KWAZULU-NATAL PROVINCE
ECONOMIC DEVELOPMENT, TOURISM
AND ENVIRONMENTAL AFFAIRS
REPUBLIC OF SOUTH AFRICA

UTHONGATHI ESTUARY MANAGEMENT PLAN

FINAL REPORT



July 2021

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research & monitoring

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Report prepared for:
Province of KwaZulu-Natal
Department of Economic Development,
Tourism and Environmental Affairs

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GLOSSARY

Abiotic	Physical rather than biological; not derived from living organisms.
Aeolian	Relating to or arising from the action of the wind.
Alien	A species that occurs outside of its natural range and dispersal potential.
Biotic	Relating to living organisms.
Benthic	Pertaining to the environment inhabited by organisms living on or in the bottom of a water body.
Biodiversity	The variety of plant and animal life in a particular habitat.
Cadastral	Pertaining to a section of a map or survey showing the extent, value, and ownership of land, especially for taxation.
Catchment area	The area from which rainfall flows/drains into the estuary.
Community	In ecology, a community is a group or association of populations of two or more different species occupying the same geographical area and in a particular time.
D'MOSS	Durban Metropolitan Open Space System: a spatial layer of interconnecting open spaces in public, private and traditional authority ownership that seeks to protect the biodiversity and associated ecosystem services of Durban for future generations.
Eutrophication	A process by which a body of water becomes overly enriched with minerals and nutrients which induce excessive growth of algae. This process may result in oxygen depletion of the water body after the bacterial degradation of the algae
Floodplain	Broad and relatively flat area on either side of a stream, river or estuary that are inundated by water during floods.
Head (of estuary)	The upstream part of the system where freshwater enters.
Indigenous	Species within the limits of their native range (Synonyms: native).
Invasive alien species	Species whose natural range occurs outside of South Africa and which were transported to their current location by humans; where they are able to reproduce, spread and typically cause negative ecological impact.
Impact	A change to the existing environment, either adverse or beneficial, that is directly or indirectly due to the development of the project and its associated activities.
Invertebrate	An animal without a backbone (e.g. a prawn, crab, or worm).
Legislation	Laws, legal requirements or the process of making or enacting laws.
Macrofauna	Animals larger than 0.5 mm.
Macrophytes	Aquatic plants large enough to be seen by the naked eye.
Microalgae	Microscopic algae, typically found in freshwater and marine systems, living in both the water column and sediment. They are unicellular species which exist individually, or in chains or group.
pH	A measure or scale used to quantify how acidic or basic (alkaline) a water-based solution is.
Phytoplankton	Microscopic organisms that live in aquatic systems that are able to photosynthesize to feed themselves.
Residence time	The period of time during which a body of water remains stationary or trapped within a specific region of the system.
River Estuary Interface	Productive zone within an estuary where marine and freshwater meets, salinity is less than that of sea water and organic deposition due to reduced current speeds and flocculation occurs and is retained.

Zooplankton	Heterotrophic plankton i.e. plankton that cannot manufacture its own food by carbon fixation and therefore derives its intake of nutrition from other sources of organic carbon, mainly plant or animal matter.

LIST OF ABBREVIATIONS

Anchor	Anchor Environmental Consultants
CFU	Colony Forming Units
CMF	Catchment Management Forum
CMP	Coastal Management Programme
D'MOSS	Durban Metropolitan Open Space System
DEAT	Department of Environmental Affairs and Tourism
DHSWS	Department of Human Settlements Water & Sanitation
DMR	Department of Mineral Resources
DoT	Department of Transport
DWA	Department of Water Affairs (Change after 2008)
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EC	Ecological Category
EDTEA	Economic Development, Tourism and Environmental Affairs
EFZ	Estuarine Functional Zone
EIA	Environmental Impact Assessment
EKZNW	Ezemvelo KZN Wildlife
EMF	Estuary Management Forum
EMP	Estuarine Management Plan Environmental Management Plan
EMPr	Environmental Management Programme
IAAP	Invasive Alien Aquatic Plants
ICMA	National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008), as amended by National Environmental Management: Integrated Coastal Management Amendment Act (Act No. 36 of 2014)
IDP	Integrated Development Plan
KZN	KwaZulu Natal
MAR	Mean Annual Runoff
MCM	Million and Cubic Metre
MEC	Member of Executive Council
MSL	Mean Sea Level
NBA	National Biodiversity Assessment
NCMP	National Coastal Management Programme
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NEMP	National Estuarine Management Protocol
NEsMP	National Estuarine Monitoring Programme
nMAR	Natural Mean Annual Runoff
PES	Present Ecological State
pMAR	Present Mean Annual Runoff
REC	Recommended Ecological Category
REI	River-Estuary Interface

RQO	Resource Quality Objective
SANBI	The South African National Biodiversity Institute
SAR	Situation Assessment Report
TEC	Target Ecological Category
WMA	Water Management Area
WWTW	Wastewater Treatment Works

1 INTRODUCTION

1.1 Background

With the implementation of the Provincial Coastal Management Programme (adopted by the MEC in September 2019) that includes strategies and plans for the effective and co-operative management of the coastal zone, the KwaZulu-Natal (KZN) Department of Economic Development, Tourism and Environmental Affairs has prioritised the better management of estuaries in the province. With the aim to mitigate the deterioration of KZN regional estuaries, an estuary prioritisation process was undertaken and the uThongathi Estuary was prioritised for the development of an Estuary Management Plan (EMP).

Located within the province of KwaZulu Natal on the east coast of South Africa, the uThongathi Estuary is approximately 35 km north of Durban in the vicinity of the King Shaka International Airport and lies on the boundary between the eThekwini Metropolitan Municipality and iLembe District Municipalities (Figure 1.1) (Forbes & Demetriades 2009). The estuary is just under 6 km in length from the mouth, which leads into the Indian Ocean, to its head, and the total estuarine area is approximately 37 ha (Adams and Van Niekerk 2020). Classed as a "Large Temporarily Closed estuary" the uThongathi Estuary mouth is reported to be open between 84-87% of the time (DWA 2013, Nunes *et al*. 2020, Van Niekerk *et al.* 2019, 2020).

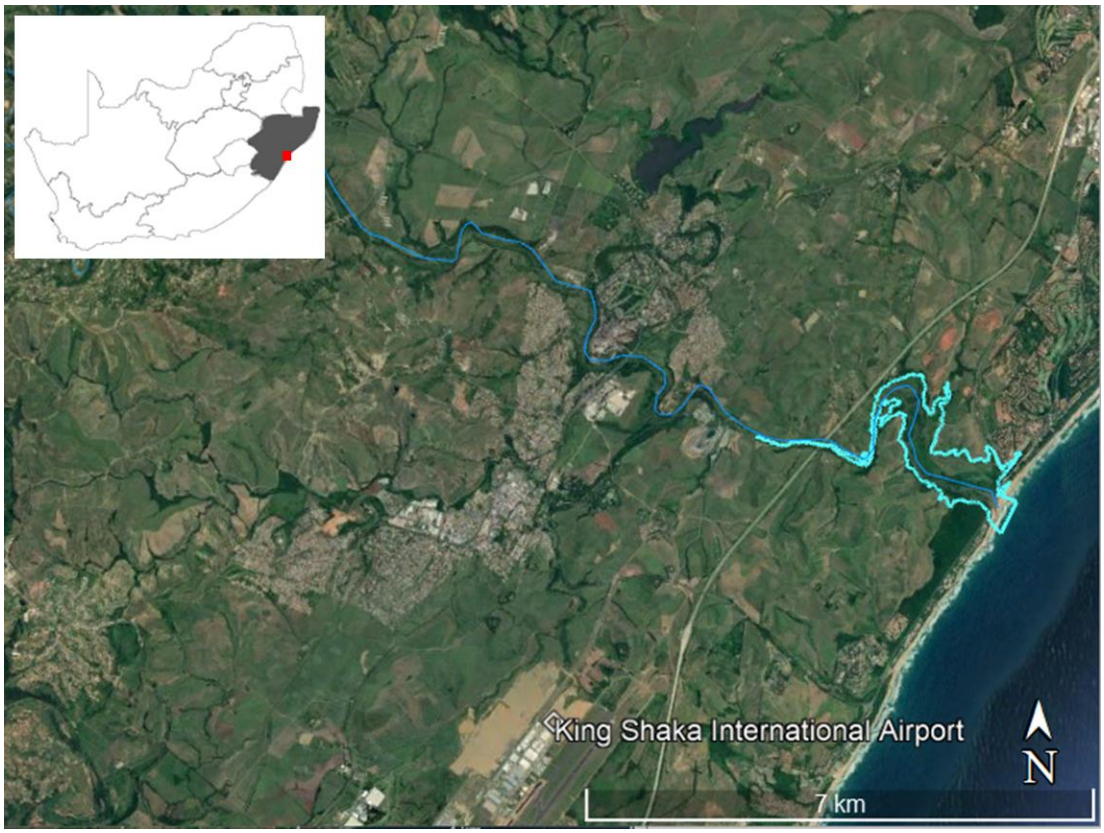


Figure 1.1 **Location of the Tongati River and the uThongathi Estuary and estuarine area within the province of KwaZulu Natal, South Africa.**

The uThongathi town and industries lie to the west/north west of the system with urban areas starting less than one kilometre from the head of the estuary. Additionally, there are residential areas to the north and south of the estuary mouth and the construction of a new residential development and golf estate has begun along the northern banks of the middle to lower reaches of the system. The vast majority of land surrounding the estuary is under agricultural development in the form of sugarcane. However, there is a significant area of coastal forest on either side of the estuary mouth which is important from a biodiversity perspective and also provides an aesthetically pleasing component to the estuary and its surrounds (Forbes & Demetriades 2009).

Described as being small with a low assimilative capacity, the estuary is sensitive to pollution and has a long history of anthropogenic change. The main sources of pollution include wastewater treatment works that discharge into the system, as well as urban and agricultural discharge and runoff in the river catchment which results in poor water quality for the inflowing water that reaches the head of the estuary (Forbes & Forbes 2012). Other threats to the system include alien invasive species (fish and vegetation), sand mining, bait collection, fish kills from oxygen depletion associated with low water quality within the estuary, and habitat loss (Van Niekerk *et al.* 2019).

The estuary has been classified as an endangered system of high biodiversity importance in the recent National Biodiversity assessment, however, it has no specific formal protection status and the present ecological state (PES) is listed as D - "Poor" or "Heavily modified" (DWS 2015a,b, Van Niekerk *et al.* 2019). Numerous restoration measures, designed to improve the estuary's ecological condition and mitigate anthropogenic pressures, were put forward in the most recent national biodiversity assessment and include the removal of alien vegetation and rehabilitation of the riparian vegetation and wetland; the eradication of alien fish; protection from mining impact and the reduction and monitoring of wastewater (Van Niekerk *et al*. 2019). This highlights the need for a management plan which assigns the responsibility of these and other activities to the appropriate parties.

This document is the Draft Management Plan for the uThongathi Estuary (from here on referred to as uThongathi EMP) and was compiled in accordance with the National Estuarine Management Protocol (NEMP) and the Guidelines for the Development and Implementation of an EMP (DEA 2013, 2015) and the Regulations in terms of the National Environmental Management Integrated Coastal Management Act No. 24 of 2008 (ICMA)).

1.2 Purpose and structure of the Estuary Management Plan

The purpose of Estuary Management Plans (EMP), as stated in the National Estuarine Management Protocol (NEMP 2013) and development guidelines "is to provide the mechanism that will enable coordination and alignment of management activities across sectors, underpinned by a shared vision – that is integrative estuarine management." (DEA 2015). The guidelines for the development of an Estuary Management Program structure the process in terms of three main phase i.e. the Scoping phase, Objective setting phase and the Implementation phase (Figure 1.2).

The Scoping Phase includes the Situation Assessment Report (SAR) which provides context to the study, reporting on the current condition of the system and status of estuarine management for the specific estuary. The document therefore provides a framework of relevant and available information

that enables the development of the Estuarine Management Plan as well as highlighting any knowledge gaps that may impact the effective implementation of the EMP.

The Objective setting phase includes the preparation of the management plan based on the minimum requirements provided in the protocol (NEMP 2013). The report will therefore include:

- A summary of the Situation Assessment Report developed during the Scoping phase;
- A geographical description and a map of the estuary based on the Estuarine Functional Zone (EFZ) clearly identifying the boundaries of the system (deviations for the EFZ should be motivated for)
- The local vision and objectives that give effect to the strategic vision and objectives;
- A list of management objectives and activities that will be required to maintain or improve the conditions of the estuary;
- Details of intended spatial zonation specifying activities that may, or may not, take place in different sections of the estuary, also indicating organs of state to be consulted given the type of zonation proposed, as well as organs of state that will have to enact relevant laws to implement proposed zonation;
- Detailed integrated monitoring plan with a list of performance indicators for gauging the progress with respect to achieving the objectives of the plan; and
- Details of the institutional capacity and arrangement required for managing different elements of the plan, taking into account different departmental mandates.

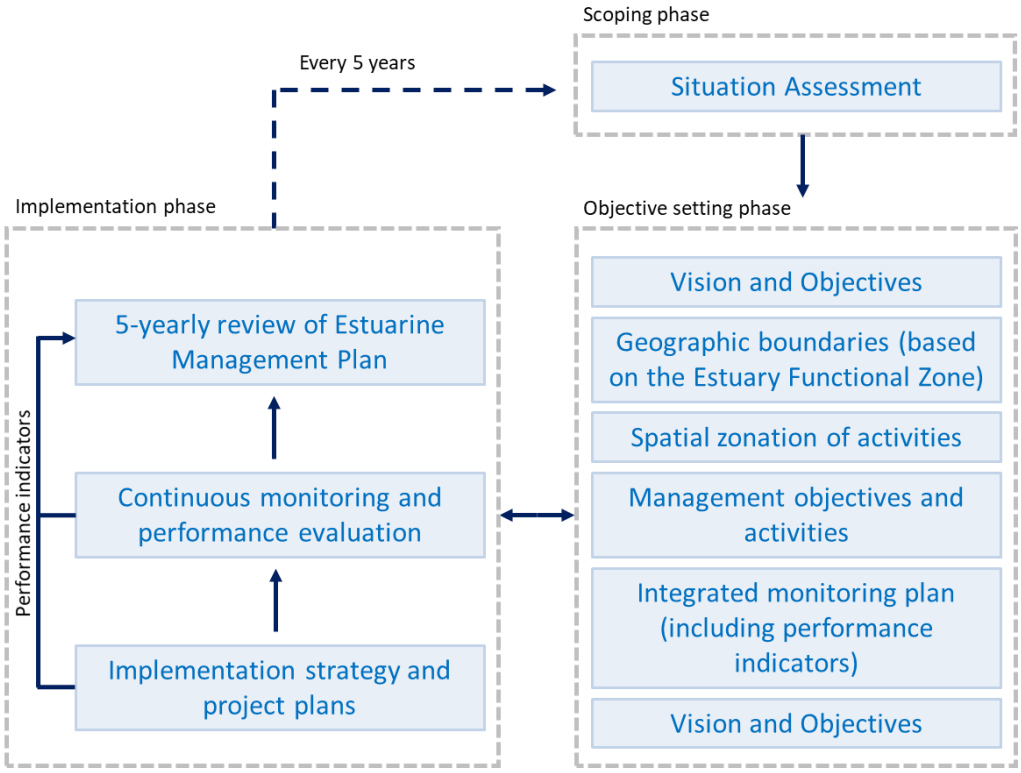


Figure 1.2 **The framework for integrated estuarine management in South Africa (DEA 2015)**

The Implementation phase comprises the execution and monitoring of the EMP developed in the Objective setting phase. During this phase responsible authorities (departments/municipalities) are required to develop project plans in terms of prioritising and integrating their responsibilities in estuarine management. It is necessary for these plans to be incorporated into broader departmental frameworks, plans and strategies to ensure that the required human and financial resources can be secured. As far as possible, responsible departments should collaborate to ensure the use of resources as effectively as possible. A co-operative approach between relevant authorities, communities, private landowners and local stakeholders should be adopted. Continuous monitoring - as set out in the monitoring plan – must be executed to gauge progress towards achieving the objectives of the EMP. It is advised that the practice of 'adaptive management' is applied, in which the implementation of management objectives and actions are responsive to changing conditions and the results of continuous monitoring. A detailed review needs to be conducted every five (5) years in accordance with the Protocol.

2 SUMMARY OF SITUATION ASSESSMENT

2.1 Catchment Characteristics

The uThongathi Estuary is located approximately 35 km north of Durban in the vicinity of the King Shaka International Airport and falls on the boundary between the eThekwini Metropolitan and iLembe District Municipalities. The estuary is just under 6 km long from mouth to head, with an estimated estuarine area of 37 ha. Anthropogenic impacts acting on the estuary include commercial sugar cane farming; residential development; two bridges (the M4 bridge located ±100 m from the mouth and N2 Bridge just short of 5 km upstream of the mouth), a causeway 2.5 km from the mouth and the discharge of wastewater into the river upstream of the estuary head. Being a small estuary that experiences strong wave action from the adjacent sea, as well as high levels of sedimentation has resulted in the development of a perched estuary (a system with a raised berm and a resulting water level that is higher than that of the adjacent sea level) and a constricted mouth which limits the extend of tidal intrusion.

