drafting of the EMP, will be undertaken. The purpose of this component is to provide an overview of the current state of the iKongeni Estuary, to review available information that will influence management decisions and to identify possible management deficiencies and recommend areas for improvement. The compilation of this Situation Assessment Report (SAR) is based on the framework provided by the 2013 Protocol and the associated EMP guideline document (DEA, 2015). The SAR explores and contextualises the iKongeni Estuary relative to various environmental, social and economic aspects.

Included in this report are the relevant maps and diagrams illustrating key features of the study area and the estuary.

1.3. Document Structure

This SAR is structured as follows:

- **Section 2** locates the iKongeni Estuary within the Ray Nkonyeni Municipality and delineates the boundaries the system;
- **Section 3** provides a description of the broader catchment within which the iKongeni Estuary is located, including geology, climate and runoff, and catchment land-use;
- **Section 4** details the current status of the estuary through an assessment of the ecological characteristics and functioning of the system as well as unpacking its health status and importance;
- **Section 5** unpacks the ecological goods and services provided by the iKongeni Estuary;
- **Section 0** locates the iKongeni Estuary within the broader socio-economic context of the region and describes the social uses and activities that are supported by the system;
- **Section 7** seeks to identify the current impacts and the potential impacting activities or threats to the ecological functioning of the system;
- **Section 8 and 9** unpack the legal instruments and related strategies and plans which govern the management of the estuary, along with the current institutional structures governing estuarine management;
- **Section 10** provides an assessment of the opportunities and constraints to identify, at latter stage during the EMP process, the necessary responses or actions to effectively utilise the strengths and opportunities for a sustainable future and also to prevent or mitigate vulnerabilities and future threats; and
- **Section 11** concluding with recommendations to address information gaps.

2. LOCATION AND DELINEATION

2.1. Location

The RNM is situated on the KZN south coast and is the largest of four local municipalities that fall within the Ugu District. It is bordered by the Umzumbe Local Municipality to the north, the Umuziwabantu Local municipality to the west, and the Imbizana Local Municipality of the Eastern Cape Province to the south (Figure 1)[1].

The RNM is the southernmost coastal local municipality in KZN and covers an area of 1 594 km²; stretching approximately 72 km in length along the coast from the Mhlungwa River in the north, to the Mtamvuna River in the south.

There are 27 estuarine systems within in the RNM. The iKongeni Estuary is located 17 km south-west of Port Shepstone, in the well-known holiday town of Margate.

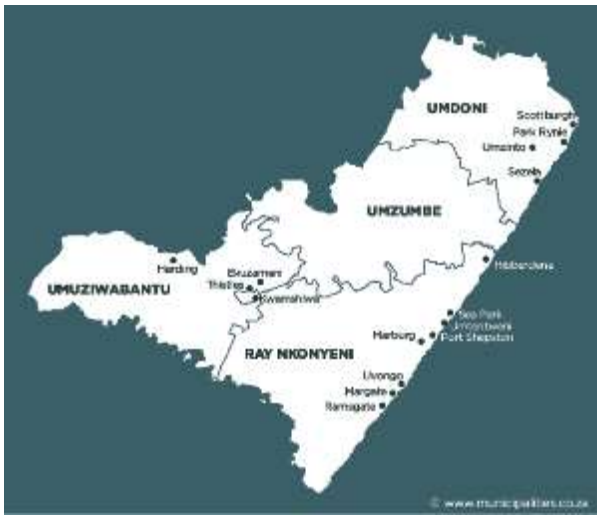

Figure 1: Ray Nkonyeni, and other municipalities within the Ugu District

2.2. Delineation

The iKongeni River estuary is categorised as a small temporarily closed estuarine system, located within the subtropical biogeographic region of South Africa. Recent studies indicate that the estuarine functional zone (EFZ), as defined by the Environmental Impact Assessment (EIA) Regulations 2014 (as amended in 2017) (GN 324), may extend beyond the current 5 m contour and that the 10 m contour may be considered the future new boundary of an estuary within KZN, as indicated in the 2018 National Biodiversity Assessment (NBA) (van Niekerk *et al.*, 2019).

Figure 2 indicates the geographical boundaries of the iKongeni River estuary constituting the EFZ based on the 10 m contour using refined Lidar contour data available for the KZN Province (CoastKZN, 2019b).

3. CATCHMENT CHARACTERISTICS

3.1. Climate

The KZN south coast exhibits a warm and humid subtropical climate with hot summers. Average daily temperatures in summer range between 21°C and 27°C. Winters are milder and drier, with average daily temperatures ranging from 9°C to 22°C.

The area falls within the coastal high rainfall zone, where the mean annual precipitation generally exceeds 1000 mm, which falls mainly during the spring to summer months (October-March) and frequently as intense rainfall events (Macfarlane and Richardson, 2013).

[1] https://municipalities.co.za/map/1080/ray-nkonyeni-local-municipality

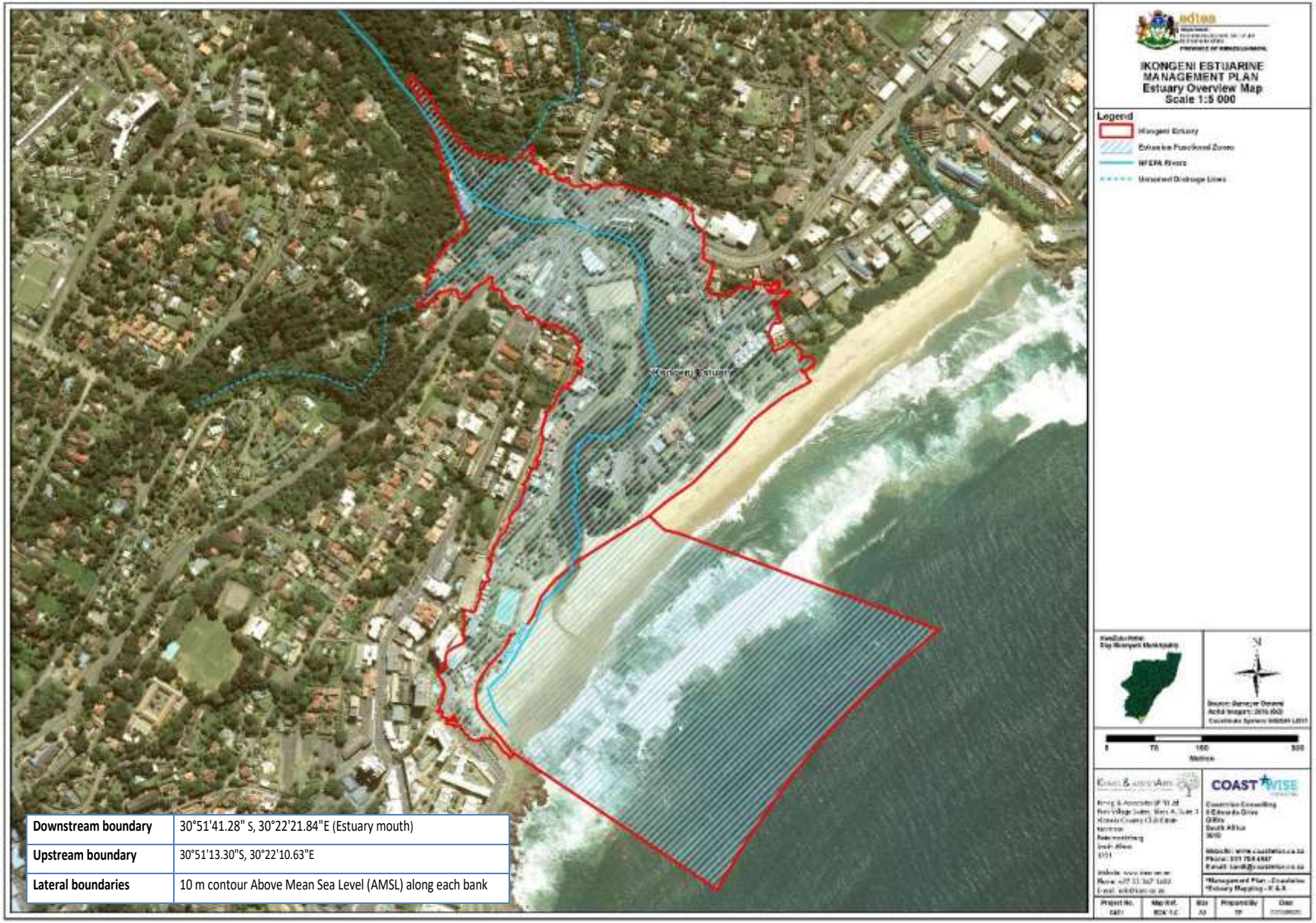

Figure 2: Delineation of the iKongeni Estuary illustrating the EFZ based on the 10 m contour, and the 5 m contour

3.2.Geology

The geology of a river catchment is important in as much as it determines the characteristics of the water and sediments which flow downstream into the estuary. The coastal geology of the RNM is varied and includes predominantly Margate gneiss (Natal Metamorphic Province), followed by Arenites of the Msikaba Formation[2] (Natal Group sandstones), Dwyka Tillite, and Ecca shales (Macfarlane and Richardson, 2013; RNM, 2019) (Table 1, Figure 3).

The iKongeni River catchment and the estuary are underlain by Margate Gneiss and Msikaba Arenites, respectively, with unconsolidated sediments of recent age occurring at the coast (Figure 3).

Table 1: Description of the geological formations present in and around the iKongeni Estuary

Group	Description and Location
Natal Metamorphic Province (1000 Ma)	Comprising Granite and Gneiss which occur along the coastline just south of Port Shepstone to Scottburgh in the north-east.
Cambrian to Ordovician Natal Group (490 Ma)	Natal Group Sandstones exhibiting structures that indicate sediments were transported and deposited by rivers. Fine-grained sandstones form resistant sandstone cliffs.
Unconsolidated sediments (recent age)	Unconsolidated sediments of recent age occurring as a series of large coast-parallel dune complexes developed from Aeolian (wind-blown) deposits occurring along most of the coastline. Includes alluvial deposits found within estuaries and along river flood plains, providing soils that are organic-rich and therefore highly productive, ranging from sandy through loamy to clay deposits.

(Source: Macfarlane and Richardson, 2013)

3.1.Vegetation

The vegetation of the RNM coastal region is predominantly KZN Coastal Belt grassland, followed by Pondoland-Ugu Sandstone Coastal Sourveld (EKZNW, 2012; SANBI, 2018). The former is typified by transformation into sugarcane fields and to a lesser extent, *Eucalyptus* (Gum) plantations. Scattered between are secondary *Aristida* grasslands, thickets and patches of coastal thornveld. Almost a third of the Coastal Sourveld vegetation type has also been transformed by sugarcane and urban sprawl. This vegetation type is strictly defined by the underlying geology, namely the hard quartz sandstones of the Msikaba Formation, which produces nutrient poor, acidic sandy soils (Mucina and Rutherford, 2006).

At a catchment level, the iKongeni Estuary is located within the KwaZulu-Natal Coastal Belt vegetation type, which comprises a mixture of coastal grasslands and subtropical coastal forest, as found along the river channel above the estuary. The catchment area above the R620 is characterised by Pondoland-Ugu Sandstone Sourveld, and below this is KwaZulu-Natal Coastal Belt grassland; both are considered Critically Endangered vegetation types (EKZNW, 2012; SANBI, 2018) (Figure 4). Plans are underway to proclaim the Solomon Gijima Dindikazi Nature Reserve to encompass the undeveloped portion of the Pondoland-Ugu Sandstone Sourveld vegetation inland of the Margate urban-edge (approximately 800m upstream of the R61), east of the Margate Airport, and the portion of the iKongeni River below this and incorporating part of the iKongweni/Margate conservancy (P. Norman, 2020, *pers. comm.*[3]; (EDTEA, 2020a). The location and boundaries of the proposed nature reserve are provided in Figure 5.

The vegetation characteristics of the iKongeni Estuary will be discussed under the Biotic Attributes (Section 4.2).

[2] The Msikaba Formation bears some correlation to the Witteberg Formation of the Cape Supergroup (Visser, 1998).

[3] Mr. P. Norman, WESSA Chairman, Minutes of the Ugu District Municipality and Coastal Committee meeting, dated 17 September 2020.



Figure 3: Geological formations of the iKongeni River catchment and estuary

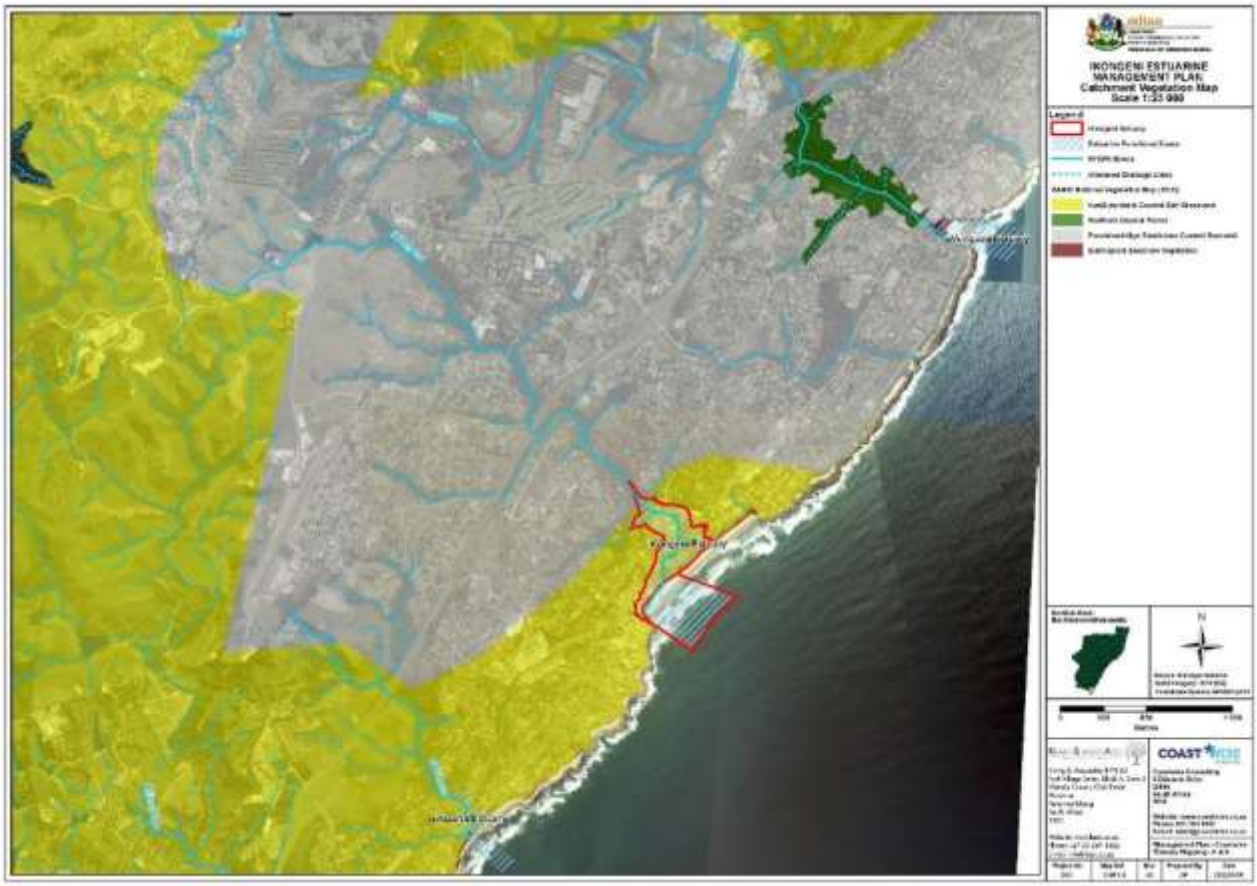

Figure 4: Vegetation of the iKongeni River catchment and estuary

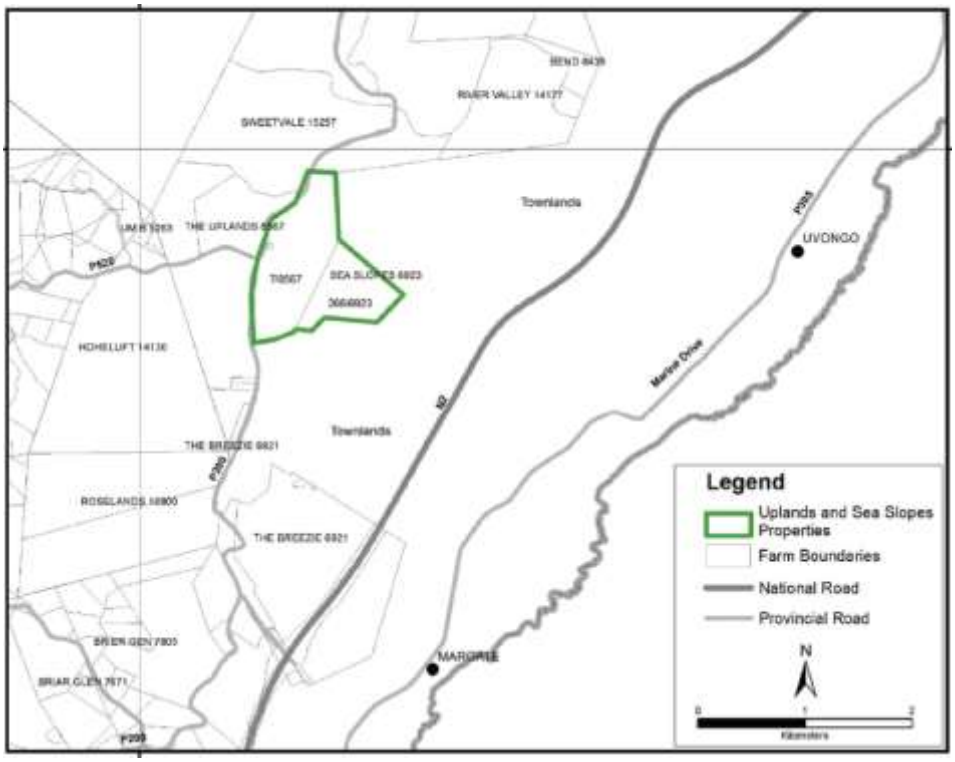

Figure 5: Location of the proposed Solomon Gijima Dindikazi Nature Reserve (EDTEA, 2020a)

3.2.Land Use and Land Cover

More than 50% of the catchment area that drains into the iKongeni Estuary is heavily urbanised, characterised by dense residential development and limited undeveloped or natural remaining land (approximately 25%) (Figure 6). Much of the immediate coastline is permanently and irreversibly transformed. This is characteristic of intense coastal ribbon development of the KZN south coast. The estuary is encompassed by the town of Margate, a coastal tourism hotspot that supports a number of commercial and entertainment activities, holiday establishments as well as retirement villages. Major transport routes traverse the river system, including the R61 and R620 (2.2 km and 0.6 km from the estuary mouth respectively), as well as several smaller roads along the estuary margins and further up in the catchment. A pedestrian bridge once existed in the lower reaches (former middle reaches) extending from the hotel on the northern bank across to the southern bank. This was completely destroyed in 2007 and rebuilt 150 m further upstream.

Within the RNM, commercial agriculture is the predominant form of land use (approximately 80% of the total municipal area) falling under primary or secondary agricultural land. Rich fertile soils and favourable climate provide for a flourishing agricultural industry (RNM, 2019). Agricultural land under sugar cane cultivation and orchards are found in the upper catchment, covering approximately 20% of the catchment.

The hinterland is characterised by rural villages and settlements under tribal authority, namely Nositha on the outskirts of Gamalakhe. Commercial activities are limited to small scale agricultural and manufacturing activities, small local convenience shops, taverns, and salons (RNM, 2019).

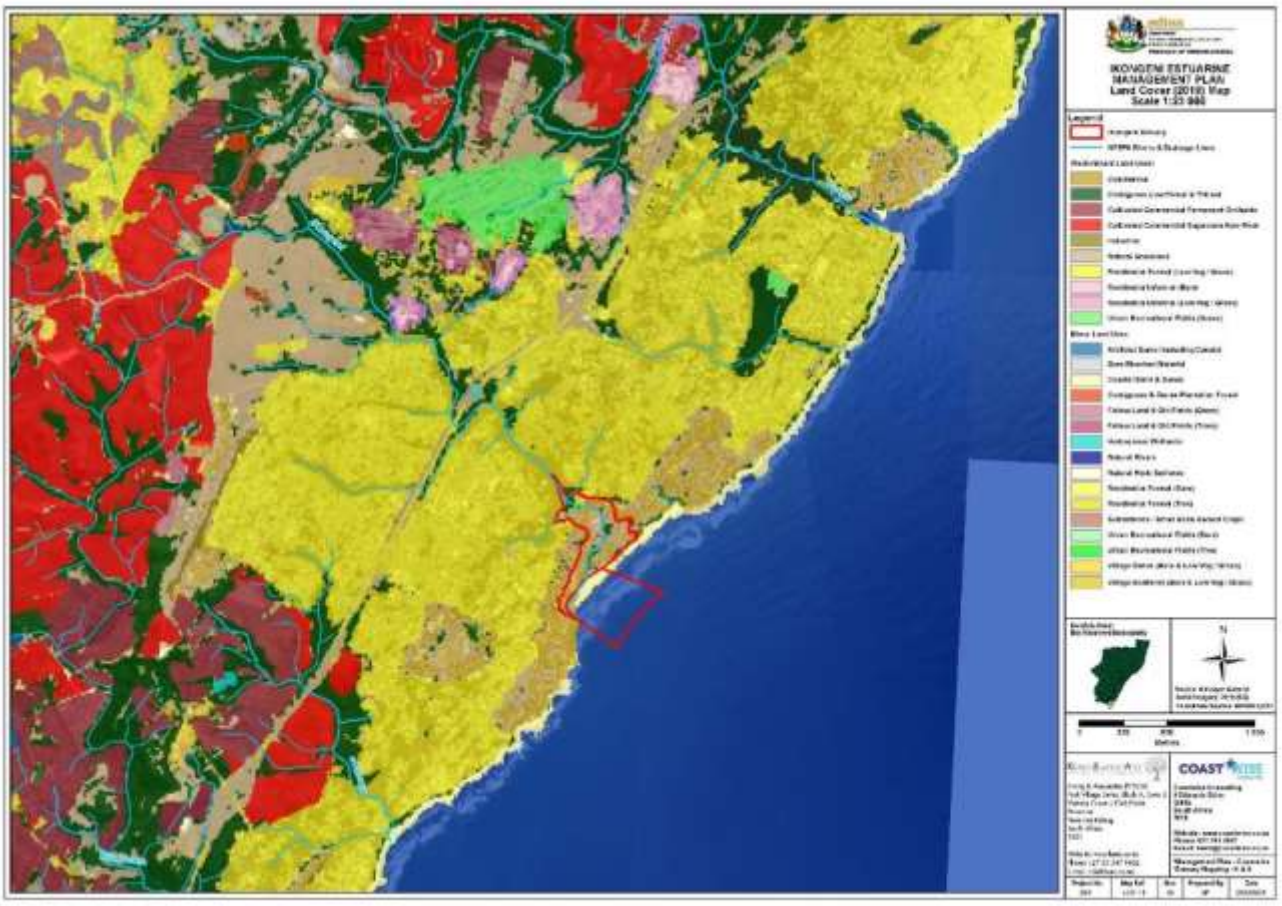

Figure 6: Types of land use present in the iKongeni River catchment and surrounds

4. OVERVIEW OF ESTUARY ECOLOGICAL FUNCTION AND STATE

4.1.Abiotic Attributes

4.1.1. Hydrology

The iKongeni River and estuary are located in quaternary catchment T40G of the Pongola-Mtamvuna Water Management Area (WMA 4). The size of catchment is approximately 7.9 km^2 in extent (DWA, 2013) with a river length of 6 km. There are at least two small farm dams and several smaller ephemeral drainage lines draining into the iKongeni River in the catchment above the urban margin, as well as two drainage lines entering the system below the R61 (Figure 7).

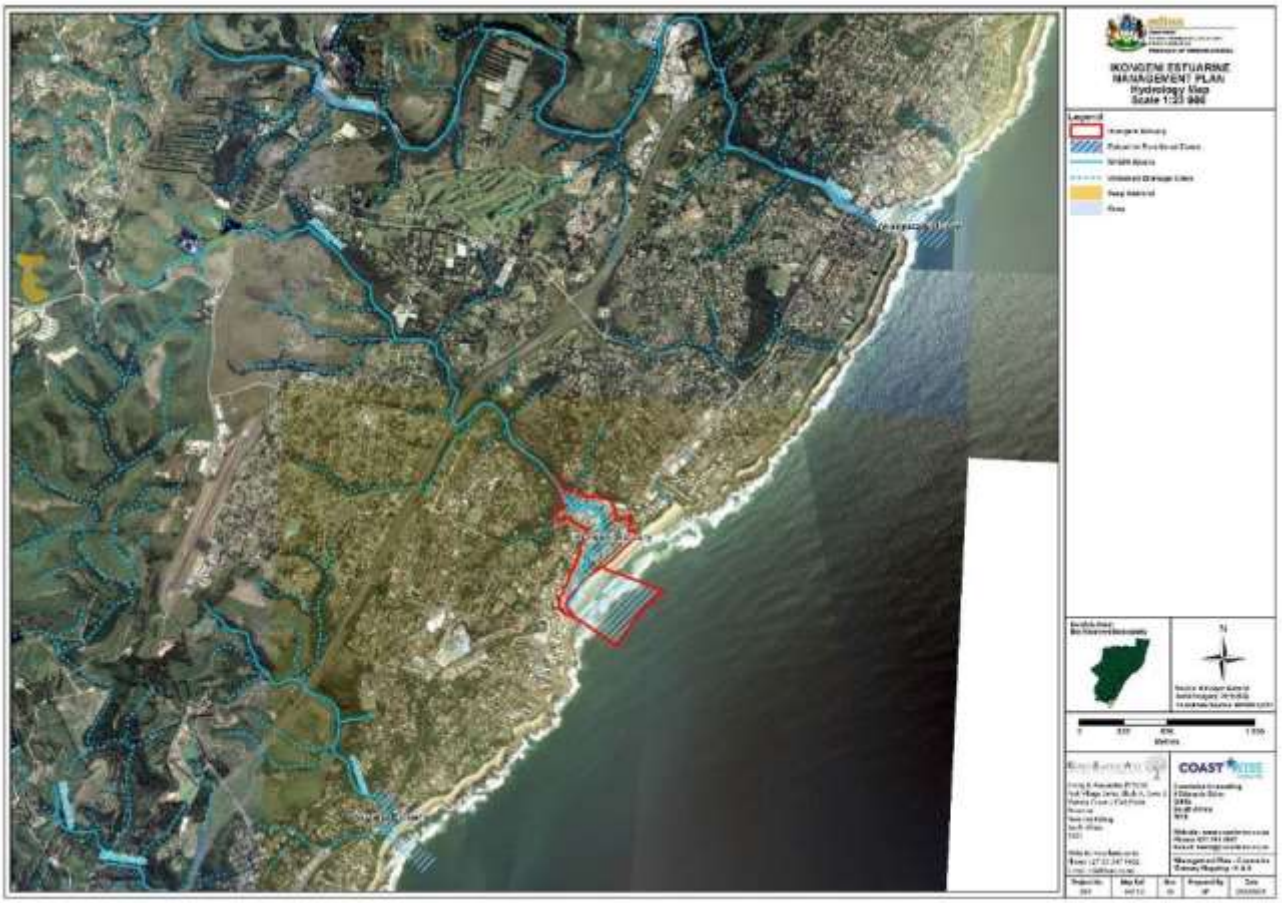

Figure 7: Major river and drainage lines feeding into the iKongeni Estuary

Under the natural undeveloped condition (termed 'Reference' State), the Mean Annual Run-off (MAR) to the iKongeni Estuary was 1.95 x 10^6 m^3 (Table 2), but this has increased by 51% to 2.95 x 10^6 m^3 under the present day condition (DWA, 2013). This change in runoff is reportedly due to discharges from the Margate WWTW[4] (estimated 4.6 – 4.9 Ml/day) (DWA, 2013; DWS, 2015a), located 1.5 km above the estuary, in combination with urban stormwater inputs. The natural flow regime is further altered by a large instream impoundment or weir.

[4] According to Ugu DM Water Services Department, the WWTW discharges via a surfzone pipeline at Lucien Beach and not directly to the Kongeni River. Minutes of the 2nd Authorities Meeting, dated 28 January 2021.

Table 2: Summary of hydrological change to the iKongeni Estuary (DWA, 2013)

Parameter	Changes in Flow Parameters
Reference MAR (million m^3/a)	1.95
Present MAR (million m^3/a)	2.95
% MAR Similarity	51.6
% Base flow similarity	91.7
Change in high flow duration	Yes
Change in low flow duration	Yes
Shift in high flow onset month	Yes

Flood Records

While there are no records for flood discharges through the iKongeni Estuary specifically, the system and its immediate surrounds have been subject to recent severe floods related to high rainfall events.

During June 2008, the KwaZulu-Natal south coast experienced an abnormally high rainfall event lasting two days that resulted in severe flooding as numerous rivers and estuaries burst their banks and widespread damage to development and infrastructure (Stow, 2011), including Margate. In June 2019, a similar event took place which again resulted in severe flooding. The photographs provided below give an account of the level of flooding of the road network at the head of the iKongeni Estuary during the June 2008 (Figure 8A-C and Figure 9A-B) and April 2019 (Figure 10A-E) flood events. High rainfall was again recorded in December 2019[5]).

Anecdotal information from a local property owner, who runs an automotive repair and panel beating business 100 m above the estuary, suggests that the flooding is exacerbated by pinching at the R602 road bridge. Given the location of his business on the immediate banks of the iKongeni River, his premises suffered severe undermining and the loss of several vehicles during the June 2019 event.

[5] https://www.timeslive.co.za/news/south-africa/2019-12-12-margate-lashed-by-nearly-150mm-of-rain-in-24-hours/







Figure 8: Margate crossroads flooded (June 2008) (Source: J. Gore[6, 7, 8]), viewed from south east corner toward Frey's Meat Market





Figure 9: A) Flooding of Margate road network above Margate bowling greens and, B) Margate Main Beach (June 2008) (Source: hibuscuscoast.wordpress.com[9])

[6] https://www.flickr.com/photos/johngore/2590097821/in/photostream/

[7] https://www.flickr.com/photos/johngore/2590097659/in/photostream/

[8] https://www.flickr.com/photos/johngore/2590097941/in/photostream/

[9] https://hibuscuscoast.wordpress.com/2010/11/01/floods-in-margate/#jp-carousel-1308



Figure 10: A) Flooding of upper reaches of estuary behind Martin Electronics, B) main cross roads looking west, C) above estuary at Frey's Meat Market looking west, D) damage to Marine Drive at head of estuary, E) upstream view of Marine Drive (photographs provided by B. Wikstrom[10])

4.1.2. Hydrodynamics

Prior to the 2018 NBA, the estuaries of South Africa were classified into five general types based on various attributes and the iKongeni River estuary was classified as a subtropical temporarily open/closed estuary (TOCE) (Van Niekerk and Turpie, 2012; Whitfield and Baliwe, 2013). More recently, however, 12 estuarine types have been identified (Van Niekerk, Adams, Lamberth, MacKay, *et al.*, 2019; Van Niekerk *et al.*, 2020) and the iKongeni Estuary is now classified as a Small Temporarily Closed estuary, exhibiting the general characteristics listed in Table 3.

The size of the EFZ based on the 5m contour and 10 m contour is 5.6 ha and 32.7 ha (excluding the marine extension) (2018 NBA spatial dataset), respectively. The length of the estuary water body from sea front to the inland extent of saline influence is approximately 800 m, covering an open water area of approximately 1.42 ha (Van Niekerk, Adams, Lamberth, MacKay, *et al.*, 2019). However, these dimensions, as well as water depth, fluctuate based on the state and position of the mouth.

