

AMAHLONGWA ESTUARY MANAGEMENT PLAN FINAL REPORT

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Prepared by



For

Triplo 4

and



Department of Economic Development, Tourism and Environmental Affairs, Province of
Kwazulu-Natal



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GLOSSARY

Abiotic	Non-living characteristics of a habitat or ecosystem that affect organisms' life processes.
Algae	Chlorophyll containing non-vascular organisms, plant or plant-like.
Alien	A species that occurs outside of its natural range and dispersal potential.
Biotic	Referring to living things
Benthic	Describing the substrate or bottom of a water body.
Benthos	Bottom-dwelling plants and animals from bacteria to the highly visible macrobenthos such as mussels, crabs and worms.
Catchment area	The area from which rainfall flows/drains into the estuary.
Estuary	A semi-enclosed body of water at the coast where land derived freshwater drainage at times meets the sea and within which seawater is measurably diluted by fresh water derived from land drainage.
Eutrophication	Process by which additions of nutrients (phosphates and/or nitrates) causes imbalances in algal and/or emergent plant growth.
Floodplain	Broad and relatively flat area on either side of a stream, river or estuary 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 the area being considered which were transported to their current location by artificial means allowing them 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 that does not have a backbone (<i>e.g.</i> a prawn, crab, or worm).
Legislation	Laws, legal requirements or the process of making or enacting laws.
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 groups.

LIST OF ABBREVIATIONS

CMP	Coastal Management Programme
DEDTEA	Department of Economic Development, Tourism and Environmental Affairs KZN
EC	Ecological Category
EFZ	Estuarine Functional Zone
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
EMP	Estuarine Management Plan
DWA	Department of Water Affairs (Changed after 2008)
DWS	Department of Water Affairs and Sanitation (Changed after May 2014)
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
MER	Marine and Estuarine Research
MLRA	Marine Living Resources Act (Act No. 18 of 1998, amended 2000)
MPA	Marine Protected Area
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act (Act No. 107 of 1998)
PES	Present Ecological State
Protocol	National Estuarine Management Protocol
REC	Recommended Ecological Category
SAR	Situation Assessment Report

aMahlongwa Estuary Management Plan



1 INTRODUCTION

1.1 Background

Estuaries along the South African coast are complex environments because they are subjected to dynamic processes arising from adjoining marine, riverine and terrestrial ecosystems. They form a connection between marine and freshwater systems and are part of regional, national, and global ecosystems linked either directly via water flows or indirectly through the movement of fauna. Along the sub-tropical KwaZulu-Natal coastline these systems are important assets supporting and providing important goods and services to the area and acting as attractive nodes for tourism and development.

1.2 Context of the Estuary Management Plan

A Situation Assessment Report (SAR) typically precedes an Estuarine Management Plan (EMP) which in combination form a sound platform to provide action plans and guidance on the best management practices. The development of an EMP is required in terms of Chapter 4, Section 34 of the National Environmental Management: Integrated Coastal Management Act, 2008 (Act 24 of 2008) ("Act") and the National Estuarine Management Protocol of 2013 ("the Protocol"). These serve as the guiding documents for the

development and implementation of EMPs. In addition, the EMP must be consistent with the National, Provincial and Municipal Coastal Management Programmes (CMP) requiring that these be taken into account as part of the process. In addition, the Department of Environmental Affairs has developed holistic and inclusive *"Guidelines for the development and implementation of Estuarine Management Plans"* to supplement the Protocol in providing clear procedures and guidance to the responsible management authority who develop and coordinate the implementation of EMPs (DEA 2015). Under the Provincial CMP, it is a requirement that strategies be developed for the effective and co-operative management of the coastal zone. It is taken as a given in this management plan that it is implicit that management refers to control of human activities in order to allow and maintain the natural functioning of coastal ecosystems, specifically including estuaries. At this point the prime anthropogenic activities impacting on or degrading estuarine function are well-known.

In the case of estuaries situated at the boundary between municipalities, in this instance between eThekweni and Ugu District Municipalities, the responsibility for the development of an EMP falls to the KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs (DEDTEA). This is the case for the aMahlomgwa Estuary.

An estuarine management framework, based on the minimum requirements stipulated in the Protocol, is required to be structured in terms of the three main phases, namely the Scoping phase, Objective setting phase and the Implementation phase.

The **Scoping** phase comprises a situation assessment to reflect on the current status of estuarine management in a specific estuary, conducted in collaboration with other relevant lead authorities and interested and affected parties, including estuarine scientists. This phase has been completed and is available in final form (MER 2021).

The **Objective** setting phase leads into the preparation of the Estuarine Management Plan, in accordance with the minimum requirements of the Protocol. The Objectives and vision for the estuary were developed in consultation with the I&APs during the meeting to present the Situation Assessment Report and is reported on here and in the Stakeholder Report by Triplo 4.

The **Implementation** phase comprises the execution and monitoring of the estuarine management plan. During the implementation phase responsible departments (or sectors) are required to develop project plans for management priorities identified in the estuarine management plan, and to execute and monitor progress in accordance with monitoring plans. In the implementation on management plan an adaptive management approach (*i.e.* learning-by doing) should be followed where new learning (*e.g.* gained through monitoring) is continuously used to improve implementation strategies and execution of projects, and ultimately to improve the estuarine management plan. A detailed review of the estuarine management plan needs to be conducted at least every five (5) years in accordance with the Protocol.

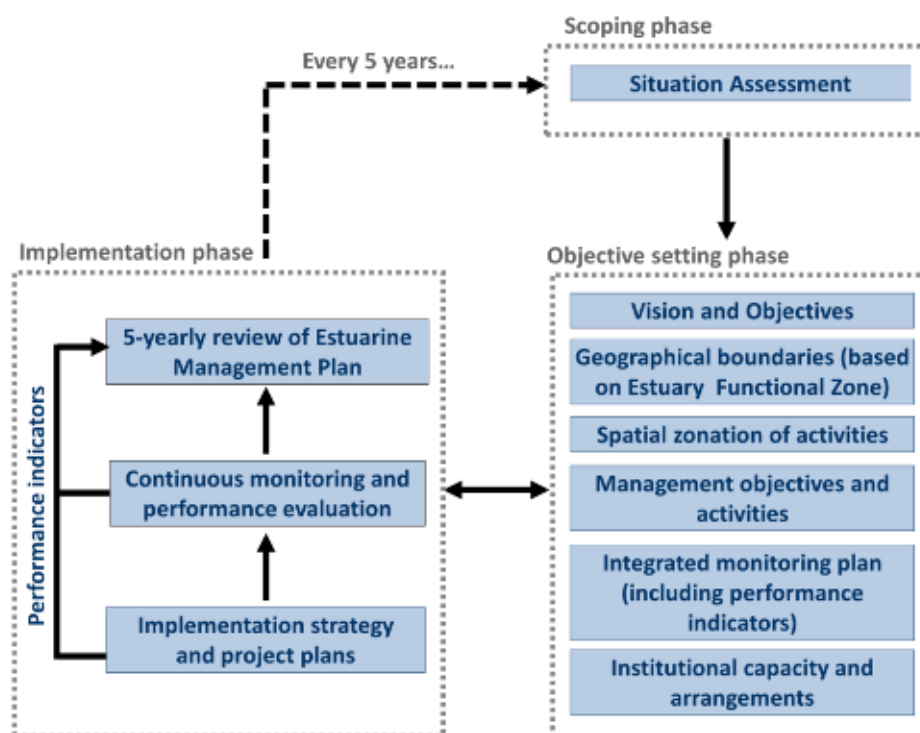


Figure 1-1 *Framework for integrated Estuary Management in South Africa (DEA 2015)*

2 SUMMARY OF THE SITUATION ASSESSMENT REPORT

The summary extracts relevant sections of the SAR (MER 2021) where these reflect the position of the aMahlongwa on the KZN coast, followed by anthropogenic impacts and changes, and particularly where these changes have the potential for adverse impact and thereby require management, mitigation, or possible reversal.