Located within a summer rainfall region, the system consists of two quaternary catchment areas totalling 423 km^2 in size. Water flow that is diverted to the two dams located on a small tributary just off the main river system, is supplemented by the addition of wastewater into the river from the Tongaat Central Wastewater Treatment works, urban, agricultural, and industrial runoff/discharges. The systems Natural Mean Annual runoff (nMAR) is approximated at 70.79 million m^3 per year, however, the present Mean Annual Runoff (pMAR) is estimated to be 79.2 million m^3 per year. Additionally, low-density and rural settlements, the Tongaat town and industrial area, and residential developments are present in the lower catchment and alongside the estuary. There is a significant area of coastal forest on either side of the estuary mouth which is important from a biodiversity perspective and also provides an aesthetically pleasing component to the estuary and its surrounds. Aside from sugarcane cultivation and built-up areas, the land cover includes three types of vegetation cover, degraded land and a small portion of invasive plant species.

2.2 Present and desired ecological state

The uThongathi Estuary's present ecological state (PES) is listed as "D" (Poor/Heavily modified) with a recommended ecological category (REC) of "C". Described as being small with a low assimilative capacity, the estuary is sensitive to pollution. The poor water quality influences biotic components of the system and is the main contributor to the low PES score. The main sources of pollution include wastewater treatment works that discharge into the catchment, discharge from industry, agricultural return flows, as well as urban runoff in the river catchment. It has been gazetted that the Target Ecological Category (TEC) for the uThongathi Estuary should be a "B/C". Achieving this mandated Ecological category (EC) will require the improvement of a several of the individual components within the system, i.e. water quality and flow, birds, fish, invertebrates. Similarly, the specific Resource Quality Objectives laid out for the estuary must be upheld to ensure that the health of the estuary does not deteriorate and will need to be improved upon, in order for the mandated category to be achieved.

Like many of the estuaries along the KwaZulu Natal coastline, the uThongathi is a perched system, with water levels higher than mean sea level (MSL). Under natural conditions, powerful wave action and increased sediment movement along the coastline cause the mouth to become restricted, reducing the tidal influence on the system and resulting in the development of a sandbar closing the estuary mouth for varying periods of time, which increases the estuary's overall water surface area. However, anthropogenic impacts have contributed to changes in the shape and the decline of the size of the estuary relative to its historical extent. These impacts include the increased, nutrient enriched, freshwater inflows causing the mouth to remain open for more extended periods of time, as well as changes in the sediment input to the estuary due to agricultural runoff, development and ad hoc sand mining operations in the system.

Due to its small size the uThongathi estuary has little resilience to changes in freshwater quantity and nutrient loading. Water quality declines dramatically during periods of low flow (reduced freshwater inputs) and closed mouth conditions when the water residence time is increased. This is primarily attributed to the accumulation of nutrients present in the effluent discharges from wastewater treatment works, as well as toxins from urban, agricultural, and industrial runoff/discharges. Water quality in the estuary has been described as "poor" as far back as 1978, although conditions improved slightly with the upgrade of the wastewater treatment works. However, the overall water quality is still considered poor with the system experiencing a build-up of nutrients and pathogens and a decline in oxygen concentrations during periods of low water flow. In addition, several nutrient parameters have been found in concentrations known to be toxic to aquatic life and fish kills have been recorded within the system.

The nutrient rich waters of the uThongathi Estuary support high levels of primary production and microalgal growth and while phytoplankton biomass within the estuary is generally below 5 ugCha/l, episodic/isolated events can result in biomass ranging from 1-120 µg Chla/l, varying with the volume of freshwater inflow, the state of the mouth and the level of nutrients being introduced by the Wastewater Treatment Works. The microalgal community within the Estuary has been classed as having an ecological status of "E" or "Severely modified".

An estimated 55% of the estuarine area has been lost to habitat transformation, with the majority of the floodplain being altered by commercial and subsistence sugarcane farming. The remaining area can generally be divided into four different vegetation types, namely (1) KwaZulu Natal coastal belt grassland, (2) Northern Coastal Forest and bushveld, (3) reeds and sedges and (4) invasive plant species. Smaller estuaries, like the uThongathi Estuary, which experience high nutrient pollution pressure and flow modification are vulnerable to the spread of invasive alien plant species and the diversity and abundance of invasive alien plants within the uThongathi Estuary has increased over time with four freshwater species of aquatic invasive species recorded. Additionally, terrestrial invasive species reported to occur along the banks of the estuary include the Caster Oil plant *Ricinus communis*, the Brazilian pepper tree *Schinus terebinthifolius,* wild-sage *Lantana camara*, the Beefwood tree *Casuarina* sp., the woody cactus *Pereskia aculeata* and a species from the daisy family *Chromolaena* sp (*Pers*. *Comm*. Don McCulloch). The macrophyte community within the Estuary has been classed as having an ecological status of "D" or "Heavily modified".

The uThongathi Estuary's invertebrate and fish communities both have an ecological status of "E" or "Severely modified". Studies show that the estuary has a reduced diversity and abundance of

invertebrates, which is an indication of a community exposed to moderate to heavy pollution, along with low salinities and low oxygen levels. Similarly, the fish communities within the system have been known to vary greatly from year to year, amongst seasons and even from month to month, depending on the state of the mouth and water quality. It appears that the species diversity and abundance of fish has decreased relative to community composition in the early 1980's. This is likely the result of loss of estuarine habitat, linked to the reduced saline intrusion (mouth condition and the obstruction created by the causeway) and declines in the water quality within the system. Three species of alien fish species are recorded as present in the estuary.

The uThongathi Estuary is considered to be of regional importance to the waterbird community of Durban's estuaries as well as being species rich and having high abundance relative to its size. However, the recent assessment of the Estuary conducted for the 2018 NBA assigned the lowest estuarine health score, "F" or "Critically modified" to the bird population. It is likely that the loss of suitable fringing habitat (in which to roost and nest); changes to in-stream vegetation and the associated loss in open sand and intertidal wading areas; as well as the low abundance and diversity of invertebrates (a food source for birds) has resulted in the change in community composition and the overall decline in bird abundances.

2.3 Good and services or human use activities (Ecosystem Services)

Defined as "the benefits that people obtain from ecosystems, including provisioning services (such as food and water), regulating services (such as flood control), cultural services (such as recreational benefits), and supporting services (such as nutrient cycling, carbon storage) that maintain the conditions for life on Earth." The list of ecosystem services provided by the uThongathi Estuary is short, as the system is small and has already been subjected to anthropogenic impacts in the past. Services provided include the provision of raw materials, the breakdown of waste and detoxifying of pollutants, as well as very limited provision of refugia and nursery area, material and nutrient export, and limited tourism and recreational value.

2.4 Threats, impacts and management issues

The estuary has been significantly modified and the ecological functioning and provision of ecosystem services has declined. The 2018 National Biodiversity Assessment rates the cumulative pressure level of the uThongathi Estuary as high, with pressures listed for the estuary including: pollution (very high); habitat loss and alien fish (high); flow modification and invasive plant species (medium); low fishing pressure, the presence of sand mining and the occurrence of unauthorised artificial breaching of the mouth. Additionally, the physical impacts acting on the system include several main categories; (1) the construction of a causeway across the upper reaches of the estuary; (2) high rates of sediment accumulation in the estuary during the last 30 years as a result of high erosion rates; (3) sand mining impacts; (4) the proliferation of sugar cultivation and invasive alien plants in the estuary, riparian zone and floodplain ; and (5) most significantly - the poor water quality within the estuary and impacts of wastewater discharges. Other identified management issues include: (1) coastal access: the poor accessibility to the estuary for those who do not live in the direct vicinity; (2) a need to increase public

awareness and education regarding the estuary; and (3) the lack of adequate warning signs regarding the presence of crocodiles in the system.

2.5 Socio-economic context

The uThongathi Estuary falls within three municipalities, the eThekwini Metropolitan Municipality and the KwaDukuza Local Municipality within the larger iLembe District Municipality. Most of the economic activity is sugarcane farming and processing as well as a small proportion of sand mining. A significant portion of the northern banks of the estuary are in the process of being developed for residential property in the form of the Zimbali Lakes and Golf Course Residential Development. Additionally, much of the land to the south west of the estuary, known as the Durban Aerotropolis, is scheduled to be developed into urban and residential area within the next 50 years. The population is growing and consists largely of people under the age of 35 years.

The cumulative population, of the six main communities surrounding the estuary, is approximately 70 612 people, from 23 548 households, which generally include three or less family member. Although households in all except one community (Greylands), are predominantly living in formal dwellings, just under 4000 households live in informal dwellings and as much as 3011 households in the region are reported to have no form of income. The families from these households are likely to be dependent on subsistence farming and harvesting/gathering natural resources from the surrounding environment. This includes utilising the uThongathi Estuary for subsistence fishing and the collection/harvesting of plants such as wild spinach i.e. uMfino, for consumption.

2.6 Constraints and Opportunities

The estuary lies on the border of three municipalities and the management of the system will need to be co-ordinated amongst all authorities therefore requiring a fair amount of cooperative governance. The majority of the land adjacent to the estuary, except the unalienated river bed (state owned), is owned by private landowners. Management objectives and actions must therefore be co-ordinated with both landowners and municipal authorities to be effective.

The poor water quality within the estuary, the occurrence of sewage spills and malfunctioning infrastructure poses the most significant and severe risk to the uThongathi Estuary. Unless the flow modification and level of enrichment within the system is reduced all other attempts to improve the condition of the estuary are likely to have minimal to no positive effect, with the estuary remaining in its current poor ecological state.

A comprehensive Environmental Management Programme (EMPr) has been developed for the Zimbali Lakes and Golf Course Residential Development (construction for which began in 2020) which falls along, and within, a substantial portion of the northern border of the Estuarine Functional Zone, between the mouth and the N2 roadway. This programme includes an estuarine rehabilitation, monitoring and management plan; a stormwater management plan, and a wetland management and rehabilitation plan; which together address and will improve a number of the issues and threats impacting the estuary. While the development does not encompass the entire estuarine area, it does

account for roughly half of the total functional zone. Therefore, as long as management efforts to address impacts on other parts of the estuary occur concurrently, this could substantially reduce the management workload of the local authorities and create a valuable opportunity to reduce the responsibility while increasing the overall impact of the Estuarine Management Plan.

The Tongaat Hulett Maidstone Sugar Mill is currently using its effluent to irrigate sugarcane fields at their Inyanga Estate. In line with their Water Use License requirements, Tongaat Hulett is planning to install an effluent treatment plant that will allow the sugar mill to recycle and reuse a portion of its treated effluent, thereby limiting the volume to be discharged to the river in the future.

2.7 Major information gaps to be addressed in plan

With the exception of a recently published paper on the invasive aquatic plant species in the estuary (Nunes *et al.* 2020), intermittent water quality monitoring as part of the National Estuarine Monitoring programme (NEsMP) and Ezemvelo KwaZulu-Natal Wildlife's mouth monitoring programme, there has been very little research or data collection conducted in the system over the last 10 years. A list of information identified as being needed to improve on future studies for the uThongathi Estuary is provided in the Situation Assessment Report (SAR) and include the collection of more accurate flow, mouth state and water quality and monitoring data.

3 GEOGRAPHICAL BOUNDARIES OF THE ESTUARY

Prior to 2010, the geographic boundary of an estuary was considered to be the extent of the open water body, however, subsequent to 2010 the use of the concept of the Estuarine Functional Zone (EFZ) was adopted under the National Environmental Management Act (NEMA), Environmental Impact Assessment (EIA) Regulations (2010) (Van Niekerk and Turpie, 2012). The National Biodiversity Assessment (NBA 2018) defines the EFZ as "*the area that not only encapsulates the estuary waterbody, but also the supporting physical and biological processes and habitats necessary for estuarine function and health. It includes all dynamic areas influenced by long-term estuarine sedimentary processes, i.e. sediment stored or eroded during floods, changes in channel configuration, aeolian transport processes, and changes due to coastal storms. It also encompasses all the multiple ecotones of floodplain and estuarine vegetation that contribute detritus (food source) and provide refuge from strong currents during high flow events*."

During the 2011 NBA the EFZ was based on the 5 m topographical contour (Van Niekerk and Turpie, 2012). In most estuaries the 5 m contour was still used to define the functional zone in the updated 2018 NBA. Additionally, features or habitats on the boundary of the system, which were surrounded by estuarine habitat on more than 75% of their perimeter, such as S-bends and islands, were also incorporated into the EFZ. However, for small, incised estuaries (i.e. 0 m, 5 m and 10 m contour in close proximity to each other such as uThongathi Estuary) with relatively high river flow, a combination of the 5 m and 10 m contour, was used as the default to accommodate mapping uncertainty (Van Niekerk *et al*. 2019). Information on the NBA 2018 delineated EFZs can be found on SANBI's BGIS website (https://bgis.sanbi.org/SpatialDataset/Detail/2689). For the purposes of this EMP the extent of the uThongathi Estuary's EFZ as delineated in the 2018 NBA was adopted (Figure 3.1).



Figure 3.1 The extent of the Estuarine Functional Zone (EFZ) as defined in the latest National Biodiversity Assessment (Van Niekerk et al. 2019).

4 LOCAL VISION AND OBJECTIVES

4.1 Vision Statement

South Africa's National Estuarine Management Protocol (DEA 2013: Government Gazette 36432. No 341 of 10 May 2013) provides a national (strategic) vision for estuary management within the country as a whole i.e. "*The estuaries of South Africa are managed in a sustainable way that benefits the current and future generations.*" However, each of the country's estuaries has its own unique suite of environmental, social and economic conditions acting upon them. Therefore, for the estuarine management of the uThongathi Estuary to be effective it is important to have a specific/focused vision of its own, which provides the authorities and stakeholders with a common understanding of what they wish to accomplish. The proposed vision statement for the uThongathi Estuary composed in consult with the stakeholders, is as follows:

> "***To make an integrated, co-operative effort to improve the health of the uThongathi Estuary to conserve the system and provide a safe, functional and sustainable ecosystem for all users***."

4.2 Key Strategic Objectives

The vision provides a common goal or ideal for the local authorities and stakeholders to strive towards achieving some desired future state for the estuary, while the key objectives help answer the question "How will you know when you have achieved the vision?" and translate the ideal defined in the vision into achievable outcomes and actions. The key objectives required in order to achieve the uThongathi's vision are outlined below (Table 4.1).

Table 4.1 Strategic objectives for the uThongathi EMP

Objective	Performance indicator/outcome
Institutional arrangements and co-operation	Relevant authorities and stakeholders are engaged in an organisational structure for implementation of the uThongathi EMP. Participants have the necessary institutional capacity for effective delivery.
Improve Estuarine health and water quality	The ecological health and functioning of the uThongathi Estuary are improved and the gazetted Target Ecological Category ("B/C") is reached.
Increase awareness, appreciation, and education	Create a greater appreciation of the environmental, social, and economic value of the uThongathi Estuary amongst all users and managers of estuarine resources and amenities.
Formal protection status	Conservation area or conservancy declared on the southern banks of the estuary
Enhance user safely and access	Through clearly visible crocodile warning signs and the development of tourist facilities such as a public parking area and restrooms

5 MANAGEMENT OBJECTIVES AND REQUIRED ACTIONS

The aim of this section is to provide an inclusive list of all issues and threats impacting the uThongathi Estuary which should be addressed in order to realise the vision and achieve the strategic objectives. The management objectives and activities provided below were identified during the development of the scoping phase of the project and during consultation with authorities and stakeholders. A description of these is provided below and a summary of all these management strategies is shown in Figure 5.3.

5.1 Institutional arrangements and co-operation with private landowners

A weakness/constraint identified in the SAR relates to the fact that the estuary lies on the border between the eThekwini Metropolitan Municipality, and the KwaDukuza Local Municipality within the larger iLembe District Municipality. Therefore, requiring a co-operative approach between the relevant authorities. The protocol (NEMP) assigns the responsibility of developing an EMP to provincial environmental department in consultation with affected municipalities and the relevant national government departments. Therefore, the institutional roles and responsibilities pertaining to the management of the estuary must be clearly defined, and coordination between responsible institutions improved and maintained. In addition, it was highlighted that the majority of the land adjacent to the estuary, with the exception of the open water body (state owned), is owned by private landowners. Therefore, any plan or management of the estuary must be co-ordinated with landowners and municipal authorities together, to ensure estuarine management is achievable. This will require the establishment of an appropriate institutional mechanism, under which estuarine management, community/landowner discussions, collaboration and implementation of the EMP can be facilitated. Each municipal authority (eThekwini, iLembe and KwaDukuza) will need to assign the responsibility of estuarine management to an individual within their environmental department. An uThongathi Estuarine Management Forum (EMF), chaired the provincial authority (EDTEA) and including the estuary members of the three municipalities, should be established under the KZN Provincial Coastal Committee. This forum should include representatives of the private landowners, local stakeholders, and should ideally include a member from the existing Mdloti-Tongaat Catchment Management Forum (CMF) to facilitate communication and collaboration between the two forums. The EMF should meet quarterly to discuss and provide progress reports regarding the implementation of the EMP.