[10] Mr. B Wikstrom, 2019, Isolendalo Environmental Consulting

Table 3: Characteristics of small temporarily closed estuaries (Van Niekerk et al., 2019)

Attribute	Description
Estuarine area (ha)	<15
% open to the sea	<50
Geomorphology	Linear/funnel with highly restricted inlet/outlet
Average tidal range (m)	0.15 – 0.3
Maximum water level determined by	Mouth state
Typical salinity range	0 - 30
Mixing process	Riverine/ wind / seepage
Sediment stability	Mobile (breaching and floods)
Mean Annual Runoff (x10^6 m^3)	0.1 - 70

The main characteristic of a temporarily closed estuary is the formation of a sand bar, or berm, at the mouth that blocks off connection with the sea for varying amounts of time during the year. In the case of the iKongeni system, the berm is south-extending with the mouth most often located against the rocky headland (Figure 11). The berm constitutes the Margate Main Beach and bathing area. During the wet summer months (October through to February) the estuary is open for, on average, 3 to 6 days per month, approximately 49% (Le Roux *et al.*, 2005; DWA, 2013) of the year. During the dry winter months (late April to July) the estuary recedes, and breaching is uncharacteristic and seldom occurs. Duration or occurrence of breaching is dependent on preceding rainfall and sea conditions (Le Roux *et al.*, 2005), as well as wastewater discharge. During artificial breaching or after high rainfall events, the outlet pushes out roughly central to the beach environment (Figure 11).



Figure 11: Differing locations of the iKongeni Estuary mouth channel, south-extending (left) (May 2017, CoastKZN) and central (right) (Feb 2010)

Due to the intermittent connection to the sea and perched[11] nature of the system, marine exchange is absent during closed mouth conditions or restricted during open mouth conditions. Thus, the average tidal range is very limited and circulation is governed largely by fluvial input, wind or seepage through the sand bar with tidal mixing processes prevalent during open mouth conditions or as a result of marine over-wash.

Consequently, salinities are highly variable and can range from full strength sea water during open mouth conditions to near freshwater caused by significant dilution by river input during the closed mouth conditions (typical salinities range between 0 – 35). Salinity gradients may be present depending on the state of the mouth and water depth.

[11] A condition typical of subtropical temporarily open closed estuaries where the bed level is at or above mean sea level as a result of silting up/sedimentation

Historical Configuration

Historical imagery[12] from 1937 shows that the lower reaches of the iKongeni Estuary comprised a relatively long narrow basin, with a shallow and narrow outlet that deflected along a vegetated embankment before discharging into the sea over a wide beach (Figure 12A). The middle reaches of the system contained noteworthy reed swamp habitat.

By 1966, development along the coastline had increased markedly, including on either bank of the estuary. However, the configuration of the estuary remained relatively unchanged (Figure 12B).

In 1972, modification of the beach and estuary mouth can be observed, and what appears to be infilling/land reclamation and rock reinforcement ("training wall") of the area adjacent to the vegetated embankment, effectively bisecting the estuary basin. The outlet was pushed northwards, and the vegetated dune that formed part of the berm on the northern bank was reduced (Figure 12C).

Imagery from 1972 to 1975 shows progressive drying of the southern extent of the basin (Figure 12D), and in 1975 construction began for the swimming pool that exists today (Figure 12E). By 1976, the southern half of the basin was completely infilled and being prepared for the development of a go-cart track (Figure 12F). From 1987 to present, the densely developed coastline and configuration of the estuary remains unchanged.

Notwithstanding the impacts of development, the estuary outlet returned to follow its "natural" course southward under normal conditions where it discharged against the rocky headland. During periods of high rainfall and flooding events, the estuary would breach naturally in line with the reinforced embankment. For several years, the "natural" configuration was seen as unfavourable as it interfered with the recreational facilities (go-cart track, putt-putt course and swimming pool), causing the infrastructure to be undermined. Artificial breaching was thus initiated to prevent this scenario (Begg, 1978). This reportedly negatively affected beach bathing conditions (Begg, 1978).

As environmental awareness and understanding of the negative impacts of artificial breaching grew over the years, this activity was halted and, in alignment with current environmental best practice, this activity is strongly discouraged, unless for exceptional circumstances and/or cases of emergency.

Nowadays, the estuary outlet channel meanders between the flood mouth position (Figure 12H) and the rocky headland to the south and between the back-beach area and wash zone (Guastella and Smith, 2013). Portions of the estuary margin have been replaced by erosion defence, namely gabion baskets and rock revetments.

In 2017, significant back beach scour and high estuary water levels coupled with strong tidal and wave activity resulted in the undermining of the coastal infrastructure as well as endangering the health and safety of beach goers as they attempted to cross the deepened estuary outlet. This was deemed a case of emergency and an interim policy (Interim Mouth Management Plan, see Section 8.3.13) was put in place to enable an approved relocation of the estuary mouth to its flood position. Ms Mhlongo confirmed on the 31st of July 2020, that the Municipality were monitoring the position of the mouth, as well as the Margate Rate Payers' Association (B. Smit, 2020, *pers. comm*.[13]), and were manipulating it to prevent it from shifting. She noted that the LM were wanting a more permanent solution and were wanting to install sand bags using capital budget, which was not in keeping with the approved plan. As such, this issue is needs to be addressed in the EMP (F. Mhlongo, 2020, *pers. comm.* [14]).

[12] Obtained from South African Estuary Information System- Kongweni. https://saeis.saeon.ac.za/Info/62. Accessed April 2020

[13] Mr B. Smit, Margate Rate Payers' Association, Minutes of the 1st public stakeholder meeting, dated 10 September 2020

[14] Ms F. Mhlongo, Ray Nkonyeni Local Municipality: Environmental Management, Minutes of the 1st authorities meeting dated 31 July 2020

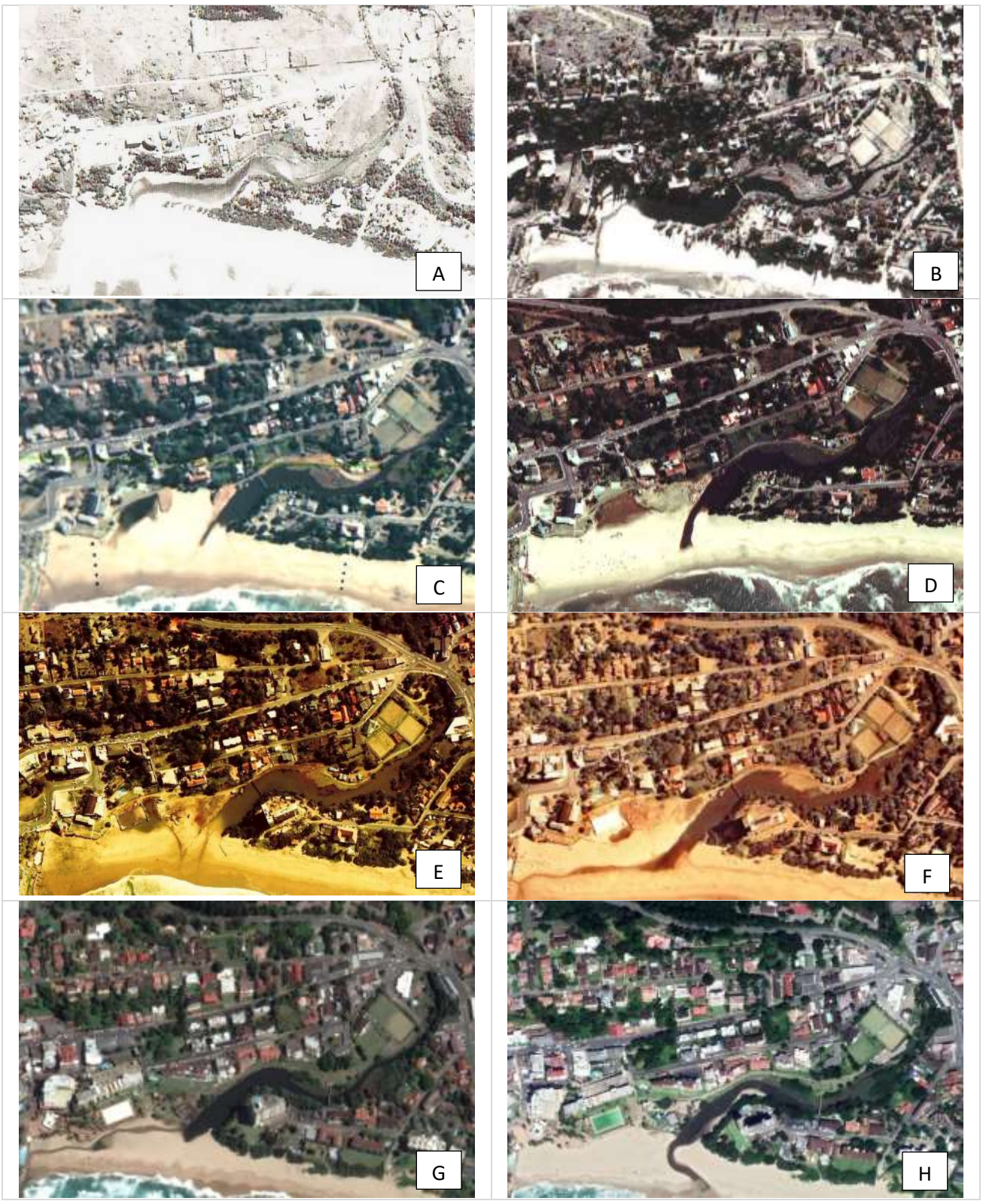

Figure 12: Historical imagery showing modifications to the of the iKongeni Estuary, A) 1937; B) 1966; C) 1972; D) 1973; E) 1975; F) 1976; G) Sept 2017; and H) Jan 2020 [Source: SAEON, 2020 and Google Earth].

Water levels

Water levels within the iKongeni estuary are dependent on the state of the mouth, the volume fluvial input as well urban inputs.

Historical accounts indicate that the system was moderately deep (average ±1.3 m), with a maximum depth of 2.3 m recorded just upstream of the "training wall" (Begg, 1984). Water depths exceeding 2 m were recorded by Harrison in October 1992 (unpub. data), while other maximum depths recorded were in the region of 1 m (Harrison, 1998 unpub.) and 1.8 m (Stow, 2011) (SeeTable 5, pg. 18).

4.1.3. Sediments

Begg (Begg, 1984) described the bottom materials of the iKongeni Estuary as comprising mainly silt and sandy mud; with beach sand lining the estuary outlet. The situation sampled by Harrison in 1998 (unpub. data) was different to that found by Begg. Harrison indicated that the substrate was predominantly medium (~40%) to coarse sand (~30%). Throughout the system, the mud fraction was absent and sediment organic material was less than 0.5% (Harrison, 1998 unpub., Stow, 2011). Repeat sampling by Stow (2011) in 2010, found a slightly different composition where the sediment was fine, comprising ~22% and 25% medium sand and coarse sand, respectively with a higher proportion of mud (~10%). This was likely attributed to an extended closed mouth state and the fluvial influx and settlement of fine material in the terminal basin. Overall, the amount of sediment organic material throughout the system was less 1% (Stow, 2011).

While the nature of the sediment is largely derived from the catchment geology and soils, it is important to note that the volume and composition of the influent water to the estuary has an important influence on the nature of sediments. For example, strong and continuous flows scour away finer material. This material serves as an important habitat and food resource for benthic organisms, which in turn are an important component of the estuarine food web.

4.1.4. Water Quality

Estuaries are the transitional point between saline marine water and land-derived freshwater. As such, the water quality of the iKongeni Estuary is strongly dependent on the quantity and quality of freshwater input, the state of the mouth and the amount of marine exchange that occurs.

Historical assessments by Begg (Begg, 1978, 1984) already documented the "*deplorable*" state of iKongeni Estuary, which included high levels of faecal contamination and dangers of contracting cholera and bilharzia, as well litter pollution. Harrison et al., (2000) considered the water quality to be "Fair" however the system received poor ratings for the individual water quality components, including, suitability for aquatic health, suitability for human contact, and trophic status (i.e. nutrient levels).

Salinities recorded by Begg (Begg, 1984) (Table 4) showed a system varying between fresh to mesohaline (moderately brackish) conditions, with surface salinities ranging from 0.0 – 10 and bottom salinities being slightly higher, ranging from 2.0 – 19.0. Stratification of the water column, indicated by marked differences in surface and bottom salinities, temperatures, and oxygen concentrations, was evident during the open and particularly during the closed phase in winter.

Surface water temperature values ranged between 15.6 °C and 26.8 °C and bottom values ranged between 18.9 °C and 26.7 °C (Begg, 1984) (Table 4). Dissolved oxygen (DO) concentrations were generally satisfactory for surface water, ranging between 3.9 mg/L and 8.6 mg/L. Concentrations in bottom waters however, were on average less than 5 mg/L, with values below 3.0 mg/L frequently recorded indicating hypoxic (oxygen-poor) conditions (Begg, 1984). Severely depleted oxygen levels (0.5 mg/L) were noted in the deeper pockets of the estuary and this was attributed to sewage contamination (Begg, 1984) (Table 4).

Laboratory results between 1980 and 1982 show that pH values ranged between 7.0 and 7.5, and water transparency was generally more than 1.5 m except during the open mouth phase (Begg, 1984) (Table 4). Similarly, the level of total dissolved solids (TDS) was particularly high at 5 160 mg/L, compared to 246 - 750 mg/L during closed conditions. Nitrate values varied between 0 to 300 µg/l and phosphate values ranged

from 3 to 13 µg/l. Concentrations of *E.coli* were high ranging between 1600 cfu/100 ml and 1800+ cfu/100 ml reflecting severe faecal contamination (Table 4). These results indicate a highly polluted system and was expected as a result of sewage discharge and ongoing spillages (Begg, 1984).

Table 4: Historical water quality measurements in iKongeni River estuary between 1980 and 1982 (Begg, 1984)

	03/1982		07/1982		10/1982	
(Mean)	T	B	T	B	T	B
Salinity	1.7	7.2	6.0	13.4	9.6	9.6
Temperature (°C)	25.4	26.0	15.7	20.5	26.4	26.2
Diss. Oxygen (mg/L)	5.7	3.0	7.9	4.4	4.5	3.3
Transparency (m)	0.75		1.63		1.57	
Mouth condition	open		closed		closed	

	08/1980	09/1981	06/1982
Total Diss. Solids (mg/L)	5 160	246	750
pH	7.5	7.0	7.3
NH_3 (ug/L)	50	300	100
NO_3 (ug/L)	50	0	300
PO_4 (ug/L)	3	13	11
***E. coli* (cfu/100ml)**	250	1 600	1 800+
Coliforms (cfu/100ml)	550	1 800+	1 800+

Water quality sampling undertaken in more recent years is provided in Table 5. It is evident that the iKongeni Estuary fluctuates between an essentially freshwater state, as evidenced in 1998, and a mesohaline state (< 18 PSU) seen in 2005 and 2010. The system exhibits typical horizontal salinity gradient as well as a marked vertical stratification when it was relatively deep (> 1 m) (2010), which was not apparent 1998. Higher salinities in the lower reaches is typically a result of marine overwash or the introduction of seawater through the open mouth into the system, which being of greater density than freshwater, sinks to the bottom. Freshwater enters the head of the estuary largely as less dense surface flow then dilutes the saline water overtime.

Deep-water conditions coupled with stratification can cause severe oxygen depletion at depth as illustrated in 1992, where dissolved oxygen concentrations of the bottom waters in the lower reaches plunged to a minimum of 0.6 mg/L. Bottom water oxygen levels were notably low throughout the system during this time (average 1.8 mg/L). This exerts significant physiological stress on organisms living in the bottom sediment, as well as in the water column. Dissolved oxygen concentrations recorded by Le Roux *et al*., (2005) and Stow (2011) were largely comparable. Water clarity, or transparency, was seen to be greatly improved during the closed mouth state (as seen 1982 and 1992). This can be explained, in part, by the prolonged mouth closure that facilitates the development of stable, deep-water conditions, and the process of saline flocculation of suspended particulate matter.

Conversely, during relatively shallow water conditions[15] (Harrison, 1998 unpub.), the estuary tends to be well-mixed, with weak to no vertical stratification, and sufficient oxygen levels. This system was fresh throughout and this sample period was likely representative of a recent post-breach state. Under these conditions, temperature, pH, turbidity and dissolved oxygen levels can be slightly elevated in the lower reaches/mouth and this is due to shallow conditions, increased marine influence and strong coastal winds causing turbulent mixing.

[15] While the available data appear to show shallower average depth between 1992, and 1998 and 2010, water depth is a function of the duration of mouth closure, and freshwater and seawater inputs, coupled with seepage through the sand bar.

Table 5: Water quality measurements in iKongeni Estuary (T= top, B= bottom) (Harrison, 1992 unpub; Harrison, 1998 unpub; Le Roux, et al., 2005; Stow, 2011)

		Harrison (1992) (Closed)						Harrison (1998) (Closed)	Le Roux et al (2005) (Open)		Stow (2010) (Closed)
		Lower		Middle		Upper			Lower	Upper	
Parameter	**Unit**	**T**	**B**	**T**	**B**	**T**	**B**	Average (±SD)			Average (±SD)
Depth (m)	m		2.4		2.2		1.7	0.78 (0.23)			1.34 (0.66)
Salinity		6	11	6	10	6	8	0.23 (0.15)	15.8	8.7	12.03 (7.91)
Temperature	°C	22	24	22	24	23	24	22.70 (0.53)	27.79	28.95	28.63 (0.2)
pH								7.64 (0.45)	8.2	7.4	7.53 (0.11)
Turbidity	NTU	0	0	0	1	0	1	15.33 (8.62)	1.7	2.0	10.01 (5.49)
Total Dissolved Solids	mg/L										9.33 (7.39)
Dissolved Oxygen	mg/L	5.5	0.6	5.8	1.2	4.8	3.5	6.36 (1.29)	6.67	4.49	6.63 (3.96)
DO saturation	%	63	7	66	15	56	42		93	65	
Transparency	cm		160		160		150				
Ammonia (NH_3)	ug/L	10	12	17	192	35	298		<10	178	
Nitrate (NO_3)	ug/L	9	0	9	9	113	0		410*	643*	
Orthophosphate (PO_4)	ug/L	7	7	11	23	12	61		76	48	
Chl-a	mg/L	6		5		16					
E. coli	cfu/100ml	5		5		48			0	0	

**Nitrate + nitrite*

Table 6: Heavy metal concentrations in the iKongeni River, Estuary and Stormwater drain in 2005 (Le Roux, et al., 2005) (Values in red exceed the SAWQG limit)

	Units	Upper River	Lower Estuary	Stormwater drain
Mercury	ug/l	0.05	<0.02	0.06
Chromium	ug/l	0.63	0.59	3.1
Cadmium	ug/l	<1.4	<1.4	<1.4
Lead	ug/l	1.3	0.65	5.4
Copper	ug/l	4.9	5.9	6.7
Arsenic	ug/l	<1	<1	<1
Zinc	ug/l	34.3	9.2	11.1
Nickel	ug/l	0.99	1.1	2.3

Harrison (1992, unpub.) also recorded nutrient levels within the system (Table 5). These levels are considerably higher than those recorded by Begg (Begg, 1984) and indicate a dramatic increase in nutrient loading, undoubtedly related to continued sewage discharge. Normally, this would result in eutrophic[16] conditions characterised by algal blooms. However, the low algal biomass (chl-*a* concentrations) and comparatively lower nitrate and phosphate concentrations in the lower and middle reaches suggested a protracted closed mouth state, whereby nutrient levels had been sufficiently depleted (by an earlier algal bloom) to hinder further algal growth. This is also supported by the anoxic (low oxygen) conditions that would have resulted from decomposition of algal matter.

[16] Eutrophication is a state of nutrient enrichment in a water body caused by excess phosphorous and nitrogen, which stimulates excessive plant growth, such as algal blooms, that in severe cases have devastating consequences for aquatic biota.

Nutrient analyses in 2005, however revealed low levels of nutrients (ammonia, nitrates, and phosphates), i.e. oligotrophic conditions, in both the river and the estuary (Le Roux *et al.*, 2005). Ammonia removal by the estuary was described as "*especially significant*", illustrated by the marked difference in ammonia concentration between the upper and lower estuary, thus indicating efficient functioning of the system (Le Roux *et al.*, 2005).

Le Roux et al., (2005) also undertook heavy metal sampling (Table 6) and organic analyses (Table 42 in Appendix A) during their study in 2005. In respect to heavy metals, their results indicated that the upper river was contaminated with mercury, lead, copper and zinc, with concentrations being an order of magnitude higher the South African Water Quality Guidelines (SAWQG) limits for freshwater ecosystems (DWAF, 1996). The copper level within the lower estuary exceeded the SAWQG limits for marine environments (DWAF, 1995). Heavy metal concentrations sampled from the stormwater drain were markedly higher than the upper river, and the outflowing water was considered to be of poor water quality with signs chemical contamination (Le Roux *et al.*, 2005). Heavy metals in high concentrations are known to have toxic effects on aquatic organisms (DWAF, 1995, 1996).

The results of the organic contaminants study (Table 42 in Appendix A) indicated the presence of polyaromatic hydrocarbons (PAHs) and other toxic compounds derived from the petroleum industry (Le Roux *et al.*, 2005). While these compounds are frequently found in rivers and estuaries in urban areas, the recorded concentrations suggest a level of potential toxicity risk for riverine, estuarine and marine biota, particularly adjacent to the stormwater drain where the petroleum hydrocarbon concentrations were highest. Various pesticides were detected in both the river and the estuary and the source was attributed to agricultural activities and the presence of livestock in the catchment (Le Roux *et al.*, 2005). In most cases, the concentrations of most contaminants were reduced in the lower estuary, further indicating ecosystem service of water quality improvement. At the time of sampling, there was no indication of industrial pollution or toxic bio-accumulative compounds in the iKongeni system (Le Roux *et al.*, 2005).

Public Health Concerns

Water quality monitoring of the iKongeni Estuary, as well as the Lucien Beach outlet, was initially undertaken by the then Hibiscus Coast Municipality as a monitoring requirement for obtaining and maintaining Blue Flag status for Margate Main Beach and Lucien Beach (Margate Beach North). This focussed on *E.coli* (and faecal streptococci concentrations) against a recommended recreational guideline value of 100 cfu/100 ml.

Sampling by Le Roux et al. (2005) indicated the presence of some faecal contamination in the Kongweni River, the estuary, at the two beach points and the Hunters Stream stormwater drain (Table 7), which day-lights below the kiddies paddling pool at the southernmost extent of the beach. High faecal coliform counts at the upper river and estuary sites was attributed to the presence of informal settlements in the catchment as well as grazing cattle. The difference in faecal coliform counts from the upper and lower estuary indicated the purification function of the estuary. Faecal streptococci counts were highest in the urban area at the head of the estuary and severe at the Hunters Stream stormwater drain, which drains parts of the upper urban area (Le Roux *et al.*, 2005). Le Roux *et al.*, (2005) also noted that the Ugu DM microbiological data for the beach stations regularly exceeded the recreational guideline limit.

In contrast, available Blue Flag monitoring results for the period 2007 to 2009 (Table 8) show high levels of faecal pollution *(E.coli)* of both the iKongeni Estuary and the Lucien Beach outlet (at Margate beach north), with the vast majority of samples exceeding the stipulated limit. The poor results collected over the years allegedly received little attention in terms of rectifying poor or failing infrastructure (A. Botha, 2020, *pers. comm.*[17]). As at August 2020, monitoring results at Lucien Beach continue to indicate high levels of faecal pollution (BNK laboratory results, 27 October 2020, courtesy of A. Botha, 2020).

[17] Mr. A Botha, Ray Nkonyeni Municipality Beach Manager, 5 August 2020

Table 7: Results of microbiological analyses from 2005 (Le Roux *et al.*, 2005)

		Faecal Coliforms	*E.coli*	Faecal Streptococci
Kongeni River	Upper	600	0	82
	Lower	220	44	500
Kongeni Estuary	Upper	160	0	200
	Lower	26	0	22
Margate Beach	North	2	0	0
	South	12	0	0
Stormwater Drain (Hunters Stream)		34000	0	1400

Three significant sewage spills and resultant poor water quality resulted in the loss of Blue Flag status in 2012. Thereafter, the municipality ceased water testing on Margate Beach and the estuary as it had become clear that the beach would never regain Blue Flag status due to poor water quality in the iKongeni River and the ongoing significant contributions from the Hunters stream outlet (A. Botha, 2020, *pers. comm.*). The impact of latter on the iKongeni Estuary is more severe during winter months and high tides, where tidal action returns polluted water back onto the beach and into the estuary (P. Massyn, 2020, *pers. comm.*[18]). Further to this, Lucien Beach also lost its Blue Flag in 2018 as a result of poor sea water samples attributed to the Margate WWTW surfzone discharge point (A. Botha, 2020, *pers. comm.*).

Table 8: Summary of *E.coli* records collected in the Kongeni Estuary and Lucien Beach outlet between 2007 and 2009

		2007	2008	2009
MARGATE	No. of samples	6	25	20
	% Exceedance	83	84	75
	Max. count/100ml	5 000	10 000	18 800
LUCIEN	No. of samples	6	16	
	% Exceedance	50	88	
	Max. count/100ml	80 000	118 000	

The Margate WWTW (7Ml/day plant) discharges treated effluent direct to the marine environment via a surfzone pipeline at Lucien Beach (S. Tenza, *pers. comm.*[19]). However, other studies indicate direct daily discharges between 4.6 and 4.9 Ml/day (DWA, 2013; DWS, 2015a; Van Niekerk, Adams, Lamberth, MacKay, *et al.*, 2019). Nonetheless, system failures and blockages have increased in frequency and have become common occurrence resulting in additional untreated effluent entering the estuary (Table 9). Consequently, numerous incidents of severe pollution and fish kills (Figure 13) have been reports on the system in recent years with increasing frequency (See online news articles marked with * in Table 9. Fish kills are often the result of polluted water and low oxygen levels. Extremely poor water quality and fish kills presents a significant threat to public health and safety, and often puts pressure on authorities to artificially breach the estuary (Figure 14).

The Ugu DM's water and waste water process audit report of 2017 revealed that irreparable mechanical plants and equipment, amongst other issues, were to blame for the frequency and severity of pollution events (South Coast Herald, 2017[20]).

[18] Mr. P. Massyn, Ezemvelo KZN Wildlife, Minutes of the 1st public stakeholder meeting, dated 10 September 2020

[19] Mr. S. Tenza, Operation Manager Area South, Ugu DM Water Services Department, Minutes of the 2nd Authorities Meeting, dated 28 January 2021

[20] S. Aylward, UPDATE: Margate sewage contamination: Who, what, where, when and why. South Coast Herald, March 9, 2017

Table 9: Series of Incidents, Alerts and News Article Links provided Omar Parak, EDTEA

Date	Incident	Comment
October 2005	Contaminated samples from nearby stormwater and sewage systems	Margate loses its Blue Flag status - http://www.iol.co.za/news/south-africa/margate-beach-loses-coveted-blue-flag-status-257087
December 2011	Pump station failure and spill	Alert from EDTEA: Ugu
April 2012	Pump station failure and spill	Margate loses its Blue Flag status again - http://www.news24.com/archives/witness/sewage-closes-beach-20150430
June 2012	Pump station failure and spill	http://www.news24.com/archives/witness/new-sewer-system-for-margate-20150430
September 2012	Pump station failure and spill	Alert from Ray Nkonyeni Municipality (Anton Botha); http://www.news24.com/archives/witness/new-sewer-system-for-margate-20150430
November 2012	Letter from DEA (now DFFE)	
May 2014	Hunters Stream beach discharge	Alert via Ray Nkonyeni Municipality (Anton Botha)
July 2015	Hunters Stream beach discharge	Alert via Ray Nkonyeni Municipality (Anton Botha)
August 2015	Hunters Stream beach discharge	Alert via Ray Nkonyeni Municipality (Anton Botha)
August 2015	Pump station failure and spill	Alert from Environmental Solutions; http://southcoastherald.co.za/103819/margate-and-ramsgate-in-the-shit/ and http://www.timeslive.co.za/thetimes/2015/09/10/Tide-of-bile-over-poo
August 2015	Illegal Breach	Alleged illegal breach commenced (letter to Minister by S Holland)
August 2015	Final notice from DWS	
September 2015		Feedback from DEA (now DFFE) that incident was not reported as per incident protocol
January 2016	Blocked main sewer line and spill	Alert via Ray Nkonyeni Municipality (Anton Botha)
March 2016	Pump station failure and spill	Alert via Ray Nkonyeni Municipality (Anton Botha)
November 2016	Hunters Stream beach discharge	Alert via Ray Nkonyeni Municipality (Anton Botha)
January 2017	Hunters Stream beach discharge	Alert via Ray Nkonyeni Municipality (Anton Botha)
February 2017	Hunters Stream beach discharge	Alert via Ray Nkonyeni Municipality (Anton Botha)
March 2017	Pump station failure and spill	http://southcoastherald.co.za/193375/urgent-notice-margate-beach-closed-due-serious-sewage-contamination/ https://southcoastherald.co.za/194030/heads-roll-over-margates-enviro-disaster/
March 2017	Alleged illegal breach commenced	
May 2017	Sewage spill – failure of pump 4A –	Reported by Ugu DM.
June 2017	Meeting with authorities – Incidents from Ugu DM Infrastructure – Sewage spillages	
February 2018	Fish kill – not reported	https://southcoastherald.co.za/266433/another-contamination-keeps-margate-beach-lagoon-closed/
February 2018*	Unidentified contamination - Presumed sewage spill	https://southcoastherald.co.za/266881/something-stinks-in-margate/
May 2018	Sewage spill - sewer pipe on Erasmus Road in Margate collapsed, blocking a manhole which caused an overflow into Hunters stream.	https://www.news24.com/SouthAfrica/Local/South-Coast-Fever/margate-beach-closed-20180526
October 2019*	Sewage spill – failure of pump 4A	Not reported. https://southcoastherald.co.za/377409/no-life-left-in-river/ https://www.iol.co.za/dailynews/wildlife-devastated-after-margate-sewage-spill-34439776
February 2020	Sewage spill – failure of pump 4A	Mouth breached – not reported
August 2020	Sewage spill	



Figure 13: Fish kill arising from contamination of the iKongeni Estuary in February 2018 (*South Coast Herald, 2018)



Figure 14: Mechanical breaching of the iKongeni Estuary in October 2019 to alleviate poor water quality as a result of a sewage spill (*South Coast Herald, 2019)

Under the auspices of the broader "Green Town" water project lead by the Ugu DM, the Kongweni River Conservancy has been conducting water sampling, specifically *E.coli* sampling of the Kongeni River and surrounds, since August 2012 (G. Holburn, 2020, *pers. comm.*[21]). Sampling of the iKongeni Estuary only began in 2019. A summary of available data since June 2016 for key sites is provided in Table 10 below (see full dataset in Appendix B). The results indicate that between 36 and 91% of all the samples collected exceeded the Target Water Quality Range (TWQR) for *E. coli* in terms of full recreational contact for freshwater streams and rivers (0-130 cfu/100 ml) (DWAF, 1996), and coastal estuarine waters (<500 cfu/100 ml) (DEA, 2012). Consistently high measurements were recorded at Frey's Meat Market at the head of the iKongeni Estuary, and provides a clear indication of the poor water quality of water entering the estuary from the catchment. Values in excess of 100 000 counts/ 100ml have been recorded most frequently at Frey's Meat Market, but also at Alexander Street Bridge, before the R61 exit, and the iKongeni Estuary.

Table 10*:* Summary of *E.coli* records collected by the Kongeni River Conservancy between June 2016 and March 2020 from the Kongeni River and surrounds

	Alexander St Bridge	Before R61 exit	Tony's Stream	Wetland Stream / Bense Stream	Freys Meat Market / Waynes Auctions	River crossing below Freda House	Margate Lagoon
Samples > TWQR	27	25	4	18	40	3	7
No. of samples taken	41	44	11	37	44	7	8
% Exceedance	66	57	36	49	91	43	88

The poor state of the estuary, specifically relating to sewage spills and discharges, as well as the lack of care or rehabilitation, was consistently raised as a critical issue to be addressed during the public participation meetings[22] and correspondence.

It is clear that water quality within and entering the iKongeni Estuary is polluted, and that there are several sources of this pollution that require urgent attention if the health and ecological functioning of the estuary is to be at least maintained and prevented from further deterioration.

[21] Mr. G. Holburn, iKongweni Conservancy Chairman, 12 March 2020.

[22] Minutes of the 1st authorities meeting, dated 31 July 2020; Minutes of the 1st public stakeholder meeting, dated 10 September 2020; Minutes of the Ugu meeting, dated 17 September 2020.