2.1 Position, major features and classification of the estuary

The aMahlongwa estuary is situated at 30°16'06" S; 30°45'54" E approximately 65 km south of Durban. It lies on the boundary between the eThekweni and Ugu District Municipalities and within the Umdoni Municipality. The most recent classification describes the estuary as a "Small Temporarily Closed Estuary", the most numerous estuary type in the sub-tropical geographic zone. This classification level is defined as an estuary smaller than 15 ha and open to the sea less than 50% of the time (van Niekerk, Skowno *et al.* 2019b). The aMahlongwa is highly unusual in a KZN context in that daily mouth condition data cover the period between January 1980 and June 2020 and indicate closure for 78% of the time and conversely open conditions for 22% of the time. This appears to be a largely natural cycle with artificial breaching having been rare since the late 90's. There is little evidence of the extensive sugar cane fields typical of coastal KZN until the area immediately to the west of the N2 is reached. Also of high significance is the adjacent Aliwal Shoal Marine Protected Area.

The railway bridge and the national road bridge cross just above the mouth area while the N2 is approximately 4 km upstream. The sandbar generally extends southwards after an estuary breach and the mouth flows out over a rocky sill on the southern side.

2.2 Catchment characteristics

The river is *ca.* 23 km long and the catchment has an area of between 90 and 100 km². The natural Mean Annual Runoff (MAR) has been estimated at 13.8 x 10⁶ m³ and a recent desktop study estimated the current MAR to be similar at 13.2 x 10⁶ m³ constituting a decrease of 4% in the overall annual volume. The estimates to changes in baseflow are more concerning and have been estimated to have decreased by 14%. This is related to direct use and abstraction. There are no dams on the river above the estuary, but it could be expected that there is some water use by the expanding rural populations in the upper reaches of the catchment although not enough as yet to significantly affect the overall

MAR. The river is located in the tertiary catchment U80 and contained within a single quaternary catchment, U80L. Some existing coastal forest has remained largely intact but large areas of former KZN coastal grassland have been transformed through sugarcane cultivation, while abandoned cane fields have resulted in the appearance of secondary scrub or bushveld.

KwaZulu-Natal has a sub-tropical climate characterized by summer rainfall accompanied by high humidity conditions on the coast and cooler, drier winters. Average annual rainfall on the coast is ca. 1 000 mm. The significance of this for the aMahlongwa estuary is the seasonality of flow which characterises these smaller, intermittently open estuaries. This means that relatively higher inflows occur during summer (ca. $0.2 \text{ m}^3.\text{sec}^{-1}$) and lower inflows (ca. $0.03 \text{ m}^3.\text{sec}^{-1}$) during winter. This is the level of flow and distribution of flows established by the recent NBA (2018) but this is extremely likely to be altered by climate crisis influences and would need to be monitored closely to allow adaptive strategies to be employed as changes occur..

2.3 State of the Estuary

Based on the categories and the ratings of the individual components the Present Ecological State (PES) of the aMahlongwa Estuary at a desktop level of assessment as of 2018 is a "C" (Table 2.1) *i.e.* an estuary in Moderate to Fair condition. As a small estuary the abiotic variables which were considered to significantly depress the overall health score were the water quality and modifications to the physical habitat. These in turn significantly depress the biotic components result in the lowered PES score.

Table 2-1 *Ecological categories associated with individual components of the estuary health index for the aMahlongwa estuary on a desktop basis.*

NBA 2018 Condition			
ABIOTIC		BIOTIC	
Hydrology	B	Microalgae	C
Hydrodynamics	A	Macrophytes	C
Water Quality	C	Invertebrates	C
Physical habitat	D	Fish	D
		Birds	C
Overall Health Score C			

Estuaries are rated in their importance from 1-5 on an increasing scale (MER 2021). The estuary is rated as a 2 for importance which implies 'some' level of importance (van Niekerk *et al.* 2019). The aMahlongwa, although not on the National priority list for conservation, is on the KZN priority estuaries conservation planning list but does not have specific protected area status. The listing for KZN places the conservation importance of this estuary at a Level 5 (the highest ranking) which marks it as requiring more effective conservation and protection, particularly given its association with the Aliwal Shoal MPA. This has resulted in the estuary's Target Ecological Category (TEC) for the aMahlongwa Estuary being gazetted as a "B" (Government Gazette 41306, Notice No. 1386 of 8 December 2017). This TEC requires that the aMahlongwa estuary health must be uplifted from its current C category, with a score between 61 – 75% of natural to a B category with a health score falling between 76 – 90%.

It must be stressed too that Table 2.1 indicates a health score that was produced as a desktop assessment using data that were over 10 years old. The different abiotic and biotic categories contributing to the overall rating of a C range from an A to a D. Intuitively this suggests that the determinants of the two D categories, as well as some of the C categories, should be prioritised for intervention and management if the target is to raise the overall rating to a B. Important in this is also the maintenance and application of the Resource Quality Objectives (RQOs) for the aMahlongwa (DWS 2015b) which are included as Appendix A.

The abiotic score for physical habitat is low and is driven largely by the modifications which have occurred to the natural channel which is now pinned in three places by bridges and their causeways. This will affect any channel movement, although such restrictions affect erosion patterns and can accelerate channel movement away from the fixed positions. The coastal vegetated dune north of the present mouth appears to present a natural feature although the erosion that is presently occurring suggests that in the past the mouth might have been well north of its present position.

Annual breaching data indicates that mouth breaching patterns vary with rainfall fluctuations with open mouth conditions increasing through times of higher rainfall and declining during periods of lower rainfall. There is no indication from this data that the periods of closure have increased since the first decade that is documented by the mouth dataset in the SAR (MER 2021). While it could be intuitively argued that human influences

have accelerated catchment sediment mobilisation, erosion and estuary sedimentation, accurate long-term quantification without real data is not possible and the frequent perception of permanent net shallowing and sedimentation of KZN estuaries requires consideration. The available aerial imagery indicates that the water surface area of the estuary has remained very similar since 1937 with variations related to floods or mouth status. Additional support for this interpretation is provided by the large *Phragmites australis* supporting sandbank in the lower estuary. The historical sequence of photographs indicates a remarkably stable area covered by this sandbank which suggests that no additional sedimentation has occurred. This is also supported by the few measurements of depth which exist. Based on aerial photographs dating from the earliest available, viz. 1937, and Google earth images incorporating the EFZ, it appears that the extent of sugar cane cultivation, within the EFZ, particularly to the east of the N2 freeway and on the south bank has declined over the last 70 years. Recovery of the natural vegetation has however been reduced by the development of Freeland Park. Structures on properties fringing the estuary on the south bank, except for one, are situated above the EFZ limit although it appears to be common practice to clear the vegetation between the houses and the water's edge, presumably to improve the view. In some cases, jetty-like structures have been established in the reed beds although they do not extend beyond the reed fringe.