5.2 Estuarine Health and water quality

Numerous methods for assessing estuary health have been developed, and include: 1) Heydorn's assessments 1980, 1986, 2) Ramm's Community Degradation Index. 3) Cooper's Estuarine Health Index, 4) CERM's Index of Physical Health, 5) Van Driel's Estuary Habitat Integrity Index, 6) "Botanical Importance Rating" index, 7) Whitfield's qualitative assessment, and 8) Harrison & Whitfield's Estuarine Fish Community Index. These indices paved the way towards the formulation of a robust health index (the Estuarine Health Index, EHI) that is routinely used for Environmental Flow

Assessments (Reserve Determination processes) for estuaries in South Africa. The first version of the EHI was finalised in 1999 after a series of workshops with members of the Consortium for Estuary Research and Management (Turpie 1999), as a component of the methodology for determining the freshwater Reserve for estuaries (DWAF 1999). Subsequently, the method was applied in studies of over 26 estuaries, during which time the various aspects of the methodology were fine-tuned. After another round of workshops and review, a second version of the method was developed in 2004 (officially published in 2008), and a third round of review and workshops by the Consortium for Estuary Research and Management led to the current (2012) version of the EHI. Details of the process and changes made are given in Turpie *et al*. (2012). In general, the changes have focused on developing a more robust and quantitative method, as well as providing clearer guidelines for its application. Fundamentally, however, the method is still very similar to its original form.

This EHI is the method that was used to determine the state of the uThongathi estuary during the 2018 National biodiversity assessment (NBA), with the estuary's present ecological state (PES) listed as "D" (Poor/Heavily modified). It has however, been gazetted that the Target Ecological Category (TEC) for the uThongathi Estuary should be a "B/C" (Government Gazette 41306, Notice No. 1386 of 8 December 2017). This is therefore the target health category to which this EMP should strive to achieve with regards to estuarine health. Estuary health can be improved through a multitude of strategies, several of which are recommended below.

5.2.1 Removal of the causeway

The removal of the causeway is listed as an urgent priority action in the Zimbali Lakes Environmental Management Programme (EMPr) and it is therefore the responsibility of this development to undertake this action. Once undertaken, the removal of the causeway will improve flows through the estuary, prevent further build-up of sediment above this structure and potentially enable smaller flood events to scour and move sediment within the system (Mer 2008). In addition, the removal of this structure and restoration to a more natural flow path may allow saline water from the mouth to penetrate further upstream thus increasing the available habitat for estuarine species. MER (2008) emphasized that the removal could lead to erosion upstream and at the site of the causeway resulting in re-deposition of sediments downstream, despite this, they concluded that its removal would be best for the long-term restoration of the upper estuarine habitat. The report emphasises that the width of the floodplain at the causeway, up to the 5 m contour, should be completely cleared of all surface material, pipes, fill material and artificial obstructions to flow, and that the process would entail the development of specific operational procedures by specialists such as engineers, sedimentologists and estuarine scientists.

5.2.2 Better understanding of sedimentation within the estuary

Sediment input to the estuary has and is being increased by agricultural development and sand mining operations (Blaber *et al.* 1984, Forbes and Demetriades 2009, Forbes and Forbes 2012). This build-up of sediment can smother benthic organisms and probably contributes to the low invertebrate health score within the estuary's ecological health status. The removal of the causeway, restoration of flow and removal of the built-up sediment may improve the condition of the invertebrate communities

which in turn provide a food source for the fish and birds thereby potentially improving the condition of these community groups as well. However, as mentioned above it may also result in a change in the sediment deposition within the system. Therefore, as suggested in the integrated monitoring plan (Section 8) a complete bathymetry survey of the estuary (mouth to head) and a baseline sediment particle size survey should be conducted prior to the removal of the causeway so that the impacts of this and the resulting shift in sediment patterns can be monitored.

5.2.3 Improved monitoring and regulation of illegal sand mining

In KwaZulu Natal, 37 out of 74 estuaries have sand mining in, or upstream of, the system, with 17 estuaries directly impacted by mining in the Estuarine Functional Zone (Van Niekerk *et al*. 2019). It was reported in 2007 that sand mining was occurring at two locations along the Tongati river just upstream of the head of the estuary (Demetriades 2007). More recently, based on google earth imagery these operations have ceased or become more ad hoc, but a larger sand mining area is present on the northern banks of the river just downstream of the Tongaat WWTWs. According to Green (2012) sand mining is regulated from an environmental perspective by three government authorities i.e. the Department of Mineral Resources, the Department of Environmental Affairs and the Department of Water and Sanitation. Based on 1) the Mineral and Petroleum Resources Development Act, 2) the National Environmental Management Act and 3) the National Water Act. However, the enforcement mechanisms needed to successfully deter illegal sand mining activities are poor and the frameworks governing small-scale sand mining in South Africa lack the necessary capacity to support better environmental compliance amongst the legal miners (Chevallier 2014). High sand mining pressure (in terms of the number, frequency and size of mining operations) is reported within the uThongathi Estuary and it has been recommended that future research and monitoring of the impacts and sustainability of local sand mining within this system, and many others along the KZN coastline, should be prioritised (CoastKZN Website[1]). It will be necessary for the three departments mentioned above to provide an update on mining activities and the environmental compliance of mining activities along the uThongathi during each meeting of the uThongathi Estuary Management Forum. Additionally, an appropriate reporting strategy needs to be developed so that illegal mining activity can be reported, investigated and halted as soon as possible.

5.2.4 Clearing of invasive/alien species

Increased nutrient levels associated with the wastewater discharge and agricultural run-off and persistent freshwater conditions can cause the stimulation of indigenous reeds such as *Phragmites australis* and rafting grasses such as *Echinochloa colona,* as well as enhancing the growth of alien plants (MER 2008, Nunes 2020). The proliferation of these species can restrict/obstruct the water channel thereby causing reduced flow rates; and when they die and decay, can result in reduced dissolved oxygen concentrations within the water column. Four species of invasive alien aquatic

[1] Operated by the Oceanographic Research Institute, in partnership with the KZN Department of Economic Development, Tourism and Environmental Affairs: http://www.coastkzn.co.za/.

plants (IAAP) are known to occur in the uThongathi Estuary. The removal of these floating macrophytes will increase light penetration to the benthos and improve flow and water quality. Approved, and suitable methods of removal must be undertaken e.g., water hyacinth is a class one invasive species which requires a permit prior to its removal. During the meeting of the Mdloti-Tongaat CMF held on 18 February 2021, it was reported that biocontrols have been released into the Wewe tributary as well as the Siphon and Dudley Pringle Dam for the control of three alien species *viz*. water lettuce *Pistia stratiotes*, Water Hyacinth *Pontederia crassipes* and parrots feather *Myriophyllum aquaticum*. The catchment forum and responsible parties for this management strategy (DEA, *Pers. Comm*. Zukiswa Zulu) should be consulted, as well as possibly approaching Professor Julie Coetzee, the Deputy Director of the CBC and aquatic weed biocontrol programme manager at Rhodes University, whose research focuses on the biological control of invasive aquatic plants, for more information and advice.

Furthermore, several species of terrestrial alien plants have been reported within the functional zone and in the coastal forest on the southern bank of the estuary. The removal of these plants and rehabilitation of degraded riparian areas will play an important role in enhancing the estuary health, improving ecosystem functioning and aesthetic value of the estuary. The Zimbali Lakes EMPr requires an initial clearing of invasive plant species followed by ongoing '*control, eradication and removal of alien invasive vegetation within the wetlands and adjacent buffer/riparian zones*'. It is to the benefit of all and will be more effective, if the removal of invasive species in the remaining areas occurs simultaneously with the invasive clearing of Zimbali Lakes to limit the spread and re-establishment of species in adjacent areas. This will require collaborative work with the private landowners which border the EFZ.

Additionally, the EMF should investigate opportunities to access the national government's Expanded Public Works Programme (EPWP) as an additional resource-base for the effective implementation of the EMP. This includes programmes such as Working for Water and Working for the Coast, which were established to help deal with some of the challenges arising during coastal management planning in line with the Integrated Coastal Management Act 28 of 2008.

5.2.5 Improved water quality

The first step towards improving the water quality within the uThongathi is through gaining a better understanding of all the pollution sources and all the legal and illegal wastewater discharges entering the estuary and the river upstream of the estuary. Water quality must be improved by reducing and/or treating wastewater inputs to the estuary, effective catchment management and improved agricultural practices. The Natural Mean Annual runoff (nMAR) of the system is estimated at 70.79 million m^3, however, the present Mean Annual Runoff is estimated at 79.2 million m^3 due to additional wastewater inputs (DWS 2015a, b). This increase in the annul flow volumes means that the system, a historically temporarily open/closed estuary, now remains open to the sea for longer periods of time relative to the natural state. The Wastewater Treatment Works are the largest contributors of wastewater discharge volumes into the system and although they discharge treated effluent, which is generally compliant with the water regulations, the combination of high volumes and high nutrient levels supports the proliferation of invasive alien aquatic plants and has a negative effect on the estuary's water quality. Additionally, the increased flow results in the full volume of the estuary being

replaced approximately every 6 days, thus preventing the accumulation of microalgae, an important primary producer and food sources for other estuarine species. The addition of any further wastewater volumes should be avoided, and the possibility of diverting or re-use of wastewater should be investigated.

5.3 Increase public awareness and appreciation for the estuary

Effective management of the uThongathi Estuary will be dependent on the involvement and interest of the local stakeholders and to a lesser extent on the visitor's appreciation of the management regulations as the estuary has a low tourism and recreational value. Therefore, education is an important tool which can be used to enhance the awareness of the local community and highlight the advantages gained when the condition of the estuary and its ability to provide goods and services is improved.

5.4 Enhanced user safety and improved access

5.4.1 Improve coastal access

Due to their smaller size and the fact that they are typically deeply incised, estuaries in KwaZulu-Natal often have limited accessibility. The highly dynamic nature of the KwaZulu Natal coastline and surrounding area presents a significant challenge for accessing the estuary and the ecosystem services they offer. The majority of the human activity within the uThongathi estuary occurs at the mouth of the system, however, there is only limited/restricted access to the system both at the mouth and along the length of the system. This is due in part to the fact that most of the land adjacent to the EFZ is privately owned (see Figure 5.1 & Figure 5.2) and because there is no formal parking or visitor facility. Current uses of the mouth area reportedly park in an informal/dirt parking area located on the north-eastern side of the M4, approximately 300 m from the bridge (Figure 5.1). However, this land (Erf 22/17, Figure 5.1) belongs to Zimbali Lakes and is going to be developed into a Beach Club, which will not have free or easy access for the general public. Additionally, during peak fishing periods it has been reported that numerous members of the public park on the M4 bridge which is a safety risk as this is a busy roadway and the railings of the bridge are in poor condition.

The possible options for the development of a general parking area are unfortunately highly limited. Although there is a small portion of state-owned land on the southern bank of the estuary, this area includes coastal forest and sensitive coastal dune habitat, therefore the development or clearing of this site should be avoided in order to conserve these habitats (Figure 5.2). Alternative options for coastal access include the construction of a parking area some distance from the mouth with a secure path or 'nature walkway' leading down to the mouth. This would likely require construction of a well-marked path adjacent to the M4 road. It appears that the best option for coastal access would be to negotiate with the Zimbali lakes development. Although the residential estate will be a restricted, access controlled area, the Zimbali Lakes development will include a Resort Node with facilities that are open to the public. Additionally, the approved development plans also include the construction of publicly accessible parking area, however, it is not currently possible to provide the timeframes in which this construction will be completed.

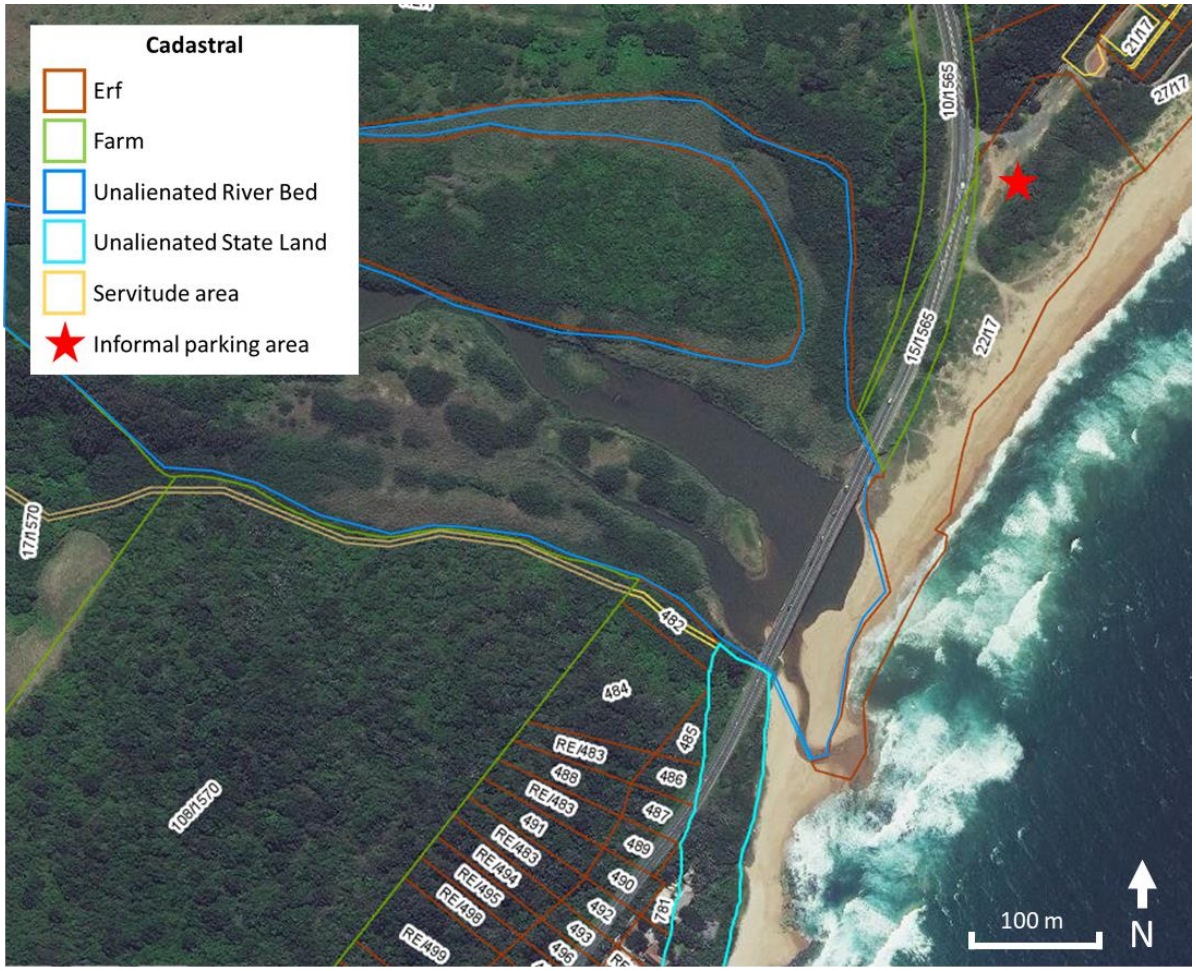


Figure 5.1 **Map showing the location of the informal parking area in use by visitors to the estuary and the cadastral boundaries adjacent to the mouth of the uThongathi Estuary. Adapted from CoastKNZ's Interactive Map.**

5.4.2 Installation of crocodile warning signs

Researchers, visitors, and locals have spotted and reported the presence of a number of crocodiles in the estuary. These crocodiles have been seen in the water, while conducting boat-based research, as well as sunning themselves on the sand banks near the mouth. While many people are naturally cautious of estuaries in KwaZulu Natal, many estuaries along the coast do not have crocodiles and are suitable for swimming, skiing and other recreational activities. The uThongathi estuary is located south of the reported South African distribution of Nile crocodiles *Crocodylus niloticus* (Isberg *et al.* 2019) and the uThongathi crocodiles likely escaped or were washed out of the Crocodile Creek facility located just below the N2 roadway. Appropriate warning signs must be erected at all points where the estuary is accessed, especially the mouth, to ensure that locals and visitors are aware of the presence of crocodiles and take the appropriate precautionary measures. Additionally, it is recommended that the authorities and the Estuarine Management Forum communicate with Crocodile Creek to ensure that the proper precautionary measures are in place to prevent further escapees from entering the system. As a precautionary measure, the crocodile population should be monitored and if they start to present a negative environmental impact on the estuary their numbers must be managed or controlled.

5.5 Strive for formal protection status

Historically, the geographic boundary of an estuary was considered to include only the open water body of the system, however, as estuarine research has improved and with the introduction of the estuarine functional zone, the geographical extent and the area needed to support and protect an estuary has increased. Given this, some existing developments, and already approved future developments are located within the EFZ. However, to preserve the environmental and aesthetic value of the estuary, further encroachment of development into the EFZ must be prevented (see section 6).