4.2. Biotic Attributes

4.2.1. Flora

Algal forms

Algal growth is influenced by nutrient availability and turbidity, and the abstraction of chlorophyll-*a* from phytoplankton and microphytobenthos. It is used as an indicator of water quality based on the quantity of algae in the water column and on bottom sediment, respectively (Forbes and Demetriades, 2010). Sampling by Harrison (1992, unpub.) produced chl-*a* values of 6 mg/L at the mouth and 16 mg/L in the upper reaches. These low results were unexpected given the known effluent spills, anticipated nutrient enrichment and elevated algal concentrations. This could have been attributed to nutrient depletion together with die-off of algal matter prior to sampling.

Riparian and estuarine vegetation

According to Scott-Shaw and Escott (2011), much of the iKongeni Estuary floodplain is classified as Marine Saline Wetland (Endangered), while the vegetation on the sandbar and adjacent shoreline is classified as Subtropical Seashore Vegetation (Least Threatened). The majority of the estuary is mapped as KwaZulu-Natal Coastal Belt Grassland, however this vegetation type comprises a number of different vegetation types, and as such, all of the vegetation currently found adjacent to the estuary does not consist of grassland but rather a mosaic of woody vegetation units, manicured areas and development (Kinvig and Styles, 2020).

Historical records of estuarine habitats noted reed beds, mangroves, sand and mud banks, the estuary channel or water course, and swamp forest (Table 11) (DWS, 2015b). However, the mangroves have been completely lost from the system as result of urban development (DWA, 2013; Van Niekerk, Adams, Lamberth, MacKay, *et al.*, 2019).

Table 11: Areas of historical habitats existing in the iKongeni River estuary (DWS, 2015b, Van Niekerk et al., 2019)

Habitat Type	Area (ha)
Reeds & Sedges	4.0
Mangroves	0.5
Sand / mud banks	1.0
Channel	1.42
Swamp forest	0.25
TOTAL	**7.17**

Begg (Begg, 1984) described the lower reaches of the iKongeni River estuary as being almost completely lacking in marginal vegetation. During his assessment, coastal forest existed along the northern bank and reeds along the southern bank in the middle reaches, whilst the upper reaches was lined with reeds.

Currently, the type and distribution of habitats (Figure 15) remains relatively unchanged from Begg's description yet markedly reduced in coverage. During the field assessment of the system, marginal vegetation was mostly absent from lower reaches, apart from dune pioneer species (Subtropical Shore Vegetation), and a narrow band of Subtropical Dune Thicket vegetation bordering the development on the northern bank, of which most of this band is no more than 30 m wide (Kinvig and Styles, 2020). Species include *Chysanthemoides monilifera* and *Mimusops caffra*, as well as swamp forest species, such as *Hibiscus tiliaceus* and *Ficus trichopoda*.

At the mouth and closely flanking the banks of the river, extending to about 100 metres east of the R602 road (i.e. the middle reaches), there is some estuarine vegetation including Lagoon Hibiscus (*Hibiscus tiliaceous*) and patchy stands of the common reed, *Phragmites australis* (Kinvig and Styles, 2020), with noteworthy beds occurring in proximity to the pedestrian bridge, and 50 m upstream on the northern bank. Artificial lawn extends for some 135 m on the southern bank into the middle reaches. Lagoon hibiscus and Northern Coastal Forest vegetation occurs along the northern bank, becoming widest in line with the bowling greens of the Margate Bowling Club. The southern bank in this area is predominantly lawn, utilised as a parking area for the bowling club, with limited emergent vegetation (*P. australis* and sedges) and isolated coastal forest and other indigenous tree species, such as *Brachylaena discolor* (Coast Silver-oak), *Syzygium cordatum* (Waterberry), *Ficus burkei* (Common wild fig) and *Erythrina caffra* (Coastal Coral Tree) (Kinvig and Styles, 2020).

The vegetation below and east of the R602 is for the most part not very species diverse, and no rare or red listed species were observed. In one area, the riparian forest has been cleared in favour of a grassed picnic site/viewing area along the estuary. Some trees, protected by the National Forests Act occur close to the mouth, not more than 200 metres inland from the shoreline. The following two species that were recorded are: *Mimusops caffra* (Coastal Red Milkwood) and *Sideroxylon inerme* (White Milkwood) (Kinvig and Styles, 2020).

Forest above and inland of the R620 is less easy to characterize. Some has been disturbed by a go-cart park and panel-beating business. There are some Swamp Forest and riparian elements along the river banks (such as *Voacanga thouarsii*), but some is rocky and transitional with Scarp Forest. The forest away from the banks is mainly composed of common or pioneer species (particularly Natal Mahogany, *Bridelia micrantha*), with scattered alien invasive species in openings and along the forest edges. It likely that a greater number of alien invasive trees occur beyond the afforded line-of-sight (Kinvig and Styles, 2020).

Invasive vegetation is most conspicuous in the middle and upper reaches, and key species observed throughout the system include, *Melia azedarach* (Syringa), *Ipomea purpurea* (Morning glory), *Schinus terebinthifolia* (Brazilian pepper tree), and *Senna didymobotrya* (Peanut butter cassia). A complete species list is attached in Table 44 in Appendix C. It is estimated that alien invasive species do not comprise more than 15% of the total vegetation component (Kinvig and Styles, 2020). The presence and abundance of alien invasive species are considered to be at levels which are not extensive and which could easily be managed (Kinvig and Styles, 2020).

It is important to note, that although natural vegetation exists within the system, the estuary margins have been critically modified particularly along the northern bank, which is lined with gabion baskets and rock revetments (some are in a poor state of repair), as well as a loffelstein retaining wall in the upper reaches, to prevent flood scour and bank erosion. Furthermore, the remaining natural dune cordon along the sea front has been severely disturbed by development and numerous access points. Ways to conserve the remaining natural habitat need to be investigated at this will contribute to improving ecosystem health of the estuary (K. Govender, 2020, *pers. comm*.[23]).

[23] Ms Karen Govender, DFFE: Forestry Management, Minutes of the 1st authorities meeting dated 31 July 2020.



Figure 15: Photographs of estuarine habitats and vegetation types currently in Kongeni Estuary, A) open mouth, B) drained south-extending estuary channel and sparse dune pioneer species, C) vegetated dune cordon in the lower reaches, D) middle reaches showing drained channel, exposed sand/mudbanks, and grassed southern bank, E) reed bed and swamp forest species of the middle reaches, F) very narrow vegetated margin of middle reaches, and grassed parking area, (…)



Figure 15 continued: G) steep cut banks and lack of vegetated margin in upper reaches, H) upper reaches showing drained conditions and forest-like marginal vegetation, I) head of estuary above the R620 road network showing grassed embankments and lack of vegetated margin, J) proceeding into remnant coastal forest vegetation.

4.2.2. Fauna

There is very little available information on the fauna of the iKongeni Estuary is limited to records from Begg (1979, 1984), Harrison (1998 unpub. data) and Stow (Stow, 2011).

Invertebrates

Begg (Begg, 1984) described the quantity of sandprawns living in the system as "*impressive*". Other invertebrate species noted included molluscs, namely the bivalve *Brachidontes virgiliae* (Mytilidae) and gastropod *Melanoides tuberculata* (Thiaridae). Three species of macrocrustaceans were collected during beam trawling for fish, namely *Neorhyncoplax bovis* (Crown crab), *Scylla serrata* (Mud crab) and *Palaeomon concinnus* (Mangrove prawn) (Begg, 1984;

Table 12).

Table 12: Fish and invertebrate species collected in iKongeni River estuary (Begg, 1984) (EDC= Estuarine Dependence Category)

Species	Family	Common name	EDC	No.	% catch
INVERTEBRATES					
Neorhyncoplax bovis	Hymenosomatidae	Crown crab		3	4.76
Scylla serrata	Portunidae	Mud crab		1	1.59
Palaeomon concinnus	Palaemonidae	Mangrove prawn		4	6.35
FISH					
Ambassis productus	Ambassidae	Longspine glassy	Ia	2	3.17
Pseudomyxus capensis	Mugilidae	Freshwater mullet	Vb	4	6.35
Oligolepis acutipennis	Gobiidae	Sharptail goby	Ia(?)	2	3.17
Solea bleekeri	Soleidae	Blackhand Sole	IIb	2	3.17
Glossogobius giurus	Gobiidae	Tank goby	IV	17	26.98
Oreochromis mossambicus	Cichlidae	Mozambique tilapia	IV	28	44.44

Sampling of the benthic macroinvertebrates of the system in 1998 (Harrison, 1998 unpub) and 2010 (Stow, 2011) indicated a marked difference in the benthic community between these times (Figure 16). Harrison recorded 23 taxa and average density of 18 484.7 ind.m^{-2}, while Stow recorded only 15 taxa and a lower average density of 5 842.7 ind.m^{-2}. In 1998, the community comprised predominantly crustaceans (57%), followed by insects (25%), and polychaete worms (16%). In 2010, however, the community was dominated by polychaete worms (72%) and crustaceans (26%) (Stow, 2011) (Figure 16). The differences in community composition is due to a combination of differences in, and preferences, for specific sediment composition, water quality conditions, as well as available food resources prevailing at the time. However, the closed mouth state generally represents a period of high productivity, which was not the case in 2010 (as it was in 1998), where abundance was consistently lower. Indices for richness and diversity were also lower than 1998 (Stow, 2011). While these data are limited and represent 'snapshots' at the respective times, it is suggested that the community of 2010 indicates a poorer state of health for the iKongeni Estuary. Overall, the invertebrate fauna of the iKongeni Estuary have been negatively affected by flow modifications, poor water quality, severe habitat destruction, and reduced food availability (DWA, 2013).

Notwithstanding, the invertebrate community maintains a relatively high diversity in comparison to other temporarily closed estuarine systems along the RNM coastline (Stow, 2011).

It is worth noting that the "*impressive*" sandprawn population described by Begg (Begg, 1984) does not persist today; the number of active sandprawn burrows observed during the recent field visit was essentially negligible.

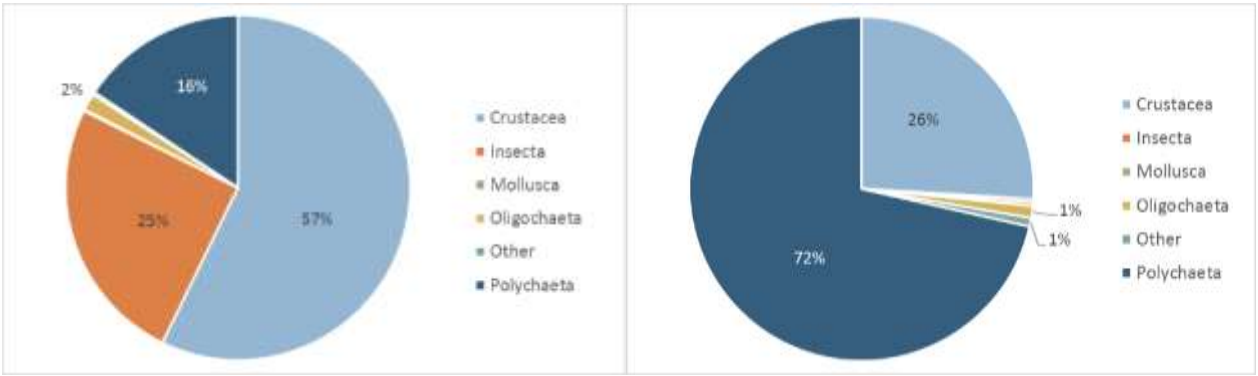

Figure 16: Percentage contribution of major faunal groups to total macroinvertebrate abundance in the iKongeni in 1998 (left) and 2010 (right) (adapted from Stow, 2011)

Fish

Begg (1984) undertook beam trawling in the iKongeni Estuary in 1982 and recorded 55 individuals from six species, as well as eight invertebrate crustaceans. In respect to the fish fauna, the most abundant species was *Oreochromis mossambicus* followed by *Glossogobius giurus,* which together accounted for 71% of the catch. On one of the three sampling occasions, no other organisms were caught throughout the system apart from a single *G. giurus*. Overall, the estuary was not considered to fulfil an important nursery function for marine species (Begg, 1984).

Harrison *et al*. (2000) rated that the condition of the fish community was 'Good'. A total of 11 species were recorded in the system in 1998 (Harrison, unpub. data; Table 13). The estuarine resident species, *Gilchristella aestuaria* (Estuarine round-herring) was the most numerically abundant species (63.4%) followed by *Mugil cephalus* (Flathead mullet) (25.7%), *Micropterus punctulatus* (Spotted bass) and *Pseuodmyxis capensis* (Freshwater mullet) (both 3.6%) and *O. mossambicus* (Mozambique tilapia) (1.8%). Other minor species included *Rhabdosargus holubi* (Cape stumpnose), *Liza dumerilii* (Groovy mullet), *Monodactylus falciformis* (Cape moony), *(Valamugil) robustus* (Robust mullet), *G. callidus* (River goby), and Liz alata (Diamond mullet). Collectively, mullet species accounted for 30% of the total catch. More importantly however, 91% of the catch comprised estuarine residents (Category Ia) and estuary-dependent marine species (Category IIa, IIb), that are reliant on the estuary for all, or part of, their lifecycles, respectively. This highlights the important role that the iKongeni Estuary served as fish nursery habitat.

Table 13: List of fish species captured in the iKongeni Estuary, November 1998 (Harrison, unpub. data)

Species	Family	Common name	EDC	No.	% catch
Gilchristella aestuaria	Clupeidae	Estuarine roundherring	Ia	1025	63.4
Mugil cephalus	Mugilidae	Flathead mullet	IIa	416	25.7
Micropterus punctulatus	Centrarchidae	Spotted bass	IV	58	3.6
Pseudomyxus capensis	Mugilidae	Freshwater mullet	Vb	55	3.4
Oreochromis mossambicus	Cichlidae	Mozambique tilapia	IV	29	1.8
Rhabdosargus holubi	Sparidae	Cape stumpnose	IIa	14	0.9
Liza dumerilii	Mugilidae	Groovy mullet	IIb	6	0.4
Monodactylus falciformis	Monodactylidae	Oval moony	IIa	7	0.4
Valamugil robustus	Mugilidae	Robust mullet	IIa	4	0.2
Glossogbius callidus	Gobiidae	River goby	IV	2	0.1
Liza alata	Mugilidae	Diamond mullet	IIb	1	0.1

Recent expert opinion indicates that the fish fauna of iKongeni Estuary has been negatively impacted by ongoing pollution and spill events, severe habitat destruction, flow modifications, artificial breaching of the estuary mouth as well as introduction of alien fish species, specifically Bass (*Micropterus* spp.) (DWA, 2013; Weerts, 2020, *pers. comm.*) [24]. The latter is likely to have greatly reduced populations of small estuarine dependent fish species (as well as estuarine invertebrates). Notwithstanding, the estuary still provides critical habitat for estuarine dependent species (Category I, e.g. *G. aestuaria*) and some freshwater species (Category IV), as well as an important nursery function for marine estuarine dependents (Category II), primarily mullet species, but also some fisheries species, such as Estuarine bream *Acanthopagrus vagus*, and Kingfish, *Caranx* spp. (Weerts, 2020, *pers. comm.*).

[24] Mr. S. Weerts, Senior Researcher, Council for Scientific and Industrial Research, 30 March 2020

Photographs following recent fish kill events also indicate the occurrence of the catadromous eel, *Anguilla* spp., which highlights the function of the iKongeni Estuary as a migratory corridor for these species.

It terms of fishing pressure, the annual total catch extracted from the system is estimated at 0.3 tons (Van Niekerk, Adams, Lamberth, MacKay, *et al.*, 2019). This is most likely undertaken by recreational fishers, as well as subsistence fishers who were observed cast-netting at the time of the site visit (Figure 17). The main species caught was Mozambique tilapia.



Figure 17: One of two subsistence fishers observed utilising cast nets in the iKongeni Estuary (July 2020)

Birds

No specific information is available on the birds of the iKongeni Estuary. Currently, the numbers of birds utilising the system are estimated to be very low due to its small size, limited habitat particularly for wading species, severe water pollution as well as frequent human disturbance (paddle boats).

During the field visit undertaken in July 2020, the following species were observed in the system: White-breasted Cormorant (*Phalacrocorax lucidus*), Egyptian Goose (*Alopochen aegyptiaca*) (breeding pair), and Domestic Goose (*Anser* spp.) (breeding pair).

Similar to other faunal groups, the bird communities of the iKongeni Estuary have been negatively affected by flow modification, water quality, severe habitat destruction, reduced food availability as well as human disturbance through recreational activities (i.e. paddle boating) (DWA, 2013).

4.3.Health Status

In early assessments of the health of the iKongeni Estuary, Heydorn (1986) acknowledged the heavily urbanised catchment and highly degraded state of the estuary, and rated the overall condition of the system as 'Poor'. Whitfield (2000; 2013) similarly deemed the estuary to be in a 'Poor' condition. Harrison *et al*., (2000) indicated that the water quality was 'Fair' and aesthetics as 'Fair'. In more recent years, the health status of South Africa's estuaries has been assessed through the National Biodiversity Assessment (2011 second iteration, 2018 third iteration). During these assessments, the health condition of each estuary (also known as the Present Ecological State, PES) was determined at a desktop level (or confirmed if updated studies were available) using the Estuarine Health Index (EHI), in which the current conditions of various abiotic and biotic components (see Table 15) were rated as a percentage of the probable pristine condition. The resultant health score was then assigned to one of six categories, ranging from natural (A) to critically modified (F) to describe the PES (Van Niekerk, Adams, Lamberth, MacKay, *et al.*, 2019).

Table 14: Correlation between the EHI Score and the PES

EHI SCORE	PES	GENERAL DESCRIPTION
91 – 100	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

In the 2011 NBA (Van Niekerk and Turpie, 2012), the provisional estuarine health score of the iKongeni Estuary was calculated as 62, corresponding to a provisional PES of C, i.e. a moderately modified system (Table 14). This infers that a loss and change of natural habitat and biota has occurred but basic ecosystem functions and processes remain predominantly unchanged.

In 2015, the status of the iKongeni Estuary, among others, was reassessed in greater detail through the estuaries Ecological Water Requirement (EWR) study, a component of the Water Resources Classification Study for the Mvoti -Umzimkulu Water Management Area (DWS, 2015a) (Table 15). In this study, the health state of the estuary was **downgraded to a Category D/E, i.e. highly degraded/ severely modified** (DWS, 2015a). This was attributed to major changes to the hydrology and hydrodynamics of the system as a result of wastewater discharge, and the concomitant change in microalgae communities. A noteworthy historical loss in the macrophyte communities, namely the Black mangrove (*Bruguiera gymnorrhiza*), was also acknowledged elsewhere in the project (DWA, 2013). The EWR maintains that further increases in WWTW discharged to the system, will result in a deterioration in health to a category E and potentially category F due to severe nutrient enrichment and the limited assimilative capacity of the system (DWS, 2015a).

The 2018 NBA (Van Niekerk, Taljaard, *et al.*, 2019), the update to the 2011 NBA, reports on and confirms this further degraded state.

Table 15: Estuarine Health Index ratings allocated to the iKongeni River estuary (DWS, 2015a)

ESTUARINE COMPONENT	CATEGORY*	STATE
HABITAT ASSESSMENT		
Hydrology	E	Poor
Hydrodynamics & mouth condition	D	Fair
Water quality	E	Poor
Physical habitat alteration	D	Fair
HABITAT SCORE	**D**	**Fair**
BIOLOGICAL ASSESSMENT		
Microalgae	E	Poor
Macrophytes	E	Poor
Invertebrates	D	Fair
Fish	E	Poor
Birds	D	Fair
BIOLOGICAL SCORE	**D**	**Fair**
PRESENT ECOLOGICAL STATE	**D/E**	**Poor**

**Category D= Largely modified; Category E= High degraded*

4.4. Conservation and Biodiversity Importance

Turpie *et al.* (2002) prioritised South African estuaries based on their conservation importance derived from various factors including size, type, biogeographical zone, habitat and biodiversity (plants, invertebrates, fish and birds). In the subsequent prioritisation (Turpie and Clark, 2007), the iKongeni Estuary received a score of 27.1 (Table 16) and was ranked 215th out of 256 systems in terms of overall importance. It was considered it to be of low to average ('some') ecological importance, due to the habitat it provides and biodiversity that it supports (DWA, 2013).

Table 16: Estuarine Importance Score for the iKongeni River estuary (Turpie & Clark, 2007)

Criterion	SCORE
Estuary Size	10
Habitat Diversity	40
Zonal Rarity Type	10
Biodiversity Importance	48.5
Weighted Estuary Importance Score	**27.1**
Importance Ranking	**Low to average**

Evidently, the iKongeni Estuary is not among priority estuaries identified as requiring formal protection in order to conserve South Africa estuarine biodiversity (Turpie, Wilson and Van Niekerk, 2012; DWS, 2015b; Van Niekerk, Adams, Lamberth, MacKay, *et al.*, 2019). However, it is considered to be of regional importance in terms of fish populations, and of high socio-cultural importance (DWA, 2013). The latter motivates for maintenance, or potentially improvement, of its current state.

Notwithstanding, the Protea Banks Marine Protected Area (MPA) is located approximately 1.5 km offshore of Margate Beach in the 20m – 3000 m depth range (DEA, 2019; Sink *et al.*, 2019). it covers an area of 1 200 km^2 and extends from the Mzimkhulu River in the north to the Mpenjati Estuary in the south, where it joins the Trafalgar MPA. The benefits of the Protea Banks MPA include: the protection of seven shark species, unique deep reefs and three submarine canyons, and spawning areas for commercial linefish species, and it secures the value of the area for ecotourism, specifically the sardine migration route[25]. The presence of this offshore MPA is of importance to the management of the iKongeni Estuary as the nursery function, resource harvesting and pollution emanating from the estuary will affect the functioning and success of the MPA (S. Bachoo, 2020, *pers. comm.*[26] and P. Massyn, 2020, *pers. comm.*).

4.4.1. Recommended and Target Ecological Category

The Recommended Ecological Category (REC), or desired state, signifies the level of protection assigned to an estuary from a flow perspective. The REC takes into account the estuary biodiversity importance and its conservation importance (protected area status).

The REC for the iKongeni is a Category D (DWS, 2015b). Thus, management interventions should aim toward preventing further ecological degradation of the system. Key interventions include restoring estuarine habitat, improving water quality and reducing base flows to the estuary to maintain the mouth state and salinity profile (DWS, 2015b).

According to the Ecological Reserve study, the D Category can be achieved under the current situation by removing half the waste and flow of current discharges (DWS, 2015a, 2015b). However, this has major socio-economic implications and will be difficult to achieve. Therefore, the Target Ecological Category (TEC), which considers all users of the system, was set to maintain the PES below a D. The gazetted TEC for the system is therefore, Category EF[27]. It is further indicated that the system should not become a health hazard.

The TEC is the assigned ecological condition by the Minister to a water resource that reflects the ecological condition of that water resource in terms of the deviation of its biophysical components from the natural reference condition. This is considered the ultimate target to achieve a sustainable system both ecologically and economically taking into account the PES and REC. Notwithstanding, this is unacceptable on ecological grounds (DWA, 2011).

4.4.2. Resource Quality Objectives and Restoration Activities

Resource Quality Objectives (RQOs) are clear and measurable specifications of ecological attributes (in the case of estuaries - hydrodynamics, sediment dynamics, water quality and different biotic components) that define a specific ecological category, in the case of the iKongeni Estuary, a Category D.

The RQOs for the iKongeni Estuary (DWS, 2015b) are provided in Table 17, and indicate that variability in the salinity is still required, and improved water quality is imperative given the status of the beach as a major holiday destination and the use of estuary and sandbar for recreational purposes. There are no objectives or specifications for other ecological components given that the TEC is a Category E/F.

[25] https://www.marineprotectedareas.org.za/protea-banks-mpa/

[26] Mr. S. Bachoo, Ezemvelo KZN Wildlife, Minutes of the 1st authorities meeting dated 31 July 2020

[27] National Water Act (Act No. 36 of 1998): Classes of Water Resources and Resource Quality Objectives for the Catchments of the Mvoti to Umzimkulu, 8 December 2017 (GN 1386)

Table 17: Resource Quality Objectives provided for the iKongeni River estuary (DWS, 2015b)

<table>
<tr><td colspan="2">PES:</td><td>E</td><td>REC:</td><td>D</td><td>TEC:</td><td>EF</td></tr>
<tr><td colspan="7">Water quality: Salinity</td></tr>
<tr><td>D</td><td colspan="6">The system needs variability in salinity regime, with a measurable increase in salinity in the lower and middle reaches during the low flow season. Mid-waters in the lower reaches should be between 5 and 10 (to be confirmed).</td></tr>
<tr><td colspan="7">Water quality: Other</td></tr>
<tr><td rowspan="2">F</td><td colspan="3">Ecosystem health:</td><td colspan="2">Recreational use:</td><td>Yes</td></tr>
<tr><td colspan="3">Water quality poses risk to REC/TEC, sufficiently reduced if:
DIN: Freshwater inflow, 50%ile <0.5 mg/l (high risk)
DIP: Freshwater inflow, 50%ile <0.125 mg/l (high risk)
DO: Lower estuary, average ≥4 mg/l (high risk)
Turbidity: Estuary, clear (<15 NTU) accept during high inflow events
Toxic substances:
Substance concentrations in estuarine waters not to exceed targets as per SA Water Quality Guidelines for coastal marine waters (DWAF, 1995);
Substance concentrations in estuarine sediment not to exceed targets as per WIO Region guidelines (UNEP/Nairobi Convention Secretariat and CSIR, 2009)</td><td colspan="3">Major holiday destination
Microbiology: Sufficient levels (DEA, 2012)</td></tr>
</table>

Restoration activities to improve the health of the system to a REC of D include (Van Niekerk, Adams, Lamberth, MacKay, *et al.*, 2019):

- Protect base flows;
- Manage/reduce urban stormwater and drainage from the flood plain;
- Improve catchment river water quality (agricultural return flows);
- Monitor and reduce/reuse waste water;
- Restore connectivity/ hydrodynamic functioning;
- Improve mouth management;
- Rehabilitate riparian areas/wetlands;
- Remove/reduce fishing pressure/ bait collection; and
- Investigate eradication of alien fish.

5. ECOSYSTEM GOODS AND SERVICES

Ecosystem services, also known as ecosystem goods and services, are the products that emerge from the natural environment through various biological, chemical, and physical processes and functions, which are typically used by people and contribute to enhanced societal wellbeing. The types of ecosystem services include provisioning services (such as food, water and other resources), regulating services (e.g. climate regulation, as well as air and water purification), life-support services (such as nutrient cycling and soil formation) and cultural services (e.g. aesthetic, spiritual, recreational, educational and cultural benefits) (Van Niekerk and Turpie, 2012).

Municipalities benefit by generating substantial revenue from higher rates that result from elevated property values along estuary shores and related economic activities, such as estuary tourism. As a consequence of these benefits, coastal communities, tourists and local governments along the coast depend on estuaries as an important source of revenue. Because estuaries are natural features, the opportunities that they provide are free. Estuary services are just like any other that may be bought, except that these are generated through the functioning of the estuary ecosystem. These services can be used directly or indirectly, or they can be left as an option for future use. However, estuaries are seldom considered a municipal asset, even though they can generate considerable revenue for local government and communities. Because of the failure to appreciate their value, little is spent on their management. Estuaries should be regarded as an asset and managed to maintain their value. Failure to do so can have major cost implications for local governments (Lamberth and Turpie, 2003).

In general, the level of ecosystem services provided by the iKongeni Estuary is low (Table 18). This is directly related to the history of human modifications to the estuary and its catchment, and the concomitant loss of ecological infrastructure. The main ecosystem services currently offered relates to water quality improvement (i.e. waste treatment through dilution and assimilation), the export of nutrients and materials to the marine environment, and noticeably socio-cultural services, namely recreational activities in the form of canoeing / boating, angling, as well as aesthetic appreciation (supporting tourist and residential accommodation needs). The latter is rated to be of high importance (DWA, 2013). Le Roux *et al.*, (2005) advise that both the iKongeni Estuary, as well as the previous Blue Flag status, makes a significant contribution to the perception of Margate as a favourable tourist destination (See section 6.4.144).

The provision of fish and crustacean nursery services, migratory corridors and protection of biodiversity is rated as medium (DWA, 2013) given the collective importance of degraded estuaries along the KZN south coast. Subsistence use of the system has been observed; however, overall usage is considered low.

Other services include contribution to primary productivity, stream flow regulation, storm/wave damage control, flood attenuation and erosion control, stream flow regulation, and preservation of natural heritage (Le Roux *et al.*, 2005; Breetzke and Meyer, 2012).

Table 18: Ecosystem services provided by the iKongeni Estuary

ECOSYSTEM SERVICES		DESCRIPTION	RATING
Provisioning services (goods)	**Water**	Provision of water for subsistence and agricultural use (only applicable in fresher upper reaches)	Low
	Food, medicines	Production of fish and food plants; medicinal plants	Low
	Raw materials	Production of craftwork materials, construction materials, fodder and biofuel (especially important in rural and arid areas)	Low
Regulating services	**Climate regulation**	Carbon sequestration, oxygen and ozone production, urban heat amelioration	Low
	Disturbance regulation	Flood control, drought recovery, refuges from pollution events	Low
	Water regulation	Provision of dry season flows for agricultural, industrial and household use (only applicable in fresher upper reaches)	Low
	Erosion control and sediment retention	Prevention of soil loss by vegetation cover and capture of soil, e.g. reeds and sedges preventing bank erosion	Low
	Ecological regulation	Regulation of malaria, bilharzia, liver fluke, black fly, invasive plants as salinity assist with pest control.	Low
Supporting services	**Waste treatment**	High retention makes is effective in breaking down waste and detoxifying pollution. Tidal and fluvial flushing assist with dilution and transport of pollutants	Medium
	Refugia/ Nursery areas	Critical habitat for migratory fish and birds, important habitats or nursery areas for species	Medium
	Export of materials and nutrients	Export of nutrients and sediments to marine ecosystems	Medium
	Genetic resources	Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species	Low
Cultural services (attributes)	**Structure and composition of biological communities**	The characteristics, including rarity and beauty, that lend an area its aesthetic qualities or make it attractive for recreational, religious or cultural activities	High

5.1. Economic valuation of ecosystem goods and services

Le Roux *et al.*, (2005) undertook an economic valuation of the ecological (ecosystem) goods and services provided by the iKongeni Estuary (Table 19). The study took into account the size of the estuary (1.4 ha), the inflation rate (using the Consumer Price Index (CPI), and exchange rate (using relative Purchasing Power Parity (PPP) as at 2005.

From the below figures, it is evident that water quality improvement was the most valuable ecosystem service offered by the iKongeni Estuary, followed by nursery function and contribution to fisheries, and stream flow regulation, specifically in terms of flood attenuation (Le Roux *et al.*, 2005). The overall estimated value of ecosystem services provided by the estuary ranged between R24 319 and R76 764 p.a. (2004 Rands) (Table 19). In present day terms, this value could potentially equate to between R57 330 and R180 966 p.a.[28].; however, the system would need to be re-evaluated to provide a more accurate account.

[28] Crudely estimated using inflation index monthly data used by StatsSA

In a similar evaluation of ecosystem goods and services for the Mpenjati Estuary (SSI, 2012), located in the Mpenjati Nature Reserve on the KZN south coast, the various estuarine habitats were assessed in terms of their contribution to the economic value of the estuary. The overall value of ecosystem services provided by this larger and formally protected system in a largely natural condition, was estimated at R16 689 515 p.a (2010 Rands), with the open water habitat, followed by coastal forest, the nearshore ocean and shallow subtidal sandbanks, being the most valuable natural assets (SSI, 2012). While the two estuaries are markedly different, the Mpenjati case study highlights, in part, the value attached to a healthier and less modified estuarine system, and implies that rehabilitation of a degraded system to a health state will increase its economic value.