2.4 Services provided by the aMahlongwa Estuary

Ecosystem services ultimately permit the survival of humanity on this planet. The water cycle, whereby evaporation from the surface of the sea becomes the source of fresh water via rainfall may be the most obvious example. Broadly speaking, ecosystem services cover 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 and carbon storage. The ecosystem services provided by the aMahlongwa Estuary are varied and range from nursery function for estuary dependent marine species, both vertebrate and invertebrate, raw materials, tourism and recreation, carbon sequestration, water treatment and the export of organisms and nutrients to the marine environment.

2.5 Threats, Impacts and Management Issues

The principal threats rated in 2008 as “Medium” on a scale of low to high were habitat loss, water quality changes, with eutrophication high on the alert list, and alien invasive plant species. The following should also be added from recent observations, viz. insensitive development, freshwater abstraction, chemical contamination, solid waste litter/debris, and sea level rise.

Historical photographs available from the South African Department of Mapping and Land Survey provide a history of changing land use around the estuary since the original surveys in 1937 when the ubiquity of sugar cane cultivation was arguably at its zenith. A feature of later years was the withdrawal of cane from the area between the R102 and the N2 freeway. Some areas have been disturbed by quarrying while sandmining in the river and riparian edges occurs immediately above the head of the estuary. Urban developments have transformed significant areas, specifically the township of Freeland Park on the south bank of the estuary between the R102 coastal road and the N2 freeway.

Physical anthropogenic impacts which modify flow patterns and sediment transport include the coastal road (R102) and rail bridges, both within 200 m of the mouth, and the N2 bridge *ca.* 1.8 km upstream. Unstable causeways at the head of the estuary and on a tributary are particularly vulnerable to high flows, resulting in the deposition and accumulation of concrete and rock debris below both structures. Stakeholder input suggests that between December 2020 and May 2021 these causeways have washed away three times. It is not known if these crossings have been authorised by the relevant authorities and whether the rebuilding of these crossings has been permitted. Small estuaries in KZN, particularly during closed phases, are vulnerable to highly polluted runoff from roads, insecticides, or herbicides from sugar cane fields, as well as organic, nutrient, and bacterial inputs from water treatment works.

Catchment erosion and transport of sediments into or through estuaries into the marine environment is a natural component of coastal dynamics. This erosion and transport process is variable depending on the magnitude of river flow. Major flood events frequently result in the temporary deepening of an estuary. No sand mining appears to have or is taking place within the EFZ but there has been reported activity in the downstream river reaches just before the head of the estuary. The removal of sand is an activity that can be expected to increase with the proliferation of developments within

the area resulting in suitable building sand in the catchment area ultimately being exploited. Other potential sources of sediment would be the quarry on the north bank where exposed areas represent a risk of accelerated runoff and erosion due to the lack of any vegetation cover.

2.6 Coastal Access

Access to the estuary for the public is limited as is the case for many of KZNs smaller estuaries where the steep terrain and surrounding developments serve to isolate the estuary. Freeland Park houses effectively limit access between the R102 and the N2. Access to the mouth is limited by the railway line as well as private developments south of the mouth, or layby areas to the north and would require an approximately 1 km walk from the north or 1.5 km from the south.

2.7 Opportunities and Constraints

Reflecting from the detail in the Situation Assessment report it is apparent that a number of opportunities exist to improve estuary health and manage impacting activities. However, several significant constraints have also been identified, particularly around infrastructure and socio-economic development of the area and these will present challenges to prevent impacting on estuary function and health.

The aMahlongwa estuary lies at the border of the jurisdiction between the Ugu District and eThekweni Municipalities. This places the EMP under the overall direction of the KZN Department of Economic Development, Tourism and Environmental Affairs KZN EDTEA. Management actions and strategies will need to be agreed upon and implementation will require substantial co-operative governance. A significant opportunity exists which emanates from the lead authority (KZN EDTEA) which is shown through their commitment in commissioning this Estuary Management Plan. This is immediately a step towards the improvement of estuary health and effective control of impacting activities on the estuary. The strong link via the coastal zone between the estuary and Aliwal Shoal MPA also makes the estuary part of an important biodiversity mosaic that is worthy of protection. In addition, the identification of the estuary as a sensitive, important environment worthy of future tourism investment by the uMkhomazi Local Area Plan provides additional motivation to make this EMP an implementation success.

The small size of the catchment and the estuaries high aesthetic value present a very realistic and good opportunity and make it a good candidate for improvement. This coupled with a low population density, low level of pollution from urban and commercial enterprises, and the reversible nature of some land-uses makes for a very real possibility of restoration/rehabilitation of candidate EFZ areas.

Constraints for the successful implementation of interventions relate to the absence of environmental data with the most recent having been collected over 15 years ago. The lack of recent in-depth survey data is a weakness that removes confidence in the assessment of estuary health scores and to some extent may hamper efforts to measure improvement in response to actions unless this is addressed as a first priority. Irreversible changes to estuary habitat within the EFZ as a result of the bridges and predominantly their supporting causeways mean a permanent loss and change of function which will always influence the health score of the estuary. Non-point sources of pollution, which occur within the catchment area have practical impacts on the implementation of the estuarine management plan, where implementation responsibilities may fall outside the mandate of the responsible agents. Along with this is the disjunct and uncoordinated variety of public, private and government entities, and ineffective implementation of legislative tools which if made more effective could together produce some significant change to the management of the estuary. One of the more significant constraints is the existing environmental authorisation(s) which have been issued for mixed-use developments surrounding the estuary (Renishaw Estate). Unfortunately, these were issued without due regard or assessment of impacts to the estuary and currently no buffers or mitigation exists which is estuary specific. This is an item for prioritisation to be taken up by the aMahlongwa Estuary Management Forum (EMF) with the developers to arrive at positive outcomes. These new developments could pose significant challenges, such as general disturbance and changes to runoff water quantity and quality. This will require innovative ways to avoid the threats. The close proximity of quarry and sand mining operations are also potential local issues as are the larger scale threats of rising sea level and sea temperature through climate change.

2.8 Key Information Gaps

A frequent gap during the development of estuarine management plans is the absence of recent data. This is true for the aMahlongwa Estuary with the last survey having been

carried out approximately 15 years ago (Forbes & Demetriades 2010). This can affect the accuracy of the SAR and the status categorisation which in desk top assessments can only rely on available data. The following is a list of information requirements identified as being needed to update knowledge and status/health assessment of the aMahlongwa Estuary in relation to the assessments of the different components of the estuary mentioned above. This information would enhance the identification of drivers of impacts on the estuary needing more management as well as assess potential threats and opportunities for stakeholder learning, training and employment: Stakeholder input would be required as part of the establishment of the Catchment Management Forum to identify the relevant responsible authorities.

- ❖ Monitoring of water quality, including sources of contamination, concentrations, seasonal fluctuations, potential for remedial actions to maintain or, where necessary, improve water quality.
- ❖ Improved quantification of water use in and around the catchment by water use licence holders or illegal abstractors or dischargers
- ❖ Analysis of possible pesticide and herbicide accumulation in estuarine sediments arising from decades of sugar cane cultivation in the catchment.
- ❖ Assessment of the presence and extent of alien invasive plants
- ❖ Continuation and maintenance of the current level of mouth state observations. This could be easily accomplished by installation of a water level recorder near the mouth.
- ❖ Detailed and regular data on the composition of plant communities as well as invertebrate, fish and bird communities. These can be done at different levels and timescales to address costs and practicality.
- ❖ The planned management forum would be tasked with maintaining contact with relevant environmental authorities and maintaining a watching brief on any developments, changes or proposed changes in the catchment which have potential impacts on the estuary.