The estuary has been classified as an endangered system of high biodiversity importance, however, it has no specific formal protection status. The Durban Metropolitan Open Space System (D'MOSS) is a conservation plan produced for the eThekwini Metro municipality, which identifies areas of open space important for biodiversity and the provisioning of ecosystem services, that require protection and management, i.e. rivers, wetlands, estuaries, grasslands, forests and coastal zone resources. D'MOSS forms part of Durban's Integrated Development Plan (IDP), Strategic Development Framework (SDF) and the regional Spatial Development Plans (SDP). Based on the eThekwini Municipality's Corporate GIS Map Viewer and the 2018 D'MOSS spatial layer, the majority of the uThongathi EFZ, as well as the coastal forest belt, and some additional land on the southern bank of the estuary falls within this open space area (Figure 5.2). This supports the need to conserve and protect the EFZ, as well as suggesting the need to push for the inclusion of the coastal protection zone (see section 6).

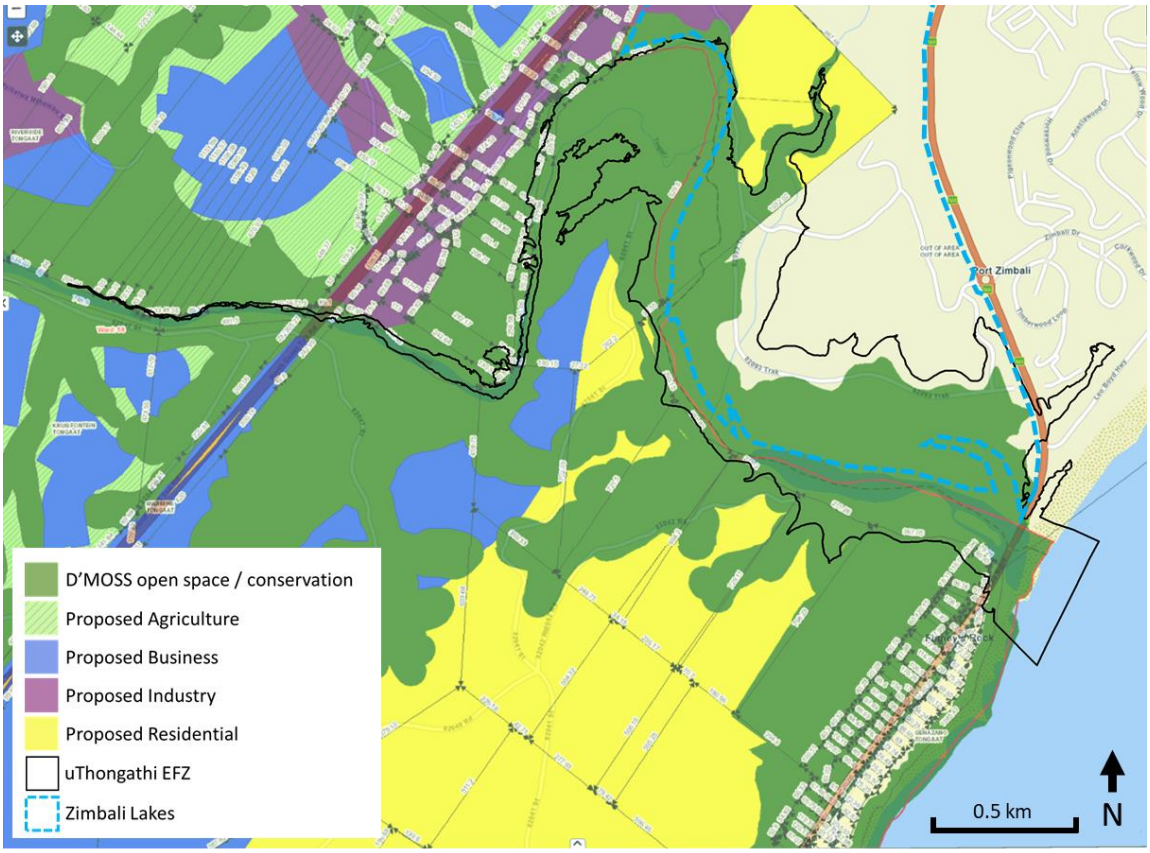


Figure 5.2 **Spatial extent of eThekwini land ownership/properties (cadastral boundaries) adjacent to the estuarine functional zone (EFZ), as well as land-use zonation based on the eThekwini SDF 2020, which includes D'MOSS areas. Source: Modified from http://gis.durban.gov.za/.**

Additionally, the authorities and EMF should negotiate with landowners of undeveloped properties within the D'MOSS area to investigate the possibility of establishing a conservancy. A conservancy is established through a voluntary agreement between two or more landowners to cooperate towards the conservation of the environment on their combined properties. Through partnerships between civil society and conservation authorities this concept has grown into a national conservation movement. The official registration of a conservancy along the uThongathi Estuary would be granted by Ezemvelo KZN Wildlife (EKZNW - the provincial conservation authority).

The National Forest Act (NFA) (Act No. 84 of 1998) was promulgated to promote sustainable forest management and the development of forests for the benefit of all, with the Department of Forestry, Fisheries and Environment, (DFFE) through the sub-directorate, Forestry Regulations and Support, the authority mandated to implement the act. Despite the fact that all natural/indigenous forests are protected in terms of the NFA, South Africa's coastal forests are decreasing at an alarming rate and are listed as threatened ecosystems. Additionally, swamps forests are categorised as vulnerable and are listed as protected ecosystems in terms of the National Environmental Management Biodiversity Act. The uThongathi Estuary supports stands of both coastal and swamp forest, which provide important ecosystem services such as coastal protection, stabilization, and the provision of refuge and food resources for numerous species. Therefore, supporting the recommendation that these ecosystems should be protected, and every attempt made to declare these areas as important conservation areas.

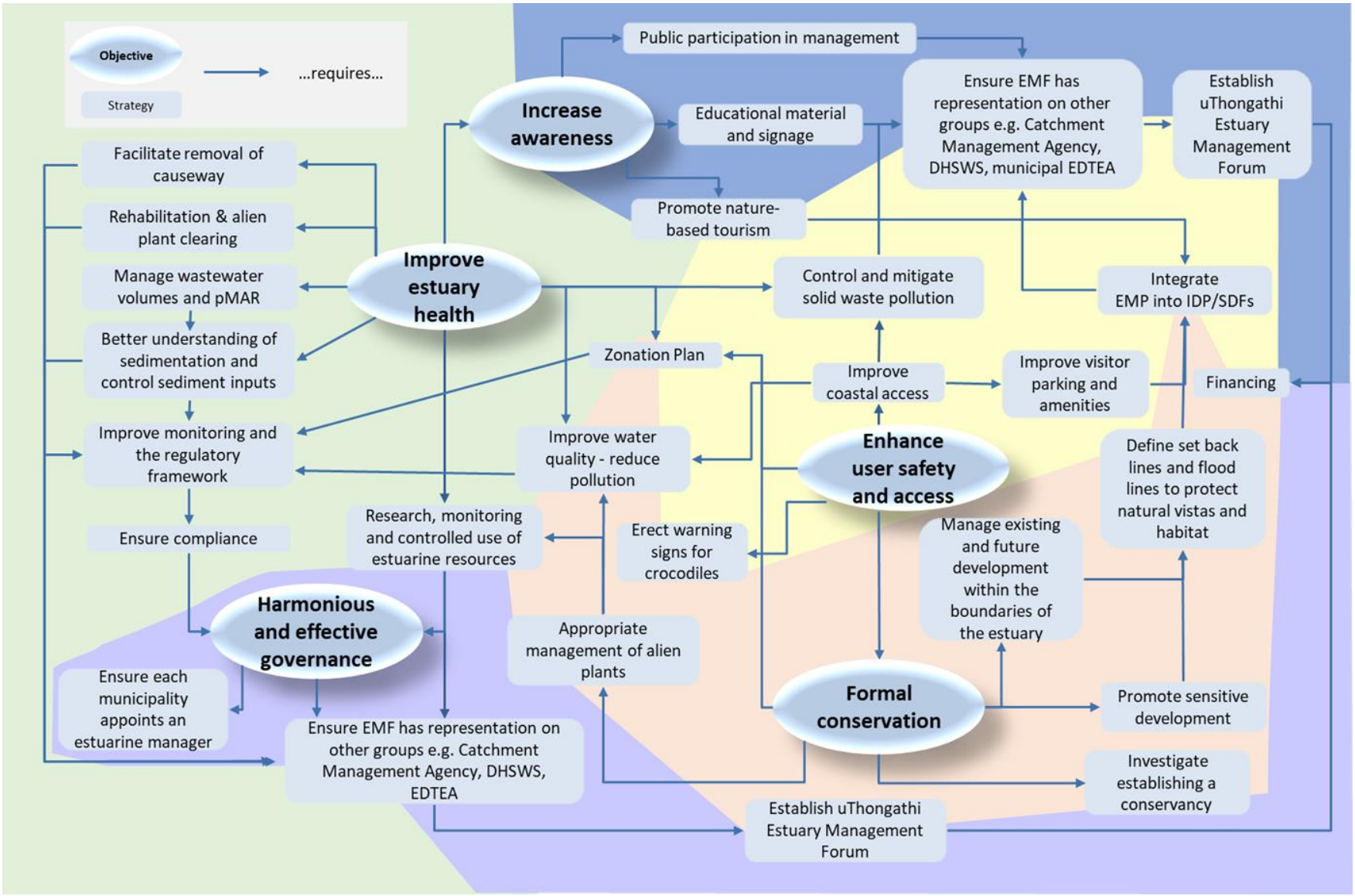


Figure 5.3 **Strategies to meet management objectives for the uThongathi Estuary.**

6 PROPOSED ZONATION OF ACTIVITIES

According to the guidelines proposed in DEA 2015 the process of zonation (or spatial planning) can be defined as "a process of analysing and allocating the spatial and temporal distribution of human activities and conservation areas in an estuary to achieve the vision and objectives (i.e., the envisaged outcomes)". A zonation plan therefore provides a means of spatially depicting the envisaged desired state for a particular estuary.

The uThongathi Estuary is relatively small, with a length of just under 6 km from the mouth to head, and the total estuarine area of approximately 37 ha (Adams and Van Niekerk 2020). The estuary was not identified as a recreational area during stakeholder meetings conducted in 2015 (DWS 2015b) and according to the data collected for the recent national biodiversity assessment (NBA 2018) fishing effort within the estuary is low (Van Niekerk *et al.* 2019). Presently, the limited access, densely vegetated banks and the presence of crocodiles in the estuary, significantly restricts the amount of recreational activity occurring within the estuary. Additionally, the private ownership of the majority of the land surrounding the estuary means that recreational activities are limited to the mouth of the estuary. However, it has been reported that local residents from the surrounding rural communities, undeterred by the presence of what they consider to be 'small' crocodiles, utilize the entire length of the system (from the mouth, through the middle and upper reaches) to undertake subsistence fishing and the collection/harvesting of wild spinach i.e. uMfino, for consumption (Pers. Comm. Monique Nunes, May 2021). An assessment of Stats SA census data indicates that approximately 3 011 households in the region have no form of income and are therefore likely dependent on the estuary for subsistence fishing and the harvesting/gathering natural resources.

6.1 Coastal Protection Zone

The coastal protection zone consists of land falling within an area declared in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), as a sensitive coastal area within which activities identified in terms of section 21(1) of that Act may not be undertaken without an authorization. Under the Integrated Coastal Management Act (2008 as amended in 2014), the Provincial MEC in consultation with the Local Municipalities is required to define a coastal protection zone. This zone extends 100 m inland of the coastal and estuarine high-water mark in urban areas which are presently zoned for residential, commercial, industrial or multiple-use purposes, and 1 000 m inland for all zoned as agricultural or undetermined use and that are not part of a lawfully established township, urban area or other human settlement. In the case of the uThongathi Estuary, and based on the eThekwini SDF 2020, the vast majority of the land surround the system is zoned as urban, for residential, business or industry, the only exception being a small area of proposed agricultural land inland of the N2 roadway (see Figure 5.2).

The Integrated Coastal Management Act (2008) also provides for the establishment of a coastal management line, designed to protect the coastal protection zone. Any future development seawards of the coastal management lines will automatically be subject to an Environmental Impact Assessment (EIA) and would have to be compatible with the vision and objectives defined within this management plan. In the case of the uThongathi the local municipalities (eThekwini, iLembe and KwaDukuza) are

required to develop the coastal management lines and it is envisaged that at the end of the process, the following should be available:

a) An accurate delineation of the high water mark;
b) A line demarcating physical processes or hazards;
c) One or more management lines, or coastal management lines, that can be used to manage development along the coast; and
d) A line demarcating the Coastal Protection Zone (CPZ) as required by ICMA.

The coastal management line will serve to protect ecological functioning and integrity of the estuary, limit disturbance to estuarine flora and fauna, and will assist in successful rehabilitation of disturbed areas in the estuary and enhance its ecotourism appeal.

6.2 uThongathi Estuary Zonation

The establishment of coastal management lines around the uThongathi Estuary should prevent development from encroaching too close to the estuary and hence will ensure an adequate buffer for the estuary. The uThongathi Estuary Management Forum should be involved in determining the position of the final coastal management line (e.g., exclusion of already developed areas within the 5m contour). A draft protection zone, represented by the purple line, has been provided in Figure 6.1, this protection zone can be used for future development decisions until a final updated protection Zone is determined. It is based on vegetation mapping from an updated satellite image (26/05/2021) in combination with previous land use and vegetation maps, the latest EFZ from the 2018 National Biodiversity Assessment, a coastal protection zone 100 m from the estuary water surface (high water mark), and the Durban Metropolitan Open Space System (D'MOSS).

It is important that the entire Estuarine Functional Zone be considered sensitive area to be preserved and that no further development, aside from that which has already been approved, occurs within the EFZ. Therefore, as a starting point, the coastal management line for the estuary corresponds with the estuarine functional zone as defined in the National Biodiversity Assessment (Van Niekerk *et al.* 2019) and depicted in Figure 3.1. The Protection zone was then increased to include the coastal protection zone - all areas within 100 m of the water surface as well as the D'MOSS open space area. Additionally, Northern Coastal Forests are endangered and are listed as threatened ecosystems in need of protection, in terms of the National Environmental Management Biodiversity Act. Therefore, the protection zone was increased to include all areas of the endangered Northern Coastal Forest belt. Isolated patches of forest located along the banks of the estuary (dark green in Figure 6.1) should be zoned as threatened/ extra sensitive, priority areas in need of protection within the EFZ. Areas marked in red (invasive alien aquatic plants, IAAPs) and brown (degraded land) should be categorised as priority areas for management intervention and rehabilitation. The larger portion of degraded land within the EFZ falls around the two Lakes of the Zimbali Lakes Resort development and should be rehabilitated as soon as building operations cease as per the approved EMPr. The area of degraded land on the northern bank of the middle reaches, below the Crocodile Creek facility, should be rehabilitated and revegetated as soon as possible.

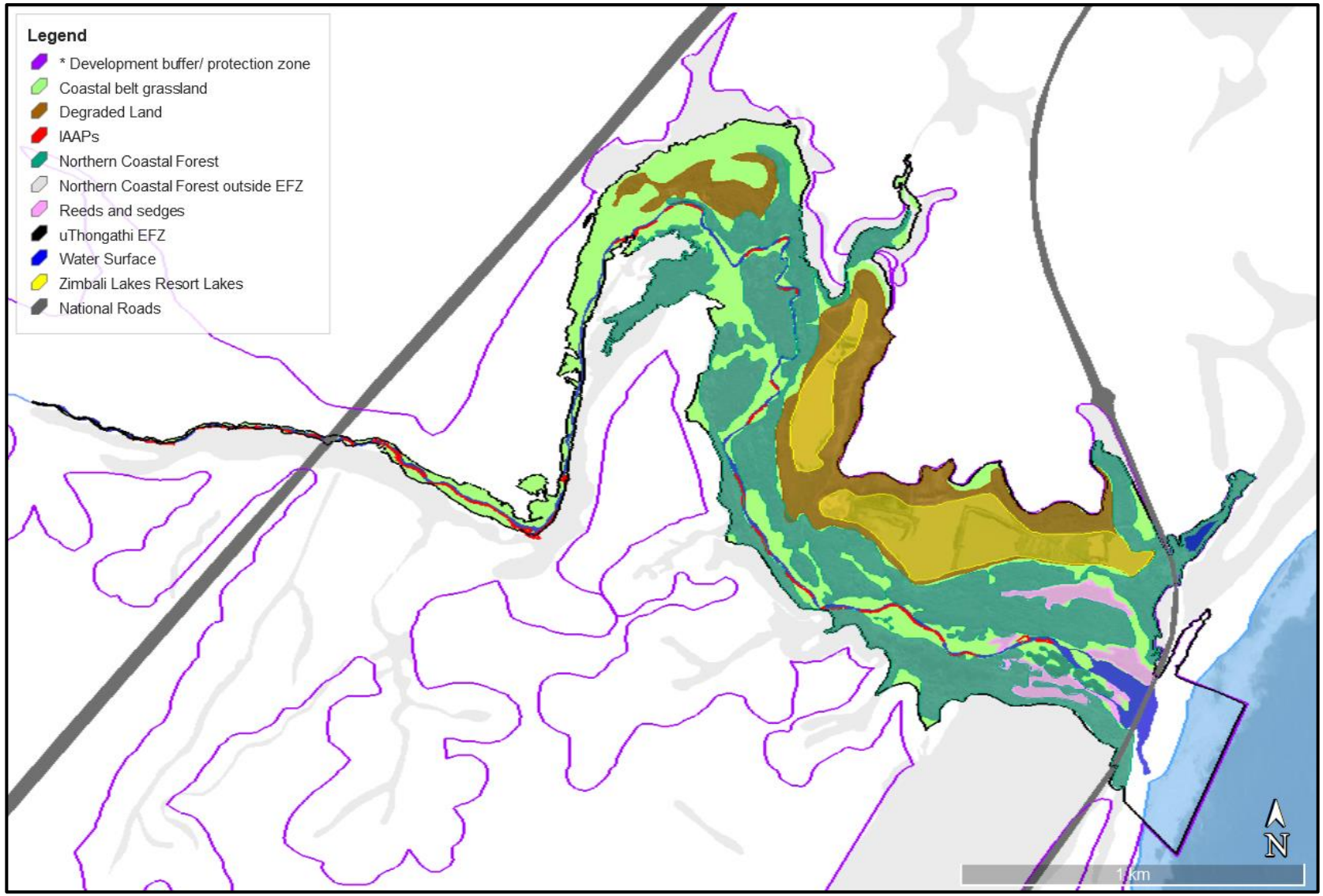


Figure 6.1 **The proposed Protection Zone for the uThongathi Estuary (purple) and the spatial distribution of threatened Coastal Forest (dark green) to be considered as extra sensitive, priority areas for protection, as well as areas of priority management intervention (red and brown) within the Estuarine functional Zone (EFZ).**

In addition to these provisions, the NEMA EIA regulations list a number of activities which, if undertaken within the estuarine functional zone, or within the defined coastal management line around the estuary (if defined, or within a distance of 100 m inland of the high water mark of the estuary) require an EIA (see section 11.3). The National Water Act (1998) also places some restrictions on development adjacent to water courses, which includes estuaries. This Act requires that authorisation (a water use licence) be obtained, from the Department of Water and Sanitation (DWS), for any alterations to the bed, banks, course or characteristics of a water course (which includes changes in land use, vegetation cover, topography, soil, etc.) or the adjacent riparian habitat (defined as any flooded area adjacent to the river channel). Based on this initial protection zone it is recommended that no further development be approved within the EFZ of the uThongathi Estuary, and that the Southern bank of the estuary, especially those areas containing Northern Coastal Forest be protected, with development in these areas strongly discouraged.