Table 19: Lower and Upper Value of Ecological Goods and services per annum (2004 Rands) (Le Roux *et al.*, 2005)

Ecosystem Goods and Services	Lower	Upper
Biological Productivity*	0	0
Estuarine fisheries & contribution to marine fisheries	8 453	8 453
Biodiversity protection	1 719	1 719
Stream flow regulation	3 973	4 113
Water regulation	140	280
Groundwater recharge	106	106
Flood attenuation	3 727	3 727
Water quality improvement	10 174	62 479
TOTAL	***24 319***	***76 764***

**No value is specified as the only values available at the time of reporting were in net present value terms (Le Roux et al., 2005)*

Using two economic valuation techniques, namely the travel cost and contingent valuation methods, combined within an economic survey, Le Roux *et al.*, (2005) went on to determine that the recreational value associated with the iKongeni Estuary was R284.62 million p.a. (2004 Rands, R672 million 2020 Rands), which was approximately a third of the value assigned to Margate Main Beach at the time. The 'partial' economic value of the iKongeni Estuary in terms of its provision of ecosystem goods and services was thus estimated between R284.62 million and R284.67 million p.a. (2004 Rands) (Le Roux *et al.*, 2005).

It thus follows that, in order for the iKongeni Estuary to continue to provide the key ecosystem goods and services highlighted above (waste treatment, refugia/ nursery habitat, export of materials and nutrients, and not least, cultural value), there should be enhancement and protection of the main water body, and the associated fringing vegetation, where much of the water quality improvement takes place through attenuation, filtration, and other biological processes; the areas that provide important habitat for fish species and food and mineral sources for the coastal environment, and the estuarine system as a whole in terms of its linkages to Margate Main Beach and the overall contribution to the tourism value of Margate.

6. SOCIO-ECONOMIC CONTEXT

6.1. Demographics

The RNM has the largest population among the four local municipalities that comprise the Ugu District, hosting a population of 348 533 people (45% of Ugu DM) (Table 20) (StatsSA, 2016). Major changes in the population numbers between 2011 and 2016 are largely due to the re- demarcation of the local municipal boundaries (merging of the former Hibiscus Coast and Ezinqoleni local municipalities), and to a lesser degree more child births and migration of people into the municipality.

The RNM municipality consists of 36 wards, nine town centres and nine traditional authority areas. The population is unevenly distributed between the urban coastal areas and the rural hinterland under traditional authorities. Municipal wards along the coastal belt are most densely populated due to economic factors, historical settlement patterns, proximity to the sea, views and improved development and services provision, while the sparsely populated wards are located in the hinterland where there is little or no economic activity taking place (RNM, 2019).

Table 20: Population statistics for the Ugu District (RNM, 2019; StatsSA 2016)

Municipality	2011	2016	Growth (%)
Ugu District	722 484	753 336	4.1
Ray Nkonyeni	308 675	348 534	11.4
Umzumbe	160 975	151 676	-6.1
Umdoni	78 875	144 550	45.4
Umuziwabantu	96 556	108 576	11.1

The vast majority of the population of the RNM is comprises Black South Africans (82%), with White communities constituting 11% and the remainder being Indian/Asian and Coloured communities and other (RNM, 2019).

More than half of the RNM population (61%) comprises individuals between the ages of 15 and 64, while 34.4% are below 15 years of age (RNM, 2019). The number of youth (15-34 years) (41%) increased substantially following the municipal amalgamation and this places pressure on the municipality to ensure that education and employment needs are met. From an education perspective in RNM, of those aged 20 years and older, 38% of the population have completed matric and 6% have some form of higher education, while a further 5.1% have no form of schooling (StatsSA, 2016).

Of the population aged 15 to 64, 63% are informally employed, whilst only 28% are formally employed, predominantly in manufacturing and retail and the agriculture sectors (RNM, 2019). As at 2016, the unemployment rate was high at 34%, with a youth unemployment rate of 27% (RNM, 2019). The RNM municipality is faced with a high rate of unemployment, especially amongst the youth, and employment opportunities for individuals with limited knowledge or skills must be provided.

The dependency ratio for the RNM is high (54%), meaning that many people depend on Government grants and subsidies as a source of income, while few hold formal jobs (RNM, 2019). However, this ratio is the lowest of the four local municipalities within the Ugu District. Statistics on household income indicate that the predominant level of annual income ranges between R10 000 and R40 000 (44%), with more than 31% of the population earning above this level (StatsSA, 2016). Nonetheless, 9% do not earn an income, while many families still live below the poverty line, which is below a R1 500 monthly income (RNM, 2019).

In terms of service provision, of the 90 409 households in the RNM, 95% have access to electricity but only 25% have access to piped water to their property, 22% have access to weekly refuse removal and 28% have flush toilets connected to formal sewerage systems. This indicates a significant backlog in the provision of basic services and is mostly reflective of the amalgamation of the predominantly rural former Ezinqoleni LM and the more urbanised and better developed former HCM.

Table 21 displays the population statistics for the small wards that make up the Margate area. A large portion of Margate Town falls within RNM Ward 2 (also includes Ramsgate); however, the iKongeni River catchment falls predominantly Ward 6, which hosts a high population density of 449 people/m^2 and estimated total population of 9 696 people (Figure 18). The population of both wards is wealthy in comparison to the broader municipal area, with 53% and 62% earning more than R40 000 in terms of average annual household income, respectively (StatsSA, 2011). This indicates the large economic return for this coastal strip.

Table 21: Population statistics for small wards within the RNM (StatsSA 2011)

	Ward 2	Ward 6
Ward area (km^2)	29.2	21.6
Total population (#)	7910	9696
Households (#)	3307	3276
Density (ppl/m^2)	271.1	449
Average annual household income (> R40 000) (%)	53	62

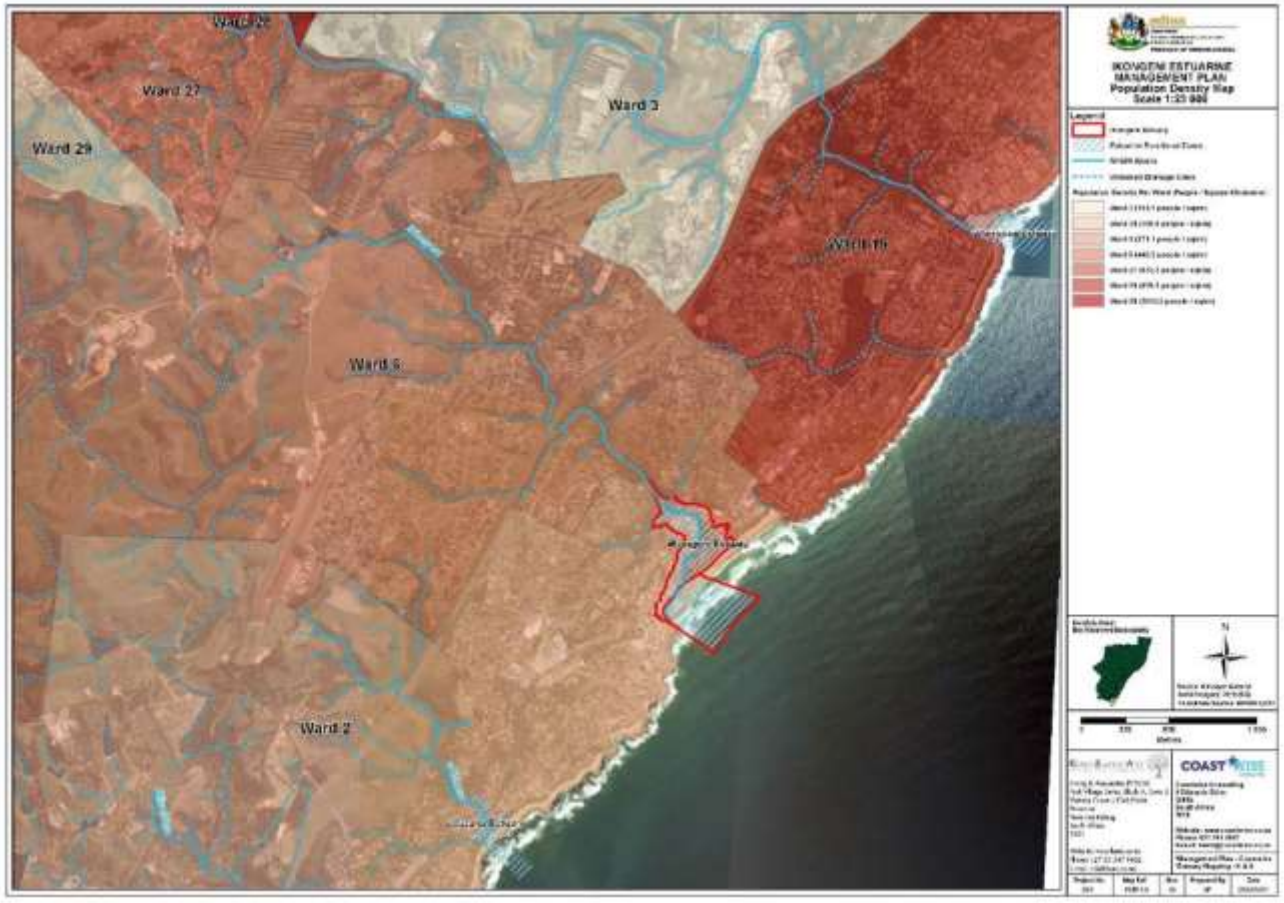

Figure 18: Population density of small wards making up the iKongeni catchment and surrounds

6.2. Economic Profile

The RNM is the most developed municipality of the four local municipalities and the most concentrated economic hub within the Ugu District, and thus the economic driver of the entire Ugu District (RNM, 2019). Since 2007, more than 60% of the economic activity of the district was concentrated in the RNM (former coastal HCM and Umdoni municipalities). In 2016, the Gross Domestic Product for the RNM was estimated at R13 billion, accounting for 61% of the Ugu District Gross Domestic Profit (GDP), followed by Umzumbe LM (20%), Umdoni (13%) and Umuziwabantu LM (6%) (TPS, 2018). There is a notable migration of people, from within the district and from the Eastern Cape, to undertake economic activity, and to search for employment opportunities in the RNM. In general terms, there is an observable growth of the urban coastal strip in terms of development and population (RNM, 2019).

The most significant shift in the economic profile of the RNM has been the decline of the primary sector (commercial agriculture) giving way to a tertiary sector (largely related to tourism) that is now leading the economy. The main economic sectors in the RNM are thus tourism (predominantly along the coastal strip) and agriculture, with vast arable land in the rural areas. Some manufacturing occurs in Port Shepstone (Marburg) as well as small-scale mining/quarrying; the latter is the smallest industry (RNM, 2019). In general, the RNM has a relatively diverse economy, with a number of economic sectors making major contributions to the municipal economy (Figure 19). The value of the tourism industry is cross-cutting and is reflected through contributions of wholesale and retail/catering and accommodation (18.7%); finance and business services (21.5%) (RNM, 2019).

According to the 2018 RNM Local Economic Development (LED) Strategy (TPS, 2018), approximately, 75% of businesses identified in the Ugu District are located within the RNM. As the tourism centre of the Ugu District, 67% of the tourist attractions are located within the RNM. These include swimming beaches, nature-based activities, birdwatching (avi-tourism), historical sites and mission tourism (TPS, 2018). The Strategy emphasises the role of environmental assets as well as coastal infrastructure in making the RNM a key tourism destination. As such, the improvement, protection and ongoing maintenance of these aspects is vital to retaining and attracting new tourists, investment and economic development (TPS, 2018).

A summary of the key economic sectors is provided Table 22 below.

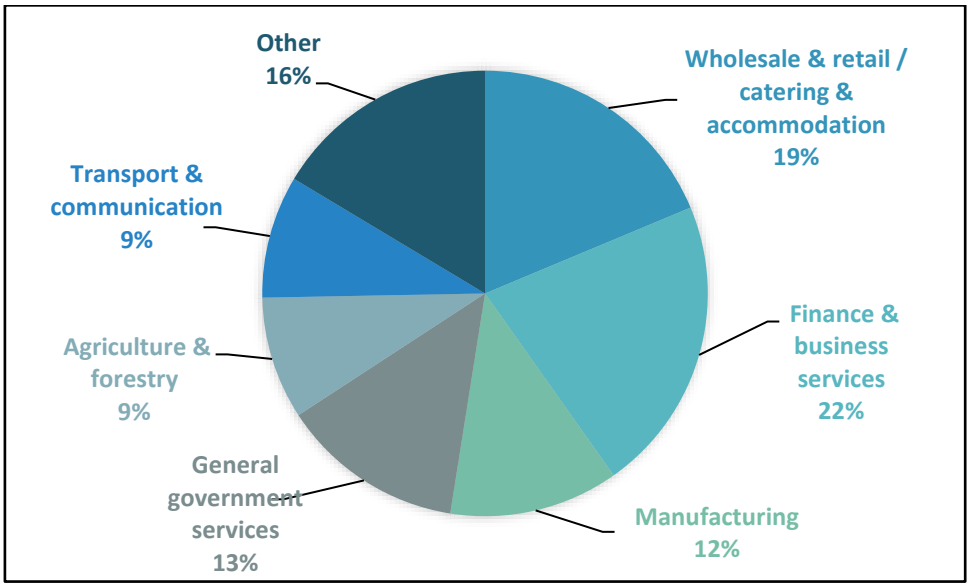

Figure 19: Important economic sectors and their contributions to economy of the Ray Nkonyeni Municipality (RNM, 2019)

Table 22: Characteristics of the key economic sectors in RNM (RNM, 2017; 2019)

Economic Sector	Description
Primary: Agriculture	• The agriculture sector has lost its competitiveness in the international market. • Commercial agriculture is dominated by two agricultural commodities, largely sugarcane and timber. • A range of agricultural products are produced in the RNM, which highlight its enormous agricultural potential. Agricultural offerings include: Bananas, Sugar cane; a range of niche market products, such as cut flowers, nuts and vegetables, livestock and poultry farming, as well as crocodile breeding, and timber farming (Pine, Gum and Wattle) which are processed by some saw mills. • Subsistence produce includes maize, dry beans, sweet potatoes and amadumbe, mostly produced for home consumption and mainly practised in the hinterland. • Small sugarcane growers in the hinterland face a number of challenges which include, amongst others, steep topography, poor infrastructure and no irrigation systems, less mechanisation, poor yields and lack of financial backup.
Secondary Sector: **Manufacturing and Retail**	• Manufacturing and retail sectors are the main industry of employment. • The formal manufacturing sector is limited to the coastal strip and primarily the Marburg and Margate areas. • About 60% of manufacturing businesses are located in the Port Shepstone / Marburg industrial area. This is the only major industrial zone in the District and supports a large variety of manufacturing and service sector businesses. The main products include furniture, textile and clothing and food. • One third of manufacturing businesses are related to Margate, thus future industrial sector planning may be required. Important industrial areas include the Margate Quarry Industry and the Margate Airport industrial area.
Tourism	• Tourism is one of the key economic drivers in the municipality and the district, with the entire municipal coastline identified as the primary attraction. More than 67% of the tourist attractions in the Ugu District are located in RNM. • The RNM coastline is a popular domestic tourist destination, with plentiful accommodation outlets, but is also the preferred retirement location. • The major concentration of tourism accommodation is in Margate (16%), Ramsgate (10%), Uvongo (9%), and Shelley Beach (8%) areas, but areas such as Port Edward, Oribi and Hibberdene make a substantial contribution. • The RNM has 29 beaches, seven of which have prestigious international Blue Flag status. The municipal beaches offer an ultimate beach holiday destination with favourable weather all year round, including the winter months. • The municipal area has numerous historical, religious and cultural assets that have potential to be further developed as tourism products, while the natural environment supports an extensive array of botanical features and wilderness areas attracting visitors for bird watching, hiking, walking, picnics and other related outdoor activities. • A key component of the RNM tourism offer is events tourism, e.g. the annual Sardine Festival. • The tourism industry is thus a key source of employment in the region, e.g. hospitality, tour guiding etc.
Tertiary Sector: Transport	• The transport sector is the critical component of the development of the RNM. • The RNM is strategically well placed for growth and development being in close proximity to Durban and straddling the old N2 airport and railway infrastructure (though currently only used for cargo) increases that accessibility of the RNM for various industries and markets. • The distinct elements for consideration in future economic development planning for RNM, include: air transport; and road freight transport.

6.3. Margate Town

Margate is the main holiday destination within the RNM and is occupied throughout the year being almost completely made up of accommodation, holiday homes, retirement estates and tourist-related establishments, and thus categorised as a tourism intensity node (RNM, 2019, 2020). It also one of six key municipal development nodes within RNM, which functions as an economic centre, providing medium order goods and services to surrounding settlements (RNM, 2020). The regional Margate Airport is located due west of the town centre between the R61 and iZotsha Roads. It reopened in November 2013 and it is anticipated that the proposed redevelopment of the airport and related infrastructure will serve as an economic growth point for the municipality (RNM, 2019).

According to the 2019 RNM Integrated Development Plan (IDP), there is rapid and growing urbanization within the RNM. The municipality has identified several investment opportunities (catalytic projects) which have the potential to significantly improve the level of unemployment, by creating permanent and sustainable jobs, and have a high impact on the municipal economy in terms of the GDP (RNM, 2019). Redevelopment of the Margate Beach front is an example of a catalytic project that is currently underway, with the first southern phase of the promenade development complete. Plans are underway for the main beach area and northern portion (RNM, 2019). Another project is the Marine Drive corridor, stretching from Port Shepstone to Margate. This is currently active, and builds on the "Village tourism" theme of *inter alia*, local arts and crafts markets, which appeals to local and international tourists (RNM, 2019).

At a national scale of importance, Margate was identified as a key node for urban renewal as a priority project under the Operation Phakisa Oceans Economy Programme (RNM, 2019), which seeks to capitalise on ocean-based economic activities, such as coastal or beach-based tourism developments and activities, to fast track the economic development of South Africa.

More specifically, and as can be seen in the land use map (Figure 6) and as ground-truthed during a field visit in July 2020, the iKongeni Estuary is surrounded by holiday accommodation (Santana, Colonial Sands, Boulevard etc.), tourist-related establishments (Kart Freaks, Zuri Beach etc.), local businesses (Frey's Meat Market, RTV Repairs, Martin Electronics, Wayne's Auctions, Hibiscus Gutters etc.), service industries (Mechanic man, BG Panel Beaters etc.), a church (Doxa South Coast), the Margate Bowling Club and well as municipal infrastructure. The southern bank consists of a grassed park-like urban environment with holiday accommodation facing onto the estuary. In contrast, a large portion of the predominantly defended northern bank inland from the pedestrian bridge, has buildings facing away from the system. Many of these businesses seem to use the EFZ as a dumping ground and/or service area.

Many of the smaller holiday accommodations seem to be managed by various managing agents (Van Heerden letting, Margate Property Management, leisure letting etc.). Of particular concern, and confirmed by the Municipality (F. Mhlongo, 2020, *pers. comm.* [29]), was the large number of establishments for sale as well as a large number of closed businesses, most likely exacerbated by the Covid 19 International pandemic.

6.3.1. Margate Town Planning Scheme

According to the 2014 Municipal Town Planning Scheme and zonation (Figure 20 and Table 23), the middle catchment is zoned mainly as Residential (Only 4), High Impact Residential as well as Agriculture 2. The Margate Waste Water Treatment Works (WWTW) is located on the southern bank adjacent to the R61. The land surrounding the estuary below the Marine Drive – R620 Road Bridge, is predominantly zoned as High Impact Residential, with Active Open Space (bowling greens) on the southern bank, Medium Impact Residential and Low Impact Mixed-Use occurring along the road network adjacent to the upper reaches. Land along the estuary outlet, where it extends furthest south, is zoned as High Impact Residential and Medium Impact Mixed Use.

[29] Ms Feziwe Mhlongo, Ray Nkonyeni Local Municipality: Environmental Management, Minutes of the 1st authorities meeting dated 31 July 2020

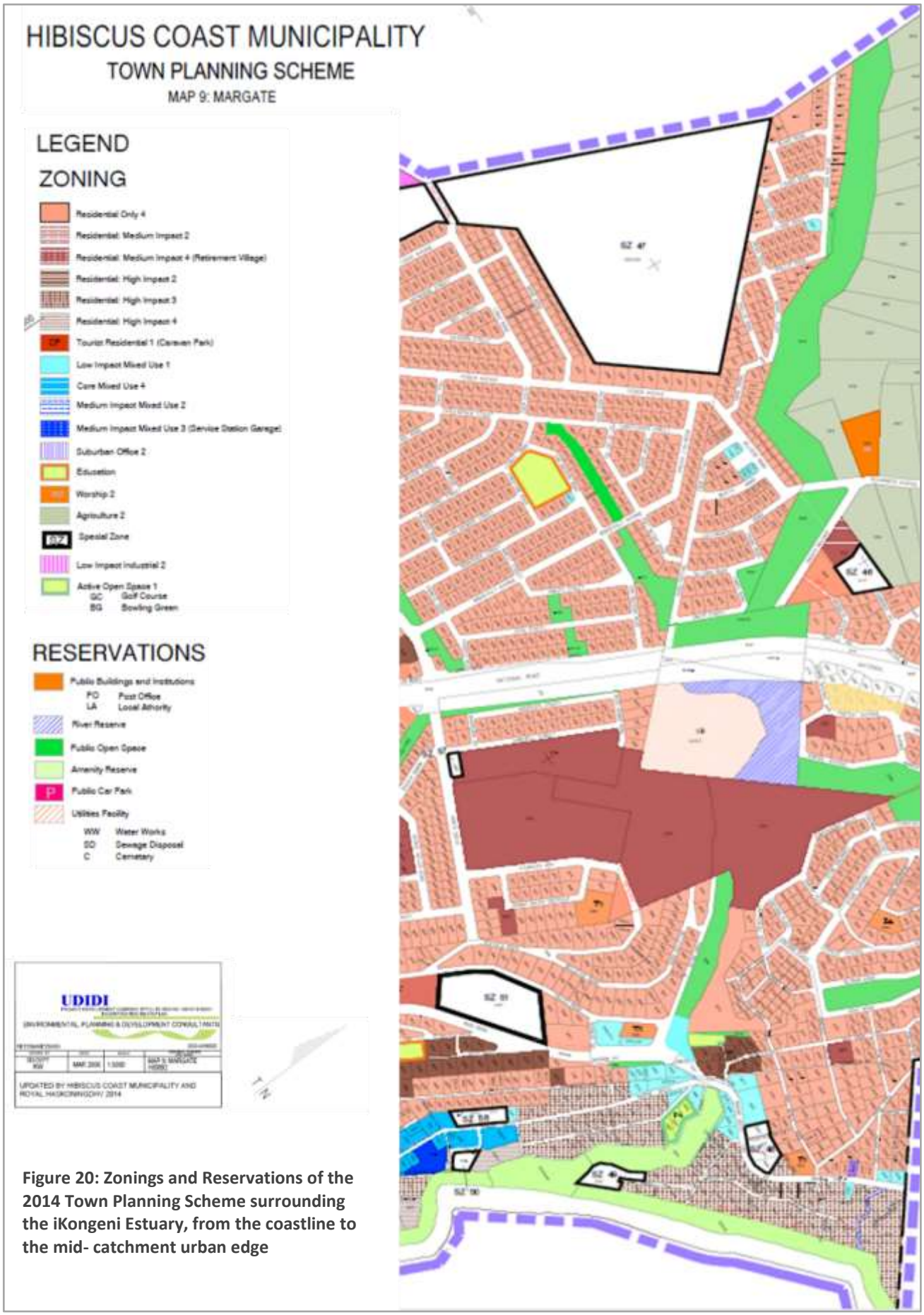

Figure 20: Zonings and Reservations of the 2014 Town Planning Scheme surrounding the iKongeni Estuary, from the coastline to the mid- catchment urban edge

The iKongeni River is zoned as various 'environmental' zonations along its course, namely Public Open Space, River Reserve and Amenity Reserve for the estuary. A section of the river below the WWTW also falls within the Medium Impact Residential Zone (Margate Retirement Village). There are also two special zone (SZ 49 and 50) at the seafront, which constitute General Residential and General Commercial, respectively. The new Zuri Beach club, located on special zone 50, while a source of concern prior to the Covid19 pandemic, was established in line with the town planning scheme development controls and did not include any extension to the existing footprint therefore did not require provincial environmental authorisation.

Table 23: 2014 Town Planning Scheme zones and descriptions

	Zoning	Description
1	Amenity Reserve / River Reserve	To provide for the continuation, maintenance and expansion of public flood control facilities and areas as well as to accommodate dynamic coastal processes and natural coastal defences (vegetated dune cordon). The purpose of these reserves and zones includes the conservation of the natural environment, the protection of the amenity, the prohibition of certain works and activities, including the restriction or limitation of access of and into such areas, reservations or zones
2	Public Open Space	To provide for the continuation, maintenance and enhancement of existing public open space areas, parks and the development of new parks, passive recreation areas and an open space system. Any works or development within this reservation, not subject to prior environmental authorisation, shall implement and apply the Hibiscus Coast Generic Environmental Management Program, in the course of preparation
3	Active Open Space 1 (Private Open Space)	Provides part of the sustainable open space system which includes independent or linked open space areas and green lung areas of the urban environment for sporting and recreational needs and associated activities of the local and visiting public and may include areas of passive open space where appropriate. These areas are to be developed and maintained for a range of active pursuits.
4	Utility Facility Sewage Disposal (Margate WWTW)	The provision of all necessary land areas for roads and essential services required within the Municipality. The identification of existing and future infrastructural service corridors and areas required for the installation, maintenance and proper functioning thereof. This includes water works, sewage disposal, refuse disposal, cemetery, public car parks, new roads and road widening, existing roads and the approximate position of new roads for the future, bus and taxi ranks, etc.
5	Low Impact Mixed Use 1	Permits the development of low order shopping centres
6	Medium Impact Mixed Use 3	Permits activities including, amongst others, shops (that are restricted in terms of scale), a public garage, service station, restaurants, vending machines, automatic tellers, and electronic games machines.
7	Residential High Impact 3	To promote the development of multi-unit residential units, each dwelling unit being for occupation by a single family. Hotels and other uses are permitted. Zone 3: Density of Residential Buildings controlled by a FAR of 0.75 and a minimum erf size of 1000 m².
8	Residential High Impact 4	To promote the development of multi-unit residential units, each dwelling unit being for occupation by a single family. Hotels and other uses are permitted. Zone 4: Density of Residential Buildings controlled by a FAR of 1.00 and a minimum erf size of 1800 m².
9	Residential Medium Impact 2	To promote the development of attached and detached dwelling units in a suburban setting developed as part of a planned residential development each unit being for occupation by a single family. Minimum erf size per development is 1800 m², with a maximum net density of 20 dwelling units/ha.
10	Residential Medium Impact 4 (Retirement Village)	To promote the development of small multi-unit residential units as part of a planned retirement village development. The minimum erf size is 1 ha, with a maximum net density of 1 dwelling units/ha.

11	Residential Only 4	To promote the development of detached dwelling units in a suburban setting, each unit being for occupation by a single family, and being individually located on erven or subdivisions with a minimum erf size of 900 m² or 700 m² if the erf is connected to municipal sewerage reticulation.
12	Agriculture	Areas of low-impact, generally small-scale agricultural activity in, or adjacent to urban areas. The minimum erf size is 2 ha. A shop is permitted with Special consent and is restricted to the sale of self-produced farm produce, floor area and coverage will not exceed 30 m².

6.4.Socio-Economic Considerations

6.4.1. Blue Flag Status

Margate Main Beach entered the international programme at its inception in South Africa in 2006/07. The Blue Flag programme, implemented in South Africa by the Wildlife and Environment Society of South Africa (WESSA), is a voluntary international initiative aimed at standardising and promoting world class clean, safe and attractive beach environments where beaches are assessed according to 25 criteria. Blue Flag is categorised as an 'eco-label' and due to the strict monitoring requirements needed to both attain and retain Blue Flag status, water quality measured at Blue Flag beaches provides a useful indicator of swimming beach water quality on South Africa's coast. Positive spin-offs and benefits of the programme, as detailed by municipalities, include increased beach visitor numbers, improved visitor behaviour, increase in land values of properties near Blue Flag beaches and visitors enjoying a well-cared for and managed beach (Breetzke and Meyer, 2012).

The beach first lost its Blue Flag status in 2005 and then again 2012 primarily as a result of three significant sewage spills and resultant poor water quality (Breetzke and Meyer, 2012). According to the study by Nahman & Rigby (2008) relating the Blue Flag Status of Margate Main Beach to the water quality of the iKongeni Estuary, the estimated cost of the loss of Blue Flag status in 2005 was estimated to lie in the range of R17-R25 million p.a. (in terms of lost recreational value). Irrespective of Blue Flag status, however, a decline in water quality (visual, odour and health effects) had a greater effect on visitor rates, with an estimated loss of R70-R82 million p.a. attributed to water quality issues (Nahman and Rigby, 2008). The increasing awareness of Blue Flag status and the 2012 loss of the flag for Margate Main Beach, and more recently Lucien Beach (2018) (A. Botha, 2020, *pers. comm.*), together with numerous negative reports in the media, has had a severe negative impact on the recreational and tourism value of Margate.

Given the magnitude of the estimated losses, drastic measures were considered to ensure reinstatement of the flag. These included the construction of a new pump station, and an investigation into unofficial and illegal sewage and stormwater connections. At the time of the study, the benefits of restoring Blue Flag status were estimated to range between R14 and R24 million p.a., and greatly outweighed the cost of the proposed mitigation measures (Nahman and Rigby, 2008).

Upgrades to the rising main, effluent gravity main and Pumpstation 3A at the head of the estuary were subsequently undertaken in 2012 at a reported cost of cost of R24.5 million[30] to address the backlog in sewerage infrastructure and increase the capacity of the system to cope with the peak flows thereby reducing leaks/spills. It is highly unfortunate that major sewage spills still occur.

6.4.2. Dependency

As detailed in Section 5, Ecosystem Goods and Services above, there is a definite level of dependency on this estuarine system from the municipality, town and surrounding property owners, albeit some more than others. This dependency is socio-economic as it both directly and indirectly impacts on livelihoods. The holiday establishments facing towards and onto the system are dependent on the good state of the system to attract

[30] Reported by Yusuf Moolla in The Mercury, 10 October 2012

visitors and encourage return visits; current and former (Jolly Boats) tourism related establishments are also dependant on the state of the system and the quality of the open space environment.

The current poor quality of the public space encourages / supports poor / unsocial behaviour with the dumping of grass cuttings and solid waste, the defacing of public and private infrastructure, illegal land reclamation and poor maintenance of defence. Specific detailed and still very valid interventions proposed in the 2012 Margate Urban Renewal project (SSI, 2011) should be carried forward to this EMP and include:

- The quality of the estuary character area is to be upgraded and the area, both visually and physically, connected to Margate Main Beach and the Northern Seafront. Recreational uses associated with the Bowling Greens are to be supported. Key interventions required in this area are related to broader catchment management issues upstream of Margate, the formalising of parking within the area and the establishment of a bus overflow parking facility for peak tourism periods;
- The Lagoon Residential character area is to be consolidated as a medium density mixed permanent and tourism residential area. Key interventions in this area involve improving the pedestrian infrastructure on Marine Drive and accommodating overflow peak period parking areas; and
- The capacity of the Margate Main Beach is to be expanded and a stronger link with the Estuary established. Key development opportunities within this character area involve the redevelopment of the 'water-world' site to include a new Beach Park/Lawn amongst others. These developments will increase the capacity of the central beach to accommodate visitors and/or events, to introduce a diverse range of activities associated with the beach and to create new pedestrian spaces.

6.4.3. Coastal Vulnerability and Risk

High risk areas in terms of the KZN Coastal Vulnerability Index (CVI) are an important informant in the assessment of potential impact in the coastal zone. Five physical parameters were used in its determination, namely: beach width, dune width, distance to the 20 m isobath, percentage rocky outcrop, width of vegetation behind the back beach. High risk areas are considered to be the most susceptible to the effects of erosion, sea-level rise or extreme events and EDTEA recommend that any new developments be set back to ensure they are not damaged or that alternate sites to develop should be sought (CoastKZN, 2019c). The vulnerability of the seaward portion of the iKongeni Estuary to coastal dynamic processes, and the representative CVI scores, is illustrated in Figure 21. Essentially the entire estuary mouth region stretching from the southern headland to slightly north of the northern bank of the iKongeni Estuary is classified as a high-risk area.

It is acknowledged that the public beach amenities at the Margate Main Beach are located too close to the shoreline and the high-water mark, and that current stormwater infrastructure is inappropriate and poorly maintained. These beach facilities were constructed prior to the enactment of environmental legislation.

