Seekoei Estuary Management Plan November 2017 - DRAFT

Seekoei Estuary Management Plan

Prepared for

KOUGA
local municipality
Good Governance through Service Excellence

By

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Executive Summary

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EXECUTIVE SUMMARY

To be finalised after stakeholder input

List of Abbreviations

CBA Critical Biodiversity Area

CSIR Council for Scientific and Industrial Research

CWAC Co-ordinated Water Bird Counts

DEA Department of Environmental Affairs

DEA: O+C Department of Environmental Affairs: Oceans and Coasts

DEDEAT Department of Economic Development, Environmental Affairs and Tourism

DWS Department of Water and Sanitation

ECBCP Eastern Cape Biodiversity Conservation Plan (2007)

ECPHRA Eastern Cape Province Heritage Resources Agency

ECPTA Eastern Cape Parks and Tourism Agency

EIA Environmental Impact Assessment

ICMA Integrated Coastal Management Act (Act No. 24 of 2008)

IDP Integrated Development Plan

MAR Mean Annual Runoff from the catchment

MLRA Marine Living Resources Act (Act No. 18 of 1998)

MSA Municipal Systems Act (Act No. 32 of 2000)

NBA National Biodiversity Assessment 2011

NCMP National Coastal Management Plan (2015)

NEM: BA National Environmental Management: Biodiversity Act (Act No. 10 of 2004)

NEM: PAA National Environmental Management: Protected Areas Act (Act No. 57 of 2003)

NEMA National Environmental Management Act (Act No. 107 of 1998)

NEMP National Estuary Management Protocol (2013)

NHRA National Heritage Resources Agency

NMMU Nelson Mandela Metropolitan University

NMU Nelson Mandela University

NPA National Ports Act (Act No. 12 of 2005)

PCC Provincial Coastal Committee

PES Present Ecological State

RDM Resource Directed Measures

SANBI South African National Biodiversity Institute

SDF Spatial Development Framework

SEA Strategic Environmental Assessment

SPLUMA Spatial Planning and Land Use Management Act (Act No. 16 of 2013)

TOCE Temporarily Open/Closed Estuary

Terminology

Berm in this document refers to the sand strip that separates the Seekoei Estuary and the surfzone on the seaward side. The berm is dynamic, increasing or decreasing in height relative to Mean Sea Level according to the interactive influence of dominant driving forces*.*

Biota refers to living organisms, plant and animal.

CWAC counts - Coordinated Water Bird Counts done at least twice a year (winter and summer) by local volunteers on identified wetlands. Programme initiated by the Animal Demography Unit (ADU) at the University of Cape Town.

Ecological Reserve refers to the quality, quantity and timing of freshwater inflows reserved to support ecosystem function.

Estuarine classification is the determination of an ecological class by taking ecological, social and economic factors into account, in a transparent, participatory process.

Estuarine classification system of Whitfield (1992) separates estuaries into permanently open estuaries, temporarily open/closed estuaries, estuarine lake systems, estuarine bays and river mouths.

Estuarine Functional Zone (EFZ) correlates with the 5 m topographical contour as delineated in the National Biodiversity Assessment: Estuary Technical Report (2012). This includes any open water areas, estuarine habitat (sand and mudflats, rock and plant communities) and floodplain areas.

Estuarine ecosystem goods and services are defined as the benefits that result from the ecological functioning of a healthy estuarine ecosystem. The ecosystem services that are provided are directly linked to the ecosystem goods.

Freshette a pulse of freshwater following a rainfall event in the catchment.

Hypersalinity occurs when the salt content of the water exceeds 35 parts per thousand. If salinity exceeds 50 - 55, the medium becomes lethal to the biota and mass mortality occurs. For many species, breeding will cease at lower levels.

Present Ecological State is a measure of the present quality (water quantity, water quality, habitat and biota) of the resource – assessed in terms of the degree of similarity to the reference condition.

Productivity the rate of biomass generation by living organisms.

Reference condition refers to the natural, unimpacted characteristics of a water resource, and represents a stable baseline.