It is also recommended that comprehensive vegetation mapping is undertaken to ground truth the distribution of vegetation and isolated pockets of natural, sensitive coastal forest vegetation along the full length of the estuary with these areas earmarked for additional protection to prevent their loss. The South African National Biodiversity Institute (SANBI) has mapped the vegetation of South Africa through the National Vegetation Map Project (VEGMAP). This data, as well as satellite imagery and ground truthing could be used to obtain an accurate representation of the vegetation within the EFZ. Additionally, the possibility of creating no take, or restricted (in terms of quantity) collection zones for subsistence fishing and harvesting should also be investigated.

7 RECOMMENDED MANAGEMENT PRIORITIES

7.1 Improve estuary health

As part of a classification of water resources and reserve determination study conducted in 2015 and the estuary realm report of the national biodiversity assessment, estuary health was assessed in terms of the degree to which the current state resembles the natural condition (DWS 2015a, Van Niekerk *et al.* 2019). Considering hydrology, hydrodynamics and mouth condition, water quality, physical habitat alteration and the ability of the habitat to support fauna and flora, the estuary was assigned a Present Ecological Status (PES) of Category D (Poor/Heavily modified) with a recommended ecological category (REC) of "C". The gazetted Target Ecological Category (TEC) for the uThongathi Estuary is "B/C" (Government Gazette 41306, Notice No. 1386 of 8 December 2017). This category represents an overall health score ranging between 67-83% of pristine estuarine health. Achieving this mandated Ecological category (EC) will require a significant improvement from the current state (40-60%.).

Anthropogenic pressures on the system are manifold and those that contribute most to a current negative trajectory of change were identified as (1) flow modifications to the estuary from the catchment, (2) poor water quality and high levels of pollution, (3) habitat loss and poor condition of riparian areas and wetlands, as well as (4) discharges from WWTW (Van Niekerk *et al.* 2019).

The addition of wastewater from the Tongaat Central Wastewater Treatment Works (WWTW), Frasers WWTW and the Hulett Maidstone Sugar Mill (intermittent), more than replaced the proportion of the mean annual runoff (MAR) abstracted within the catchment or diverted to the Siphon and Dudley Pringle Dams. However, the water is of poor quality and has been contributing significantly to the deterioration of estuary health. The Natural Mean Annual runoff (nMAR) for the estuary is estimated at 70.79 million m^3, however, the present Mean Annual Runoff is estimated at 79.2 million m^3 due to the addition of wastewater inputs into the system (DWS 2015a, b). This results in the mouth of estuary remaining open for longer periods of time and the constant flow of freshwater pushes the River Estuary Interface (REI) further downstream and limits the intrusion of saline water into the estuary.

The Tongaat Central WWTW became operational in 1983 with a capacity of 3 ML/day) and since then has been discharging effluent into river upstream of the estuary head. The WWTW was upgraded to 6 ML/day and then 8.75 ML/day in 1987 and 2000, respectively. Together with the Frasers WWTW which discharges into the Begota stream, and then into the middle reaches of the estuary, the total volume of wastewater is approximately 12,42 ML/day (Van Niekerk *et al.* 2019).

Alien invasive plant species are prevalent in the Estuarine Functional Zone, as well as in the catchment. Alien invasive plants are known to have greater water requirements compared to indigenous vegetation and rehabilitation of invaded areas throughout the catchment could assist in increasing water availability in the estuary. Clearing efforts are currently underway in the form of bio-controls introduced into Wewe tributary and Siphon Dam. Systematic alien clearing within the EFZ could contribute towards reducing erosion of the banks and improving health of riparian vegetation and improve wetland areas situated within the flood plain.

The priority of this first generation EMP is to reverse the negative trajectory of change of the uThongathi Estuary health and therefore two of the above-mentioned key pressures, namely improving water quality and monitoring WWTW discharges (addressing point (2) and (4)), were

identified as separate management actions (Section 7.2). The Management Action Plan (MAP) for improving estuary health (Table 7.1) thus only includes detailed actions concerning flow modifications and eradication of alien invasive species (addressing point (1) and (3)).

Although reducing the pMAR to volumes more similar to the nMAR may prove difficult over the prescribed five-year implementation period, determining the sources and volumes of pollutants entering the system will contribute towards ensuring better compliance of water users and achieving the goal of improved estuary health. Referring to the Resource Quality Objectives (RQO's) set out in DWS 2015b may also provide methods for improving the estuary health (section 11.1).

Table 7.1 Management Action Plan to improve uThongathi Estuary health. DHSWS = Department of Human Settlements, Water and Sanitation, CMF = Catchment Management Forum, EMF = Estuary Management Forum, ETH = eThekwini Metropolitan Municipality, IDM = iLembe District Municipality & KDM = KwaDukuza Municipality.

Strategies	Actions	Deliverables/Indicators	Timing	Implementation	Indicative budget
1. Identify the pollution sources driving the state of the receiving environment	i. DHSWS/CMF to conduct a water audit of the uThongathi catchment to establish the location and number of, and volumes discharged by - a. water use license holders b. illegal abstractors, discharges and significant points of runoff/stormwater	• A database of all license holders detailing abstraction & discharge volumes is available. • Illegal abstraction and discharges have been located and volumes have been determined. • An estimate of the total water volume that is abstracted from and the volumes discharged into uThongathi catchment per annum has been calculated.	2022	DHSWS, CMF, EMF, ETH, IDM & KDM	N/A
	ii. DHSWS/CMF to ensure compliance with water use licenses	• Compliance monitoring records are available	Ongoing	DHSWS, CMF, EMF, ETH, IDM & KDM	N/A
2. Eradication/management of alien invasive species from the estuary, EFZ and catchment	i. Assess extent of alien invasive species in the EFZ.	• A plan of action for the clearing of alien invasive plants that prioritises certain species and areas within the rehabilitation focus area.	2022	EDTEA, DHSWS, CMF, EMF, ETH, IDM & KDM, SANBI	To be determined
	ii. Prioritise areas for the clearing of alien invasive plants in the EFZ.				
	iii. Organise funds to clear alien invasive plants in the EFZ	• Records from alien clearing programmes (ha cleared of alien vegetation).	Initial clearance 2022, ongoing		
	iv. Clearance of alien invasive vegetation from the uThongathi EFZ and catchment.				
	v. Co-ordinate with Zimbali Lakes clearing teams			CMF, Zimbali Lakes	N/A
3. Facilitate removal of causeway	i. Conduct necessary baseline monitoring for the removal of the causeway (the latter is required in Zimbali Lakes EMPr).	• Bathymetry and sediment survey complete, causeway removed	2023	ETH, IDM & KDM, CMF, Zimbali Lakes	To be determined

7.2 Improve water quality

The water quality characteristics of the uThongathi Estuary are influenced by a number of factors, the most important of which are wastewater discharge, runoff and mouth state. While the mouth of the estuary is open and the water residence time within the estuary is not too high i.e. there is adequate flushing, water quality may be generally poor but does not pose a risk to human health or the health of the fauna or flora of the estuary. Following periods of prolonged closure or pollution spillage events, water quality characteristics can change rapidly and begin to pose a threat to human and/or ecosystem health. For example, prolonged exposure to either very low (hyposaline <5 PSU) or very high (hypersaline, >40 PSU) conditions can cause mass mortality of marine (mostly the former) and estuarine organisms (mostly the latter), while even short-term exposure to low levels of dissolved oxygen (< 4 mg/l) can cause mass mortalities of all types of aquatic organisms. Large-scale fish kills have become a common phenomenon in estuaries impacted by anthropogenic activities and the uThongathi Estuary is no exception. The most recent fish kills in the estuary occurred in August/September of 2018 and 2020. Understanding the causes of fish kills will be fundamental in order to implement preventative measures to reduce their frequency and magnitude in the long-term. The need for a standardised national protocol to deal with such incidences was recognised and a national protocol has been proposed by Grant *et al.* 2014 (Refer to section 11.2).

High nutrient levels (nitrates, ammonium, phosphates) in the estuary can lead to proliferation of macroalgae (especially invasive aquatic alien plants IAAP) or blooms of microalgae in the estuary (phytoplankton or benthic microalgae) which are unsightly, can smother natural vegetation, clog gills of fish, inhibit feeding by fish and birds, and frequently leads to the occurrence of low oxygen events. High levels of indicator bacteria (*E. coli*, faecal coliforms and/or Enterococci) are indicative of the possible presence of pathogens or disease-causing organisms in the estuary that can pose a risk to the health of recreational users.

Although the WWTW has more than replaced the MAR impounded by the Siphon and Dudley Pringle Dams, the water is of poor quality and has been contributing significantly to the deterioration of estuary health. Agricultural return flows containing fertilisers, stormwater runoff, raw sewage spills, malfunctioning pumpstations, broken sewer lines and blocked or overflowing manholes are all sources of pollutants influencing water quality in the estuary. While the WWTW provides the bulk of nitrogen and phosphate to the estuary, it has been shown that bacterial contamination and other pollution indicators are also elevated upstream of the WWTW, suggesting additional sources of pollution inputs.

River Flow rates and water quality in the uThongathi Estuary have been monitored by the Department of Water and Sanitation (DWS) at various stations in the uThongathi since 1967 and 2014, respectively (see section 8). Early detection of low oxygen events, eutrophication risks or bacterial contamination and their appropriate management actions (short to long-term interventions) rely on continued monitoring that is aligned with existing water quality sampling locations and methods used by the DWS. A more detailed action plan for the implementation of such a monitoring programme is provided in section 7.3, while the recommended monitoring programme in section 8 provides more details regarding temporal and spatial scales for different water quality variables.

The action plan for improving water quality (Table 7.2) includes detailed actions concerning the management of pollutant sources, including identification, licensing, pollutant reduction and ensuring compliance.

Table 7.2 Management Action Plan to improve water quality of the uThongathi Estuary.

Strategies	Actions	Deliverables/Indicators	Timing	Implementation	Indicative budget
1. Identify pollution sources	i. DHSWS/CMF to conduct a water audit to identify unlicensed discharges and establish the location and number of water use license holders and the amount of effluent that is discharged in the uThongathi Catchment	• Water audit has been completed and a licence database is available. • Unlicensed discharges have been licensed or stopped.	2022	DHSWS, CMF, EMF, ETH, IDM & KDM	N/A
2. Reduce pollutants into the uThongathi Estuary	i. WWTW to improve effluent quality in terms of inorganic nutrient concentrations. • Thoroughly investigate the possibility of re-use or installing floating wetlands or conventional wetlands ii. Investigate how contingency plans for the malfunctioning of the WWTW and related infrastructure can be updated to reduce the risk of poorly or untreated sewage entering the uThongathi Estuary.	• Improved water quality in the estuary as evidenced by water quality monitoring data. • *E. coli* and Enterococci counts comply with the ranges for good or excellent water quality in terms of the receiving water quality guidelines for recreational use (RSA DEA 2012) • Ecological Specifications (RQO) for the Recommended Ecological Category C are met, health improving to meet the mandated B/C TEC.	2024-	DHSWS, CMF, EMF, ETH, IDM & KDM	R230 000 p.a.
	iii. Lobby farmers to reduce application of inorganic fertilizer in the uThongathi catchment				
	iv. Ensure that malfunctioning pumpstations, sewer pipes and manholes are repaired/replaced.				
	v. Improved treatment and investigate diversion of wastewater for irrigation to reduce volume discharged into the uThongathi catchment				
3. Improve compliance	i. Improved compliance by water users regarding discharge limits (volume and pollutants) contained in water use licenses.	• Compliance monitoring records are available	2022	DHSWS, CMF, EMF, ETH, IDM & KDM	N/A

7.3 Research and monitoring

The uThongathi Estuary management plan has been drafted based on the current understanding of the functioning of the estuary. It is evident that ongoing research and monitoring is required to fill information gaps and to improve the management plan. Post implementation monitoring of the EMP is critical given that the determination of the present ecological state was undertaken in 2015 and revised in 2018, updated baseline data is also vital to ascertain whether the measures that have been put in place are adequate to ensure that there is no further deterioration in the health of the estuary. The responsibility for this monitoring resides with the Department of Human Settlements Water & Sanitation (DHSWS) but may be delegated to another agency.

Monitoring and research are essential in enabling the respective agencies responsible for management of the estuary to adapt management plans, operational plans and activities to changing circumstances. Key focal areas for monitoring and research associated with the uThongathi Estuary include water quantity and quality, physical characteristics, and rehabilitation.

The research and monitoring MAP is given in Table 7.3. Recommended protocols for monitoring the health of the uThongathi Estuary are included in section 8. The Resource Quality objectives (RQOs) for the uThongathi Estuary should guide the monitoring programme and are included as section 11.1. In addition to monitoring the biotic and abiotic health of the uThongathi Estuary, it is recommended that visitor numbers, profiles, behaviour and opinions are monitored on a regular basis to gauge management effectiveness and user responses to management.

7.4 Increase awareness and education

Effective management of the uThongathi Estuary will be dependent on the involvement and interest of the local stakeholders and on the visitor's appreciation of the management regulations. Education is an important tool which can be used to enhance the awareness of the local community and highlight the advantages gained when the condition of the estuary and its ability to provide goods and services is improved. Although the estuary is small and not heavily used for recreational purposes, the mouth is frequently visited and along with the coastal forest belt, this area could provide opportunities for the public to view species in their natural environments, and to experience natural ecosystems. Provision of interpretive and educational material at these sites can greatly enhance this experience as it focuses attention of visitors on goods and services provided by the environment of which they may not have been aware, highlights keys aspects of the environment that are special or unique to the area and can be used to highlight the impact of human activities on the environment. Furthermore, the better people understand the issues surrounding the rehabilitation of an ecosystem, the more they are likely to respect the management requirements and regulations. It could be highly advantageous to request that researchers and/or students conducting work in the catchment deliver public talks or seminars to local communities, schools or even at clubs within the Zimbali residential estates (Zimbali Lakes and Zimbali Coastal Estate). Additionally, increased awareness and appreciation for the system could encourage the locals to become more involved in the management of the estuary and therefore, more likely to observe and report incidences that may negatively affect the estuary. The MAP for Increasing public awareness and estuarine education is given in Table 7.4.

Table 7.3 Management Action Plan for research and monitoring of the uThongathi Estuary.

Strategies	Actions	Deliverables/Indicators	Timing	Implementation	Indicative budget
1. Promote scientific research.	i. Identify information gaps and develop research programme(s) aimed at gathering/ consolidating ecological data.	• Research projects. • Scientific reports, paper and publications.	ongoing-	EDTEA, CMF, EMF, ETH, IDM & KDM	-
	ii. Engage local research institutes and universities to collaborate on priority research projects.				
	iii. Solicit research funding support.				
2. Implement monitoring programme for biological, physical and chemical indicators of estuary health (section 8) [National Water Act 1998].	i. Implement the monitoring programme in section 8. a. Clearly define responsible agencies for each monitoring component (i.e. municipality, service providers, EKZNW etc). b. Ensure that each monitoring component has a clearly defined methodology.	• Monitoring data and reports are available on a real time basis. • Monitoring data and reports inform short-term and long-term management interventions (e.g. dealing with fish kills, mouth management, alien clearing)	Ongoing: Initiated in 2021.		R650 000 p.a.
	ii. Assess results in terms of RQOs (section 11.1).				
3. Monitor human use of the estuary [National Water Act 1998].	iii. Carry out monitoring programme as outlined in section 8.				