As a result of anticipated sea-level rise and the increased intensity and frequency of coastal storms, coastal erosion is anticipated to increase in the long-term leading to higher and continued risk to human life and to the natural and built environments. Best international practice in the face of sea-level rise and changing coastal dynamics is a managed retreat away from the shoreline, which should be considered as part of the RNM's long- term plans (Breetzke *et al.*, 2009).

The ICM Act also requires Provincial Government to determine Coastal Management line(s) (CML), which will prohibit development beyond a delimited line and which can be established for various reasons. Coastal Management Lines will assist in controlling development along an ecologically sensitive or vulnerable area, or any area that poses a hazard or risk to human life (DEAT, 2000). KwaZulu-Natal is in the process of delineating a CML and has proposed three-time horizon for sea-based risk scenarios in anticipation. These scenarios, or proposed risk zones, consider sea-level rise projections, extreme events as well as short, medium and long-term coastal changes and approximate future high-water mark locations. Risk zones in respect to estuaries is currently still being modelled however the 5 m amsl is used as a proxy for the CML with the 10 m amsl considered to be the coastal protection zone (CPZ) (CoastKZN, 2019a). The risk lines relative to the iKongeni Estuary are illustrated in Figure 22. While these lines are indicated to extend up into the estuary, it is clear that much of beach front amenities, the estuary mouth and part of the lower reaches would be at risk into the long timer.

It should be noted that the KZN CMP notes that "*the [KZN] south coast is particularly vulnerable to coastal erosion. It is also the area with the highest flood hazard and the highest climate-human vulnerability risk in South Africa*" (EDTEA, 2014, p. 18).



Figure 21: Vulnerability of the iKongeni Estuary to coastal dynamic processes



Figure 22: Coastal Risk Lines relative to the iKongeni Estuary

7. CURRENT IMPACTS & THREATS

The iKongeni Estuary is a highly transformed system. The 2018 NBA considers the level of cumulative pressure on the estuary to be very high (Van Niekerk, Adams, Lamberth, Taljaard, *et al.*, 2019). The environmental processes, activities and developments that currently impact the system and pose future threats are discussed in the following categories:

- Land-use and infrastructure development;
- Water quality and quantity issues;
- Exploitation of natural resources; and
- Environmental hazards.

7.1.Land-use and infrastructure development

Urban development - The catchment and physical habitat of the iKongeni estuary has been severely modified from its pristine state by land reclamation (infilling), dense urban development and associated anthropogenic or human impacts. This has reduced the extent of available estuarine habitat through infilling and development in the floodplain, accelerated surface runoff and sedimentation within the system, and the removal of natural vegetation. The natural margins have been replaced by hardened surfaces, a pedestrian bridge, roads, and gabion baskets and rock revetments (predominantly along the defended northern bank). The weir above the estuary alters freshwater flow patterns to the estuary to a certain extent. It also acts as a physical barrier to migratory aquatic species moving upstream, e.g. *Anguilla*. Further habitat degradation has occurred through the widespread dumping of solid waste, littering and infilling.

Road infrastructure – The regional transport route and main coastal road intersect at the head of the estuary. The main road bridge has narrowed the estuary channel and impedes tidal flow through the system. The roads and grassed carparks along the estuary margins result in a major loss and modification of both the instream and riparian (river bank) habitat.

Bulk infrastructure – the sewer pump station and the bulk sewer line located in the estuary flood plain (within the estuarine functional zone) are prone to failure and typically overflow during high rainfall events. There are regular spillages of effluent into the estuary. There is also the risk of ongoing and emergency/incidental discharge of treated effluent from the Margate WWTW in the event of system malfunctions, failures or overflows.

Overall the level of modification to the iKongeni Estuary is rated as Very High (Van Niekerk, Adams, Lamberth, Taljaard, *et al.*, 2019).

7.2. Water quality and quantity issues

Water quality deterioration – The poor water quality of the iKongeni Estuary is primarily caused by wastewater discharges and failing sewage infrastructure along the estuary margins, e.g. the pump station 3A on the estuary has an overflow outlet to the estuary. This introduces excessive nutrients, organic material, and pathogens to the system. The estuary also receives contaminants, such as hydrocarbons and heavy metals, transported to the system through stormwater runoff from the neighbouring development as well as the road network and parking areas, via diesel and petrol spillages, and potentially agricultural return flows from the upper catchment.

In severe cases of nutrient and organic loading, known as eutrophication, there is excessive algal growth and die off. When combined with the decomposition of sewage waste and naturally occurring plant material, this has a severe knock-on effect of plummeting dissolved oxygen concentrations of the water body and frequent die-offs of the residing organisms, most notably fish. Pollution events result in increased pressure to breach the estuary to purge the system and to relieve the ecological stress. The ecological pressure caused by pollution on the iKongeni Estuary is rated as Very High.

Altered flow – The natural mouth dynamics of the system have been drastically altered by urban stormwater runoff and the ongoing and incidental discharge of both untreated and treated wastewater. The MAR to this system has consequently increased by 52%. This influences the physico-chemical characteristics of the estuary, thereby altering the structure and functioning, as well as the diversity of the biological communities within it.

The level of modification to the natural flow regime is rated as Very High (Van Niekerk, Adams, Lamberth, Taljaard, *et al.*, 2019).

Invasive Alien Plant Species (IAPs) – While the presence of IAPs is not particularly high within or around the estuary, areas above the estuary are infested and degraded. Alien vegetation further reduces the quantity of freshwater input, as well as the natural biodiversity of the iKongeni river and estuarine system.

7.3. Exploitation of natural resources

Harvesting of living resources – Fishing pressure on the system is rated as medium (Van Niekerk, Adams, Lamberth, Taljaard, *et al.*, 2019), undertaken largely by recreational as well as subsistence fishers.

Urban development – the natural assets of the area, namely the coastline (dune and beaches) and the estuary, have been exploited for their tourism and aesthetic value. This has resulted in extensive urban development in the catchment, in the EFZ - constraining the natural dynamics of the system – as well as along the sea front, resulting in fragmentation and disturbance to the vegetated dune cordon.

Mouth manipulation – The natural meandering and migration of the iKongeni Estuary mouth, has contributed to erosion and undermining of beach amenities and coastal defences. When water levels in the estuary are high, the estuary channel also interferes with access to the Margate Main beach, making use of the inoperable, resulting in pressure to relocate/breach the estuary mouth in a more favourable position.

7.4. Environmental hazards

Climate change – In light of the potential impacts of climate change, a number of likely impacts have been identified that could affect the KZN south coast (EDTEA, 2014; Aurecon, 2016). The following are particularly relevant to the iKongeni River and estuary:

- An increase in the annual average temperature of 0.7 °C by 2030 for the coastal areas, thereby increasing potential evaporation and decreasing water balance;
- Higher maximum temperatures, more hot days and more heat waves;
- Increased rainfall variability and subsequent drought potential, thereby decreasing water resources and water quality;
- Increased stream flow variability despite higher predicted flows overall;
- Delay in streamflow's by one month;
- Increased frequency and intensity of rainfall events, leading to increased flooding, soil erosion, river bank erosion and demands for protective structures;
- Increased mean sea level and associated storm surges, leading to coastal flooding, erosion and damage, saline intrusion, and ecological impacts on estuaries; and
- Decreased sediment yield along the coast.

Flooding – Extensive modification of the system by urban development as well as the road network, and the removal of natural vegetation renders the system vulnerable to flood damage and severe erosion. The river and estuary channel have been constrained by infilling, bridge construction and hardened surfaces leading to blockages, elevated water levels, and increased flow velocities. There is clear evidence of erosion issues through the extensive placement of gabion baskets and rock revetments along the lower and middle estuary margins. Furthermore, sewage infrastructure is sited below known flood levels (P. Norman, 2020, *pers. comm.*) will be increasingly at risk to flood damage, posing a significant threat to downstream environments.

Drought – Drought conditions and lowered baseflows will result in more concentrated treated effluent entering the estuary, as well as more frequent closure. Eutrophic and highly polluted conditions are likely to prevail creating ecological and public health risks.

Coastal dynamics – The iKongeni Estuary is at high risk of coastal storm surges and erosion because of the wide beach frontage and highly modified state of the system. Consequently, the beach amenities including the restaurant, swimming pool and newly developed beach club, are highly vulnerable to dynamic coastal processes. Low lying areas and hardened (developed) surfaces, as well as sewage infrastructure located within the EFZ, will be increasingly at risk as sea level rise progresses (P. Massyn, 2020, *pers. comm.*).

A map detailing identified issues and areas of concern is included as Figure 23 (pg. 51).

The impacts affecting the iKongeni Estuary are summarised in Table 24 below.

Table 24: Current impacts/pressures facing the iKongeni estuary

THREATS	COMMENTS	2018 NBA Rating
1. Flow modification *(Freshwater additions and diversions)*	The WWTW discharges direct to the marine environment through a surfzone pipeline at Lucien Beach. The estuary is subject to additional freshwater input through discharges from the WWTW. This has affected the natural flow regime and mouth dynamics.	Very High
2. Pollution: Eutrophication	The system is subject to frequent spillages of raw sewage and discharges from the WWTW works, causing excessive faecal contamination, eutrophication and fish kills.	Very High
3. Pollution: Chemical contamination	In addition to the above, the system also receives run-off containing urban contaminants (heavy metals, fuels, oils and greases) entering the system through numerous roadside stormwater systems, as well as service station spillages. There are numerous car wash facilities around the estuary that would contribute toxic soaps and other cleaning agents to the system.	
4. Pollution Litter/debris	Litter and solid waste dumping on the estuary margins were particularly noteworthy in the upper reaches in proximity to the R61 road bridge.	
5. Habitat Loss	There has been significant urban encroachment and transformation of the EFZ through infilling, sedimentation, and clearing of natural vegetation, which have contributed to major habitat loss within the system. The catchment area is heavily urbanised. Infilling and reclamation following flood erosion upstream of the estuary.	Very High
6. Overexploitation	Subsistence fishing was observed; however, this is likely to be low and opportunistic. Recreational fishing and bait harvesting are likely to increase during peak holiday season despite poor water quality and health risks.	Medium
7. Breaching	Historical breaching has occurred to prevent erosion to beach amenities and enable access to Margate Main beach for holiday makers. Unauthorised breaching has been reported and “recreational” breaching by holiday makes is also a likely occurrence.	Unauthorised
8. Invasive alien species	There is modest level of IAP infestation along the estuary. It is estimated that IAPs do not comprise more than 15% of the total vegetation component	Low
9. Sea-level rise	By virtue of the wide seafront, shortness of the estuary water body, and limited natural remaining coastal vegetation, the risk of sea-level rise is high.	High



Figure 23: Areas of concern within the iKongeni estuarine functional zone

8. LEGISLATIVE INSTRUMENTS AND RELATED STRATEGIES/ PROGRAMMES

The purpose of this section is to review the current legalisation, policies and management of estuaries within South Africa that will have an influence on the management of the iKongeni Estuary. This will highlight two issues, firstly the issue of legal requirements, that is, the proposed minimum requirements for legal compliance, and secondly, the direction provided by such legal instruments and the proposed interventions required.

8.1. National Legislation and Policy Directives

8.1.1. Overview

Table 25 provides an overview of legislation and policy applicable to the management of estuaries in South Africa and specifically to the development of an EMP for the iKongeni estuary.

Table 25: National legislation and Policy Directives

Legislation/Policy directive	Description
The Constitution	The South African Constitution is the supreme law of the land, and provides the legal framework for legislation regulating environmental management in general. Section 24 of the Constitution states that: "*Everyone has the right: to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that – prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."* This lays the basis for environmental law in South Africa and is a very important justification for the wise use of estuarine biodiversity.
National Environmental Management Act (No. 107 of 1998)	The Department of Forestry, Fisheries and the Environment, (DFFE, formerly DEFF) is the lead agent for National Environmental Management Act (Act 107 of 1998) (NEMA). NEMA provides for co-operative environmental governance through the establishment of national environmental management principles, and procedures for their incorporation into decisions affecting the environment. NEMA emphasizes co-operative governance and assists in ensuring that the environmental right and related rights in the Constitution are protected. NEMA requires the DFEE to be the lead agent in ensuring the effective custodianship of the environment. In particular the Act provides that sensitive, vulnerable, highly dynamic or stressed ecosystems, such as estuaries require specific attention in management and planning procedures, especially where subjected to significant human resource usage and development. Various activities listed in the NEMA 2014 Environmental Impact Assessment (EIA) Regulations (as amended in 2017) Listing No 1 (GNR No. 327), Listing Notice 2 (GNR No. 325) and Listing Notice 3 (GNR No. 324)) relate to the coastal zone and require environmental authorisation before they can proceed. The EIA Regulations regulate procedures and criteria for the submission, perusal, consideration and decision of applications for the environmental authorisation of specified activities. These regulations are especially pertinent to estuaries as many estuaries are situated within rapidly expanding development nodes along the South African coast and are under tremendous pressure from human activities. The listed activities relating to estuaries require environmental authorisation to be obtained prior to undertaking activities within the 1: 100-year flood line or within 32 m from the bank of a water course or wetland, within in an estuary or within 100 m of the High-Water Mark (HWM). Waste disposal activities are also scheduled activities under these regulations. Specifically, in respect to estuaries, the 2014 EIA Regulations (GN 324) (as amended in 2017) adopt the EFZ in the definition of an estuary: “the area in and around an estuary which includes

	the open water area, estuarine habitat (such as sand and mudflats, rock and plant communities) and the surrounding floodplain area…". The EFZ also includes the extent of dynamic processes, such as back-flooding and tidal fluctuations, which characterise the estuarine environment (Van Niekerk & Turpie, 2012). The EFZ is delineated by the 5 m contour, however, it must be noted that recent studies indicate that the EFZ may extend beyond the current 5 m contour, and the 10 m contour may, in the near future, be considered the new boundary of an estuary. Until this is formally approved, the 5 m contour remains the default estuarine boundary, but provisions should be made in future development planning to accommodate the 10 m EFZ. The draft EFZ is illustrated in Figure 2 (pg.4) for comparative purposes (CoastKZN, 2019).
National Environmental Management: Integrated Coastal Management Act (No. 24 of2008)	The National Environmental Management: Integrated Coastal Management Act (Act No 24 of 2008 as amended in 2014) (ICM Act), provides the overarching legal framework for proposed development and decision-making in the coastal zone and in respect to estuaries. Chapter 4 of the ICM Act, aims to facilitate the efficient and coordinated management of all estuaries, in accordance with: The Protocol (Section 33) approved by the Ministers responsible for the Water and Environment Affairs; and Estuarine Management Plans (EMPs) for individual estuaries (Section 34). The Protocol, promulgated in 2013, updated in 2021 (draft), provides a national policy for estuarine management and guides the development of individual EMPs. It must be ensured that the EMPs are aligned with the National Coastal Management Programme (CMP) and the Protocol. As this Act has particular relevance to this EMP, additional detail is provided below in respect to the National Coastal Management Programme as well as the National Estuarine Management Protocol.
National Water Act (No. 36 of 1998)	Water quality and quantity are mainly controlled from the terrestrial side under the National Water Act (No. 36 of 1998, NWA), via the national Department of Water and Sanitation (DWS). The ICM Act provides for the authorisation of discharge of effluent into coastal waters via a Coastal Waters Discharge Permit and for consultation with the Minister of Water and Sanitation related to estuarine discharges. The NWA provides the legal framework for this policy thus ensuring the protection of South Africa's water resources and aquatic ecosystems, including estuaries. The NWA makes provision for a water "Reserve" which provides the quantity and quality of water flow required in aquatic ecosystems in order to meet basic human needs and to protect the natural functioning of a water resource. The latter portion of the reserve is known as the Ecological Reserve which will be secured for the aquatic system (DWA, 2011). **Classification Process** The extent to which an estuary's functioning is catered for is determined by the designated "class" (i.e. future state of health) of that estuary, with some estuaries being assigned a low class to allow maximal water provision and others being assigned a high class in order to meet conservation needs. The decision as to the designated class of the estuary is thus a critical one. This takes place using a gazetted classification process which entails consideration of the trade-offs in value generated by allocating water (or pollution rights) to off-stream users (e.g. irrigation agriculture), flow-reducing activities (e.g. plantation forestry) and polluters (e.g. municipalities, farmers) versus allocating water to the environment for the provision of ecosystem services (e.g. fishing, tourism). **Reserve Determination Process** For systems that have yet to be classified, the Ecological Reserve is determined on the basis of recommendations emanating from a reserve determination study using the Resource Directed Measures (RDM) methodology in conjunction with considerations of the demand for water in the catchment (the classification process described above will effectively standardise the way this is done). The establishing the Ecological Reserve entails the determination of the Present Ecological State (PES) of an estuary and the Recommended Ecological Category (REC), which is the target for protection and management of the resource from an ecological perspective. The Target Ecological Category (TEC) is the assigned ecological condition by the Minister to a water resource that reflects the ecological condition of that water resource in terms of the deviation of its biophysical components from the natural reference condition. This is considered the ultimate target to achieve a sustainable system both ecologically and economically taking into account the PES and REC. The Classification Process for water resources in the (former) Mvoti to Umzimkulu Water Management Area was concluded in 2015, and the class and Resource Quality Objectives

	(RQOs) for estuaries within this region were established (at a desktop level) and gazetted (GN. 1386, 8 December 2017). As stipulated in the NWA, once the class of a water resource and the RQOs have been determined, they are binding on all authorities and institutions when exercising any power or performing any duty under this Act.
Marine Living Resources Act (No. 18 of 1998 as amended 2000)	The exploitation of marine living resources in South Africa (which includes those in estuaries) is governed by the Marine Fisheries Policy for South Africa (1997) and the Marine Living Resources Act (No. 18 of 1998, MLRA). This Act is enforced by the national Department of Forestry, Fisheries and the Environment (DFFE). Objectives of the policy and Act are as follows: • to achieve optimum utilisation and ecologically sustainable development of marine living resources; • to conserve marine living resources for present and future generations, to use marine living resources; • to achieve economic growth, human resource development, capacity building within fisheries and mariculture branches, employment creation and a sound ecological balance consistent with the development objectives of national governments; • to protect the ecosystem as a whole, including species which area not targeted for exploitation; and • to preserve marine biodiversity. The MLRA defines the species that can be exploited, and protection measures for those species, such as closed areas, closed seasons and size and bag limits. Various types of resource-use permit systems are also defined under this Act.
Minerals and Petroleum Resources Development Act (Act No. 28 of 2002)	The Minerals and Petroleum Resources Development Act (Act No. 28 of 2002) (MPRDA), administered by the Department of Minerals and Energy (DME) makes provision for equitable access to and sustainable development of the nation's mineral and petroleum resources. The Act affirms the State's obligation to protect the environment for the benefit of present and future generations, to ensure ecologically sustainable development of mineral and petroleum resources and to promote economic and social development. Currently this Act has no specific relevance due to no sand winning authorisations being issued or illegal activity taking place.
Spatial Planning and Land Use Management Act (No. 16 of 2013)	The primary aim of the Spatial Planning and Land Use Management Act (No.16 of 2013) (SPLUMA), insofar as it relates to estuarine management, is for the provision of a framework for spatial planning and land use management as well as: • Provide for monitoring, coordination and review of spatial planning and land use management systems; • Provide for inclusive, developmental, equitable and efficient spatial planning at different spheres of government; • Provide a framework for policies, principles, norms and standards; • Address past spatial and regulatory imbalances; • Promote greater consistency and uniformity in the application procedures and decision-making processes by local authorities responsible for land use decisions and development applications; • Provide for establishment, functions and operation of Municipal Planning Tribunals; and • Provide for facilitation and enforcement of land use and development measures. Section 7 of this Act sets out the following five development principles that are applicable to spatial planning, land development and land use management, as follows: • Spatial justice refers to, inter alia, to the need for improved access and use of land in order to readdress past spatial and development imbalances as well as the need for SDF's and relevant planning policies, spatial planning mechanisms, land use management systems and land development procedures to address these imbalances; • Spatial sustainability refers to, inter alia, the need for spatial planning and land use management systems to promote land development that is viable and feasible within a South African context, to ensure protection of agricultural land and maintain environmental management mechanisms. It furthermore relates to the need to promote effective/ equitable land markets, whilst considering the cost implications of future development on infrastructure and social services as well as the need to limit urban sprawl and ensure viable communities;

	• Efficiency relates to the need for optimal use of existing resources and infrastructure, decision-making that minimises negative financial, social, economic or environmental impacts and development application procedures that are efficient and streamlined; • Spatial resilience refers to the extent to which spatial plans, policies and land use management systems are flexible and accommodating to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and environmental shocks; and • Good administration refers, inter alia, to the obligation on all spheres of government to ensure implementation of the above efficiently, responsibly and transparently. Linkages between the municipalities spatial planning and land use management system and the proposed zonation of activities must be specified and the SDF used as the preferred implementation vehicle.
National Environmental Management: Protected Areas Act (No. 57 of 2003)	The National Environment Management: Protected Areas Act (No. 57 of 2003) provides for the declaration and management of protected areas, and can also provide for co-operative governance, the sustainable utilisation of protected areas that preserves their ecological character, and the participation of local communities in the management of protected areas, where appropriate. A consultation and public participation process are outlined in the Act. It also contains the requirement that marine and terrestrial protected areas with common boundaries must be managed as an integrated protected area by a single management authority. It is also important to note that under this Act, commercial prospecting or mining is prohibited in any nature reserve. The ICM Act also provides for the establishment of Specialist Management Areas that are wholly or partially in the coastal zone. These areas may only be declared by the Minister and such declaration may prohibit certain activities from taking place within such a management area. Specific impacts on the Protea Banks MPA need to be taken into consideration when developing the EMP.
National Environmental Management: Biodiversity Act (No. 10 of2004)	The National Environment Management: Biodiversity Act (No. 10 of 2004) provides for the conservation of biological diversity. It requires identification of important landscapes, ecosystems, ecological process and species for biodiversity conservation, and promotes monitoring of these. It also provides for the proclamation of protected areas, recognising South Africa's obligations to international conventions, such as the Convention on Biological Diversity, the Convention on Wetlands of International Importance, especially Waterfowl Habitat (Ramsar Convention) and the Convention on Migratory Species (Bonn Convention).
National Environmental Management: Waste Act (Act No. 59 of 2008)	The National Environmental Management: Waste Act (NEM: WA) (Act No. 59 of 2008) aims to reform the laws regulating waste management to protect health as well as the environment by providing reasonable measures for: pollution prevention, ecological degradation and to secure ecologically sustainable development. The Act provides for institutional arrangements and planning matters; national norms and standards for regulating the management of waste by all spheres of government; specific waste management measures; the licensing and control of waste management activities; the national waste information system; and compliance and enforcement. The NEM: WA covers a broad range of waste issues ranging from sustainable use of natural resources to pollution prevention, thus the broad objectives of the Act are to protect health, well-being and the environment by providing reasonable measures for minimising natural resource use; avoiding/minimising accumulation of waste; reducing, reusing, recycling an recovering waste; treating and safely disposing of waste (as a last resort); preventing pollution and ecological degradation; securing ecological sustainable development while promoting justifiable economic and social development; promoting and ensuring waste service delivery; and remediating land where contamination presents, or may present, significant risk to health/environment. It also aims to ensure people are aware of impacts of their waste on their health and the environment; and ensure compliance with the aforementioned points.
Conservation of Agricultural Resources Act (No. 43 of1983)	Department of Agriculture, Land Reform and Rural Development (DALRRD) is the lead agent for Conservation of Agricultural Resources Act (No. 43 of 1983, CARA). The objective of CARA is to provide for the conservation of the natural agricultural resources of South Africa by: the maintenance of the production potential of land; the combating and prevention of erosion and weakening or destruction of the water sources (including estuaries); and the protection of the vegetation and the combating of weeds and invader plants.

National Heritage Resources Act (No. 25 of 1999)	South African Heritage Resources Agency is the lead agent for the National Heritage Resources Act (No. 25 of 1999, NHRA). The NHRA provides an integrated and interactive system for the management of national heritage resources (which include landscapes and natural features of cultural significance). One of the important elements of the Act is that it provides the opportunity for communities to participate in the identification, conservation and management of cultural resources. The Act also requires that in areas where there has not yet been a systematic survey to identify conservation-worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected. Anyone who intends to undertake a development must notify the South African Heritage Resources Agency and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the developer's cost. Development must cease if a heritage resource is discovered.
National Health Act (No. 61 of 2004)	While the Department of Health is the lead agent for the National Health Act (No. 61 of 2004, NHA), the implementation of this act is delegated to the local municipal and provincial authorities. The responsibility for rendering environmental health services under the NHA has been delegated to metropolitan and district councils as from 1 July 2004. Every metropolitan and district municipality must ensure that appropriate municipal health services are effectively and equitably provided in their respective areas. These include (insofar as it influences human health, except in ports), water quality monitoring; waste management; and environmental pollution control.
Local Government: Municipal Systems Act (No. 32 of 2000)	The national Department of Provincial and Local Government is the lead agent for the Municipal Systems Act (No. 32 of 2000, MSA). The MSA (Chapter 5) deals with Integrated Development Planning (IDPs) that sets the social and economic objectives for a particular area. An IDP is intended to encompass and harmonise planning over a range of sectors such as water, transport, land use and environmental management. The Act requires each local authority to adopt (and regularly update) a single, inclusive plan for the development of the municipality which: • Links, integrates and coordinates plans and take into account proposals for the development of the municipality; • Aligns the resources and capacity of the municipality with the implementation of the plan; • Forms the policy framework and general basis on which annual budgets must be based; and • Is compatible with national and provincial development plans and planning requirements that are binding on the municipality in terms of legislation. The Municipal Planning and Performance Management Regulations promulgated in terms of this Act describe the content requirements of IDPs. The regulations, for example state that the Spatial Development Framework (SDF), reflected in the municipality's IDP, must 'contain a strategic assessment of the environmental impact of the spatial development framework'.
Disaster Management Act (DMA) (Act No. 57 of 2002)	The Disaster Management Act (DMA) (Act No. 57 of 2002) aims to provide an integrated and co-ordinated disaster management policy with a focus on the prevention and reduction of the risk of disasters, the mitigation of severity of disasters, emergency preparedness, as well as a rapid and effective response to disasters and post-disaster recovery. The Act provides for the establishment of national, provincial and municipal disaster management centres as well as disaster management volunteers to assist metropolitan or district municipalities. At the local level, the Act prescribes that each metropolitan and each district municipality establish a disaster management framework in consultation with local municipalities aimed at ensuring an integrated and uniform approach to disaster management. Each metropolitan and each district municipality must also establish a disaster management centre for its municipal area which, must educate and promote formal and informal prevention, mitigation and response initiatives to encourage risk-avoidance behaviour in all spheres of government, non-governmental organisations and community-based organisations. In addition, each municipal entity in the respective framework, must prepare a disaster management plan that must be incorporated into the municipal integrated development plan. With an emphasis prevention and mitigation, the disaster management plan must, inter alia: • Identify potential risks in the municipal area; • Identify areas and groups of people at risk to disasters;

	• Have contingency and mitigation measures in place to reduce the effects of disasters on these areas and groups both before and after disasters; and • Provide for the allocation of responsibilities to various role players and co-ordination of carrying out those responsibilities.

8.1.2. Integrated Coastal Management Act: National Coastal Management Programme

South Africa's National Coastal Management Programme (CMP) was released in 2014, and provides the direction and guidance towards a structured and standardised approach to coastal management in South Africa, including an appropriate cooperative governance framework (DEA, 2014) . It is strongly founded on the initial precepts of the White Paper (DEAT, 2000)such that the vision and principles of integrated coastal management are the same, and the national mandate, in terms of the ICM Act.

The National CMP was developed using a framework of key components of an integrated CMP, where nine key priorities for coastal management were determined (DEA, 2014). These priorities, together with the Vision, function as the pillars of this primary policy directive on coastal management for South Africa. Each is bolstered by a primary goal, specific management objectives, actions and performance indicators to give direction for planning implementation. Collectively, these elements constitute national government's commitment to implementing the ICM Act over the next five years (2013-2017).

Integrating management in Estuaries is among these priorities (Priority 3) and the overarching goal echoes that of the ICM Act. The National CMP concludes with a process towards implementation that provides the template for Implementation Plans that should developed up for each individual action (Table 26).

Table 26: The National Goal, Management Objectives and Actions for estuarine management in South Africa (DEA, 2014)

GOAL: Ensure that all estuaries along the South African coast are management in an integrated, holistic manner in accordance with the National Estuary Management Protocol and the extent to which activities within estuaries are consistent with the other key priorities for coastal management
Management Objective 1: **Develop and implement a national estuarine management protocol for a uniform approach to estuarine management, including individual estuary management plans that are tailored to suit the current and future requirements including social, economic and ecological considerations**
• Develop a national sustainability plan for estuarine resources • Develop guidelines for the development and implementation of estuary management plans allowing for a differentiated approach across South Africa • Develop estuary management plans for estuaries assigned to national government (DEA) • Ensure alignment between EIA regulations and the National Estuarine Management Protocol
Management Objective 2: **Establish appropriate institutional mechanisms for estuarine management to facilitate dialogue, collaboration and implementation of Estuarine Management Plans**
• Develop guidelines for coastal committees that include institutional substructures for integration and coordination of estuary management • Prepare Standard Operating Procedures to facilitate an integrated approach towards the implementation of estuarine management plan across relevant departments

8.1.3. National Estuarine Management Protocol

It is important to note that the 2013 Protocol is currently under review[31] and is in draft format pending finalisation (DEFF, 2021). The Protocol lays out the strategic vision and objectives for achieving effective integrated management of estuaries in South Africa; the standards for the management of estuaries; the procedures regarding how estuaries must be managed and how the management responsibilities are to be exercised by different organs of state and other parties; the minimum requirements for EMPs; detail on who must prepare EMPs and the process to be followed in doing so; and the process for reviewing EMPs to ensure that they comply with the requirements of the ICM Act. Specific strategic objectives outlined and management standards prescribed are detailed in Table 27.

Table 27: 2021 Draft National Estuarine Management Protocol: strategic objectives and management standards (DEA, 2021)

Strategic Objectives	Management Standards
• To conserve, manage and enhance sustainable economic and social use without compromising the ecological integrity and functioning of estuarine ecosystems; • To maintain and/or restore the ecological integrity of South African estuaries by ensuring that the ecological interactions between adjacent estuaries, between estuaries and their catchments, and between estuaries and other ecosystems, are maintained; • To manage estuaries co-operatively through all spheres of government; and to engage the private sector/entities and civil society in estuarine management; • To protect a representative sample of estuaries (such protection could range from partial protection to full protection) in order to achieve overall estuarine conservation targets as determined by the National Biodiversity Assessment (NBA) of 2011 and the subsequent updates; • To generate awareness, education and training that relate to the importance, value and management of South African estuaries; and • To minimise the potential detrimental impacts of predicted climate change through a precautionary approach to development in and around estuaries and with regard to the utilisation of estuarine habitat and resources.	• An estuary must be managed according to the allocated management class and resource quality objectives (as per the National Water Act, 1998), which must take into account the current ecological health status, recommended extent of protection and recommended ecological category in order to meet the biodiversity targets as set in the most recent NBA. • An estuary must be maintained in its ecological category as determined in the most recent NBA in order to meet biodiversity targets, and to take into account the recommended extent of protection and recommended ecological health category; • An estuary must be managed to avoid, minimize or mitigate significant negative impacts that include but are not limited to reduced water flows and loss of habitat or species (This will require the participation of Departments responsible for utilization of estuarine resources); • Promoting the integration of land use planning and natural resource management outcomes with estuarine management outcomes; • Management actions should be based on sound scientific evidence and, where lacking, the precautionary approach should prevail; and • The adoption of risk management approaches to address issues such climate change and associated impacts as well as potential disasters, must be promoted.

[31] The Protocol has been reviewed predominantly as a result of the so-called Abbott Judgement. On the 20th of May 2016, the Supreme Court of Appeal dismissed the appeal of Mr Abbott who sought to review and set aside the decision of the Overstrand Municipality who refused to take steps to prevent damage being caused to his house in Hermanus by the flooding of the Klein River. Abbott failed to prove that the municipality had the legal authority or obligation to take such steps (Abbott vs Overstrand Municipality and Others (99/2015) 2016). The Court did however note that while it could be possible for a municipality to administer an estuary in terms of ICMA in the future, this could only happen if it agrees, and has the capacity, to do so, in accordance with section 156(4) of the Constitution. As this had not happened in the case of the Overstrand Municipality, the municipality did not have any authority under ICMA to manage the estuary, including the breaching of the mouth of the estuary (Abbott vs Overstrand Municipality and Others (99/2015) 2016) (WCG, 2019).