1. Introduction

1.1. Background

Estuaries represent the meeting place of rivers and the sea; salinity along the length of an estuary therefore ranges from freshwater at the river end (salt content of the water is near-zero), to full seawater at the other (salt content is around 35). Because of the ever-changing salinity, estuaries support a unique assemblage of plants and animals able to tolerate salinity fluctuations; species richness is relatively low, but abundance of individual species is high. Productivity (the rate of biomass generation by living organisms) is naturally high and estuaries are ranked among the most productive systems on the planet. Estuaries provide numerous goods and ecosystem services including the seasonal utilization of the estuary as a nursery for juvenile fish. However, anthropogenic activities in the catchment of estuaries can impact negatively on their health and functioning. Estuary management plans thus ensure that a balance is maintained between providing for human needs and the maintenance of natural estuarine functions.

The small Seekoei Estuary, a temporarily open closed estuary (TOCE) is located between the resort towns of Aston Bay and Paradise Beach in the Eastern Cape. These two townships fall under the Kouga Municipality (one of seven in the Sarah Baartman District). Two tributaries (the Swart and the Seekoei) discharge into the Seekoei Estuary about 1.3 km from the beach (Figure 1). The two rivers originate northwest of the town of Humansdorp and are each approximately 35 km in length. At its widest point, the estuary is 580 m wide, with a variable depth profile. Tidal reach extended 4.2 km upstream and the original tidal prism was 0.82×10^6 cubic metres of water per cycle (Esterhuysen 1982). The total area of the Seekoei Estuary is 276 ha (Refer to Table 9). The landscape between the estuary and Humansdorp is largely transformed, with extensive farming activity undertaken.

The need for Estuary Management Plans (EMPs) in South Africa is addressed in the Integrated Coastal Management Act (Act 24 of 2008; ICMA). Historically, estuaries and the management thereof have not been adequately addressed by marine, freshwater and biodiversity conservation legislation. However, the ICMA recognises the importance of estuaries and their management and outlines a National Estuarine Management Protocol (NEMP) to support this. The protocol identifies the minimum requirements for the development of EMPs, and delegates responsibility to relevant authorities and agencies in an attempt to align and coordinate estuaries management at a local level.

The NEMP identifies three phases in the development of an Estuary Management Plan that are:

1. **Scoping phase**, which includes initial stakeholder engagement and the development of the Situation Assessment report

2. **Objectives setting phase** where:
- Vision and objectives for estuary management are identified,
- Geographical boundaries of the estuary are delineated and graphically represented,
- Spatial zonation of activities is determined,
- Management objectives and activities are described,
- An integrated monitoring plan is developed, and
- Institutional capacity and arrangements are discussed.

3**. Implementation phase**, which is based on:
- The development of an implementation strategy and project plans,
- Continuous monitoring and performance evaluation, based on performance indicators, and