Table 7.4 Management Action Plan for increasing awareness and education for the uThongathi Estuary.

Strategies	Actions	Deliverables/Indicators	Timing	Implementation	Indicative budget
1. Create effective mechanisms for on-going communication with stakeholders and an incident reporting strategy.	i. Develop an effective communication and incident (pollution spill/fish kill/sand mining) reporting strategy and advertise it.	• Communication strategy developed.	2021-	EDTEA, EMF, DMR, ETH, IDM & KDM	R23 000
	ii. Maintain stakeholder database.	• Stakeholder database developed and maintained.			
	iii. Explore alternative communications mechanisms (workshops, signage, social media platforms, radio etc.).	• Record of communications kept.			
2. Develop an effective education and awareness programme for the uThongathi Estuary that enhances visitor experiences.	i. Source and/ or commission educational and informative material including: educational signage at the mouth, posters, pamphlets, and relevant literature that will be housed in appropriate localities that will enhance visitor experiences.	• Posters, pamphlets, signage, literature developed and distributed/displayed.	2021-	EMF, ETH, IDM & KDM	R15 000
	ii. Encourage field excursions to the estuary by local schools, community groups, and other stakeholder groupings.	• Field excursions undertaken.			
	iii. Facilitate educational talks/seminars presented by those conducting scientific research within the system	• Talks/seminars delivered			

7.5 Improve public access and recreational value, and investigate conservation methods

Together, the limited access and lack of official parking area, as well as the presence of crocodiles and low water quality within the system are reducing the recreational value of the estuary The primary challenge facing the future management of the estuary is to provide a quality experience for residents as well as visitors to the estuary alike, while at the same time managing activities in a manner that ensures that management efforts to improve the health and water quality of the estuary are not compromised (Table 7.5).

The coastal forest on the southern bank is valuable undisturbed area that provides an opportunity to protect and conserve a portion of the natural environment, especially given the extent of future development proposed for the surrounding area (see Figure 5.2). The management forum and local municipalities should encourage landowners of undeveloped properties within the coastal forest or adjacent to the EFZ to investigate the possibility of establishing a conservancy (refer to section 5.5). This combined with appropriate nature friendly infrastructure for visitors to the estuary (parking, bird hides, walking paths, nature trails) could improve the recreational value of the system and encourage environmentally friendly activities for visitors to engage in. The registration of this area as a conservancy can also help prevent future developments altering more of the EFZ. Authorities should consult/negotiate with the Zimbali Lakes development with regards to the public parking areas proposed for their resort node, possibly offering incentives for this area to be developed sooner.

7.6 Harmonious and effective governance

Owing to their position on the boundary between freshwater, terrestrial and marine environments, management of estuaries requires cooperation from a large number of separate national, provincial and local government agencies, each acting under a different legislative mandate. As a minimum, the following national government agencies are implicated in management of the uThongathi Estuary: Department of Economic Development, Tourism and Environmental Affairs (EDTEA), Department of Human Settlements, Water and Sanitation (DHSWS), Department of Mineral Resources (DMR) and the Department of Forestry, Fisheries and Environment (DFFE). Provincial and local government agencies implicated in management of the estuary include the Ezemvelo KZN Wildlife (EKZNW), eThekwini Metro Municipality, iLembe District Municipality, and the KwaDukuza Local Municipality. Recognising that the difficulties of ensuring a sufficiently high level of integration and cooperation amongst all of these different agencies are likely to extend beyond the mandate and capacity of a single local authority or agency, an estuary management forum (uThongathi EMF) will be established, that will include representatives from all of the principal national, provincial and local government agencies as well as representatives of key stakeholder groups. The purpose of the uThongathi EMF will be to provide a body for stakeholders with an interest in the future of the uThongathi Estuary to exchange information and ideas, and to reach agreement on action for the effective management of the estuary. It is essential that all these agencies work co-operatively to ensure the vision and defined management objectives can be realised. Individual agencies may also have to make provision for the funding required to fulfil their management obligations in the medium and long-term (Table 7.6).

Table 7.5 Management Action Plan for improving the recreational value and public access of the uThongathi Estuary.

Strategies	Actions	Deliverables/Indicators	Timing	Implementation	Indicative budget
1. Improve accessibility	i. Create a public parking area or enter discussions with Zimbali lakes to bring forward the development of public parking at the resort node..	• Official Parking available close to estuary mouth.		EMF, ETH, IDM & KDM, Zimbali lakes	
2. Establish and manage visitor's facilities.	ii. Erect informative and educational signage at key access points that highlights the ecological importance and value of the uThongathi Estuary.	• Visitors are sensitive to and aware of activities affecting health and functioning of the estuary, and management regulations governing use of the estuary.		EDTEA, EMF, ETH, IDM & KDM	Budget as per section 7.4.
	iii. Develop appropriate nature friendly infrastructure for visitors to the estuary (ablutions and parking) in collaboration with local communities and independent contractors that does not detract from sense of place of the area or impact on the environment.	• Visitor infrastructure and facilities have been erected.			R3 M
	iv. Ensure that visitor facilities are maintained in good condition at all times to maximise visitor experiences.	• Facilities receive good reviews.	ongoing		To be determined.
3. Improve visitor safety	i. Erect warning signage at key access points that highlights the presences of crocodiles within the estuary.	• Locals and visitors are aware of the danger	2021	EDTEA, EMF, EKZNW, ETH, IDM & KDM	To be determined.
4. Facilitate estuary protection and conservation	ii. Encourage the establishment of a nature conservancy on the southern banks.	• Registration of a conservancy		EMF, EKZNW	N/A

Table 7.6 Management Action Plan for harmonious and effective governance of the uThongathi Estuary.

Strategies	Actions	Deliverables/Indicators	Timing	Implementation	Indicative budget
1. Constitute the uThongathi Estuary Management Forum (EMF) [National Environmental Management Integrated Coastal Management Act 2008]	i. Invite representative members of stakeholders and government to be members of the uThongathi Estuary Management Forum (EMF)	• A list of members of the forum and their contact details	2021	EMF, CMF, EDTEA, DHSWS, DFFE, DMR, DEADP, EKZNW, ETH, IDM & KDM, Zimbali Lakes	R12 000 p.a.
2. Define co-operative governance arrangements for management of the uThongathi Estuary	i. Estuary management Forum to obtain agreement from participating agencies in respect of their roles and responsibilities and develop a working group with its own terms of reference, providing the "rules of the game' and defining the roles and responsibilities of all involved.	• Signed letters of commitment from all agencies to be involved with the management of the uThongathi Estuary	2021		N/A
3. Secure financing	i. Individual government agencies to make provision for the necessary resources in the short, medium and long-term expenditure frameworks to create and fill posts, and acquire necessary infrastructure and resources for effective management of the uThongathi Estuary	• Provision made for estuary management in budgets and expenditure frameworks	ongoing	EMF, CMF, EDTEA, DHSWS, DFFE, DMR, DEADP, EKZNW, ETH, IDM & KDM	N/A
	ii. Develop a long-term financing plan				
4. Develop adequate resources and capacity	i. Individual agencies to acquire access to necessary equipment (office equipment, water quality meter, boat, vehicle) for effective management of the uThongathi Estuary	• Staff & resources deployed for management of uThongathi Estuary		EMF, CMF, EDTEA, DHSWS, DFFE, DMR, DEADP, EKZNW, ETH, IDM & KDM	-
	ii. Individual agencies to identify and address training needs among staff involved in estuary management	• Training records			
	iii. Evaluate performance of staff, contractors and volunteers	• Performance evaluations			
5. Ensure that all stakeholders are informed regarding management progress and challenges faced	i. Create and administer a website/platform for the uThongathi Estuary Forum (upload minutes, photos, data, monitoring reports. Possibly include a blog/social media to facilitate discussions)	• Website is available and up to date		EMF, environmental authorities (website to be administered as part of the EMF?)	To be determined

7.7 Summary of Management actions and timing

Table 7.7 provides a summary of the tasks to be carried out over the next 5 years for the implementation of the uThongathi Estuary Management Plan. The KZN Department of Economic Development, Tourism and Environmental Affairs (EDTEA), is the primary agency responsible for the management of the estuary (mandated in terms of the National Estuary Management Protocol published under the National Environmental Management: Integrated Costal Management Act of 2008) but will be assisted by the eThekwini Metropolitan Municipality, and the KwaDukuza Local Municipality within the larger iLembe District Municipality, the uThongathi Estuary Management Forum and a range of other government agencies including the Department of Water and Sanitation (DWS), Department of Fisheries, Forestry and Environmental (DFFE), Ezemvelo KZN Wildlife (EKZNW), and the Eden District Municipality (EDM).

Table 7.7 **Summary of actions and timing of actions pertaining to each of the key result areas and management priorities over the period August 2021 – July 2026 (5 years). DHSWS = Department of Human Settlements, Water and Sanitation, CMF = Catchment Management Forum, EMF = Estuary Management Forum, DMR = Department of Mineral Resources, ETH = eThekwini Metropolitan Municipality, IDM = iLembe District Municipality & KDM = KwaDukuza Municipality.**

Key Result Area	Action	Agency responsible	2021	2022	2023	2024	2025	2026
Improve estuary health	Identify the sources driving the state of the receiving environment	DHSWS, CMF, EMF, ETH, IDM & KDM						
	Eradication/management of alien invasive species from the estuary, EFZ and catchment	EDTEA, DHSWS, CMF, EMF, ETH, IDM & KDM, SANBI, Zimbali Lakes						
	Facilitate removal of causeway	CMF, EMF, ETH, IDM & KDM, Zimbali Lakes						
Improve water quality	Identify pollution sources	DHSWS, CMF, EMF, ETH, IDM & KDM						
	Reduce inputs of pollutants to the uThongathi Estuary	DHSWS, CMF, EMF, ETH, IDM & KDM						
	Improve compliance	DHSWS, ETH, DMR, IDM & KDM						
Research and monitoring	Promote scientific research	DHSWS, CMF, EMF, ETH, IDM & KDM						
	Implement monitoring programme for biological, physical and chemical indicators of estuary health							
	Monitor human use of the estuary							
Enhance awareness and education	Create effective mechanisms for on-going communication with stakeholders and incident reporting strategy	DHSWS, CMF, EMF, ETH, IDM & KDM						
	Develop and implement an effective education and awareness programme for the estuary that enhances visitor experience							
Improve public access and recreational value	Improve accessibility	EMF, ETH, IDM & KDM, Zimbali lakes						
	Establish and manage visitor facilities	EDTEA, EMF, ETH, IDM & KDM						
	Improve visitor safety – Erect warning signs for crocodiles	EDTEA, EMF, EKZNW, ETH, IDM & KDM						
	Facilitate estuary protection and conservation	EMF, EKZNW						
Harmonious and effective governance	Constitute the uThongathi Estuary Management Forum.	EMF, CMF, EDTEA, DHSWS, DFFE, DMR, DEADP, EKZNW, ETH, IDM & KDM, Zimbali Lakes and private landowners						
	Define co-operative governance arrangements for the management of the estuary.							
	Secure financing for effective management.							
	Secure resources and capacity for effective management.							

8 INTEGRATED MONITORING PLAN

Monitoring is undertaken by the Department of Water and Sanitation (DWS)[2] for the protection of water resources especially those in estuarine environments which fall under the National Estuarine Monitoring Programme (NEsMP). The relative location of existing and new monitoring stations recommended for the EMP can be seen in Figure 8.1 and Table 8.1. The available data includes flow rate data recorded since 1967 captured by a flow gauging station (U3H001) located roughly 14.5 km upstream of the estuary mouth. Additionally, water quality in the uThongathi has been monitored by DWS at various stations (Figure 8.1) in the river and estuary since 2014. However, while these stations are recorded as being 'Active' data provided in 2020 was only available from 2014-2018 and a number of the stations did not include all the necessary water quality parameters. Monitoring at these stations should occur monthly and include all parameters, *viz* temperature, salinity/conductivity, pH, total suspended solids, oxygen, Nitrates, Nitrites, Ammonium, Phosphates and *E. coli*. There are two stations located at the mouth of the estuary that could be combined into one monitoring point as long as all parameters are recorded at the site. Additionally, new monitoring sites are recommended to gain a better understanding of conditions in the river and the estuary and to help determine the source of pollutants effecting the system.

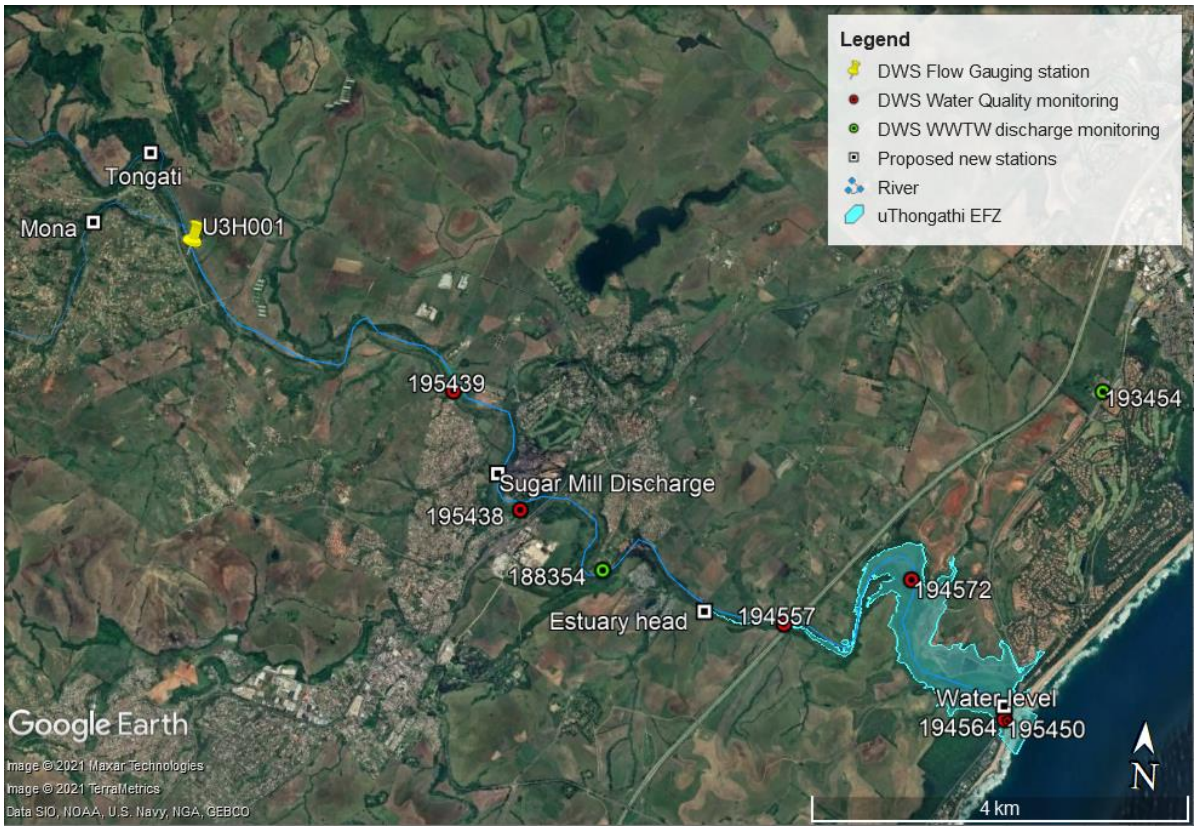


Figure 8.1 **Monitoring stations within the uThongathi River and Estuary. Coloured markers represent existing/active stations and white markers represent stations suggested for the EMP Estuary Monitoring Plan. Also shown are the river course and the Estuarine Functional Zone.**

[2] Department of Water and Sanitation is now a department/subsector under the Ministry of Human Settlements, Water and Sanitation (DHSWS)

New stations include: a water quality station at the bottom of each fork of the river leading into the main Tongati River (Figure 8.1), to help determine the level of pollution introduced into the main river from each source. Although flow rate within the river is determined at U3H001, before the estuary, water is diverted from the river into two dams and wastewater is discharged into the river. It is therefore recommended that another flow gauging station is installed at the head of the estuary to accurately determine the amount of water reaching the estuary. Additionally, the monitoring stations for the wastewater treatment works (WWTWs) discharge pipelines (188354 and 193454 Figure 8.1 and Table 8.1) must record both water quality parameters and total flow/discharge volumes. Wastewater from the sugar mill is being used for irrigation and there are plans to install an effluent treatment plant that will allow the Maidstone Sugar Mill to recycle and reuse a portion of its treated effluent, limiting the volume to be discharged to the river in the future (*Pers. Comm*. Sinthi Naidoo, Production manager at Tongaat Hulett, Feb 2021). However, it is still important to know the quality and quantity of wastewater discharged, even if only intermittently, and a monitoring station for water quality and flow/discharge volumes must be maintained at the sugar mill's discharge pipeline, similar to those of the WWTWs. The last recommended monitoring station includes a water level station at the mouth of the estuary which, along with a possible time lapse camera, can provide continuous data regarding the state of the mouth of the estuary. These devices can be provided by companies such as Obscape (already in use in eThekwini) or Water management companies such as or JOAT (in use by the Upper Mlazi Water User Association and Heatonville Irrigation Board). Before a water level gauge is installed, the EMF should communicate with the DWS as it has been proposed that they are investigating the replacement of a level gauge once present at the mouth. Additionally, it is noteworthy that there are water management platforms (Such as 'Hydrolytics' by JOAT) that have been developed to provide the mechanism for inter-departmental groups to share all critical information/data available on a system with all those involved (authorities and stakeholders).