In the 2013 Protocol, the Ray Nkonyeni Local Municipality was the identified Responsible Management Authority (RMA) for all estuaries within its municipal boundary and was therefore responsible for the development and overall co-ordination of the implementation of individual EMPs.

However, in the draft 2021 Protocol, the Provincial Environmental Department (i.e. EDTEA) is responsible for developing and coordinating implementation an EMP, in consultation with affected local/district municipality (in this case of the iKongeni Estuary, these are RNM and Ugu municipalities) and the relevant national government departments.

While the Protocol does not propose new institutional arrangements, i.e. the establishment of specific estuarine advisory forums, it does allow for private entities and non-government organisations (e.g. conservancies, advisory forums, etc.) to play a supporting role in the development of these plans, assume an informal advisory role to facilitate implementation of the various project plans, and to foster continuous stakeholder engagement. The institutional arrangements provided for in the ICM Act, i.e. the formation of coastal committees at provincial and municipal levels, will serve as the primary platform(s) for monitoring implementation and reporting on progress of the EMP (DEA, 2013; DEFF, 2021).

Also, the DFFE may be approached to provide technical and management support to capacitate a municipality where the need arises, but this will depend on the importance of the estuary in terms of meeting biodiversity targets and/or the strategic objectives of the national department (DEA, 2014).

8.1.4. Estuary Early Warning - Emergency Preparedness and Response Guide for South Africa

The South African Estuary Early Warning - Emergency Preparedness and Response Guide (EEW-EPRG) (Stander *et al.*, 2012) forms part of the South African Multi-Hazard Early Warning System, to address flood risk in estuaries as result of land-based rainfall in combination with ocean storm events. In line with the general principles of effective Early Warning Systems, the EEW-EPRG addresses five elements, namely:

- **Risk identification**: High risk estuaries identified; Institutional arrangements; Specific weather indicators identified; and Risk reduction system for each estuary;
- **Monitoring and warning system**: Information flow prior to and during incidents, emergencies and disasters; Institutional arrangements; Requirements for monitoring and real time data acquisition; and Infrastructure and equipment requirements;
- **Alert dissemination:** Information flow prior and during incidents, emergencies and disasters; Institutional arrangements; and Infrastructure and equipment requirements;
- **Response actions:** Institutional arrangements; and Roles and responsibilities of role players and stakeholders;
- **Reporting and evaluation:** Institutional and information flow; and Infrastructure and equipment requirements.

The EEW-EPRG approach is structured to reduce the risk to human life/infrastructure losses through an early warning system, particularly for high risk estuaries. However, it would be preferable that steps be taken to mitigate or reduce the risk completely by guiding new development and the placement of infrastructure.

The Guide details the roles and mandates of the various authorities, working together with the South African Weather Service, in managing flooding disasters and implementing an estuary early warning system. Figure 24 illustrates the components and process flow of an estuary alert system. Based on the Common Alert Protocol, the Guide prescribes a plan of action for responding to estuary warnings, including the establishment of a joint operations centre to put mitigation and response measures in place (Stander *et al.*, 2012).

It is evident that critical information, EMPs and Mouth Management Plans have not been developed for high risk estuaries, and thus influences the predictability of flooding risks and impacts, and in turn the appropriate responses and mitigation actions required. The Guide emphasises that such plans should be developed and important information gathered as a matter of urgency for priority systems. The EEW-EPRG provides a list of critical/high risk estuaries per coastal municipality, for which early flood warning systems should be developed. The iKongeni Estuary is among the ten high risk estuaries identified in the former HCM (Stander *et*

al., 2012).

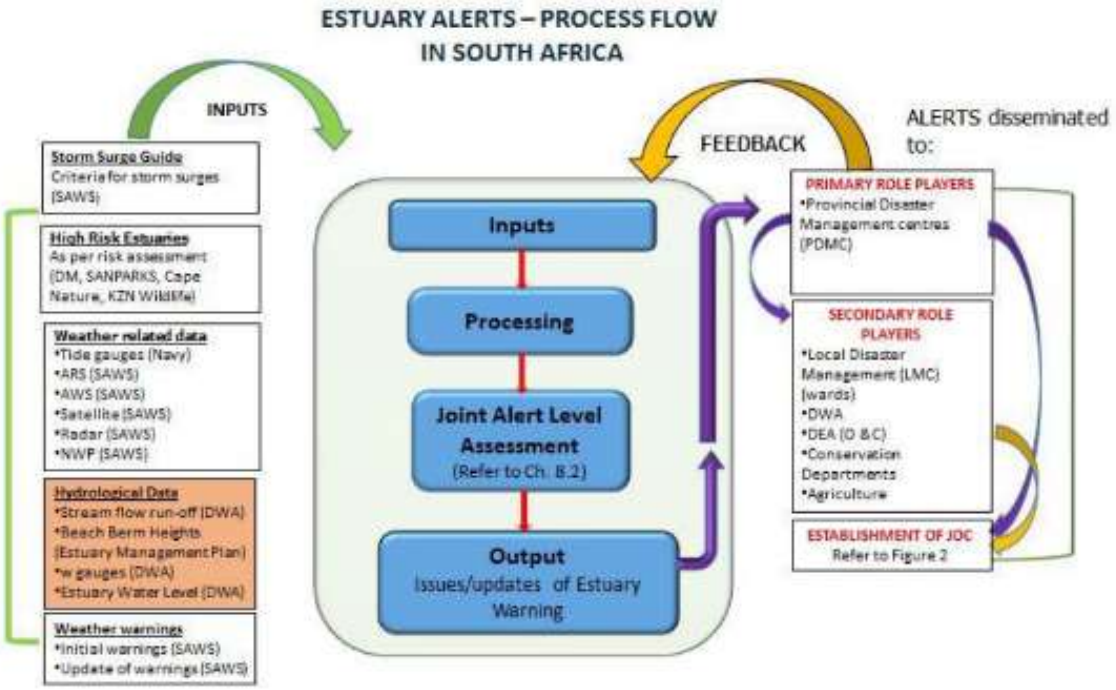

Figure 24: Estuary Alerts Process Flow (Stander *et al.*, 2011)

8.2.Provincial Legislation and Policy Directives

Provincial legislation and policies that are relevant for management of the iKongeni Estuary include the KZN Provincial Growth and Development Strategy/Plan, the KZN Provincial Spatial Development Framework, as well as the KZN Coastal Management Programme (2017-2022).

8.2.1. KZN Provincial Growth and Development Strategy and Plan

The KwaZulu-Natal Provincial Growth and Development Strategy and Plan (PGDS and PGDP) (KZN PPC, 2016, 2019) provide a long term vision, sustainable growth and development strategy and implementation plan for KZN. It identifies seven strategic goals and associated strategies to guide development in the province. Those of most relevance to the iKongeni Estuary study area are:

- Safeguard and enhance sustainable livelihoods and food security;
- Ensure availability and sustainable management of water and sanitation for all;
- Enhance KZN waste management capacity;
- Enhance resilience of ecosystem services;
- Adapt and respond to climate change;
- Enhance the resilience of new and existing cities, towns and rural nodes, ensuring equitable access to resources, social and economic opportunities; and
- Promote sustainable human settlements.

The town of Margate is identified as a Tertiary Intervention node with the intended purpose of providing services to the sub-regional economy and community needs. In respect to specific budget allocations, provisions are made for the Margate Airport (KZN PPC, 2019). This is sure to bring an economic boost to the region, as well as Margate itself. This may result in indirect pressures on the iKongeni Estuary, such as development pressure in the catchment; waste management, including domestic and potentially industrial

effluent, and solid waste, and potential increase in spillages into drainage lines and watercourse that ultimately drain into the estuary.

8.2.2. KZN Provincial Spatial Development Framework

The draft Provincial Spatial Development Framework (PSDF), as per the requirements of the SPLUMA 2013, is currently under review, which is proposed to be undertaken during 2020/2021. This framework presents the KZN long-term spatial vision and spatial expression of the KZN PGDS. It, amongst other issues, indicates the desired and intended pattern of land use in KZN and future development scenarios.

The environmental analysis highlights *inter alia* the increasing threat of climate change (linked to vulnerability), land cover transformation, increased habitat loss and the compromised functioning of terrestrial and aquatic ecosystem and the linkages to water security (KZNPG, 2020). Furthermore, it acknowledges the need to halt/reverse environmental degradation whilst enabling socio-economic development, as well as the need to build resilient socio-ecological settlements that will be able to adapt to environmental change. The PSDF also desires critical thinking around increasing food production, water security and promoting the green economy in an increasingly compromised natural environment. These aspects are all applicable to the management of the iKongeni Estuary.

8.2.3. KZN Coastal Management Programme (2017 – 2022)

The KZN Coastal Management Programme (CMP) (EDTEA, 2019) is aimed at promoting sustainable coastal development and the long-term benefits for the sustainable utilisation of coastal resources. The provincial CMP defines the coastal zone and proposes a vision for the KZN coast:

Vision for the KZN Coast

A vibrant, healthy and safe coast with sustainable access to resources for all

Mission

"Through co-operative governance and best practice, the intrinsic value of the coast is protected, restored and enhanced for future generations, while promoting equitable access and sustainable use of coastal resources for all stakeholders and user groups."

The KZN CMP embodies the National CMP principles for coastal management and identifies nine priority areas with related goals, as well as a plan of action, which includes a requirement to monitor implementation (Table 28). Estuarine management is a priority for the Province, and the goal is to manage estuaries in a manner which optimises the value of these systems, without comprising their future disposition and provision of ecosystem services. This is to be done in accordance with the Protocol, and strengthened through long-term estuarine monitoring. Priority actions for KZN thus include the identification of priority estuaries for the development of EMPs; developing a KZN estuary breaching policy; developing EMPs for the iKongeni, Tongati and Mahlongwa estuaries; undertaking a visual assessment of estuarine status; and the physical monitoring of priority estuaries.

Table 28: Priority Areas, Goals and Management Objectives of the KZN Coastal Management Programme

Priority Area	Goal	Management Objectives
Coastal Access	Promote safe and equitable access to the coast	▪ Enable physical public access to the sea, and along the seashore, on a managed basis
Coastal and marine planning	Promote balance between economic development and conservation of natural resources	▪ Ensure coastal development is appropriate ▪ Protect the existing natural coastal environment
Coastal information & research	Promote relevant research and access to information	▪ Develop an appropriate information management and sharing system ▪ Identify research priorities and opportunities in support of ICM
Coastal vulnerability: adaptation and building resilient communities	Promote resilience to the effects of climate change, dynamic coastal processes and natural hazards	▪ Ensure that coastal planning and development minimises the exposure of people, infrastructure and economic activities to significant risk from dynamic coastal processes ▪ Facilitate rehabilitation of degraded natural coastal infrastructure, coastal ecosystems and habitats
Cooperative governance	Establish and strengthen institutional partnerships and mechanisms for ICM to facilitate better management	▪ Promote provincial as well as local government objectives through participation in the National Coastal Committee (MINTEC Working Group 8) ▪ Strengthen and support Provincial and Municipal Coastal Committees ▪ Establish strategic PCC subcommittees with Terms of Reference specific to improve governance and ICM implementation
Education, awareness and training	Develop capacity and promote public awareness and education for integrated coastal management	▪ Build political and stakeholder support for effective coastal management in KZN ▪ Create general awareness about the coast and coastal issues in KZN, in order to change behaviour (linked to understanding & appreciating the value of the coast) ▪ Undertake a prioritised ICM training and capacity development programme
Estuarine management	Undertake estuarine management which optimises the value of these systems on a sustainable basis	▪ Ensure management of estuaries in accordance with the National Estuarine Management Protocol ▪ Long-term monitoring of estuaries
Land & marine-based sources of pollution	Minimise the impacts of pollution and waste on the health of coastal communities and coastal ecosystems	▪ Develop and implement water quality improvement programmes for prioritised coastal areas Develop and implement pollution control measures using best practice
Monitoring, compliance and enforcement	Monitor the State of the Coast (SoC) and promote compliance with coastal and other regulations	▪ Reporting on the state of the KZN coastal environment ▪ Long-term coastal monitoring

8.2.4. Protocols for requests to breach estuary mouths in KZN

In March 2020, the KZN Department of EDTEA published two protocols for requests to breach estuary mouths in KZN. One is in respect to Mouth Maintenance Management Plans (EDTEA, 2020c), and the second in relation to Emergency Situations (EDTEA, 2020b). These protocols replace the previous Ezemvelo KZN Wildlife Estuaries Breaching Policy.

The purpose of these protocols is to promote consistent implementation by documenting the principles and processes to be followed in response to requests to manipulate or breach estuary mouths in KZN via approved mouth maintenance management plans (MMPs) and in emergency situations. The development and use of these protocols aim to promote consistent implementation (i.e. one rule for all) of the NEMA in accordance with the principle of Duty of Care. Of importance is that legally, breaching can only be considered in response to an emergency situation or if undertaken in accordance with an approved MMP.

Key principles for artificial breaching are included, as well as detail on when to breach, how to breach as well as factors to be taken into consideration prior to breaching. The protocols conclude with recommendations for future consideration as well as minimum requirements for MMPs as well as information requirements for breaching in emergency situations.

8.3. Local Management and Policy Directives

8.3.1. Ugu District Municipal Integrated Development Plan

The 2016/2017 Integrated Development Plan (IDP) for the Ugu District Municipality (DM) (Ugu DM, 2016) recognised the value of the coastal environment, and some noteworthy observations relating to estuaries in general included the following:

- "Intense inappropriate development, industrial and storm water pollution and degeneration stemming from river catchment activities threaten the ecological role and function of estuaries"; and
- "There are only four, out of the 42 estuaries in the region with their flood plains in good condition and over 50 % of the estuaries are in a moderate to poor state with regard to invasive vegetation."

In addition, numerous serious environmental concerns were highlighted for the District in terms of environmental management, and almost all are notoriously prevalent in KZN estuaries (Ugu DM, 2016):

- Over exploitation of resources;
- Loss of wetlands, coastal forests, bushlands and grasslands, and associated biodiversity;
- Loss of ecosystem services – flooding, erosion and infrastructure damage;
- Alien plant encroachment;
- Poor state of rivers and estuaries;
- Soil erosion, loss of soil fertility in sugar lands, over grazing and uncontrolled land use in traditional areas;
- Illegal sand mining and quarrying;
- Loss of ecological linkages – fragmentation;
- Uncontrolled urban and rural sprawl;
- Siltation and irrigation compromising water supply; and
- Little evidence of climate change adaptation.

The Ugu IDP takes cognisance of the fact that its coastal corridor is predominantly a built environment that is relatively well developed comprising hard and bulk infrastructure, and a mix of light industries, small holdings and large-scale agriculture, and intensive residential and holiday resorts establishments. Key assets of the natural environment are described, with particular reference to protected areas and the need to secure and manage Critical Biodiversity Areas (CBAs) given the critical levels of transformation in the district and pressures on the remaining land. The vulnerability of coastal development to sea level rise is also acknowledged together with the recommendations of the CVI for precautionary measures at medium to high risk areas.

The 2016/2017 Environmental Trends Analysis identified environmental challenges associated with *inter alia*, Alien Invasive Plants Management, Environmental Impact Management (i.r.t. infrastructure projects), Coastal Management, Climate Change, Environmental Strategic Planning, and Education, Awareness and Training. The 2020-2021 (Spatial and) Environmental Trends Analysis (Ugu DM, 2020a) is less detailed and focusses on Climate Change Impacts and Environmental degradation due to settlement/urban sprawl. The development of various strategic environmental documents (e.g. Ugu EMF, Integrated Waste Management Plan, Climate Change Adaptation Plan, etc.) is viewed as a major strength. Opportunities include capitalising on the coastal environment as a tourism draw card, including Blue Flag to boost tourist confidence, garnering assistance from environmental conservancies in addressing environmental threats, waste management services, projects that focus on environmental problem areas, the presence of some level of human resource capacity at the local level, and improvement of the policy environment (in reference to bathing, waste management and by-laws to address specific issues). Relevant shortfalls and threats, which could potentially influence estuarine management, include implementation of the strategic documents, environmental degradation, human and financial resources capacity, co-ordination of environmental projects, pollution threatening the coastal environment (thereby compromising beach tourism and human health), the compromised state of water resources, and environmental compliance monitoring (Ugu DM, 2020a).

There are numerous priorities or commitments within the Environmental Health Services department (Ugu DM, 2020a) that are likely to have a significant role to play in terms of estuarine management and improving

estuarine health insofar as it pertains to protecting human health and safety. The follow key aspects are extracted and highlighted based on the issues identified for the iKongeni Estuary:

- "to mitigate against such [environmental health] risks and ensure promotion of a healthy environment;
- "water utilized for recreational purposes is in compliance to regulations thereby preventing water borne diseases" - Water samples are reportedly taken monthly, from various sources, namely, tankers, standpipes, rivers, lagoons, and boreholes, for testing;
- "ensuring water safety in respect of safe quality (microbiological and chemical), and accessibility…. to quality of water for recreational, industrial, food production and any other human and animal use"
- "ensuring monitoring and effective waste water treatment and water pollution control"
- "Environmental Health Officials have a vital role to play in terms of…
    - ensuring hygienic working, living and recreational environments;
    - identifying the polluting agents and sources of water, air and soil pollution;
    - taking the required preventative measures to ensure that the general environment is free from health risks; and
    - ensuring the registration, permitting, monitoring and auditing of all industries, activities, trade etc., which involves controlling the internal effects of pollution on the worker and the external effects of pollution on the community and the environment."
- "ensuring the proper refuse storage, collection, transportation, transfer and processing, materials recovery and final disposal"; and
- "ensuring proper management of liquid waste, including sewage and industrial effluents."

In respect to the disaster management functions of the Ugu DM, risks identified for the RNM that have affected, or may potentially affect, the iKongeni Estuary include, drought, floods, hazardous material via road, storm surge, water pollution and drownings (Ugu DM, 2020a). There are extensive institutional arrangements within the Ugu DM for risk reduction and prevention as well as response and recovery.

The 2020-2021 IDP identifies key challenges faced by the Ugu DM, which include the:

- Provision of basic services (including, inter alia, ageing infrastructure, rate of responding to leaks, waste water quality below minimum standards, illegal connections, sanitation backlog),
- Municipal transformation and organisational development (inter alia, disengaged employees leading to mismanagement, poor performance management, lack of monitoring and evaluation, lack of human resource capacity, ambiguous delegations of Ugu authorities leading to a lack of accountability);
- Local Economic Development (including inter alia, unfavourable LED environment, poor resourcing of LED);
- Municipal financial viability and management (including inter alia, poor budget management and inaccurate financial reporting, poor procurement planning, inadequate expenditure management)
- Good government and public participation (including inter alia poor communication and stakeholder engagements, disintegrated public participation and lack of inter departmental collaboration); and
- Cross cutting issues, such as outdated and insufficient environment strategies (e.g. outdated integrated waste management plan), insufficient and inconsistent compliance with environmental requirements by Water Services projects, among others.

Estuaries are not addressed directly in the Ugu DM and, despite the socio-economic value of the Margate Beach environment and coastal tourism, reference to enhancing the condition of the iKongeni Estuary is absent. There are no specific programmes or directives to address the estuarine issues identified above. Rather, "pollution of estuarine and riverine environments by municipal effluent" is duly acknowledged as a key issue and is attributed to the "lack of compliance with environmental, health and wastewater regulation standards" (Ugu DM, 2020a).

The vision and mission as adopted in the Ugu IDP gives direction to what the DM wants to achieve in terms of its medium- and long-term developmental goals. They highlight key issues that need to be addressed for the

region. As of the next 5-year cycle (2017/2018-2020/2021), a new municipal vision and mission were adopted and are as follows:

Vision

"By 2035 Ugu District Municipality will provide adequate access to basic services in an efficient and sustainable manner, enhancing the quality of its citizens in an inclusive progressive economy."

Mission

"To ensure all our communities have access to quality drinking water, decent sanitation, sustainable economic opportunities underpinned by the active participation of our citizens in exemplary government."

In order to achieve the above vision and mission, the Ugu DM has identified 22 strategic objectives across six key performance areas (KPA) (Ugu DM, 2017). Environmental management considerations fall under KPA 6 – Cross Cutting Interventions, under the strategic objectives CCI1 (Disaster prevention and management) and CCI3 (disease exposure and health risks), but perhaps most appropriately, under CCI2 – *Promote a healthy, safe and sustainability environment*.

Effort will focus on:

- Managing the pressures on biodiversity and environmental quality through developing and/or implementing various environmental management programmes, strategies, and plans; and
- Ensuring efficient environmental monitoring, and safeguarding public health through environmental and health awareness/education initiatives, public health bylaws and environmental policies.

The role of Ugu DM in providing and maintaining sanitation infrastructure, which is considered cross cutting with management of the iKongeni Estuary, is considered under KPA 2 - Basic Service Delivery. Significant funding was spent in 2014/2015 towards sanitation projects, including the refurbishment of 25 pump stations to ensure minimal sewage spillages due to aged infrastructure. The Margate Sewer Pipeline Upgrade was earmarked for 2015/2016, however the status of this project remains unclear[32]. Nonetheless, replacement of the pipeline is documented within the Service Delivery and Budget Implementation Plan, as well as an emergency pipeline project (Ugu DM, 2020a).

In terms of development planning, Margate is classified as a municipal development node. It is recognised as the biggest and most popular tourism destination in the RNM and was flagged for urban renewal project with a time frame 2017-2020. However, the most recent IDP review focusses on the upgrade/ redevelopment of the Margate Airport. This project is one of 16 catalytic projects, identified to be drivers of change, unlocking resources and businesses opportunities for the Ugu DM (Ugu DM, 2020a).

8.3.2. Ugu District Environmental Management Framework

The Ugu District Environmental Management Framework (EMF) (Mott MacDonald, 2013) gives due consideration to the attributes of the coastal environment. The EMF acknowledges the ICM Act as the foundation to coastal management and recognises the municipal responsibilities in this regard, including the need to develop and implement a municipal CMP to address environmental priorities, risks and vulnerabilities, disaster management and climate adaptation measures in the coastal zone.

Secondly, it acknowledges estuaries as key components of coastal biodiversity, and the responsibility of developing EMPs for each estuary as stipulated by the ICM Act and the Protocol (Mott MacDonald, 2013). It emphasises the degraded and/or heavily impacted state of majority of estuaries within the Ugu DM, with only 20% of estuaries in a Good or Excellent condition. Ezemvelo KZN Wildlife has identified almost all Ugu estuaries as priority systems, except for Intshambili, Mhlabatshane, Mhlangeni and Mhlungwa.

[32] http://ugu.gov.za/Newsroom/Pages/-Millions-budgeted-for-water-and-sanitation-services-improvement.aspx , dated 7/5/2018

The concern for biodiversity captured in the Ugu EMF relates particularly to environmentally sensitive areas including "*terrestrial land, aquatic features as well as marine areas which must be safeguarded in their natural state if biodiversity is to persist and ecosystems are to continue functioning*" (Mott MacDonald, 2013). These areas are captured in a Critical Biodiversity Area map, which "*aims to guide sustainable development in the District by providing a synthesis of biodiversity information to decision makers*." The EMF indicates that, while most rivers in the Ugu DM are generally in reasonable condition, there are numerous small rivers closer to the coast that are more heavily modified. Moreover, wetland transformation and the prevalence of invasive alien species are key threats to the biodiversity as well as the provision of ecosystem services derived from natural ecosystems in the Ugu region. The key drivers of biodiversity loss include, inter alia, the demand for land for economic and social development, agricultural activities, subsistence living areas and climate change (Mott MacDonald, 2013).

In terms of conservation, merely 2% of the Ugu District area falls within seven terrestrial formally protected areas, which is significantly lower than international and national benchmarks, and is considered inadequate to ensure protection of a diversity of species. There are also two marine protected areas[33]. These conservation areas, together with the broader coastal environment, are identified as important attractions for the tourism industry which contributes significantly to the economy of the Ugu DM (Mott MacDonald, 2013).

The EMF identified four distinct landscape character zone, namely predominantly natural areas, altered landscapes within a natural setting, transformed landscape with a rural setting, and the coastal and urban zone. The latter was characterised as having scenic beaches and the high occurrence of estuaries/lagoons, very high development pressure due to tourism activities along the Indian sea board, and very high scenic quality/attraction due to ocean vistas. This zone was deemed to require the highest level of management amongst all the zones in order to protect its visual resources and landscape character (Mott MacDonald, 2013).

Lastly, the EMF provides several recommendations to better manage the various zones within the Ugu region. For the coastal and urban zone, these included (Mott MacDonald, 2013):

- Recommended activities: predominantly tourism and tourism related developments, as well as lower density residential land uses that are sensitive to the environment;
- Specific attention should be given to the protection of beaches, dunes and estuaries, with an additional focus on the management of natural open spaces within this zone;
- Development should not infringe on these scenic features and should preferably be located within already disturbed areas, or favour in-fill developments; and
- Future industrial or large-scale commercial developments within this zone should ideally be discouraged or located to more suitable areas with a compatible land use character.

In respect of better managing biodiversity (which includes the coastal environment), the following responses were proposed recommended (Mott MacDonald, 2013):

- Integrating biodiversity into municipal and development planning;
- Protection and management of critical biodiversity areas;
- Rehabilitation of degraded areas;
- Protection of water resources; and
- Coastline management (including the development and implementation of a municipal coastal management programme and estuarine management plans).

The Desired State Report (Mott MacDonald, 2014) puts forward the future state of the various sensitive components that comprise the Ugu DM based on environmental priorities. It forms the basis of the management guidelines and strategic objectives of the EMF. The following table is extracted from the report provides a summary of the provision of the EMF to address threats and opportunities related to coastal management and estuaries. Aspects of tourism, water resources and biodiversity are cross cutting with estuarine management. These will also be consulted for the development of the iKongeni EMP.

[33] Now three with the inclusion of the Protea Banks MPA.

Table 29: Provisions of the EMF to address threats and opportunities related to the coastal zone and estuaries (Nemai Consulting, 2018)

COASTAL MANAGEMENT ***Desired State is to protect the coastal zone from degradation and to maintain the scenic beauty of the Ugu coastline***		
Threats	Opportunities	EMF support
• The coastline of the District is under threat of development, which poses a threat to the coastal ecosystem. Increase in development will also place added pressure on waste infrastructure, which could result in waste ending up in the ocean. • The Ugu coastline is very aggressive and poses a threat in terms of coastal erosion and destruction of coastal infrastructure. • Coastal pollution resulting from poorly maintained municipal waste and sewerage infrastructure. • Development pressure resulting in loss of ecosystem processes and functions. • Tidal surge events and coastal erosion, especially with climate change, resulting in risk to structures and infrastructure and loss of beach areas for tourism	• The existence of three* Marine Protected Areas (Aliwal Shoal, Protea Banks, Trafalgar) off the coast of the Ugu DM is an opportunity for marine conservation and the associated impact on ecotourism. • The existence of Marine Protected Areas and undeveloped green areas, for the establishment of coastal protection areas. • Tourist friendly beaches, allowing socio-economic development. • Marine living resources for sustainable livelihood projects. • The existence of Marine Protected Areas and undeveloped green areas, for the establishment of coastal protection areas. • Ugu DM has developed a CMP which guides future opportunities within the coastal zone in a sustainable manner.	• The Coastal and Estuarine EMZ incorporates various factors, including the biodiversity of the marine and inshore environments (including marine and estuarine CBAs and ESAs), CVI (based on the relative physical vulnerability of the coast to erosion, sea-level rise and extreme events), scenic quality and tourism-based land use. • Specific measures included in the Coastal and Estuarine EMZ to safeguard the values of the District's coastline.
ESTUARIES ***Desired State is to prevent further degradation of Ugu's estuaries and to protect them from future development***		
Threats	Opportunities	EMF support
• 30% of estuaries in the District are reported to be in poor condition. Impacts such as inadequate sanitation and waste disposal facilities result in the pollution of estuaries. Unpermitted artificial opening of estuaries to negative impacts on estuarine functioning. • Poorly managed upstream activities have a detrimental effect on the condition of estuaries in the District. • Illegal sand winning poses a threat to estuarine and coastal ecosystems by changing the dynamics of the system.	• 7 Estuaries in the District have been reported to be in good condition and one in excellent condition. The Kaba, Ku-Boboyi and Zolwane estuaries have been flagged as Fresh Water Priority Areas as part of the National Biodiversity Assessment. Estuaries that are in good condition provide an opportunity to preserve associated biodiversity and sensitive estuarine ecosystems. • Development of estuarine management plans to proactively manage living resources and enhance biodiversity while supporting socio-economic growth of the area. • Cooperative governance approach/ efforts involving DMR, EDTEA, Local Government and traditional authorities will lead to improved estuarine status as a result of improved upstream management of potential impacts, as well as direct impacts on the estuaries themselves.	• The Coastal and Estuarine EMZ incorporates estuaries of high conservation significance (including estuarine CBAs and ESAs). • Specific measures included in the Coastal and Estuarine EMZ to safeguard the values of the District's estuaries.

**the number of MPA is increased to three, to include the Protea Banks MPA*

In specific reference to Coastline Management the following critical strategies are to be implemented to safeguard the coastline (Mott MacDonald, 2014):

- Develop and implement a Coastal Management Programme;
- Municipal Coastal Management Forum [Municipal Coastal Committee] to guide coastal management within the District and represent the District at the Provincial Coastal Management Forum [Provincial Coastal Committee];
- **Develop and implement Estuarine Management Plans**;
- Determine appropriate activities that may be carried out within the coastal zone if managed accordingly**. Prohibit inappropriate activities**;
- Establish coastal protection areas and set aside beaches for conservation and eco-tourism purposes;
- **Ensure sustainable utilization of marine living resources** through appropriate management, monitoring and compliance initiatives;
- Identify inappropriate encroachments and developments within the coastal zone that require removal and rehabilitation in terms of the NEM: ICMA;
- **Retain the Admiralty Reserve** and allow no encroachment or clearing of vegetation within this zone. The Admiralty Reserve acts as a "protective green buffer", especially during coastal erosion events;
- **Develop procedures for coastal emergencies (e.g. pollution)** for implementation as and when an emergency incident occurs, in a manner that minimizes potential harm to marine living resources; and
- Implement measures for the identification and rapid response to alien and invasive marine species, particularly if aquaculture facilities and/or marinas are established.

The Desired State Report makes specific reference to the fact that "*it is clear that there is room for improvement of both the drinking and wastewater quality in the District. Urgent measures need to be put in place to protect consumers and the water resources. Once the sanitation needs outlined in the Infrastructure Audit have been met, the effluent problem may decrease and improve the Green Drop status*" (waste water quality score) (Mott MacDonald, 2014). It emphasizes the protection of water resources and their value in providing critical ecosystem good and services. The following responses, which are also applicable to estuarine management include (Mott MacDonald, 2014):

- Rehabilitation of wetlands should be actively encouraged, and opportunities to initiate a new Working
- for Wetland or similar project in the area should be explored;
- Future developments should be excluded from flood lines and designed to minimize potential impacts to water resources through appropriate mitigation measures (e.g. establishment of suitable buffer zones);
- Storm water management should be integrated into existing and future development designs in order to prevent further flood risks and impacts to aquatic resources;
- Industrial and waste discharges should be closely monitored;
- Efforts to reduce impacts of waste water works on water resources should be prioritized; and
- Increased municipal engagement with catchment management fora.

Coastal management objectives related to water resources should include:

- Adequate management of sanitation and waste disposal facilities to prevent pollution of estuaries and inappropriate opening of estuary mouths;
- Development of procedures for coastal emergencies (e.g. pollution) for implementation as and when an emergency incident occurs, in a manner that minimizes potential harm to marine living resources and the estuarine environment;
- Development and implementation of Estuarine Management Plans, which take into consideration the management of estuaries during times of high rainfall when artificial opening of these estuaries may need to be considered;
- Education of the local community and visitors in the important roles of estuaries, so as to discourage unpermitted artificial opening of estuaries; and
- Management of river systems to ensure appropriate flush of rivers during high rainfall events, allowing sand to be washed into the sea for beach nourishment.