- Review of the EMP every five years

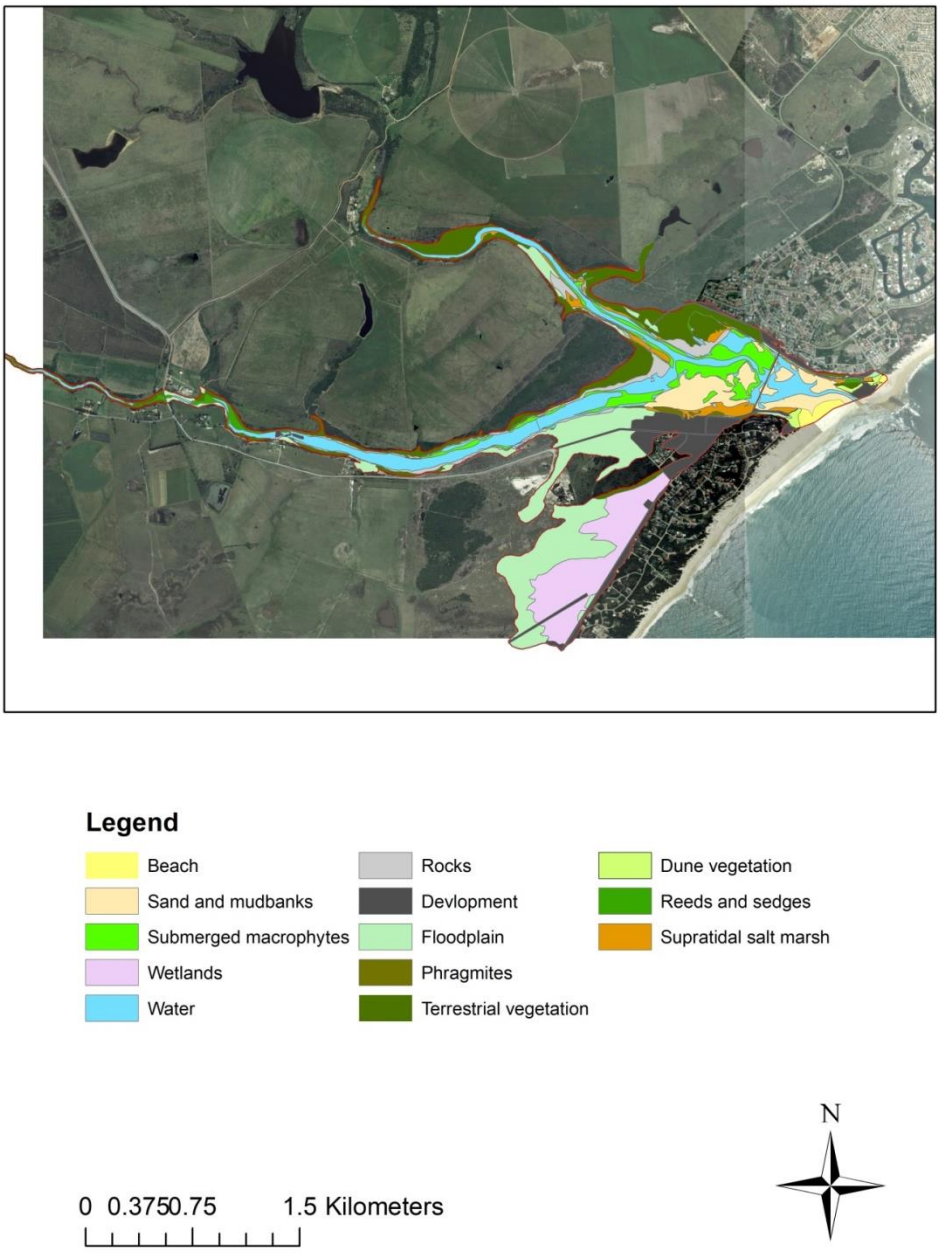

Figure 1 **Map of the Seekoei Estuary showing the resort towns of Paradise Beach (south of the estuary) and Aston Bay on the northern side. The Seekoei tributary to the south and the Swart to the north flow in to the estuary basin. Also shown are the habitat types below the 5 m contour line around the estuary (outlined by the red line). The area below the 5 m contour line is referred to as the Estuary Functional Zone (EFZ). Note the extensive area of wetland to the west of Aston Bay.**

1.2. Purpose of Estuary Management Plan

The Estuarine Management Plan (EMP) has been developed in two phases: 1.) Situation Assessment Phase; and 2.) Estuarine Management Plan and Implementation Plan. The EMP has been developed through a public consultative process, which included two workshops and direct engagement with key stakeholders.

The Situation Assessment report provided the baseline assessment to inform the EMP and aided in the development of the local vision for the Seekoei Estuary and the identification of management objectives and priorities, and should be read in conjunction with this EMP.

The purpose of this EMP for the Seekoei Estuary is to:

- Provide a summary of the Situation Assessment,
- Define and delineate the geographical boundaries of the Seekoei Estuary,
- Highlight the local vision and objectives of the management of the Seekoei Estuary,
- Identify management objectives pertaining to the Seekoei Estuary,
- Delineate and map proposed zones to which specific activities should be allocated,
- Provide recommended management priorities, and
- Develop an integrated monitoring plan for the implementation of the EMP.