It has been emphasised that the successful management, monitoring and report back of all activities occurring in and around estuaries requires an integrated monitoring plan that encapsulates all relevant monitoring activities undertaken by government departments (DWS, EDTEA, DFFE, provincial agencies and municipalities, Van Niekerk *et al.* 2015). Estuarine monitoring should be integrated and informed by and Estuarine Management Plan. The Guidelines for the development of an EMP (DEA 2015) highlight that three categories of monitoring are required for the effective management planning of individual estuaries, namely:

- **Resource monitoring**, which refers to specific ecological indicators that provide information of the state or health of the estuary as defined by the EFZ;
- **Compliance monitoring**, which relates to the intensity and character of activities/uses of the resource so as to test compliance with relevant laws and policies, as well as timeously identify potential threats; and
- **Performance monitoring**, which is aimed at gauging progress in terms of achieving the management objectives, and ultimately, the vision (and associated outcomes) for a particular estuary.

In the case of the uThongathi Estuary the Present Ecological State (PES) of the estuary is "D – heavily modified" (Van Niekerk *et al.* 2019) and it has been gazetted that the Target Ecological Category (TEC) for the uThongathi Estuary should be a "B/C" (Government Gazette 41306, Notice No. 1386 of 8 December 2017).

Table 8.1 Station ID, status and GPS location for existing and recommended new monitoring stations in the uThongathi River and Estuary.

Monitoring station ID	Status	Location	GPS coordinates
Water Quality Parameters			
194564	Existing - DWS	Estuary Mouth.	29°34'21.43"S, 31°11'04.81"E
195450	Existing - DWS	Estuary Mouth.	29°34'21.00"S, 31°11'03.80"E
194572	Existing - DWS	Middle reaches of estuary.	29°33'35.28"S, 31°10'24.67"E
194557	Existing - DWS	Upper reaches of estuary.	29°33'53.14"S, 31°09'34.79"E
195438	Existing - DWS	Downstream of sugar mill.	29°33'19.44"S, 31°07'47.10"E
195439	Existing - DWS	Upstream of sugar mill.	29°32'39.48"S, 31°07'17.11"E
Mona Tributary	Recommended	Above split in river: on the Mona river.	29°31'21.28"S, 31°05'06.90"E
Tongati Tributary	Recommended	Above split in river: on the Tongati river.	29°31'47.34"S, 31°04'46.05"E
Discharge monitoring station (Water quality and flow rate/discharge volumes)			
193454	Existing	Frasers Wastewater Treatment Works.	To be determined – approx. 29°32'25.80"S, 31°11'38.40"E
188354	Existing	Tongaat Central Wastewater Treatment Works.	To be determined – approx.. 29°33'38.52"S, 31°08'21.48"E
Sugar Mill discharge	Recommended	At the Maidstone Sugar Mill discharge point.	To be determined
Flow Gauging station			
U3H001	Existing - DWS	Weir roughly 14.5km from the mouth of the estuary.	29°31'57.46"S, 31°05'25.00"E
Estuary head	Recommended	Just above head of estuary to determine incoming flow.	29°33'50.28"S, 31°09'03.49"E
Water Level			
Water level	Recommended	Estuary Mouth on the M4 bridge	To be determined – approx. 29°34'18.77"S, 31°11'05.47"E

Table 8.2 provides a list of recommended abiotic and biotic parameters to be monitored for the uThongathi Estuary. These generic recommendations were sourced from Van Niekerk *et al.* (2015) and were adapted where necessary to reflect the specific needs of the uThongathi Estuary and to align future monitoring with existing monitoring wherever possible. Early detection of low oxygen events, eutrophication risks or bacterial contamination and their appropriate management actions (short to long-term interventions) rely on continued monitoring that is aligned with existing water quality sampling locations and methods of the DWS. Refer to Figure 8.1 and Table 8.1 for the location of the recommended water quality monitoring stations. In line with recommendations by DWS the monitoring programme includes a baseline survey and ongoing monitoring thereafter to assess changes in health of the system over time. Recommendations for monitoring of visitor numbers, profiles and opinions, and angler catch and effort required in terms of the management plan are also included here.

Table 8.2 Recommended baseline and long-term monitoring protocols for the uThongathi Estuary. Monitoring parameters include biotic and abiotic components and are modified from the generic monitoring protocol provided in Van Niekerk *et al*. 2015.

Ecological Component	Monitoring Action	Temporal Scale (frequency and when)	Spatial Scale (No. Stations)
Hydrology	Record river inflow at the head of the estuary, near the upstream boundary of the estuary	Continuous	Install recorder at estuary head
	Obtain effluent volumes released into the estuary from the WWTW and other discharge points (Tongaat Hulett)	Monthly	WWTW/industry outfall point
Hydrodynamics	Record water level in the estuary	Continuous	Install a recorder at the mouth/M4 road bridge.
	Measure freshwater inflow into the estuary	Continuous	Install a flow gauge near head of estuary
	Aerial/Satellite photographs of estuary	Once-off (baseline), thereafter every year.	Entire estuary
	Mouth State: • Take at least one photo from the same angle each time. • Note whether the estuary is open, closed or overflowing. Note whether there is evidence of illegal artificial breaching.	Weekly.	Mouth
Sediment dynamics	Bathymetric surveys: Series of cross-section profiles and a longitudinal profile collected at fixed 200-500 m intervals, but in more detail in the mouth (every 100 m). The vertical accuracy should be about 5 cm.	Once-off (baseline before the removal of the causeway and 1 year after), thereafter every three years and after large re-setting event.	Entire estuary.
	Collect sediment grab samples (at cross section profiles) for analysis of particle size distribution (and ideally origin, using microscopic observations).	Once-off (baseline), thereafter every three years (concurrent with benthic invertebrate sampling)	Entire estuary
Water quality	Water quality (e.g. system variables (e.g. pH, oxygen, turbidity), nutrients and toxic substances) measurements on river water entering at the head of the estuary.	Monthly continuous	Close proximity to head of estuary
	Longitudinal salinity and temperature profiles (in situ) collected over a spring and neap tide during high and low tide at: • end of low flow season (i.e. period of maximum seawater intrusion) • peak of high flow season (i.e. period of maximum flushing by river water.	Seasonally every year	Entire estuary (3-10 stations)

Ecological Component	Monitoring Action	Temporal Scale (frequency and when)	Spatial Scale (No. Stations)
	System variables: pH, oxygen, total suspended solids & nutrients: nitrate, nitrite, ammonia, phosphate.	Monthly	At all stations. (Surface and bottom water)
	Measurements of organic content and toxic substances (e.g. trace metals and hydrocarbons) in sediments along length of the estuary, where considered an issue.	Once-off (baseline), thereafter every three to five years.	Focus on sheltered, depositional areas (i.e. muddy areas, to be determined)
	Dissolved oxygen and surface water temperature.	Take daily measurements for 30 days if insufficiently treated sewage has been released into the estuary. Dissolved oxygen must be measured before sunrise (DO minimum is expected at night)	At all stations
	E. coli and *Enterococci*	Monthly. Weekly for one month after insufficiently treated sewage has been released into the estuary from WWTW.	At all stations
Microalgae	• Record relative abundance of dominant phytoplankton groups, i.e. flagellates, dinoflagellates, diatoms, chlorophytes and blue-green algae (cyanobacteria). • Intertidal and subtidal benthic chlorophyll-a measurements (4 replicates each) using a recognised technique, e.g. sediment corer or fluoroprobe. • Chlorophyll-a measurements taken at the surface and 1 m depths, under typically high and low flow conditions using a recognised technique, e.g. spectrophotometer, HPLC, fluoroprobe.	Summer and winter survey baseline survey, thereafter seasonal surveys every 3 years.	Along length of estuary. (3-10 stations)
Macrophytes	• Develop ground-truthed maps: Map area covered by different macrophyte habitats using recent imagery. Conduct field survey to record total number of macrophytes habitats, identification and total number of macrophytes species, number of rare or endangered species, or those with limited populations.	Once-off in summer (baseline). Thereafter every three years in the late summer.	Entire estuary
	• Assess extent of Invasive Alien Aquatic Plants (IAAPs) in EFZ (see Nunes et al 2020).	Seasonally: summer and winter (July/August), with surveys preferably conducted via boat. Monthly winter monitoring would be beneficial as the species composition of IAAPs changes, influencing the selection of appropriate biocontrol agents.	Entire estuary

Ecological Component	Monitoring Action	Temporal Scale (frequency and when)	Spatial Scale (No. Stations)
Riparian vegetation and coastal forests	• Conduct comprehensive vegetation mapping to identify, enumerate and determine the location of all terrestrial vegetation types, especially isolated pockets of natural, sensitive coastal forest vegetation along the full length of the estuary.	Once-off in summer (baseline). Thereafter every three years in summer.	Entire estuary
	• Assess extent of invasive plant species in the EFZ	Annually in the summer	Entire Estuarine functional zone
Invertebrates	• Record species and abundance of zooplankton, from mid-water levels using WP2 nets (190 um mesh), based on samples collected across the estuary at each of a series of stations. • Record benthic invertebrate species, abundance and biomass, based on subtidal and intertidal grab samples at a series of stations up the estuary, and counts of hole densities from the bottom substrate in mid-channel areas at same sites as zooplankton (each sample to be sieved through 500 um). • Intertidal invertebrate hole counts using 0.25 m^2 grid (3 replicates per site). Establish the species concerned (*Kraussillichirus kraussi* or *Upogebia Africana*) using a prawn pump. • Collect sediment samples using the grab for particle size analysis and organic content (at same sites as zooplankton) (preferably link with sediment dynamics)	Summer and winter survey baseline survey, thereafter seasonal surveys every 3 years.	Entire estuary (3-10 stations) For hole counts –three sites in each of muddy or sandy areas,
Fish	• Record species and abundance of fish, based on seine net and gill net sampling. **Ongoing:** • **In the event of fish kills:** Identify species, count, measure, and weigh dead fish.	Once-off in summer & winter (baseline). Thereafter in summer & winter every three years. **Ongoing:** Monitor daily until no more deaths occur (refer to section 11.2)	3-5 stations (mouth, mid, top) **Ongoing:** **Fish kills**: Entire estuary
Birds	Undertake counts of all water-associated birds. All birds should be identified to species level and total number of each counted, covering as much of the estuarine area as possible, from a boat and on foot.	Annual winter (Jul/Aug) and summer (Jan/Feb) surveys	Entire estuary, continuous methodology – see CWAC data for methodology.
Human use	Survey visitor and local opinions on impacts of key management interventions.	Every two years	Entire estuary

Ecological Component	Monitoring Action	Temporal Scale (frequency and when)	Spatial Scale (No. Stations)
	Fisheries Creel surveys of Catch, Effort and C.P.U.E. for shore-based anglers.	Conduct a survey on five randomly selected days (include weekends and public holidays) over a two-month period during peak holidays (December & January). Repeat every 5 years.	Entire estuary
	Collect statistics on the profile (origin, sex, age, income category) and activities of visitors to the uThongathi Estuary using self-fill in questionnaires	Continuous	Visitor entry points and key sites of interest

9 INSTITUTIONAL CAPACITY AND ARRANGEMENTS

South Africa has an extensive legal framework for governing the protection and sustainable use of the coastal marine environment including at least 19 international obligations and agreements to which the country is signatory and approximately 46 national acts (Taljaard 2011, DEA 2014 and Taljaard *et al*. 2019).

The authorities responsible for developing and implementing an Estuary Management Plan depends on the location of the estuary. In the case of the uThongathi Estuary, which falls on the boundary of three municipalities, the authority falls to the provincial environmental department (EDTEA) and the affected municipalities or local government i.e. eThekwini Metro, iLembe District Municipality and KwaDukuza Local Municipality. However, the environmental legal landscape is highly fragmented, with the responsibility of a large proportion of the governing activities and developments, potentially impacting on the estuary, distributed across a range of sector-based government departments. It is therefore strongly recommended that a governmental/authorities subcommittee or working group be developed within the estuarine management forum. This group will include representatives from all the government sectors responsible for monitoring and enforcement within the estuary. The working group will need to develop its own constitution (framework for governance), as well as terms of reference for the estuary forum, providing the "rules of the game' so that those joining the forum understand how the roles and responsibilities will be assigned. Therefore, also providing a guide for management that is in line with the vision of the estuary provided in this plan.

As a result of both natural processes and anthropogenic activities estuaries are dynamic systems which are continuously experiencing changing conditions. Consequently, an effective management plan for an estuary must retain flexibility so that modifications can be made in relation to environmental change and changes in human activities. The EMP therefore needs to be considered as an evolving programme of co-operative government, communication and action, rather than a one-off, all embracing management plan.

The management actions outlined in this EMP are not exhaustive and should be added to as the plan progresses and goals are achieved. Additionally, when new issues come to light, and as existing issues are resolved, the necessary adjustments to the EMP should be made. This EMP is regarded as the first of a series of evolving/rolling five-year plans, with the EMP being subject to on-going review and performance monitoring to ensure continuing validity and relevance.

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11 APPENDICES

11.1 Appendix 1: uThongathi RQOs (DWS 2015b)

<table>
<tr><td colspan="2">PES:</td><td>D</td><td colspan="2">REC:</td><td>C</td><td colspan="2">TEC:</td><td>D*</td></tr>
<tr><td colspan="9">Key components that require protection to maintain the TEC:
• Baseflows to estuary to maintain mouth state and salinity profile.
• Maintain water quality; and
• Maintain of estuarine riparian habitat.

Components that require interventions to achieve the REC include:
• Restore baseflows to estuary to improve mouth state and salinity profile.
• A significant improvement in water quality needed; and
• Partial restoration of estuarine habitat.
• Remove weir/causeway in upper reaches.
• Prevent low oxygen events that results in fish kills.</td></tr>
<tr><td colspan="9">Flow:</td></tr>
<tr><td>PES</td><td colspan="4">nMAR (MCM)</td><td colspan="4">pMAR (MCM)</td></tr>
<tr><td rowspan="2">C</td><td colspan="4">70.79</td><td colspan="4">79.21</td></tr>
<tr><td colspan="8">Flows should not exceed natural and seasonal distribution should not be compromised. Current baseflows should be upheld into estuary to maintain present mouth state and salinity regime. The distribution patterns of the flood components differ by no more than 10% (in terms of magnitude, timing and variability) from that of the Present (2015).

Present flows poses a risk to the REC.</td></tr>
<tr><td colspan="9">Sediment processes:</td></tr>
<tr><td>D</td><td colspan="8">• The flood regime maintain the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow do not deviates by more than 20% of the present sediment load-discharge relationship (to be determined). The sedimentation and erosion patterns in the estuary do not differ significantly from present (± 0.5 m) (to be determined).
• Changes in tidal amplitude of less than 20% from present (to be determined).
• Changes in sediment grain size distribution patterns similar to present. The median bed sediment diameter deviates by less than a factor of two from present levels (to be determined). The sand/mud distributions in middle and upper reaches do not change by more than 20% from Present State over a five year average.</td></tr>
<tr><td colspan="9">Mouth state:</td></tr>
<tr><td>B</td><td colspan="8">Mouth open conditions should be maintained within the current range: 84% (± 10%).</td></tr>
<tr><td colspan="9">Water quality: Salinity</td></tr>
<tr><td>C</td><td colspan="8">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="9">Water quality: Other</td></tr>
<tr><td rowspan="2">F</td><td colspan="5">Ecosystem health:</td><td colspan="3">Recreational use:</td><td>N/A</td></tr>
<tr><td colspan="5">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="4">Not identified as recreational area in stakeholder meeting</td></tr>
</table>

Macrophytes (plants)	
D	• Maintain the distribution of current macrophyte habitats (< 20 % change in the area covered by different macrophyte habitats which accounts for natural changes due to the dynamic nature of estuaries). • Maintain the integrity of the riparian zone. No further bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. In particular by sugarcane cultivation in the EFZ. • No invasive floating aquatic species present in the estuary e.g. water hyacinth. • Control the spread of invasive plants in the riparian zone. Invasive plants (e.g. syringa berry, Casuarina, Spanish reed, black wattle, Brazilian pepper tree) cover <5% of total macrophyte area. • Maintain present salinity regime to maintain reed & sedge habitats (< 50 % loss of reed & sedge habitats in non-flood year).
Inverts	
E	As sampled by plankton net, grab and dip nets/traps (as appropriate): • Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 50%. • Zooplankton should be dominated by estuarine copepods *Acartia natalensis* and *Pseudodiaptomus hessei*, but include other groups such as mysids. Meroplankton occur frequently. • Macrobenthos should be abundant and dominated by polychaetes but should include amphipods, isopods, tanaids, polychaetes and the crab *Hymenosoma projectum.* Insect taxa should occur in the far upper reaches only. • Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos. • Penaeid and carid prawns should occur. • Sandprawn *Callichirus kraussi* should occur in sandy areas in the systems lower reaches (to be confirmed). • Molluscan assemblage should include bivalves and gastropods. • Large brachyuran crabs (macrocrustacea) should include *Scylla serrata*, *Varuna litterata, Macrophthalmus sp.,* Sesarmidae and *Uca sp,* • Invasive alien species do not dominate macrobenthos in lower reaches.
Fish	
E	As sampled by seine and gill net in open waters: • 10 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes. • Estuarine resident species should comprise a minimum of 3 species. • *Glossogobius callidus, Myxus capensis* and *Rhabdosargus holubi* should occur with 100% frequency of occurrence (every sampling trip). • *Pomadasys commersonni* should be sampled with 30% frequency of occurrence. • Pelagic piscivores should occur (including *Caranx* spp.). • No alien fish species should occur. • Fish should be free of lesions and other anomalies related to water quality. No fish kills should occur.