8.3.3. Ugu District Environmental Management Framework: Strategic Environmental Management Plan

The Strategic Environmental Management Plan (SEMP) (Nemai Consulting, 2018) was compiled based on the outcomes of the EMF described above, and also draws on the Ugu Biodiversity Sector Plan (EKZNW, 2014). It serves to plot the way forward for attaining the desired state identified in the EMF, by demarcating Environmental Management Zones (EMZs), providing management guidelines for these zone and strategies for controlling the activities that may impact negatively on the natural environment. The following EMZs were delineated:

- Formally Protected Terrestrial Areas;
- Terrestrial Biodiversity;
- Aquatic Biodiversity;
- Coastal and Estuarine Environment;
- Agriculture;
- Heritage; and
- Urban Areas.

To facilitate the attainment of the desired state for these zones, guidelines are provided, which stipulate compatible activities and specific management requirements and objectives that need to be adhered to when development is proposed in a zone.

In specific reference to the Coastal and Estuarine EMZ, as this is the most applicable in terms of management of the iKongeni Estuary, the desired stated is as follows:

> *"Sustainably managed and protected coastal and estuarine environments within the Ugu DM."*

The governance framework is provided, including laws and policies, strategies, plans and programme and relevant authorities, along with implementation mechanisms, as well as compatible and incompatible activities (based on the Ugu BSP), and indicators for performance management. The management guidelines are unpacked in detail (which will inform the management objectives and actions of the iKongeni EMP) and include the following aspects:

- Planning priorities;
- Development guidelines;
- Specific interventions (which includes the development and implementation of estuarine management plans, and developing procedures for coastal emergencies, discouragement of artificial breaching);
- Managing and conserving biodiversity;
- Stakeholder engagement;
- Compliance and enforcement; and
- Specialist studies.

The SEMP goes on to describe the implementation strategy for the EMF, towards achieving the Desired State, including recommendations for EMF-enabling institutional arrangements, and the roles and responsibilities of various roleplayers, and also provides a monitoring and evaluation framework.

8.3.4. Ugu District Water Services Master Plan (2020 – 2050)

The Ugu District Water Services Master Plan (WSMP) provides an overview of the municipality's current infrastructure and service delivery across the respective local municipal areas, as well as its future infrastructure development plans (Ugu DM, 2020b). The purpose of the WSMP is to provide relevant water services planning inputs for incorporation into the Ugu IDP process (Ugu DM, 2020b).

Ugu DM is a Water Services Provider (WSP) and therefore responsible for bulk water provision, water reticulation, sewerage services and bulk wastewater collection and treatment to the towns and villages in its area of jurisdiction (Ugu DM, 2020b). It is the only municipality that performs both functions of bulk water provision and reticulation provision (i.e. operation and maintenance of the distribution networks) (Ugu DM, 2020b), and presents numerous challenges for the municipality.

As detailed in the WSMP, a key feature of the coastal strip is the ageing infrastructure, which has for the most part exceeded its life span having been installed more than 50 years ago. Moreover the seasonal demand on water services continues to increase, however refurbishment has not kept up with the deteriorating systems (Ugu DM, 2020b). Water services development in recent years focussed on providing necessary infrastructure to rural areas, with the resultant neglect of existing systems. Within the urban reticulation system, only 18% of the coastal strip has piped water-borne sanitation; the remaining less densely populated areas have conservancy tanks, septic tanks, ventilated improved pit-latrines (VIPs) or basic pit-latrines. There are numerous pump stations in the narrow, low-lying coastal strip as a result of the incised topography, with the WWTWs being located slightly inland (Ugu DM, 2020b). The WSMP highlights the difficulties and cost implications of providing and upgrading reticulated water-borne sewerage to the coastal strip, which is estimated to be in the order of R 6 billion, and is subsequently being delayed.

Focussing on effluent management, the WSMP maintains that treatment plants should only accept the quality and quantity of effluent for which they were designed, in order for any discharge to a water resource to comply with the prescribed standards and the minimum requirements for waste disposal. It is further noted that the (historical) WWTWs in coastal areas do not comply with current design standards. They are described as being in a state of total disrepair, having received little or no maintenance for many years, and thus requiring major refurbishments and upgrades, especially in respect to increasing treatment capacity (Ugu DM, 2020b). The peak demand over the December holiday period, as well as significant stormwater ingress during storms, poses a serious problem for the WWTWs, which are not designed for major influxes of effluent but rather a slow, steady supply. The Plan paints a dire picture stating that "*the total collapse of the entire wastewater treatment system is imminent and drastic steps are required to prevent an environmental disaster*" (Ugu DM, 2020b, p. 139).

Table 30: Status of the Margate Sanitation System (Ugu DM, 2020b)

- ±90% of Margate is reticulated
- Margate WWTW will require upgrading once Margate is fully developed
- Pump stations 3A requires upgrading
- Storm water ingress results in overflows and pump stations cannot cope with peak flows
- Pump station 4A has been upgraded – the pipeline to bypass 4A has been completed
- Masinenge sanitation will be pumped to Margate WWTW
- Pollution of the Margate Beach due to sewerage spillages remains a challenge when existing infrastructure fails
- The new pumps must be installed at pump station 3A
- The rising has been completed and is lying idle because the pumps have not been installed
- The recent audit of the WWTW found that 22 of the 26 issues identified are of high risk

The WSMP acknowledges that various water quality standards are required for different water uses, including the maintenance of ecosystems (such as estuaries). This is an important consideration, since the failure and/or malfunction of Ugu's sanitation infrastructure is impacting negatively on the health of the receiving natural environment, as in the case of the iKongeni Estuary. Overall, the effluent quality for the Ugu DM is unacceptably poor due to the state of disrepair, with non-compliance amounting to approximately 30% of all WWTWs (as at September 2020). Reasons cited for this include, lack of mechanical and electrical maintenance, lack of chemicals (i.e. chlorine), lack of funding, lack of operator capacity with suitable skills level, and lack of buy-in (Ugu DM, 2020b). A comprehensive monitoring programme is in place, including river systems receiving

WWTW effluent discharges (e.g. Vungu, Mbango). It is presumed that the iKongeni River does not appear on this list as it does not receive direct discharges (according to Ugu DM Water Services department), however, it remains severely impacted by effluent spills. Major upgrades to the WWTWs will be needed to ensure compliance, however, this would be extremely expensive for both the municipality as well as consumers (Ugu DM, 2020b).

Shortcomings and the way forward

The WSMP highlights the short-comings of the Ugu DM relative to the norms and standards for both water and sanitation services. Numerous challenges faced by the municipality relate to:

- Capacity (e.g. staff capacity/experience as well as treatment capacity);
- Operations and Maintenance Planning;
- Performance monitoring of projects;
- Basic services backlogs;
- Inadequate services leading to sewer blockages amongst others;
- Meter reading challenges resulting in cash flow shortages;
- Ageing infrastructure requiring refurbishment;
- Limited serviced residential stands;
- Poor blue- and green drop compliance; and ultimately
- Inadequate funding.

Areas of improvement, specifically in respect to the refurbishment of the WWTW and pump stations, include the following (Ugu DM, 2020b):

- An approved Business plan is in place for the refurbishment project, however additional funding is required to accommodate all the necessary work as Ugu is unable to fund all the project components;
- A proper operations and maintenance plan must be developed to ensure that all plant and equipment is appropriately maintained;
- The Asset Management Project by the Department of Cooperative Governance and Traditional Affairs (COGTA) will ensure that all assets are captured and maintained in accordance with Generally Recognised Accounting Practice (GRAP) standards; and
- The performance of the call/control centre needs to be improved mostly through improved systems, which provide correct information to the call centre operators.

The WSMP details a strategic plan comprising three key areas, viz. Administration, Socio-economic, and Financial Profile, complete with 5-year, 10-year, 20-year and 50-year targets for each of the different strategies. Refurbishment of the urban sanitation system is one of the many strategies to achieve the objective of bringing the infrastructure up to an appropriate standard. This is dependent on the implementation of the Asset Management Project across all the time horizons, but with limited funding noted as a constraint to the project initiation. With the RNM, the Margate Central Business District (CBD) is flagged for, *inter alia*, pipeline replacement, however Municipal Infrastructure Grant (MIG) funding is limited.

8.3.5. Ugu District Climate Change Response Strategy

The Ugu District recognises the crucial role it plays in responding to climate changes by building resilience and adaptive capacity, particularly with regard to human settlement and urban development planning in the short, mid and long term. In this regard, the Ugu DM sets forward a Climate Change Response Strategy (Aurecon, 2016) that places a strong emphasis on managing climate change, rather than simply responding passively. Through this Strategy, the District commits itself to effective and integrated pro-active day-to-day climate change response inclusive of monitoring, mitigation and adaptation, thereby reducing environmental degradation and socio-economic vulnerability while building resilience against climate variability.

The Strategy prescribes a three-pronged approach to ensure that action can be undertaken by all applicable stakeholders. The different levels are outlined as follows:

- Strategic level: Strategic response presenting sectoral risks and high-level actions and direction to be undertaken by decision makers;
- Action plan: Action planning is the bridge between the strategic level directional guide and the local level decision support matrix. It comprises project level actions, integrating climate resilience into existing and future developments and larger scale planning campaign objectives; and
- Decision making support matrix: Presentation of climate risks per local municipality, impacts and consequences, targeted adaptation, and mitigation options for the four-variable area/land use types of Urban and Rural areas, Commercial and Subsistence agriculture. The implementation options account for both community based and governmental stakeholders.

In terms of implementation, the Ugu DM supports the requirement that integrated planning at all levels of government should include the consideration of climate change aspects in relevant sectors. The District is also of the opinion that the mitigation of- and adaptation to climate change will require standalone mitigation and adaptation policies and plans, as well as the mainstreaming of adaptation measures into the existing activities and functions of national, provincial and local government. The mainstreaming of climate change response implies that local government adopt, expand and enhance the measures that factor climate risk into their normal day-to-day activities and planning processes.

The Strategy provides climate risk profiles at a sub-municipal level by taking a range of factors into account, including the climate related variables, land cover, population distribution and environmental resilience as well as institutional and policy capacity. The risk profiles also differentiate between urban and rural areas. The abbreviated risk profile for the RNM, and its coastal region, is provided in Table 31 and the comprehensive risk profile is provided in Table 45 in Appendix D.

Table 31: Abbreviated climate change risk profile for RNM (Aurecon, 2016)

Risk Factor	Level of Risk
Increased annual rainfall	Minimal to Moderate
Seasonal rainfall shifts	Insignificant (coastal) to Moderate (hinterland)
Increased summer rainfall intensity	Moderate
Drought potential	Minimal to Moderate
Increased temperature	Minimal
Increased extreme temperature days	Moderate
Increased heat wave incidence	Moderate
Decreased number of cold nights	Insignificant (coastal) to minimal (hinterland)

Within the RNM, water resources and agriculture are categorised as being at predominantly major to moderate risk of climate change impacts (Aurecon, 2016). The medium priority sectors, namely municipal infrastructure, terrestrial biodiversity, disaster management and tourism exhibit varying levels of risk. Terrestrial biodiversity, which bears linkages to the estuarine and coastal environments, is particularly at risk of seasonal rainfall shifts, while seasonal rainfall shifts and drought potential being the major threats to tourism, which the economic driver of the RNM.

The Strategy goes on to indicate areas and infrastructure at risk to ocean impacts e.g. sea level rise and heightened storm surges. The shoreline from Uvongo to Ramsgate is categorised as low to medium risk (Aurecon, 2016). The iKongeni Estuary, along with 10 other systems, is predicted to suffer very little impact in respect of sea level rise. This is however in conflict with the KZN CVI illustrated in Figure 21 (Section 6.4.3, pg. 45) and as reported in the Ugu EMF SEMP (Nemai Consulting, 2018).

8.3.6. Ugu Biodiversity Sector Plan

The Biodiversity Sector Plan for the Ugu District was developed by Ezemvelo KZN Wildlife (EKZNW) as a precursor to the Bioregional Plan. Its primary purpose is to inform land-use planning, environmental assessment and authorisations, and natural resource management, by the range of sectors whose policies and decisions impact on biodiversity (EKZNW, 2014). The plan identifies and maps critical biodiversity assets in the

District and provides associated management guidelines which aim to maintain the integrity of the important biodiversity features (EKZNW, 2014).

According to the Ugu BSP (EKZNW, 2014), there are natural features within the iKongeni estuary catchment that possess important biodiversity value. These are summarised below (Table 32) along with the recommended land-use objective and guideline. It is important to note, the iKongeni Estuary itself is not identified as an important biodiversity feature. Further land use management practices /controls are provided in the BSP.

Table 32: Land-use Objectives for Conservation categories associated with the iKongeni Estuary (EKZNW, 2014)

Area / Category	Description	Land-use Management Objective and Guideline
Above the R61, the remaining coastal riparian forest along the iKongeni River and undeveloped landscape* up to iZotsha Road are classified as Critical Biodiversity Areas (CBA Irreplaceable)	Natural or near natural areas considered critical for meeting biodiversity targets and thresholds, and which are required to ensure the persistence of viable populations of species and the functionality of ecosystems and ecological infrastructure. There are no alternative sites available**	Maintain in a natural state with limited to no biodiversity loss. Compatible land-use: Conservation management & stewardship and Ecological Infrastructure
The sandy beach, including the vegetated dune cordon at that mouth that stretches northwards to Lucien Beach, is classified as a CBA and 'Critical Linkage' coastal Landscape Corridor (Admiralty reserve)	Landscape corridors allow for regional connectivity to ensure persistence of movement-related ecological processes (e.g. migration, climate change responses, etc.)	
The vegetated dune cordon at that mouth that stretches northwards to Lucien Beach is an Ecological Support Area (ESA)	ESAs are functional and largely natural landscapes that are required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the CBAs. These areas also contribute significantly to the maintenance of ecological infrastructure	Maintain ecosystem functionality and connectivity allowing for some loss of biodiversity Compatible land-use: Conservation management & stewardship and Ecological Infrastructure Modified open space, low impact ecotourism, intensive crop production, airstrip, roads and railways, utilities and services, bulk water projects

*Pondoland Ugu Sandstone Coastal Sourveld

**Category driven by species and feature presence

8.3.7. Ray Nkonyeni Integrated Development Plan (2019/2020 Review)

In August 2016, the interior Ezinqoleni LM was merged into the coastal Hibiscus Coast LM (HCM), which was subsequently renamed the RNM. Both municipal areas are now included in the RNM IDP for the period 2017 – 2022 and the subsequent reviews (RNM, 2019).

The vision for the RNM, which also applies to the RNM Spatial Development Framework (SDF), is as follows:

> ***Vision***
>
> *"By 2036 Ray Nkonyeni Municipality will be a prime tourist-friendly, economically diversified and smart Municipality with equitable access to opportunities and services in a safe and healthy environment."*
>
> ***Mission***
>
> *"The municipality is committed to create an enabling environment for the establishment of agriculture; maritime; leading tourism and industrial hub to create business employment opportunities for sustainable development and improved quality of lives through shared vision; smart service delivery solutions and collaboration with stakeholder representations."*

This vision is aimed at providing quality, sustainable services and protecting the environment and is informed by the principles of sustainable development. Objectives and strategies associated with the key performance areas of the IDP indicate that the RNM is geared towards providing basic municipal services, facilities and infrastructure to underdeveloped areas, alleviating poverty and to increasing social and economic development.

There are no specific objectives directed at increasing conservation or protecting natural ecosystems within the eight goals adopted by the municipality, which are:

- Eradicating poverty and hunger;
- Creating a conducive environment for inclusive and diverse economic growth and development;
- Promoting health lives and equitable access to education and learning opportunities;
- Developing a capable, equitable and financially viable institution and ensuring good and sound governance;
- Ensuring infrastructure development and universal access to reliable services;
- Promoting a safe and secure society;
- Combating climate change and ensuring sustainable development and resilient communities; and
- Facilitating spatial integration and development of sustainable and resilient human settlements.

There is, however, reference to the natural environment under the Goal 7 of "*Combating climate change and ensuring sustainable development and resilient communities"* (KPA 6: Cross Cutting Issues), through five strategic objectives. Their applicability to estuarine management is provided in the table below (Table 33).

Table 33: Applicability of environmental strategic objectives

KPA 6: CROSS CUTTING ISSUES	
GOAL 7: Combating climate change and ensuring sustainable development and resilient communities	
To promote the sustainable utilisation of natural resources and compliance with environmental legislation	Estuaries generally support a high biodiversity of fauna and flora. Many estuarine resources (e.g. vegetation, and fish and bait populations) have been overexploited or are at risk of overexploitation, or further degradation without compliance enforcement, particularly in respect to pollution, and development controls.
To promote a healthy and hygienically safe environment and create an environmentally educated society	Estuaries often abut popular tourism beaches, which are of critical importance to RNM in terms of tourism-based local economy. Estuaries themselves are frequently used for recreational activities and are perceived as sheltered and safe areas. However, many RNM estuaries are polluted and pose a serious health risk

	to all users and visitors. The poor condition of the iKongeni Estuary has been shown to have a significant negative effect on tourism in the RNM area.
To promote the green economy	Estuaries provide a variety of ecosystem goods and services, which can make a valuable contribution to the economy (e.g. employment opportunities) if sustainably utilised.
To implement climate change mitigation and adaptation strategies	Dense coastal development around estuaries and ongoing degradation from a variety of sources have decreased the capacity of estuaries to withstand some of the impacts of climate change. Such strategies will be of benefit to the longevity of estuaries and the provision of ecosystem goods and services.
To strengthen disaster management and mitigate disaster impacts through resilience planning	Dense coastal development around estuaries and ongoing degradation from a variety of sources have decreased the capacity of estuaries to withstand natural (e.g. flooding) and human-induced disasters (e.g. pollution spills). Such strategies will be of benefit to the longevity of estuaries and the provision of ecosystem goods and services.

There are other synergies between non-environmental goals and estuarine management. These are summarised below (Table 34).

Table 34: RNM Strategic goals and applicability to estuarine management

GOAL	STRATEGIC OBJECTIVE AND APPLICABILITY
Eradicating poverty and Hunger	Estuarine management also seeks to provide sustainable livelihood opportunities to local communities. Such programmes, EPWP programmes, are often incorporated into estuarine management strategies.
Creating a conduce environment for inclusive diverse economic growth and development	Studies have shown that the poor state of the iKongeni Estuary has a significant impact on the economy of Margate and thus RNM. It is therefore vital that this system and the impacting issues are appropriately managed
Promoting health lives and equitable access to education and learning opportunities	There are lessons to be learnt from new science and the past mismanagement of estuaries. Increasing environmental awareness and understanding of the important of estuaries and how they function is an important objective of estuarine management. The poor state of the iKongeni Estuary poses a serious health and safety risk to the local community as well as international tourists. Estuarine management promotes improving ecosystem health.
Developing a capable, equitable and financially viable institution	Estuarine management is critically dependent on effective cooperative governance on numerous levels, including between government and civil society. Various departments have a role to play depending on their mandate, and which typically includes provision of funding for specific estuarine management related actions.
Ensuring infrastructure development and universal access to reliable services	Coastal development and infrastructure in various forms impact significantly on coastal ecosystems including estuaries. Oftentimes, ill-placed and failing infrastructure can cause environmental disasters. In the case of the iKongeni Estuary, issues surrounding the sewage reticulation system cause frequent pollution events and fish kills. Maintenance of municipal infrastructure and a quick response to such incidences is important for estuarine ecosystem health. In addition, persistent pollution of water resources is often caused by the lack or inadequate provision of municipal services, e.g. waste collection, sanitation etc. This goal therefore supports the protection of estuarine ecosystems.
Facilitating spatial integration and development of sustainable and resilient human settlements	Coastal development and infrastructure in various forms impact significantly on coastal ecosystems including estuaries. Further, the impacts of climate change must also be taken into account in the form of sustainable development planning. Healthy ecosystems support resilient communities, and thus provisions must be made to ensure the continued functioning healthy well-being of the natural environment, inclusive of estuaries which provide numerous ecosystem goods and services to the benefit of society.

The RNM Environmental Analysis (as part of the environmental *status quo* 2017 -2022 IDP), although only a desktop study, highlights the value of the municipality's freshwater ecosystems, namely rivers and wetlands as well as the high biodiversity value associated with them. In general, it is stipulated that land-use practices or activities that will lead to deterioration in the current condition of a river or wetland are not acceptable.

Overall, estuaries do not receive specific mention as important coastal ecosystems that provide vital ecosystem services, nor the myriad of human impacts and exploitations that affect them which require regulation or mitigation. It appears that the actual development of EMPs are the only solution provided to addressing estuarine issues that are yet to be tabled.

Evidently, EMPs are among several environmental sector plans that have been developed, or are to be developed to facilitate the achievement of the environmental strategic objectives, namely the:

- Environmental Management Programme;
- Coastal Management Programme;
- Greening Plan;
- Estuarine Management Plans (collective 7 -estuaries EMP already developed);
- Strategic Environmental Assessment; and
- Alien Invasive Management/ Control Plan.

8.3.8. Ray Nkonyeni Spatial Development Framework (2020/2021)

The key purpose of the RNM SDF is to guide the form and location of future spatial development by facilitating decision making and guiding investment. It also strengthens democracy and spatial transformation and facilitates the effective use of scarce land resources while promoting intergovernmental coordination on spatial issues and serves as a framework for the development of a detailed Land Use Management Scheme (LUMS) (RNM, 2020).

The spatial development vision for the RNM (RNM, 2020) reads as follows:

Spatial Development Vision

"By 2036 Ray Nkonyeni will be a spatially efficient, socially equitable, environmentally sustainability and economic power house of KwaZulu-Natal with the unique tourism economy".

The objectives for the RNM SDF are guided by the five SPLUMA principles and aim to build on the existing opportunities within the Municipality (RNM, 2020). These are summarised in Table 35 below. Numerous strategies have been identified as the means to achieve the respective objectives and there are synergies with estuarine management and these are highlighted in bold.

Table 35: Spatial development objectives of the Ray Nkonyeni Municipality (RNM, 2020)

SPLUMA PRINCIPLES	RNM Objective
Spatial Justice	• Transform the apartheid city • Encourage integrated settlement patterns • Establish an integrated town-wise public transport system that support the accessibility grid • Address spatial economic imbalances
Spatial Sustainability	• Encourage a more compact form of development • **Manage urban development impacts on natural resources and critical biodiversity networks** • **Integrated land use, economic and transport planning** • Support the rationalisation, upgrade and/or development of economic gateways and manage land uses around them appropriately
Spatial Efficiency	• Make efficient use of non-renewable resources • Protect and enhance the municipality's rural environment • Improve connectivity within the Municipal area

	• Promote accessible, town wide destination places
Spatial Resilience	• **Sustain natural environments and resources** • **Enhance the unique sense of place and quality of the built form of Ray Nkonyeni** • **Enhance the value of heritage resources and scenic routes**
Good Administration	• **Facilitate urban development** • Promote inclusive, shared economic growth and development

In the environmental analysis included in the SDF, the iKongeni River is not recognised as an important water resource or freshwater ecosystem. It does, however, contain a collective estuarine management plan (See 8.3.1 below) which recognises the value of estuaries, details specific estuarine management priorities and actions as well as includes spatial zonation proposed to control activities in relation to the seven (7) EMPs already completed. The SDF also includes an Alien Invasive Plan alien plant control programme, however the iKongeni system is not prioritised therein (RNM, 2020).

Relevant spatial planning issues and challenges identified include, amongst others, the urban coastal corridor, the significance of tourism and environmental anxieties. The conceptual framework included acknowledges that tourism is the backbone of the Ray Nkonyeni economy with the natural resource base resultantly being deemed critically important. Green corridors and lungs are further proposed to be protected and preserved (RNM, 2020).

The opportunities highlighted comparatively recognise the ongoing negative impacts on coastal settlements including the loss of property and damage to infrastructure, rising sea levels and storm surges, sewage and wastewater systems causing damage and hazardous pollution and reduced income from tourism as a result of reduced marine recreational opportunities and increased impact on tourism supporting infrastructure (RNM, 2020).

Broad land use management categories identified include a coastal management parent zone with three possible zones namely coastal management, sea shore and estuary management (Figure 25). These zones provide for the management and development of land located within the low and high-water mark and along the coast including, inter alia, bathing, shore angling, deep-sea angling, jet skiing, surfing, boogie boarding, kite-surfing, construction of tidal pools and the erection of shark nets. The purpose of the zone is to ensure that permitted activities do not impact negatively on ecosystems, marine and coastal, fauna and flora, within these areas. The environmental sensitivity is recognised with a more prescriptive approach to land use management being required. Existing and future land uses include Recreation, Park, Beachfront and Private Beach (RNM, 2020).

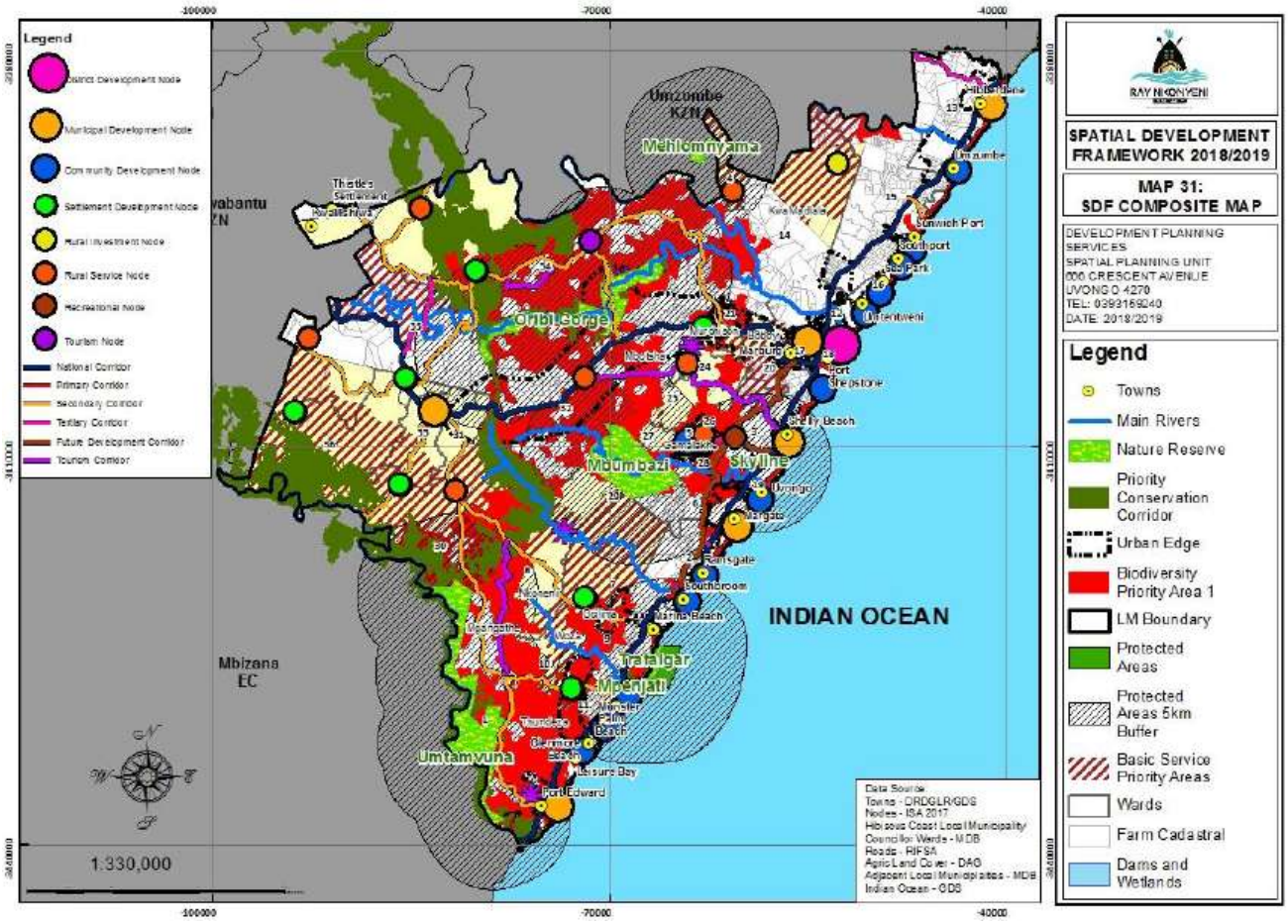

Figure 25: RNM SDF Composite Map (RNM, 2020)

8.3.9. Ray Nkonyeni Local Economic Development Strategy

As with the IDP and SDF, each Municipality is required to prepare an LED strategy to support the development and growth of the local economy through the facilitation of public and private sector investment. The RNM has developed a strategy for the period 2018 to 2023 (TPS, 2018) and key issues relevant to this EMP, which provide direction to this strategy include: promoting RNM as a prime tourism and investment destination as well as promoting sustainable livelihoods by assisting communities through various government led job creation programmes and social programmes. Margate is identified in the strategy as one of eleven town centres but focus is on revitalising the Margate airport. Margate's swimming beaches and nature-based activities are seen as important draw cards; however, it is acknowledged that some improvement needs to be undertaken in order to consolidate RNMs position in the sector both regionally and nationally. A number of priority actions identified include: the maintenance of existing infrastructure and introduction of new, modern facilities in order to retain existing and attract new tourists and the protection of environmental assets along the coastal strip which is proposed to be undertaken collectively supported by public private-partnerships (TPS, 2018).

One of the key implementing programmes referenced is the Operation Phakisa Oceans Economy initiative which identified four harbour related activities (Hibberdene Waterfront Development; Port Edward Small Fishing and Development Harbour; Port Shepstone Boat building, maintenance, repairs, economic zone; and Shelly Beach Water Theme Park) plus three additional projects, in order of priority, the Port Shepstone Urban Renewal, Beachfront and John Mason Park Development; a Technology Hub; and finally the Margate Urban Renewal (TPS, 2018).

8.3.10. Ray Nkonyeni Municipal Bylaws

The environmental conservation by-laws of the former HCM (2007), published under the Municipal Systems Act (Act 32 of 2000), stipulate activities that require written authorisation from the Council before being undertaken. These activities are applicable to the future management of the estuaries within the RNM, their interconnected habitats and uses of the systems and surrounding areas. These include

- The clearing of land and the and the removal/partial removal of indigenous vegetation;
- The erection of or extension of buildings;
- The construction of railways, slipways or jetties;
- The building of dams, canals, reservoirs, water purification plants or sewerage works (including septic tanks);
- The construction of pipelines, power lines or fencing;
- The construction of waste disposal sites for the dumping of refuse; and
- The development of industrial and residential townships whether previously used for agricultural purposes or not.

The by-laws also provide guidance with regards to preventing environmental degradation. More specifically in relation to wetlands (which includes estuaries and river margins), the following must be avoided:

- Development that is harmful to sensitive natural environments;
- Development in naturally hazardous zones, for example flood prone areas, high water table areas, areas below the 1:100-year floodline, or storm surge zone;
- Interference with natural processes including stream flow patterns, wetland functions, sand movement, sedimentation rates and patterns, and plant successions;
- Pollution of surface and groundwater caused by the disposal of sewage and refuse; and
- Undue destruction of vegetation, accelerated erosion or siltation as a result of construction.

8.3.11. Hibiscus Coast Coastal Management Programme

Prior to the merging of the Hibiscus Coast and Ezinqoleni municipalities, the former Hibiscus Coast Municipality (HCM) developed the draft municipal Coastal Management Programme (CMP) (Nzingwe Consultancy, 2016).

The CMP aims to facilitate the coordinated, collaborative and participatory management of the Municipality's coastal zone. The ultimate purpose of the CMP is to ensure that the coastal zone is sustainably managed, that the benefits thereof are maximised, existing and potential conflicts and harmful effects are minimised, and access to this precious resource is enabled for all citizens of South Africa and the Hibiscus Coast now Ray Nkonyeni coast (Nzingwe Consultancy, 2016).

The Vision for coastal management of the HCM is:

"To be a thriving, well-managed, tourist-friendly, national leader providing all its inhabitants with quality services in a safe and healthy environment."

The specialist estuarine assessment to the CMP (MER, 2014) indicated that many of the impacts affecting the estuaries within the HCM are common to most of the systems and include:

- Historical cultivation of the estuarine floodplain for sugar and/banana production which has resulted in the draining and modification of estuarine wetlands, streams and rivers;
- Low-lying development within the estuarine functional zone resulting in a loss of habitat but also erosion problems during high flow periods and flood event;
- Infilling and constriction of the lower reaches by bridges as a result of the routing of the railway line, the N2, R102, R61 and R620 along the south coast. This has an impact on flood flows tidal exchange and salinity regimes;
- Poor water quality as a result of the discharge of treated wastewater into these small and retentive systems and the failure of many treatment plants and processes; and

- Artificial breaching practices to protect inundation of low-lying development or to manage poor water quality ("flushing").