3 GEOGRAPHICAL BOUNDARIES OF THE ESTUARY

In order to ensure the present and future health of estuaries, it is necessary to define the 'space' within which estuaries function over longer time scales – these areas are referred to as the EFZ. The NBA (Van Niekerk et al. 2019 a,b,c,d) 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"*

The upstream boundary of the estuaries was determined as the limits of tidal variation or salinity penetration, whichever penetrates furthest. The estuary mouth was taken as the downstream boundary of an estuary. The highly dynamic nature of this area presents a significant challenge to accessing change in biodiversity and even managing estuaries. To account for this, and to allow for a seamless integration with the Marine and Coastal Realm, the concept of 'Estuarine Shore' was introduced to reflect the dynamic nature of the interface between estuaries and the coast. Estuarine shores refers to sand berms or bars that form in front of estuaries. They vary substantially in size and shape over decadal scales and can be completely absent during a flood or a near permanent feature during periods of low flow. Estuarine Shore was defined as the area from the base of the foredune, or where this line would be if dunes were present, to the back of the surf zone. The full extent of the Estuarine Shore is encapsulated in the EFZs and not be considered separate from the functional unit. The surfzone was included to reflect a continuum in estuarine-marine connectivity through estuarine inputs to the surfzone, either as direct flow through an open mouth or in seepage through the berm in a closed system.

Previous delineations utilised the 5m contour however the 2018 NBA delineation utilised for small, incised estuaries with relatively high river flow, a combination of the 5 m and 10 m contour. This was used to accommodate mapping uncertainty (Van Niekerk et al. 2019). In these small, steep estuaries the 0 m, 5 m and 10 m contours are in close proximity to each other as is the case for the aMahlongwa Estuary and therefore these

lines are used where applicable. For the purposes of this EMP the extent of the aMahlomgwa Estuary's EFZ as delineated in the 2018 NBA was adopted.

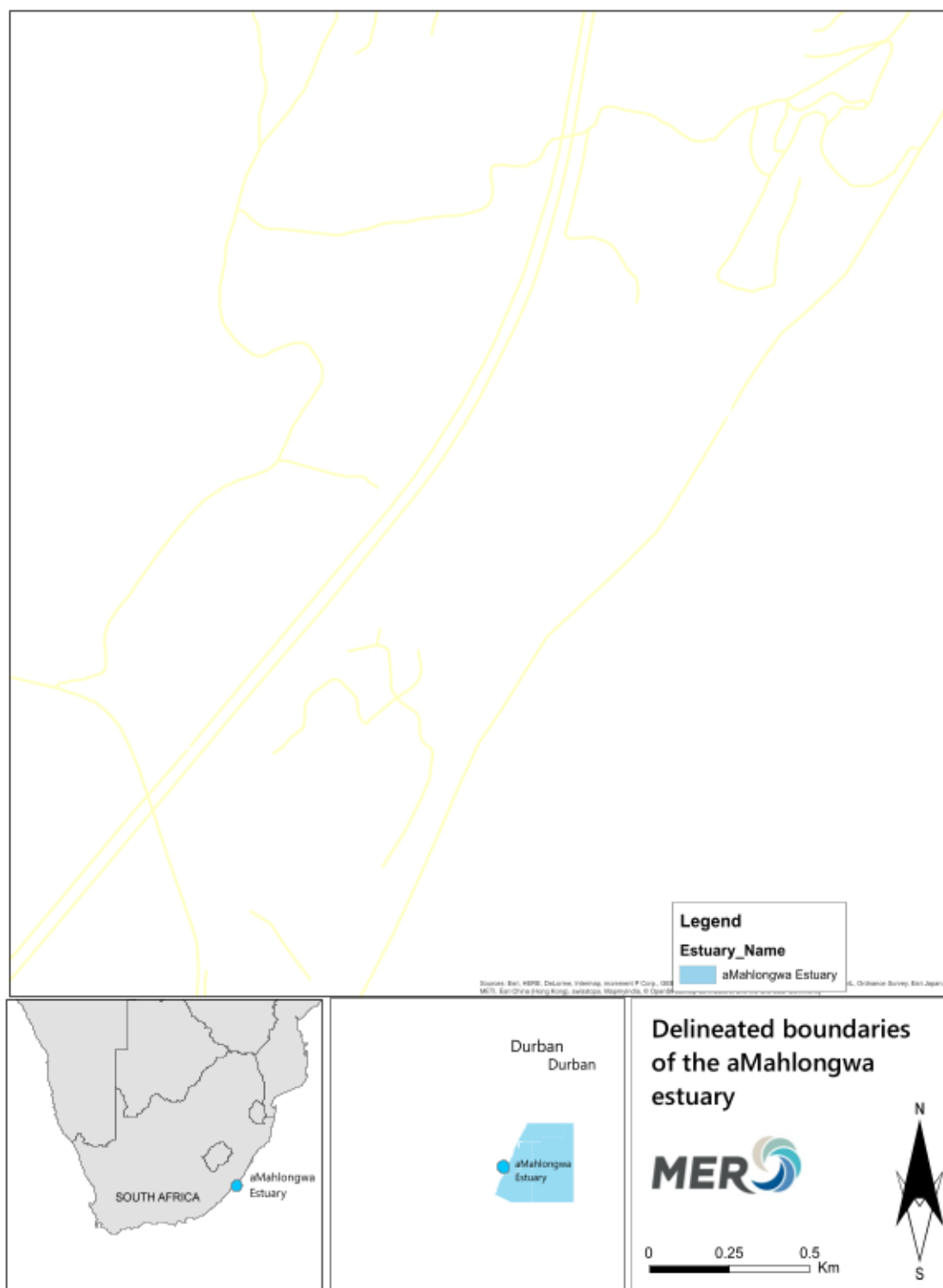


Figure 3-1 Delineation of the aMahlongwa estuary boundaries

4 VISION AND KEY STRATEGIC 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 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."* Implicit again in this statement, as previously emphasised, is the fact that management must refer to the control and mitigation of human impacts on estuarine function while appreciating that diversity within the natural drivers of catchment effects and marine influences have historically been the determinants of the nature of individual systems.

The following vision statement for the aMahlongwa estuary was developed and accepted at a workshop to present the aMahlongwa Estuary Situation Assessment Report (MER 2021) held on the 17th June 2021 with stakeholders:

"The aMahlongwa estuary should be cared for to ensure a healthy estuary that is improved and restored through the positive actions of the users who are the custodians of the estuary and who will benefit from a beautiful, productive ecosystem."

4.2 Key Strategic Objectives

The specific objectives which underpin this vision statement include, not necessarily in priority order, are as follows:

- ❖ Improve institutional arrangements and cooperation through the formation of an Estuary Management Forum (EMF) composed of relevant authorities and stakeholders who will undertake to implement the aMahlongwa EMP.
- ❖ Develop partnerships for the integrated management to assist the EMF to achieve the targets of the EMP
- ❖ Update and implement the monitoring programmes of abiotic and biotic components over the entire EFZ.