11.2 Appendix 2: National response protocol for fish kills

Large-scale fish kills have become a common phenomenon in estuaries impacted by anthropogenic activities. The most recent fish kills in the uThongathi Estuary occurred in August/September of 2018 and 2020. An understanding of the causes of fish kills that may occur in future is fundamental in order to implement preventative measures to reduce their frequency and magnitude in the long-term. Grant *et al.* (2014) recognised the need for a nationally applicable response protocol for fish kills to streamline the investigation and reporting of fish kill incidents. This protocol has four phases including the Pre-Incident Phase, the Trigger Phase, the Investigation Phase and the Stand-down Phase. The Protocol should be consulted for detailed explanations and actions to be taken to successfully complete each of these phases.

The pre-incident phase of a fish kill investigation represents any stage where no fish kill incident is reported or no fish kill investigation is active, and encompasses a range of ongoing tasks that will develop and maintain a level of preparedness in the event of a fish kill occurring. Such tasks include:

- interdepartmental and interdisciplinary communication;
- public awareness communication;
- obtaining and maintaining fish kill investigation kits and sample containers;
- identification and communication with relevant specialists and laboratories able to
- provide the necessary analyses; and
- training.

The remaining three phases, i.e. the Trigger Phase, the Investigation Phase and the Stand-down Phase are shown in form of decision tree diagrams in Figure 11.1. Figure 11.2 shows a recommended decision tree to establish whether a detailed fish kill investigation is required.

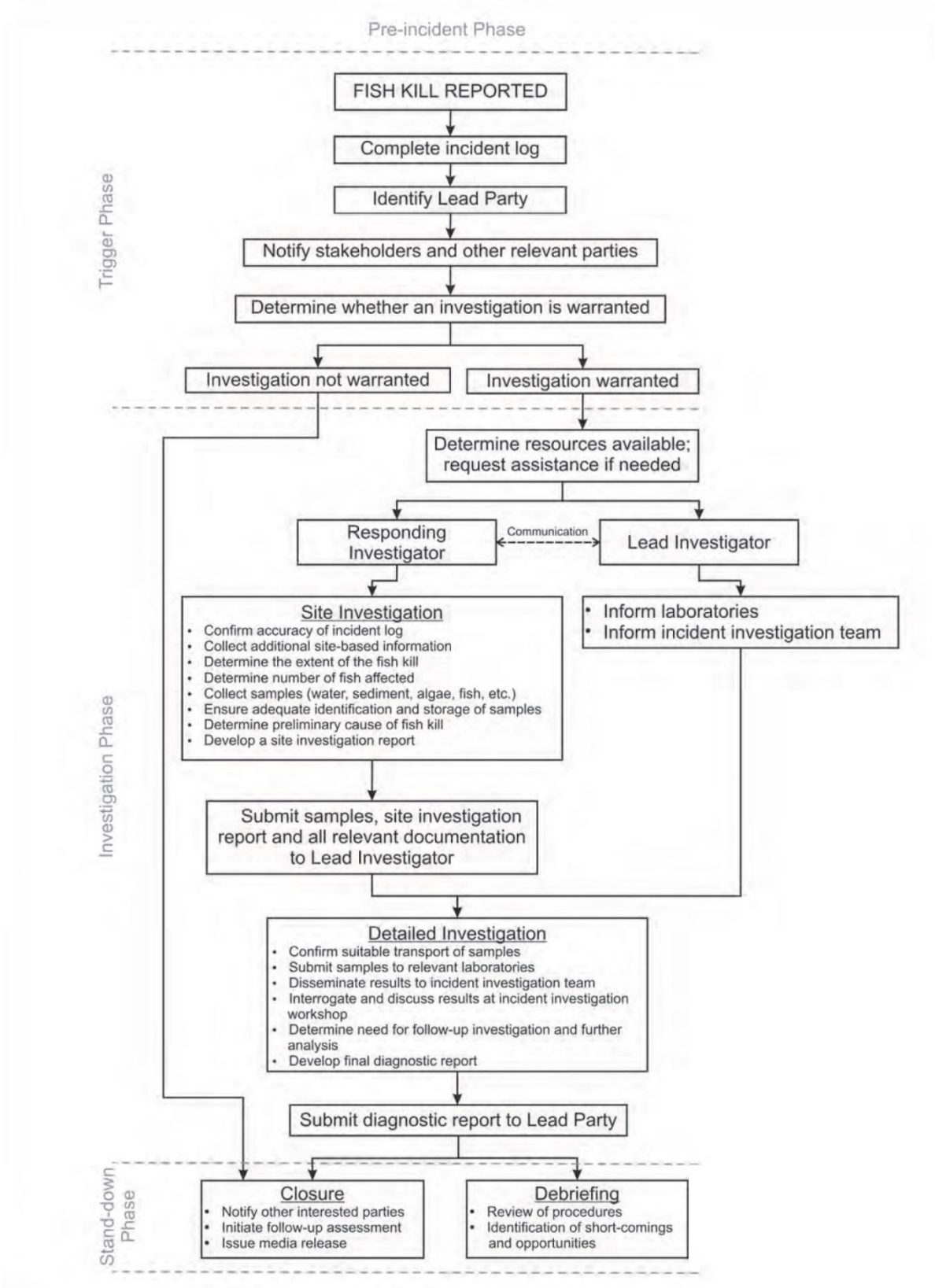


Figure 11.1 **Fish kill investigation protocol showing steps to be taken during the Trigger, Investigation and Stand-down phases (Source: Grant et al. 2014).**

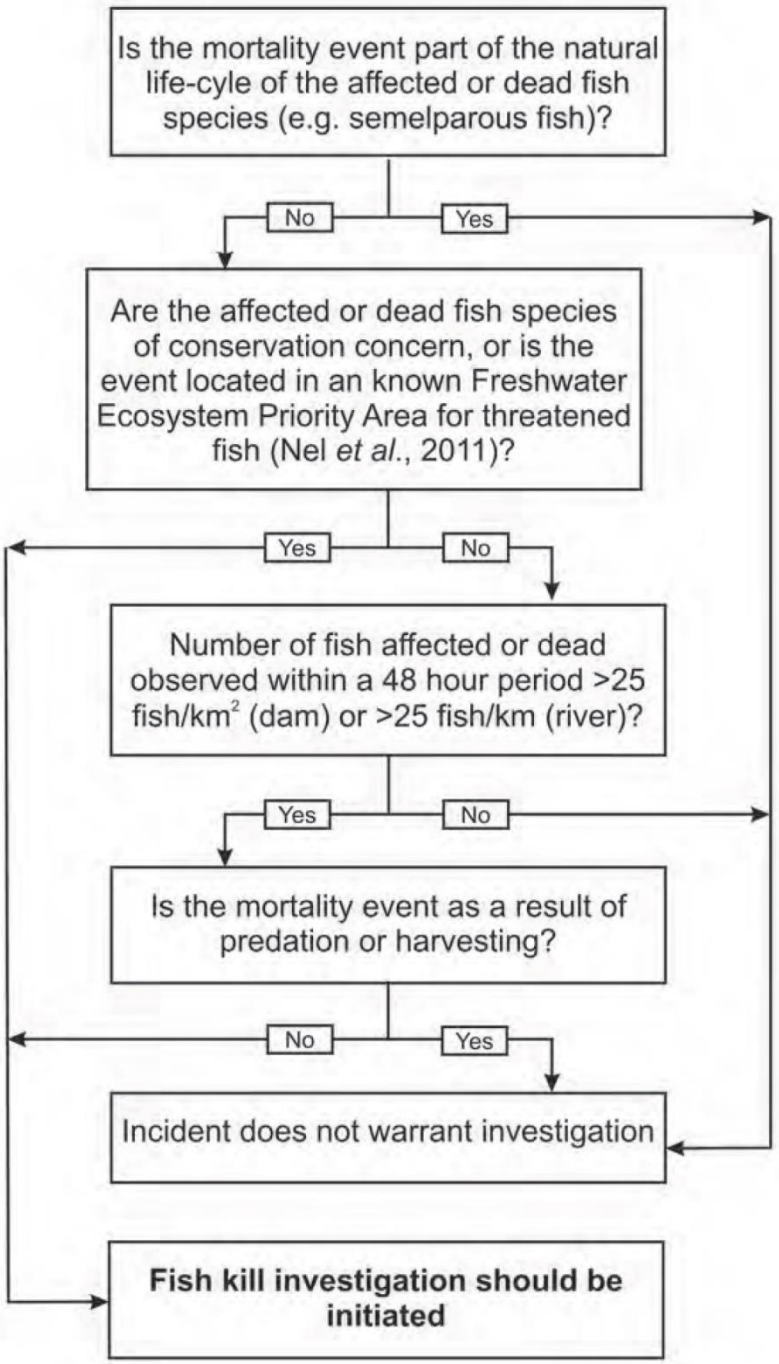


Figure 11.2 **Recommended decision tree for determining the need for a detailed fish kill investigation (Source: Grant *et al.* 2014).**

11.3 Appendix 3: Listed activities for which an EIA is required for estuaries according to the National Environmental Management Act (NEMA)

GN R. 983: Listing Notice 1 – Basic Assessment

List No.	Activity description
17	Development- (i) in the sea; (ii) in an estuary; (iii) within the littoral active zone; (iv) in front of a development setback; or (v) if no development setback exists, within a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever is the greater; in respect of- (a) fixed or floating jetties and slipways; (b) tidal pools; (c) embankments; (d) rock revetments or stabilising structures including stabilising walls; (e) buildings of 50 square metres or more; or (f) infrastructure with a development footprint of 50 square metres or more - but excluding- I. the development of infrastructure and structures within existing ports or harbours that will not increase the development footprint of the port or harbour; II. where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; III. the development of temporary infrastructure or structures where such structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared; or IV. where such development occurs within an urban area.
19	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from- (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater – but – excluding where such infilling, depositing , dredging, excavation, removal or moving- (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance (c) management plan; or (d) falls within the ambit of activity 21 in this Notice, in which case that activity applies.
54	The expansion of facilities - (i) in the sea; (ii) in an estuary; (iii) within the littoral active zone;

List No.	Activity description
	(iv) in front of a development setback; or (v) if no development setback exists, within a distance of 100 metres inland of the high water mark of the sea or an estuary, whichever is the greater; in respect of- (a) fixed or floating jetties and slipways; (b) tidal pools; (c) embankments; (d) rock revetments or stabilising structures including stabilising walls; (e) buildings where the building is expanded by 50 square metres or more; or (f) infrastructure where the development footprint is expanded by 50 square metres or more, but excluding- I. the expansion of infrastructure or structures within existing ports or harbours that II. will not increase the development footprint of the port or harbour; or III. where such expansion occurs within an urban area.
55	Expansion- (i) in the sea; (ii) in an estuary; (iii) within the littoral active zone; (iv) in front of a development setback; or (v) if no development setback exists, within a distance of 100 metres inland of the high water mark of the sea or an estuary, whichever is the greater; in respect of- (a) facilities associated with the arrival and departure of vessels and the handling of cargo; (b) piers; (c) inter- and sub-tidal structures for entrapment of sand; (d) breakwater structures; (e) coastal marinas; (f) coastal harbours or ports; (g) tunnels; or (h) underwater channels; but excluding the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.

GN R. 984 Listing Notice 2: Scoping & EIA

List No.	Activity description
26	Development-- (i) in the sea; (ii) in an estuary; (iii) within the littoral active zone; (iv) in front of a development setback; or (v) if no development setback exists, within a distance of 100 metres inland of the high-water (vi) mark of the sea or an estuary, whichever is the greater; in respect of - (a) facilities associated with the arrival and departure of vessels and the handling of cargo; (b) piers; (c) inter- and sub-tidal structures for entrapment of sand; (d) breakwater structures; (e) coastal marinas; (f) coastal harbours or ports; (g) tunnels; or (h) underwater channels; but excluding the development of structures within existing ports or harbours that will not increase the development footprint of the port or harbour.

GN R. 985 Listing Notice 3: Basic Assessment

List No.	Activity description
4	The development of a road wider than 4 metres with a reserve less than 13,5 metres. (d) In KwaZulu Natal: **i. In an estuarine functional zone** **xi.** Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; xiii. In urban areas; (aa) - Areas zoned for use as public open space; (bb) - Seawards of the development setback line or within 100 metres from the high-water mark of the sea if no such development setback line is determined; or (cc) - Within urban protected areas.
5	The development of resorts, lodges, hotels and tourism or hospitality facilities that sleep less than 15 people. a) A protected area identified in terms of the NEMPAA; b) Outside urban areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; f) In KwaZulu Natal: v. In an estuarine functional zone ix. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority xiii. In urban areas; (aa) - Areas zoned for use as public open space;

List No.	Activity description
	(bb) - Seawards of the development setback line or within 100 metres from the high-water mark of the sea if no such development setback line is determined
6	The development of resorts, lodges, hotels and tourism or hospitality facilities that sleeps 15 people or more. (d) in KwaZulu Natal i. In an estuarine functional zone ii. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority xiii. In urban areas; (aa) - Areas zoned for use as public open space; (bb) - Seawards of the development setback line or within 100 metres from the high-water mark of the sea if no such development setback line is determined
10	The development of facilities or infrastructure for the storage, or the storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres. (d) In KwaZulu Natal: **i. In an estuarine functional zone** **xii.** Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; xiv. In urban areas; (aa) - Areas zoned for use as public open space; (bb) - Seawards of the development setback line or within 100 metres from the high-water mark of the sea if no such development setback line is determined; or (cc) - Within urban protected areas.
12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. (b) In KwaZulu Natal: vi. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; **xii.** Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; **xiii. In an estuarine functional zone**
14	The development of- (i) canals exceeding 10 square metres in size ; (ii) channels exceeding 10 square metres in size; (iii) bridges exceeding 10 square metres in size; (iv) dams, where the dam, including infrastructure and water surface area exceeds 10 square metres in size; (v) weirs, where the weir, including infrastructure and water surface area exceeds 10 square metres in size; (vi) bulk storm water outlet structures exceeding 10 square metres in size; (vii) marinas exceeding 10 square metres in size; (viii) jetties exceeding 10 square metres in size; (ix) slipways exceeding 10 square metres in size; (x) buildings exceeding 10 square metres in size; (xi) boardwalks exceeding 10 square metres in size; or (xii) (xii) infrastructure or structures with a physical footprint of 10 square metres or more Where such development occurs –

List No.	Activity description
	(a) Within a watercourse; (b) In front of a development setback; or (c) If no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; Excluding the development of infrastructure or structure within existing ports or harbours that will not increase the development footprint of the port or harbour. (d) In KwaZulu Natal: i. In an estuarine functional zone viii. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; xi. In urban areas; (aa) - Areas zoned for use as public open space; (bb) - Seawards of the development setback line or within 100 metres from the high-water mark of the sea if no such development setback line is determined; or (cc) - Within urban protected areas.
17	The expansion of a resort, lodge, hotel and tourism or hospitality facilities where the development footprint will be expanded. (d) In KwaZulu Natal: iv. In an estuarine functional zone xi. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; xiii. In urban areas; (aa) - Areas zoned for use as public open space; (bb) - Seawards of the development setback line or within 100 metres from the high-water mark of the sea if no such development setback line is determined; or (cc) - Within urban protected areas.
18	The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre (d) In KwaZulu Natal: v. In an estuarine functional zone xi. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; xiii. In urban areas; (aa) - Areas zoned for use as public open space; (bb) - Seawards of the development setback line or within 100 metres from the high-water mark of the sea if no such development setback line is determined; or (cc) - Within urban protected areas.
22	The expansion of facilities or infrastructure for the storage, or the storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres. v. In an estuarine functional zone xii. Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; xiv. In urban areas; (aa) - Areas zoned for use as public open space; (bb) - Seawards of the development setback line or within 100 metres from the high-water mark of the sea if no such development setback line is determined.



KWAZULU-NATAL PROVINCE

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