Furthermore, the current biggest pressures facing the coastal environment were identified and are listed in Table 36 below. All of these issues are pertinent to estuarine management and will require consideration in the development of the individual EMPs.

Table 36: Pressure on Coastal Resources in the HCM (Nzingwe Consultancy, 2016)

RISK	DESCRIPTION
Stormwater discharge	- Poor stormwater quality - Poor management of stormwater infrastructure – stormwater introducing waste (solid and liquid) to the beaches where it discharges)
Beach erosion	- Storm events resulting to beach erosion - Coastal watercourse entrance instability
Waste Management	- Poor waste management - Insufficient waste management
Water and sediment quality	- Point source pollution - Decline in coastal water quality which can reduce its life supporting capacity and/or its cultural, recreational and commercial value - Effluent, sewerage transfer or disposal - Contaminated sediments
Development	- Inappropriate coastal development and poor catchment land use management resulting in a loss of natural character. - Modification of beaches, freshwater runoff, catchment issues of rivers feeding into the estuaries
Land Management	- Introduction of alien invasive species (animals and plants) - Erosion issues
Social access and uses of the coastal area	- Conflict between the demand for public access to and along the coast, and the need to restrict access for conservation, tourism, safety, security or defense purposes. - Too much noise in the coastal environment can damage amenity and conservation values - Informal settlements upstream on the river bank and development on river catchments which results in pollution and erosion
Transport	- Spillages from land-based transport - Discharge from vessels
Recreational activities	- Impact from beach driving, impacting on the ecosystems and habitats - Poor waste management
Economic issues	- Harvesting of marine living resources, fishing, by-catch mortality and poaching - High concentration of population in the coastal belt
Estuarine health	- Loss of estuarine vegetation - Changes in condition of coastal wetlands, riparian vegetation - Erosion caused due to physical processed and flood events - Changes in tidal exchange, salinity regimes - Changes in catchment inflows (e.g. upstream diversions, river regulation. Land clearing) - Changes in flood flows/tides across the estuary due to construction of coastal structures, river diversions, culverts, flood gates or reclamation
Climate change	- Sea level rise and upward movement of water tables

8.3.12. Ray Nkonyeni Estuaries Management Plan

In 2017, a collective EMP was developed for seven estuaries within the RNM, namely the Mhlangamkulu; uMthente; Umzimkulu; Mbango; Mhlangeni, Bilanhlolo and uMuntongazi estuaries (RHDHV, 2017a, 2017b). The EMP lays out the Vision for the estuaries in the RNM as well as the Key Objectives underlying the Vision. The Vision for the estuaries of the RNM is as follows, with the Key Objectives summarised in Table 37 below.

"The estuaries of the Ray Nkonyeni Municipality are managed sustainably as functioning, healthy and attractive ecosystems to the benefit of all"

Table 37: Key Objectives for Estuarine Management in RNM, their indicators and level of priority

	Sector / Category	Key Objective	Indicators	Priority
1	Estuarine health and functioning	The ecological health and natural functioning of the RNM estuaries is improved and safeguarded	• Ecological health of estuaries is improved • Estuarine habitat is regained and restored	**High**
2	Conservation	The biodiversity of the RNM estuaries is conserved	• Formal and informal estuarine conservation areas are designated/declared	**Medium**
3	Land-use and Infrastructure Planning and Development	All developments and proposed changes in land-use, including infrastructure and agriculture, which impacts or could impact on the RNM Estuaries, are assessed and controlled	• All development and land use changes surrounding and within the EFZ comply with environmental legislation and environmental best practice / risk aversion approach	**Medium**
4	Institutional and Management Structures	Effective management and co-operative governance of the RNM estuaries by the RMA is achieved	• Municipal estuarine management co-ordinator appointed • Estuary advisory committee established • Ongoing meetings of estuary advisory committee • Estuarine bylaws are drafted	**High**
5	Socio-economic considerations	Socio-economic benefits are enhanced and regulated to ensure sustainable resource use	• Increase in employment opportunities and figures • Resources utilised within legal limits	**Medium**
6	Education, awareness, monitoring and research	The scientific aspects, value and importance of the RNM estuaries is well understood and made known to members of society	• Increase in number of research projects • Signage erected; information disseminated • Awareness programme developed and successfully implemented on an on-going basis	**Medium**

The Vision and Key Objectives speak volumes for the aspirations of the RNM towards restoring and preserving the estuaries within its boundaries.

The development of the iKongeni EMP is informed to a large degree by the work already undertaken and lessons learned during the development of the collective SAR and EMP.

8.3.13. iKongeni Estuary and Margate Main Beach Emergency Mouth Management Plan

In 2012, following a relatively prolonged period of the iKongeni Estuary following its natural course and opening at the southern extent of beach, combined with abnormally high rainfall, a large volume of sand was removed from the back portions of the Margate Main Beach. As a result, there was extensive undermining of the existing beach infrastructure, exacerbated by tidal action, with increasing risk of damage or collapse. Furthermore, access to the beach had been completely restricted and traversing the rapidly moving and potentially polluted water was deemed extremely dangerous.

While this southern position was acknowledged as being the estuary's natural course, the major socio-economic implications were noted by provincial and municipal role-players. Relevant officials met to discuss the need for management interventions and it was agreed that, while in principle, interference with natural processes is inappropriate from an ecological perspective, in this instance there was a need for intervention[34] to minimize the adverse impacts on the socio-economic aspects for the area.

To this end, various products including an Emergency Mouth Management Plan, were developed for the iKongeni Estuary and Margate Main Beach on behalf of the RNM (then Hibiscus Coast Municipality), namely:

- Environmental Management Programme (EMPr) for Margate Main Beach and iKongeni Estuary Short-term Emergency Response (2012) (Breetzke and Meyer, 2012);
- EMPr for Margate Main Beach and iKongeni Estuary Short-term Emergency Response: August report (Breetzke and Clark, 2013);
- iKongeni Estuary Interim Mouth Management Plan (2013) (Breetzke and Meyer, 2013); and
- Coastal & Estuarine Specialist and Risk Assessment: iKongeni Estuary, Margate (2014) (Breetzke, Moore and Meyer, 2014).

The risk assessment was undertaken as part of a basic assessment process and considered the likely impacts and damage from dynamic coastal processes and predicted implications of global climate change, reviewed and assessed the viability of the Municipality's proposed development options and their viability assessed; and mitigation / adaptation measures proposed to minimise the anticipated impacts associated with the proposed development.

8.3.14. Margate Beach and iKongeni Estuary Basic Assessment (DC21/0013/2013) and Environmental Authorisation granted

Environmental Solutions were appointed by the RNM to undertake a Basic Assessment (BA) in response above issues with the project assessing and providing for the:

- Management of the iKongeni estuary and mouth, Margate beach and the immediate surround, in order to ensure that infrastructure and tourism facilities are not damaged by high water levels due to closed mouth conditions or flooding as a result of high rainfall or pollution by any means;
- Maintenance and repairs to existing infrastructure, including retaining walls, sewer reticulation and stormwater systems and the construction of new infrastructure required as a result of increased urban development; and
- Improve and maintain coastal access.

Five (5) specific activities were assessed namely:

- Activity A1 – preferred immediate activity - Moving sand on the beach and creating sand berm;
- Activity A2 – also preferred immediate activity – Repair and maintain existing infrastructure and retaining structures and plant vegetation on vulnerable areas;
- Activity A3 – short to medium term – improve access to beach;
- Activity A4 – medium term – extend Hunters Stream outfall; and/or

[34] According to P. Massyn, a historical protocol was in place for controlling the mouth migration that entailed forcing the estuary to breach opposite the swimming pool wall. Minutes of the 1st public stakeholder meeting, dated 10 September 2020.

- Activity A5 – medium term – construct a permanent berm onto beach half way along Olympic Pool.

Environmental authorisation was subsequently granted to the municipality on the 30th of September 2014 however only authorised two activities, namely:

- Activity 1: Berm (with associated trough); and
- Activity 2: Fortification of existing defences (Lifeguard building to the Amusement Park) using soft engineering.

The authorisation also detailed the approved mouth management method.

While motivation was provided for the proposed alternative of fixing the estuary mouth position using various permanent structures (as detailed in the coastal engineering specialist report undertaken by Dr Andrew Mather), detailed reasons were provided in the environmental authorisation as to why this option was not authorised. It should be noted that the RNM still believe that this is the correct response, even though authorisation was not granted, the capital investment would have been approved and made available[35].

8.4. Key activities relevant to estuarine management

A summary of the key activities directly and indirectly relevant to the use and / or management of estuaries, the Acts that govern, and the parties responsible for implementation is presented in Table 38.

Table 38: Key Estuarine Use / Management Activities in respect to the iKongeni Estuary (adapted from (DEA and Royal HaskoningDHV, 2017)

Key Acts / legal instruments	Estuarine Management Activity governed by the Act/legal instrument	Responsible Parties in respect to the iKongeni Estuary
National Estuarine Management Protocol (2013, 2021)	• Development of EMPs • Standards for estuarine management • Determination of responsibilities for estuarine management • Specifications for review of EMPs	DFFE; EDTEA, UDM, RNM
National Environmental Management: Integrated Coastal Management Act (Act 24 of 2008)	• Coastal access land • Land reclamation • Coastal leases and concessions • Unlawful structures • Off-road vehicles • Public launch sites • Effluent discharges into the coastal zone • Dumping at sea	DFFE; EDTEA, UDM, RNM
National Environmental Management Act (Act 107 1998) – Environmental Impact Assessment Regulations 2017.	Coastal and estuarine related activities which are listed in terms of Government Notices R327, R325 and R324 of 2017, require environmental authorisation.	DFFE and / or EDTEA responsible for environmental authorisations; DMR for mining related authorisations.
National Environmental Management: Biodiversity Act (Act 10 of 2004) and National Environmental Management: Protected Areas Act (Act 57 of 2003)	Biodiversity and protected areas management where these include estuaries, including control of invasive alien species.	DFFE and Ezemvelo KZN Wildlife
Marine Living Resources Act (Act 18 of 1998)	Designation and management of Marine Protected Areas.	DFFE

[35] Feziwe Mhlongo, RNM, Minutes of the 1st authorities meeting, dated 31 July 2020

Marine Living Resources Act (Act 18 of 1998)	• Marine aquaculture / harvesting of marine resources e.g. bait collection; • Fisheries Management.	DFFE
National Heritage Resources Act (Act 24 of 1999)	Estuaries declared as part of natural cultural heritage landscapes.	AMAFA, EDTEA, RND
Government Immovable Asset Management Act (Act 19 of 2007); State Land Disposal Act (Act 48 of 1961)	State assets in the coastal zone.	RNM, National Department of Public Works and Infrastructure; all other state departments with land assets in the coastal zone.
Conservation of Agricultural Resources Act (Act 43 of 1983); National Forests Act (Act 84 of 1998)	Harvesting of coastal resources (land-based); control of invasive alien plants in estuary basins.	DALR&RD
National Ports Act (Act 12 of 2005); International Health Regulations Act (Act 28 of 1974)	Management of ports in coastal lagoons or estuaries.	NPA
National Water Act (Act 36 of 1998)	Freshwater flows into estuaries (quantity and quality).	DWS
Mineral and Petroleum Resources Development Act (Act 28 of 2002)	Mining in the coastal zone; oil and gas exploration.	National Department of Mineral Resources and Energy
Local Government: Municipal Systems Act (Act 32 of 2000); National Building Regulations and Building Standards Act (Act 103 of 1977 as amended 1982, 1984, 1989, 1995, 1996); Spatial planning and land use management Act (Act 16 of 2013); WC Land Use Planning Act (Act 3 of 2014)	Standards and permissions for coastal infrastructure (land-based).	COGTA, UDM and RNM
National Health Act (Act No. 61 of 2003)	Monitoring of recreational water quality (including estuaries).	National Department of Health; municipalities.

9. CURRENT INSTITUTIONAL STRUCTURES GOVERNING ESTUARINE ISSUES

As detailed in the 2015 Guide (DEA, 2015), 'effective institutional structures and arrangements are critical support elements for the successful implementation and coordination of activities as set out in the EMP'. The 2013 Protocol (and draft 2021 Protocol) also prescribed various actions for successful implementation and co-ordination of the actions and relies on "*effective institutional structures and arrangements*" via the institutional arrangements set out in Chapter 5 of the ICM Act that contribute to co-operative coastal governance in South Africa, including: The National Coastal Committee; Provincial lead agencies; Provincial Coastal Committees; Municipal Coastal Committees; and Voluntary Coastal Officers.

As detailed in this SAR, various organs of state are responsible for implementation of various actions in relation to estuaries, for example, the DWS must monitor water quality, while DFFE, in addition to its overriding estuarine management responsibilities, must ensure compliance with matters related to fisheries as well as ensure the protection of national forests. The Department of Agriculture, Land Reform and Rural Development (DALR&RD) must ensure agricultural best practice, control alien invasive plants, provide for land distribution and development as well as facilitate rural development.

The Protocol still considers effective institutional structures and arrangements as crucial support elements for the successful implementation and co-ordination of actions. It does not propose any new structures and vests the monitoring of the implementation of EMPs in coastal committees. It proposes any existing and/or planned individual estuary forums be regarded as informal additional advisory bodies for facilitating the implementation of the project plans identified in the EMPs and in order to foster continuous stakeholder engagement.

Within the RNM, the following functional environmental structures/ forums exist (RNM, 2019):

- Ugu District Coastal Committee (in terms of the ICM Act);
- Municipal Environmental Sub-Committee;
- Invasive Alien Forum;
- Working for the Coast Forum;
- Environmental Education and Awareness Forum; and
- Waste Management Forum.

In addition, the following structures are identified at the district level within the Ugu EMF:

- Coastwatch and WESSA are NGOs involved in these committees;
- Sezela Environmental Liaison Committee (which involves the sugar farmers);
- KZN Wildlife and Environment Working Group;
- Numerous conservancies; and
- A number of alien plant working groups, run both by the EDTEA and Ugu DM.

Relevant local structures structures/forums include:

- The Margate Business Association; and
- The Margate Rate Payers Association.

Of particular and dire concern in respect to the proposed implementation of the iKongeni EMP is the current capacity and apparent apathy of the Ugu District Municipality[36]. This has significant impact of the functioning of the estuarine system as a result on ongoing pollution.

10. OPPORTUNITIES AND CONSTRAINTS

A Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis is a useful tool to obtain a general understanding of a particular project or topic. It provides an excellent framework for reviewing the positive (strengths and opportunities) and negative (weaknesses and threats), aspects and assists designing strategies or identifying methods to either develop or prevent these aspects. A SWOT analysis was conducted for the management of the iKongeni Estuary, and estuarine management in the RNM in general, using information gathered from literature and reports together with stakeholder input from the key authorities and public workshops. The SWOT analysis has been crudely divided into ecological, socio-economic and institutional sphere, however many of the recorded items are cross-cutting (Table 39 - Table 41).

[36] Minutes of the 1st authorities meeting, dated 31 July 2020 and follow up meeting with Ugu DM officials and the Ugu Coastal Committee on the 10th of September 2020

Table 39: Ecological SWOT analysis

Strengths ***(highlights, uniqueness?)***	**Weaknesses** ***(what could be improved?)***
• Estuary retains biodiversity worth preserving • Estuary still provides ecosystem good and services worth preserving • Water quality monitoring undertaken, some data is available • Conservancy members partake in water quality sampling on behalf of Ugu DM • Active conservancy and concerned citizens, with some riparian owners/conservancy members committed to biodiversity conservation	• Estuary currently in a largely modified state, but at tipping point to highly degraded state • Numerous intense urban impacts (habitat loss and transformation, severe urban encroachment, pollution, etc.) • Poor water quality due WWTW discharge, faulty/failing sewage infrastructure and urban run-off • Limited assimilative capacity • Invasive alien vegetation • Inappropriate development in floodplain • Artificial breaching
Opportunities *(Opportunities for positive change)*	**Threats** *(what could prevent the EMP from working?)*
• Improve the health status of the estuary and reduce pollution incidents and negative impacts • Develop standard operating procedures (SOPs) in cases of emergency (e.g. pollution, flooding, land slippage), including SOP for clean-up operations • Engage and formalise relationships with the iKongeni Conservancy (and other NGOs) as a watch dog for environmental incidents • Rehabilitate degraded areas • Establish water quality monitoring programme • Ecological scientific research	• Estuaries are the endpoint of unregulated inland issues (catchment scorecard) • Increasing development – population growth, increased service provision, more recreational pressure and more pollution of the environment • Flood risk to low-lying developments • Upstream contaminants from known and unknown sources • Climate change impacts (Sea Level Rise, flooding & erosion) • Catchment erosion, sedimentation and shallowing of estuaries • Unsustainable land-use (agriculture, contaminating industries, mining) • Indiscriminate artificial breaching by land owners and holiday makers

Table 40: Socio-economic SWOT analysis

Strengths ***(highlights, uniqueness?)***	**Weaknesses** ***(what could be improved?)***
• Estuary possesses high aesthetic and socio/economic (recreational) value • Coastline is the foundation of the tourism industry and RNM economy • Outstanding nature-based and cultural tourism destination	• Artificial breaching • Lack of public awareness • Poor water quality due WWTW discharge, faulty/failing sewage infrastructure and urban run-off • Negative public perceptions of drained systems and water pollution
Opportunities *(Opportunities for positive change)*	**Threats** *(what could prevent the EMP from working?)*
• Establish community-based advisory forum using conservancy and business owners to assist municipality/authorities, which allows designated members to take action • Increase public awareness and education on estuarine health, function and value, as well as downstream impacts of catchment activities • Improved estuarine value will have knock-on improvement for the local economy	• Unsustainable land-use (agriculture, contaminating industries, mining) • Indiscriminate artificial breaching by land owners and holiday makers • Conflict between preserving estuarine integrity versus human life and developments

Table 41: Institutional SWOT analysis

Strengths ***(highlights, uniqueness?)***	**Weaknesses** ***(what could be improved?)***
• RNM Environmental committee as well as Ugu District Coastal Committee in existence • Support from EDTEA and Ezemvelo KZN Wildlife for estuarine management	• Poor inter-governmental cooperation, and seemingly overlapping mandates • Lack of commitment of local and district municipalities and low accountability • Restricted institutional resources, particularly funding to implement critical projects (e.g. sanitation refurbishment) • Lack of clarity regarding applicability of municipal environmental by-laws • Lack of environmental awareness • Lack of policing, and compliance and enforcement monitoring • Lack of enforcement of laws, policies, regulations and bylaws • Limited local information / data
Opportunities *(Opportunities for positive change)*	**Threats** *(what could prevent the EMP from working?)*
• Develop standard operating procedures (SOPs) in cases of emergency (e.g. pollution, flooding, land slippage), including SOP for clean-up operations • Public-private partnerships between various government departments, agencies and institutions (e.g. iKongeni Conservancy) • Instate policing/improved policing • Ugu District Municipality can utilise this information to facilitate access to additional funding from DWS	• Ignorance of authority roles and responsibilities • Non implementation of management actions / project plans • Reallocation of funds • Lack of political will • Lack of communication and co-operative governance between municipalities • Slow approval processes (e.g. Bilanhlolo MMP) • Changing legislation and policy

11. RECOMMENDATIONS TO ADDRESS INFORMATION GAPS

Forbes & Forbes (2012, p. 125) state that "*the collective value of the small systems of KZN comes from the cumulative area of the estuarine nursery grounds contained within the estuarine functional zones and the overall connectivity they impart to estuaries within the region*." Despite the highly degraded state of the iKongeni Estuary, at a local level it is critically important in terms of tourism that it maintains some ecological value as a coastal habitat in an otherwise urban environment.

Physical, chemical and biological information on the iKongeni Estuary is either scarce or the available data is significantly outdated. More recent data generation is generally piece-meal or undertaken at a desktop level corroborated by expert input (DWA, 2013; DWS, 2015b; Van Niekerk, Adams, Lamberth, MacKay, *et al.*, 2019). This is the case for most of RNM estuaries. The following specific recommendations are made with the view of preventing further degradation of the iKongeni Estuary:

- Maintain basic monitoring toward establishing a long-term database, to monitor impacts and guide mitigation measures;
- Co-ordinated research of the biotic and abiotic components to gain a better understanding of the estuarine structure and functioning to better inform management decisions;
- Establishing the contribution of the estuary, and other south coast systems, to the regional estuarine nursery function;
- Compile a municipal inventory of estuarine pollution sources must be undertaken. Although the generic sources are anticipated, the location of these sources and responsible contributors need to be detailed at the local level to solicit support to resolve ongoing problems. Specific clarity is required regarding the volume of effluent discharged from the Margate WWTW to the Kongweni River and to the surfzone outfall;
- By virtue of coastal development within the EFZ (and many others estuaries in RNM), flooding is a very real and regular threat, from estuary mouth closure and backflooding, and on the sea front. Flood levels, i.e. the 1:100-year flood line, must be determined, preferably in parallel with the determination of the CML, to formally establish flood risks and thus develop appropriate alerts and responses/mechanisms to mitigate these risks; and
- An updated economic evaluation of the ecosystem goods and services provided by the iKongeni Estuary should be undertaken as it would be useful to ascertain how (if) this had decreased due to the degraded state of the system.

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13. APPENDICES

13.1. Appendix A

Table 42: Results of organic contaminants study on the iKongeni system (Le Roux et al., 2005)

Total Extractable Petroleum Hydrocarbons

ug/l	Upper	Estuary	Stormwater
Naphthalene	14.6	53.1	1229
Naphthalene, 2-methyl-	8.73	<5	22.9
Acenaphthylene	<5	<5	10.3
Acenaphthene	<5	<5	5.73
Fluorene	<5	<5	10.3
Phenanthrene	<5	<5	5.7
Anthracene	18.6	<5	<5
Fluoranthene	<5	<5	<5
Pyrene	16.9	9.31	14.6
Benz[a]anthracene	<5	<5	<5
Chrysene	<5	5.89	8.85
Benzo[b]fluoranthene	<5	<5	<5
Benz[k]fluoranthene	<5	<5	<5
Benzo[a]pyrene	<5	<5	<5
Indeno[1,2,3-cd]pyrene	<5	<5	<5
Dibenz[a,h]anthracene	<5	<5	<5
Total PAHs	58.8	68.3	1307
Total Aliphatic Hydrocarbons	1229	486	6850

Chlorinated Pesticides

(ug/l)	Upper	Estuary	Stormwater
à-Lindane	<0.2	<0.2	<0.2
b-Lindane	<0.2	<0.2	<0.2
g-Lindane	<0.2	<0.2	<0.2
d-Lindane	<0.2	<0.2	<0.2
Heptachlor	<0.2	<0.2	<0.2
Aldrin-R	<0.2	<0.2	<0.2
Heptachlor epoxide	0.77	1.9	<0.2
à-Chlordane	16.9	0.57	<0.2
b-Endosulfan	<0.2	<0.2	<0.2
á-Chlordane	18.6	0.29	<0.2
Dieldrin	<0.2	<0.2	0.33
p,p'-DDE	5.33	<0.2	<0.2
Endrin	<0.2	<0.2	<0.2
á-Endosulfan	<0.2	<0.2	3.45
DDD	<0.2	0.84	<0.2
Endrin aldehyde	<0.2	<0.2	<0.2
Endosulfan sulphate	<0.2	<0.2	4.61
DDT	<0.2	0.86	<0.2
Endrin ketone	<0.2	<0.2	<0.2
Methoxychlor	34.67	12.9	<0.2

Polychlorinated Biphenylated Compounds

(ug/l)	Upper	Estuary	Stormwater
2-chlorobiphenyl	<0.2	<0.2	<0.2
2,3-dichlorobiphenyl	<0.2	<0.2	<0.2
2,4,5-trichlorobiphenyl	<0.2	<0.2	2.83
2,2',4,4'-tetrachlorobiphenyl	<0.2	<0.2	4.77
2,2',3,5,5-pentachlorobiphenyl	<0.2	<0.2	<0.2
2,2',4,4',5,6-hexachlorobiphenyl	<0.2	<0.2	<0.2
2,2',3,3',5,5',6-heptachlorobiphenyl	<0.2	<0.2	<0.2
2,2',3,3',4,4',5,6-octachlorobiphenyl	<0.2	<0.2	<0.2

13.2. Appendix B

Table 43: Water quality monitoring results from the Kongweni River Conservancy

	Alexander St bridge	Before R61 exit	Tony's Stream	Today wetland Stream / Bense Stream	Freys Meat Market / Waynes Auctions	River crossing below Freda House	Margate Lagoon
06/06/2016	400	100	100	100			
20/06/2016	1400	100	0	300			
07/11/2016	>100000	100	100	3200			
08/01/2016	600	400	400	4200	4300		
22/08/2016	1800	>100000		400	1400		
12/09/2016	300	900	2900	0	1200		
03/10/2016	500	700	600	100	>100000		
14/11/2016	200			800	100		
30/01/2017	300	100	100		5100		
20/02/2017	1200	1400		1200	>100000		
13/03/2017	700	500		300	2100		
05/06/2017	1300	100		0	300		
26/06/2017	1200	1500		300	1700		
17/07/2017	100	100	100		1400		
07/08/2017	100	100	0	100	2400		
28/08/2017	0	200		100	5900		
18/09/2017							
10/02/2017	200	100		100	200		
23/10/2017	0	600		0	800		
13/11/2017	200	100		400	1500		
12/04/2017	0	0		0	1700		
15/01/2018	50	100		800	1300		
05/02/2018	100	100		300	1600		
26/02/2018	100	200		300	1400		
19/03/2018	100	100		300	700		
09/04/2018	0	300		200	500		
30/04/2018	1000	350		0	900		
21/05/2018	100	100		100	>100000		
11/06/2018	5100	200		0	2600		
23/07/2018	100	100		0	1900		
13/08/2018	200	250					
24/09/2018	300	600		0	3700		
15/10/2018	200	300		100	500		
05/11/2018	250	200		1200	1100		
17/12/2018	99	300		99	100		
14/01/2019	200	400		0	1100		
04/02/2019	400	500		800	2800		
18/03/2019	99	500		99	>100000		

08/04/2019		100		100	99	100	
10/06/2019	400	300		400	5100		
22/07/2019		99			2200	100	
12/08/2019		100			700	400	600
02/09/2019		99			>100000	99	>100000
04/11/2019			1600		1400	2000	7600
25/11/2019			99		100	100	400
06/01/2020	4100			200	1700		1300
27/01/2020	900	1600			300		1800
17/02/2020	600	700			1300		>100000
03/09/2020		1200			2100	2300	3500
Readings > TWQR*	27	25	4	18	40	3	7
No. of readings	41	44	11	37	44	7	8
% Exceedance	66	57	36	49	91	43	88

*applicable target water quality range: 0-130 cfu / 100 ml (DWAF, 1996); < 500 cfu / 100 ml (90%) (DEA, 2012)

13.3. Appendix C

Table 44: List of plant species recorded occurring in and around the iKongeni Estuary, including indigenous and alien species (Kinvig & Styles, 2020)

Species Name	Growth Form	Status
Bridelia micrantha	Tree	Indigenous
Cyperus dives	Sedge	Indigenous
Erythrina caffra	Tree	Indigenous
Ficus burkei	Tree	Indigenous
Phragmites australis	Sedge	Indigenous
Schefflera arboricola	Tree	Indigenous
Senecio madagascariensis	Forb	Indigenous
Typha capensis	Sedge	Indigenous
Hibiscus tileaceus	**Tree**	**Indigenous Protected**
Mimusops caffra	**Tree**	**Indigenous Protected**
Sideroxylon inerme	**Tree**	**Indigenous Protected**
***Ageratum* sp.**	Forb	Invasive Alien - Category 1B
Anredera cordifolia	Creeper	Invasive Alien - Category 1B
Canna indica	Forb	Invasive Alien - Category 1B
Cestrum laevigatum	Forb	Invasive Alien - Category 1B
Chromolaena odorata	Woody Shrub	Invasive Alien - Category 1B
Colocasia antiquorum	Forb	Invasive Alien - Category 1B
Eucalyptus grandis	Tree	Invasive Alien - Category 1B
Ipomoea purpurea	Creeper	Invasive Alien - Category 1B
Lantana camara	Woody Shrub	Invasive Alien - Category 1B
Melia azedarach	Tree	Invasive Alien - Category 1B
Montanoa hibiscifolia	Shrub	Invasive Alien - Category 1B
***Passiflora* sp.**	Creeper	Invasive Alien - Category 1B
Pennisetum purpureum	Graminoid	Invasive Alien - Category 1B
Pereskia aculeata	Creeper	Invasive Alien - Category 1B
Pinus elliottii	Tree	Invasive Alien - Category 1B
Schinus terebinthifolius	Tree	Invasive Alien - Category 1B
Senna didymobotrya	Shrub	Invasive Alien - Category 1B
Senna pendula* var. *glabrata	Shrub	Invasive Alien - Category 1B
Solanum mauritianum	Tree	Invasive Alien - Category 1B
Sphagneticola trilobata / Wedelia trilobata	Creeper	Invasive Alien - Category 1B
Tecoma stans	Tree	Invasive Alien - Category 1B
Psidium guajava	Tree	Invasive Alien - Category 2
Ricinus communis	Shrub	Invasive Alien - Category 2
***Morus* sp.**	Tree	Invasive Alien - Category 3
Achyranthes aspera	Forb	Alien
Bidens pilosa	Forb	Alien
***Conyza* sp.**	Forb	Alien
Monstera deliciosa	Epiphytic Climber	Alien
Tagetes minuta	Forb	Alien
Furcaea foetida	-	-

13.4. Appendix D

Table 45: Climate Change Response Strategy for Ray Nkonyeni Municipality: RNM Risk Profile (Aurecon, 2016)

Ray Nkonyeni (coastal) LM		Relative Risk Priority		Hazard Indices			Vulnerability Rating			
Climate change impacts	Range of time variability	Rural Areas Commercial farming	Urban Areas Subsistence Farming	Likelihood	Predictability	Hazard severity	Population clusters	Agricultural vulnerability	Environmental resilience	Cumulative Climatic hazards
Increase annual rainfall	> 10 years	Moderate risk Moderate risk	Moderate risk Moderate risk	Almost certain	Forecastable	Significant impact	There are large population clusters in this LM with high population density. Climate impacts are therefore likely to disrupt more people.	There is commercial agriculture in this LM but is not very sensitive irrigation deficit	This LM is transformed and has commercial agriculture and there is little natural vegetation. Environmental resilience is medium to low	Little climate changes projected to take place in this as the change is mitigated by the proximity to the ocean.
Increased rainfall intensity in summer	> 10 years	Major risk Major risk	Major risk Major risk	Almost certain	Highly variable	Significant impact				
Seasonal rainfall shifts	> 10 years	Minimal Risk Minimal Risk	Insignificant Risk Minimal Risk	Likely	Highly variable	Minimal Impact				
Drought potential	> 10 years	Moderate risk Moderate risk	Moderate risk Moderate risk	Likely	Mildly predictable	Significant impact	Manageability / Capacity to Cope indices			
							Measureable adaptation	Policy capacity	Personal Capacity	Institutional Capacity
Increased temperatures	> 10 years	Minimal Risk Minimal Risk	Minimal Risk Minimal Risk	Almost certain	Forecastable	Medium impact	Social structures allow for better adaptations for the rural and subsistence areas such as usage of water storage and organic farming awareness and mitigation activities. There are maps available for both rural and urban areas to help with planning activities.	The LM focuses on climate change in the IDP and the SDF and sees the need to have this mind-set in development.	The population of this LM have a combined high capacity. This is derived from their level of education and personal income	The institutional capacity is high as there are several economic hubs, urban infrastructure and a focus on development
Increased extreme temperature days	> 10 years	Major risk Moderate risk	Moderate risk Major risk	Almost certain	Mildly predictable	Significant impact				
Increased heat wave incidence	> 10 years	Major risk Moderate risk	Moderate risk Major risk	Almost certain	Mildly predictable	Significant impact				
Decreased number of cold nights	> 10 years	Insignificant Risk Insignificant Risk	Insignificant Risk Insignificant Risk	Almost certain	Forecastable	Minimal Impact				