- ❖ Improve the present-day estuarine health raising it from its present **C** category to the recommended **B** status. This requires a multipronged approach to deal with different estuary abiotic and biotic components as well as impacting activities and inappropriate infrastructure.
- ❖ To ensure that the aMahlongwa Estuary's resilience is improved and that this ecological resilience remains in place as the area surrounding it continues to be developed and transformed.
- ❖ Educate and raise awareness to creation of a greater appreciation of the environmental, social, and economic value of the estuary amongst all neighbours and users of the system.
- ❖ Consideration of the protection of the estuary through its incorporation into a formal conservation area or as an area incorporated into a biodiversity stewardship project under the National, Provincial or Municipal Biodiversity Stewardship initiatives.

5 MANAGEMENT OBJECTIVES AND REQUIRED ACTIONS

5.1 Objectives

The management objectives for the aMahlongwa Estuary have been developed from both the opportunities and threats identified during the Situation Assessment as well as from the local vision and key objectives for the estuary. The aim of this section is to list the overarching objectives which deal with the activities impacting the health of the aMahlongwa Estuary and which will need to be addressed to achieve the vision and allow implementation of the required actions. The management objectives and activities were identified during the scoping phase of the project through consultation with authorities and stakeholders.

In order to achieve the vision for the estuary, the following key management objectives have been identified:

- ❖ Conserve and protect the remaining habitats within the delineated estuary boundary. This should include the establishment of appropriate buffers where topography and proposed development and other activities are proposed.
- ❖ Update estuary health status and implement monitoring programmes to confirm present ecological status (currently only historical or desktop) and track changes.
- ❖ Encourage natural ecological functioning and processes and improve the overall health of the estuary by restoration/remediation of habitats or mitigation of impacting activities.
- ❖ Establish an estuary management forum and develop partnerships for the integrated management of the estuary.
- ❖ Monitor and facilitate responsible commercial and infrastructural development within and immediately adjacent to the EFZ.
- ❖ Provide reasonable and safe public access to the estuary.

- ❖ Ensure that any economic development in the EFZ and the immediately adjacent areas occurs in a manner that does not negatively impact the health of the system and is in full compliance with all relevant environmental legislation.
- ❖ Promote education and awareness and facilitate research opportunities within the estuary.
- ❖ Strengthen compliance monitoring and enforcement of activities within and immediately adjacent to the EFZ.

5.2 Management actions

The objectives in Section 5.1 have been assigned actions and where applicable, a description of the ecological impact or socio-economic consequence, the responsible implementing agent as well as the expected duration in which the action should be implemented has been provided. Where objectives are achieved through similar action items these have been combined to produce an easy-to-follow guide to the actions in the tables below.

5.2.1 Conserve and protect the remaining habitats within the delineated estuary boundary. This should include the establishment of appropriate buffers where topography and proposed development and other activities are proposed and Encourage natural ecological functioning and processes and improve the overall health of the estuary by restoration/remediation of habitats or mitigation of impacting activities.

Specific action	Ecological consequence	Responsible Agency	Duration
Establish boundaries of EFZ on the ground and determine appropriate buffers particularly in light of the EAs issued for Renishaw.	Protection of estuary space providing room for natural processes and forming a first line of defence from impacting activities along estuary boundary	EMF with strong support from EPCPD (EM) and KZN EDTEA	Immediate and urgent action item and on-going
Enact some form of protected status for the estuary. Consideration of the protection of the estuary through its incorporation into a formal conservation area or as an area incorporated into a biodiversity stewardship project under the National,	The estuary interfaces with the Aliwal Shoal MPA and as such there is a strong motivation for estuary to be incorporated with protected status as part of this important biodiversity mosaic. It is also a good candidate area for a biodiversity stewardship	EMF in collaboration with - it is recommended that the eThekweni Municipality's Biodiversity Stewardship Programme ¹ is	Ongoing

¹ Establishment of the EM's Biodiversity Stewardship Programme prompted the formation of the Biodiversity Stewardship Task Team (BSTT), comprised of staff that either (a) have biodiversity stewardship as a deliverable on their individual performance plans or, (b) are voluntary members with keen interest in biodiversity conservation. The task team currently consists of members from several branches of the Environment Planning and Climate Protection Department (EPCPD), which deal with biodiversity planning, development impact assessment, project implementation, and environmental management. Since the establishment of the BSTT, the team has had the eThekweni Biodiversity Stewardship Policy developed and formally approved by Council in May 2017. The team has also had the BS eco-file produced (in both isiZulu and English) to raise awareness about the eThekweni

Specific action	Ecological consequence	Responsible Agency	Duration
Provincial or Municipal Biodiversity Stewardship initiatives.	project through a municipal, provincial or national programme.	contacted initially for advice on how to proceed.	
Establish appropriate management lines in addition to the EFZ to reduce risks and enhance Climate Crisis adaptation measures	Management lines determined and enforced. This ensures estuary function and sustainability on a longer time scale.	KZN EDTEA (DEFF) EM EMF	Urgent and ongoing
Establish the water quantity and quality inputs to the estuary and put steps in place to manage these into the future.	A health hydrological profile and quality of water to the estuary are the main drivers of ecosystem health.		As soon as possible and ongoing
Rehabilitate riparian vegetation where necessary within the EFZ and in collaboration with neighbouring landowners.	Removal of alien invasive species (terrestrial and aquatic) to improve overall EHI through a change to the vegetation score and even possibly the invertebrate, fish and bird biotic scores.	DEA, DWS, EPCPD, EPWP & EMF	As soon as possible and ongoing
Management and control of alien invasive floating aquatic plant species. It is important that this response is not treated but the causes which result in the proliferation of these species i.e. excessive nutrient input (see specific actions under water quality)	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.	DEA, DWS, EPCPD, EPWP & EMF	As soon as possible and ongoing
Facilitate removal of unnecessary or unpermitted causeways and other flow obstructions and/or improve design of essential ones	Design improvements and/or removal of the causeways will improve flows through the upper estuary, prevent further build-up of sediment above this structure and potentially enable smaller flood events to scour and move sediment within the system. This may improve the upstream habitat for estuarine species.	DWS / EMF in collaboration with specialist estuarine scientists, sedimentologists and engineers.	ASAP and to be completed within first six months of EMP implementation.

5.2.2 *Update estuary health status and implement monitoring programmes to confirm present ecological status (currently only historical or desktop) and track changes.*

Specific action	Ecological consequences	Responsible Agency	Duration
Implement the Recommended Integrated Monitoring Plan	Confirmation of the historical and desktop PES is critical to establish a realistic baseline against which to track progress of the EMP	EMF with strong support from DWS, DEFF, UGU, Umdoni EPCPD (EM) and KZN EDTEA	Immediate and urgent action item and on-going
	A deeper understanding of the state of the estuary, will allow better and more focussed responses to the specific action items needed to improve the outcomes of the EMP		
Forensic audit of impacting activities including diffuse and point source pollution inputs, irregular infrastructure	Understand the issue and focus interventions starting with the most impacting activities and working down.	EMF with strong support from DWS, DEFF, UGU, Umdoni, EPCPD (EM) and KZN EDTEA	Immediate and urgent action item and on-going

5.2.3 *Establish an estuary management forum (EMF) and develop partnerships for the integrated management of the estuary and Monitor and facilitate responsible commercial and infrastructural development within and immediately adjacent to the EFZ*

Specific action	Ecological consequence	Responsible Agency	Duration
Establishment of an EMF with a clear terms of reference and wider representation from government and stakeholders	Co-ordinated and co-operative management of the estuary guided by the EMP	KZN EDTEA/ UGU/Umdoni EM/ Stakeholders /IAPs	Immediate
Landowners not already participating in this EMP within and adjacent to the EFZ should be drawn into the planning and implementation.	Co-operative management improved of the estuary improved and better control of impacting activities.	EMF with strong support from UGU, Umdoni, EPCPD (EM) and KZN EDTEA	Urgent for immediate action.
Develop partnerships with developers of Renishaw and other authorised developments to ensure the most appropriate outcomes and best practice implementation during construction and through the life of the development	Protection of the estuary through actions and buffers from disturbance (influencing sensitive biota), poor water quality and quantity runoff (whole estuary benefits), and pressure impacts.	EMF with strong support from UGU, Umdoni, EPCPD (EM) and KZN EDTEA	Urgent for immediate action.
Explore possible eco-tourism and other appropriate activities which will enhance the value of the estuary and surrounding areas through additional services and benefits.	The estuary will be surrounded by an additional protective layer through activities that are low impact or have no impact or enhance estuary services. This will provide some assurance of sustainability of estuary process and function into the future.	EMF with a specialist economist or specialist in integrated conservation and rural development programmes that improve social and economic well-being while considering environmental processes.	First three years

5.2.4 Promote education and awareness and facilitate research opportunities within the estuary.

Specific action	Ecological consequence	Responsible Agency	Duration
Increase awareness of estuary importance, health, impacting activities and ecosystem services	Develop and implement public awareness programme	EMF KZN EDTEA/ UGU/Umdoni EM/	Ongoing and life of EMP
Maximise education opportunities	Encourage active involvement of schools, particularly local schools within the catchment, through environmental education programmes. An education centre is a possibility to be considered here.	EMF with strong support from UGU, Umdoni, EPCPD (EM) and KZN EDTEA	Ongoing and life of EMP
Involvement of stakeholders, scholars and neighbours in monitoring of the estuary	Prepare annual report card on estuarine health with benefits of increasing awareness.	EMF with strong support from UGU, Umdoni, EPCPD (EM) and KZN EDTEA	Ongoing and life of EMP
Ensure that any economic development in the EFZ and the immediately adjacent areas occurs in a manner that does not negatively impact the health of the system and is in full compliance with all relevant environmental legislation.	The estuary will be surrounded by an additional protective layer through activities that are low impact or have no impact or enhance estuary services. This will provide some assurance of sustainability of estuary process and function into the future.	EMF with a specialist economist or specialist in integrated conservation and rural development programmes that improve social and economic well-being while considering environmental processes.	First three years

5.2.5 Strengthen compliance monitoring and enforcement of activities within and immediately adjacent to the EFZ.

Specific action	Ecological consequence	Responsible Agency	Duration
Identify pollution sources driving degradation of water and habitat quality	A clear database of all illegal and legal discharges. Legal discharges should be checked for compliance with conditions	EMF with strong support from DWS, UGU, Umdoni, EPCPD (EM) and KZN EDTEA	Immediate and urgent action item and on-going
Improve ecological integrity of degraded estuary habitats through compliance with the legislated requirements for specifically identified interventions.	Removal of alien invasive vegetation Removal or improvement of all causeways or unnatural flow obstructions	DEA, DWS, EM (incl) EPCPD, EPWP & EMF	Prioritise / Ongoing
Audit sand mining operations impacting on the estuary and ensure compliance	Disturbance of habitats, destruction of riparian vegetation, facilitation of alien vegetation colonisation and sediment budget disturbances to estuary and coast.	EMF, DMR, KZN EDTEA, EM, UGU, Umdoni	Prioritise / Ongoing
Compliance with development authorisations and conditions.	Best practice and principles applied to ensure impacts to estuary are minimised.	EMF	Prioritise / Ongoing

6 PROPOSED ZONATION OF ACTIVITIES

DEA (2015) states that the planning and zonation of activities in coastal environments are increasingly becoming a necessity rather than an option. This need has been acknowledged by stipulating the zonation of activities as one of the minimum requirements in estuarine management planning. They define the process of zonation (or spatial planning) in the context of estuarine planning 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 and would typically allow for:

- ❖ Partitioning of activities within the estuary and its catchments thus permitting their existence without one activity precluding or conflicting with another.
- ❖ Identifying sensitive habitat fragments for protection.
- ❖ Focussing management activities in specific areas.
- ❖ Guiding future land/water uses and development activities in the area.

The aMahlongwa estuary, however, as previously mentioned is small and much of the system is relatively inaccessible. The length of the estuary is only 3 km while the area of the EFZ encompasses 14 ha. Activities in and around the estuary are restricted very often to the mouth area where local fisherman utilise the beach for rock and surf angling. No other significant recreational use was highlighted to the team during circulation of the SAR or stakeholder workshops. Given the size of this estuary and the sensitivity of the entire resource unit because of its vulnerability to any unnatural perturbation, zonation is not considered to be practical or useful for this estuary’s management.

7 RECOMMENDED MANAGEMENT PRIORITIES

This chapter prioritises the listed management actions (linked to Section 5.2 Management Actions) and will not repeat the detail included. It simply provides a list of priority actions in the order they should be undertaken under each management category.

1. Establishment of an Estuary Management Forum which is representative of all sectors relevant to the estuary. A number of urgent sub-actions flow from this which are listed in Section 5.2.3 including the inclusion of landowners and partnerships to be established with developers of proposed new urban areas around the estuary. This will address one of the requirements of the plan which is to facilitate effective and co-ordinated governance.
2. Confirmation of the historical and desktop PES through acquisition of up-to-date data as per the Integrated Monitoring Plan in Section 8. The implementation of the the monitoring plan would follow on from the first round of sampling to establish current baseline
3. Establish boundaries of EFZ on the ground and determine appropriate buffers particularly in relation to the EAs issued for surrounding developments. This also relates to the establishment of appropriate management lines in addition to the EFZ to reduce risks and enhance Climate Crisis adaptation measures
4. Identify pollution sources driving degradation of water and habitat quality with enough detail to create a clear database of discharges and compliance with conditions as well as illegal discharges.
5. Facilitate removal of unnecessary or unpermitted causeways and other flow obstructions and/or improve design of essential ones. An immediate and obvious problem and impact on the upper reaches of the estuary is in relation to the concrete pipes or culverts covered with loose sand and rocks which have been used to construct causeways across the upper reaches of the estuary as well as a tributary. The instability of these structures has resulted in sand and rocks being deposited in the channel downstream. This practice should be stopped immediately, and instructions issued that the deposited material be removed from the water course.

8 INTEGRATED MONITORING PLAN

Estuaries are dynamic systems and conditions are continually changing as a result of natural processes and human activities. Consequently, an effective management plan for an estuary must retain certain 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 a rolling programme of liaison 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. Also when new issues are highlighted and as issues currently highlighted are resolved, the necessary adjustments to the EMP will be made. This EMP is regarded as the first of a series of rolling five year plans, with the EMP being subject to on-going review to ensure continuing validity and relevance.

A significant constraint to change detection in estuaries is the lack of long-term measured data on South African estuaries. One of the challenges that has led to this situation is the existence of a range of mandated Departments involved in estuary management and therefore monitoring. However, some progress has been made since the NBA 2011.

The Department of Water and Sanitation established the National Estuarine Monitoring Programme, NEsMP, in 2008. However, currently, the National Estuary Monitoring Programme implemented by DWS is under resourced (Cilliers and Adams 2016). This multi-tier, multi-parameter (include biotic and abiotic components) programme is based on current best practice and with sufficient funding, and support from other organs of state, could go a long way in addressing data deficiencies in future estuary assessments. The purpose of NEsMP is the monitoring of water quality, physico-chemical and biological aspects for determining long-term trends and changes in the condition of South African estuaries. The NEsMP coordinates national monitoring efforts and provides support in the form of sampling equipment, training, data management and information dissemination, while collaborating institutions collect physico-chemical data and water samples. Unfortunately to date this has not rolled out to the aMahlongwa Estuary but has focussed on the protected area systems e.g. Mpenjati

However, the DEA 2015 estuary management guideline stipulates that an integrated monitoring plan should be developed for each estuary and must cover three categories, namely:

- ❖ Resource monitoring, which is directed at specific ecological indicators (to monitoring the state or health of the natural resource – in this case the aMahlongwa estuary as defined by the EFZ)
- ❖ Compliance monitoring, which aims to monitor the effectiveness of the implementation of the EMP by assessing the intensity and nature of the activities occurring within the aMahlongwa Estuary. It would also serve to identify activities that are not compliant with the relevant legislation, policies and guidelines as described in the EMP, as well as timeously identify potential threats to estuary health.
- ❖ Performance monitoring, which is aimed at gauging progress in terms of achieving the management objectives, and ultimately, the vision (and associated outcomes) for the aMahlongwa estuary, relative to its management plan.

To address these categories the integrated monitoring plan has been provided that indicates the activity/output, the indicator, the temporal scale, the target, and the responsible authority. The summary for each monitoring component is provided below.

Table 8-1 Monitoring recommendations for the aMahlongwa Estuary

Ecological Component	Action	Spatial Scale	Temporal Scale	Responsible Authority
BATHYMETRY				
Depth profiles of the estuary	Measure depth across sectional profiles and longitudinal profile at 200m intervals to a high level of accuracy	Every 200 m	Baseline and thereafter every 5 years	EMF
WATER QUANTITY				
Hydrology	Measure freshwater inflows just above the estuary.	Install a flow meter or recorder at or above the head of the estuary	Continuous	DWS
	Record Water Level in the estuary relative to mean sea level.	As close to the estuary mouth as possible (railway bridge likely position).	Continuous	DWS
	Record scale, frequency and duration of episodic events.	The estuarine area whenever events occur e.g. flood, fish kill, pollutant contamination	Episodic	EMF
Hydrodynamic s	Visual record of mouth.	Fixed point photography of mouth	Weekly	EMF
Mouth dynamics	Ensure daily mouth record is maintained.	Mouth	Daily	EMF
Sediment fluxes	Collect grab samples across and along the estuary for analysis of particle size distribution.	Whole estuary at sampling sites	Baseline and thereafter every 2 years	EMF
WATER QUALITY				
Physical and chemical variables	Measure temperature, salinity pH, dissolved oxygen, turbidity and toxins	Longitudinal axis of estuary over one spring and one neap tide (at least 5 stations)	Quarterly (seasonal)	DEFF/DWS
	Measure nutrients (nitrate, nitrite, ammonia and phosphate) and suspended solids.	Longitudinal axis of estuary over one spring and one neap tide (at least 5 stations)	Monthly	DEFF/DWS
	Analyse water samples for pathogens such as bacteria, Staphylococci and Enterococci species such as Escherichia coli	Longitudinal axis of estuary over one spring and one neap tide (at least 5 stations)	Monthly Weekly for one month if a sewage spill has occurred	DEFF/DWS
	If contaminated water reaches the estuary measure dissolved oxygen concentration in the water.	Longitudinal axis of estuary (at least 5 stations)	Daily for one month before sunrise	DEFF/DWS

Ecological Component	Action	Spatial Scale	Temporal Scale	Responsible Authority
BIOTA				
Microalgae	Water chlorophyll-a measurements taken at the surface and 1 m depths, under typically high and low flow conditions. Intertidal and subtidal benthic chlorophyll-a measurements using a recognised technique or SANAS accredited laboratory.	Longitudinal axis of estuary (at least 5 stations)	Quarterly (seasonal)	DEFF/ DWS/ EMF
	Record relative abundance of dominant phytoplankton groups, i.e. flagellates, dinoflagellates, diatoms, chlorophytes and blue-green algae (cyanobacteria).	Longitudinal axis of estuary (at least 5 stations)	Quarterly (seasonal)	DEFF/ DWS/ EMF
Macrophytes	Map macrophyte communities in EFZ using hi-res aerial photography. This must be groundtruthed by field surveys. Red-data, protected and invasive species must be noted.	Whole EFZ	Once a year in summer	DEFF/ DWS/ EMF
Invertebrates	Surveys of the zooplankton, benthic invertebrate and larger crustaceans must be conducted. This should include burrowing species such as <i>Kraussilichirus kraussi</i>	Longitudinal axis of estuary (at least 5 stations)	Quarterly (seasonal)	DEFF/ DWS/ EM
	Collect sediment samples using the grab for particle size analysis and organic content (at same sites as zooplankton) (preferably link with sediment dynamics)	Longitudinal axis of estuary (at least 5 stations)	Quarterly (seasonal)	
Fish	Record species and abundance of fish, based on seine net sampling. Gill nets should not be deployed in such a small estuary as they will result in fish deaths	Longitudinal axis of estuary (at least 3-5 stations)	Quarterly (seasonal)	DEFF/ DWS/ EM
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.	Whole EFZ	Seasonal (winter and summer counts must be conducted annually)	EMF

9 IMPLEMENTATION AND INSTITUTIONAL ARRANGEMENTS

Effective institutional arrangements dictated by legislative frameworks are crucial in achieving the goals of the EMP. The implementation of the various action items which have been listed need to be adopted and rolled out by a group of dedicated people both government and private sector. The development and implementation of this EMP is governed by the Integrated Coastal Management Act (ICMA). The National Estuarine Management Protocol was published in terms of section 33(2) of this ICMA in Government Notice 341 in Government Gazette 36432 of 10 May 2013. The protocol does not propose anything new with regards the institutional arrangements for estuary management but rather states that the provincial or coastal committees serve as the formal institutions for development and implementation. Section 5 of the Protocol identifies the Provincial Department as the authority responsible for developing the EMP for the aMahlongwa River Estuary, but that the development is done in consultation with the two responsible district municipalities and is inclusive of other relevant stakeholders. This is where the development and role of the estuary management fora become key.

Section 34(1)(ii) of the ICMA in turn requires that an EMP must be consistent with the National Coastal Management Programme and any applicable provincial coastal management and municipal coastal management programmes. In addition, section 34(1)(a) requires that the development of the EMP must follow the public participation process described in Part 5 of Chapter 6 of ICMA.

The National Coastal Management Programme (NCMP) has identified estuaries management as one of the national priorities. In response to the implementation of the national priorities pertaining to estuaries management, the KZN EDTEA has as the lead agency for estuary management plans in KZN commissioned this aMahlongwa EMP in terms of section 5.6 of the Protocol. This EMP has taken into consideration all the requirements of the ICMA, the Protocol and the Guidelines (DEA 2015).

To recognise and effectively manage the unique environmental, economic, and social aspect of this estuary, it is important to develop relationships and build trust amongst stakeholders with an interest in the estuary. In terms of practical implementation of this EMP, each responsible government department is required to produce project plans linked the identified management actions, and in line with their legislative mandates. The co-ordination and implementation of the EMP, and thus overall responsibility in terms of

estuarine management is vested within the Department. To ensure the implementation of the project plans are achieved, an advisory body, the EMF, should be established to increase transparency and greater responsiveness amongst the stakeholders and to foster continuous stakeholder engagement.

The provincial and municipal coastal committees established in terms of Chapter 5 of the ICMA shall serve as forums for monitoring the implementation of this EMP and the Department will report on the progress and achievements related to this EMP. Subsequent to the reporting, an annual report will be submitted to the Minister on the implementation of this EMP and then tabled in Parliament as required by the ICMA.

Appropriate resources both financial and human are of fundamental importance for the implementation of this EMP. Undoubtedly, these are often the stumbling blocks and challenges which will affect the success of the outcomes from this plan. All relevant authorities and key stakeholders should investigate ways of co-funding the implementation of this management plan. Routes that should be explored for financing are from government (e.g. DEA, KZN EDTEA or DWS), non-government organisations (e.g. WWF, WESSA) and the private sector. The development of a budget to initiate and implement the management plan over the next 5 years should be formulated as a matter of priority within the first six months following the acceptance and gazetting of this EMP. It is anticipated that the major portion of the budget will be for the implementation of the various Management Action Plans, such as monitoring of estuary health and sustainable development as well as conservation management functions (e.g. monitoring, rehabilitation and invasive alien plant management).

The Provincial and Municipal coastal committees established in terms of Chapter 5 of the ICM Act shall serve as forums for monitoring the implementation, reporting progress and achievements of this EMP. The monitoring, progress report and achievements will ultimately be submitted as an

10 REFERENCES

- Department of Environmental Affairs (DEA). 2014. The National Coastal Management Programme of South Africa. (Cape Town, South Africa).
- Department of Environmental Affairs (DEA). 2015. Guidelines for the Development and Implementation of Estuarine Management Plans in terms of the National Estuarine Management Protocol. Cape Town.
- Department of Water and Sanitation (DWS), South Africa., September 2015. Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: Volume 4: Estuary Resource Quality Objectives. Prepared by: Van Niekerk L., Adams J., Taljaard S. & Weerts S.
- EM 2010 Umkhomazi Local Area Plan. August 2010. RCR Collaborative Project Team.
- Forbes A.T. & Demetriades N.T. 2010. Estuaries of Durban, KwaZulu-Natal, South Africa. Report for the Environmental Management Department, eThekweni Municipality. Second Edition.
- MER 2021. aMahlomgwa Estuary Management Plan Situation Assessment Final Report 09/21
- Van Niekerk L., Adams J.B., Lamberth S.J., Taljaard S., MaKay F., Bashoo S., Parak O. & Weerts S. 2019a. Chapter 6: Pressures on the Estuarine Realm. South African National Biodiversity Assessment 2018: Technical Report. Volume 3: Estuarine Realm. South African National Biodiversity Institute, Pretoria. Report Number: SANBI/NAT/NBA2018/2019/Vol3/A.
- Van Niekerk L., Skowno A., Adams J.B., Lamberth S.J., Turpie J., MacKay C.F. & Sink K. 2019b. Chapter 8. Ecosystem Threat Status and Protection levels', South African National Biodiversity Assessment 2018: Technical Report. Volume 3: Estuarine Realm, South African National Biodiversity Institute, Pretoria. Report Number: SANBI/NAT/NBA2018/2019/Vol3/A.
- Van Niekerk L., Taljaard S., Adams J.B., Clark B., Lamberth S.J., MacKay C.F., Weerts S.P. & Whitfield A.K. 2019c. 'Chapter 7: Condition of South Africa's estuarine ecosystems' in South African National Biodiversity Assessment 2018: Technical Report. Volume 3: Estuarine Realm. South African National Biodiversity Institute, Pretoria. Report Number: SANBI/NAT/NBA2018/2019/Vol3/A.
- Van Niekerk L. & Turpie J.K. (eds.). 2012. South African National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component. CSIR Report Number

CSIR/ NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research, Stellenbosch.

Van Niekerk L., Turpie J.K, & Lamberth S.J. 2019d. Estuary Biodiversity Importance. South African National Biodiversity Assessment 2018: Technical Report. Volume 3: Estuarine Realm, South African National Biodiversity Institute, Pretoria. Report Number: SANBI/NAT/NBA2018/2019/Vol3/A.

11 APPENDIX A

aMahlongwa Estuary Resource Quality Objectives (DWS 2015)

PES:	C	REC:	B	TEC:	B
Components that require interventions to achieve the TEC:					
• Protect baseflows to estuary to maintain mouth state and salinity profile. • Improve water quality. • Partial restoration estuarine riparian habitat. • Control and reduce fishing pressure.					
Flow:					
PES	nMAR (MCM)		pMAR (MCM)		
	13.76		13.18		
B	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).				
Sediment processes:					
D↑	• The flood regime maintains the sediment distribution patterns and aquatic habitat (instream physical habitat). The suspended sediment concentration from river inflow does not deviate 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.				
Mouth state:					
A	Mouth open conditions should be maintained within the current range: 22% ($\pm 5\%$).				
Water quality: Salinity					
B	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 exceed 10 (to be confirmed).				
Water quality: Other					
D↑	Ecosystem health:			Recreational use:	Yes
	Water quality poses risk to REC/TEC, sufficiently reduced if: • DIN: Freshwater inflow, 50%ile < 0.2 mg/l (high risk). • DIP: Freshwater inflow, 50%ile < 0.015 mg/l (high risk). • DO: Entire estuary, average ≥ 6 mg/l (high risk). • Turbidity: Estuary, clear (< 10 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).			Microbiology: Sufficient levels (DEA, 2012).	
Macrophytes (plants)					
C↑	• 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 bare patches or unvegetated, cleared areas along the banks. Prevent further disturbance and development of the floodplain habitat. • 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 and sedge habitats ($< 50\%$ loss of reed and sedge habitats in non-flood year). • Improve salinity regime to encourage the reestablishment of mangrove habitat.				
Inverts					
C↑	As sampled by plankton net, grab and dip nets/traps (as appropriate):				

PES:	C	REC:	B	TEC:	B
	- Population abundances of plankton and benthic assemblages (baselines to be set) should not deviate by more than 30%. - Zooplankton should be dominated by estuarine copepods <i>A. natalensis</i> and <i>P. hessei</i>. - Macrobenthos should be abundant and dominated by amphipods, but should include isopods, tanaids, polychaetes, the crab <i>H. projectum</i> and insect taxa. - Chironomid larvae and oligochaetes should not occur in abundance and should not dominate the benthos. - Penaeid and carid (Caridina and Macrobrachium) prawns should occur. - Sandprawn <i>C. kraussi</i> should occur in sandy areas in the systems lower reaches (to be confirmed). - Large brachyuran crabs (macrocrustacea) are dominated by <i>V. litterata</i>. - Molluscan assemblage should include bivalves and gastropods (including <i>Melanoides tuberculata</i>). - Invasive alien species should not occur in abundance.				
Fish					
C↑	As sampled by seine and gill net in open waters: 15 species should occur to include freshwater, estuarine resident and estuarine dependant marine fishes. - Estuarine resident species should comprise a minimum of four species. - Estuarine resident and estuarine dependant marine fishes should dominate catches by abundance. <i>G. callidus</i>, <i>M. capensis</i> and <i>R. holubi</i> should occur with 100% frequency of occurrence (every sampling trip). <i>P. commersonni</i> should be sampled with 70% frequency of occurrence. - Pelagic piscivores should occur. - No alien fish species should occur. - Fish should be free of lesions and other anomalies related to water quality. - No fish kills should occur.				