2. Synopsis of Situation Assessment

This chapter provides a synopsis of the detailed Situation Assessment report that was developed for the Seekoei Estuary. The detailed Situation Assessment Report is available from http://cmr.mandela.ac.za/Consulting/Seekoei-Estuary-Project.

2.1. Introduction

Temporarily open/closed estuaries (TOCE's) such as the Seekoei constitute more than 72% of our estuarine types in South Africa (Whitfield 1992, Perissinotto *et al.* 2010). The physico-chemical attributes of these estuaries are recognizably very different when compared to the other four broad estuarine types, supporting their own unique floral and faunal assemblages. Changes in biotic structures and ecological functioning between individual TOCEs also exist, linked to physico-chemical conditions at any time.

Anthropogenic impacts change the physico-chemical environment and concomitantly biotic response. Historically, effective management of our estuaries were not adequately addressed by marine, freshwater and biodiversity conservation legislation. This led to *The Integrated Coastal Management Act (Act 24 of 2008, ICMA)* which recognized the importance of estuaries together with their effective management. Estuary Management Plans (EMPs) for all South African estuaries became mandatory in terms of the Act and this Act outlines a National Estuarine Management Protocol (NEMP) to support this.

The Seekoei Estuary is located between the resort townships of Aston Bay on the eastern side and Paradise Beach on its western side (Figure 2). These two townships fall under the Kouga municipality (one of seven in the Sarah Baardman District) which has approximately 113 000 residents in the municipal area (Kouga Integrated Development Plan 2017 – 2022, (Kouga Municipality 2017). Kouga is the second smallest region in district, covering only 4.1% of the land area. Despite its relative small size, it is the most populous region representing approximately 24% of the total population in the district.

2.2. Overview of ecological function and state of the estuary

The geographical boundaries are defined as follows (Gauss Projection, Clarke 1880 Spheroid):

Downstream boundary: The estuary mouth (34° 05' 10" S, 24° 54' 30" E)

Upstream boundary: Seekoei River (34° 05' 20" S, 24° 51' 50" E)

Swart River (34° 04' 35" S, 24° 52' 35" E)

Lateral boundaries: 5 m contour above MSL along the banks.

Figure 2 The resort townships of Aston bay (to the north) and Paradise Beach (to the south) relative to the Seekoei Estuary and its catchment

The catchment of the Seekoei Estuary is strongly associated with intense agricultural activities. On the coast, the townships of Aston Bay and Paradise Beach flank the estuary. Figure 3 illustrates land patterns surrounding the estuary. The Seekoei Estuary and environs have a long history of man-induced changes, some of which have impacted the structure and functioning of the system in a severe way. Whitfield and Bruton (1989) and Reddering (1988) described the Seekoei as a freshwater starved estuary. Along with dams (large and small, Figure 5 in the Situation Assessment Report) in the catchment, other forms of water abstraction include irrigation and non-irrigation uses. Based on DWS reporting and model estimates, approximately 17.35 x 10^6 m^3 of water is abstracted/stored from the catchment from non-irrigation (0.8%), irrigation (57%) and current storage (42% dams). Given that the average annual runoff for the catchment is estimated to be 17 x 10^6 m^3, the abstraction equals to, or surpasses runoff, further demonstrating the impact of the lack of freshwater inflow on the estuary.

Invasive alien plants such as *Acacia mearnsii* (Black Wattle), *Acacia cyclops* (Rooiikrans) or species of *Eucalyptus* among others use much more water than indigenous trees and plants. Water consumption by these invaders can lead to reduction in river flow, or even the drying up of springs and streams. In the case of the Seekoei Estuary, invasive plants (particularly the *Acacia* species) in the relatively small catchment will impact downstream waterflow in a meaningful way, further leading to negative impacts on the estuary.

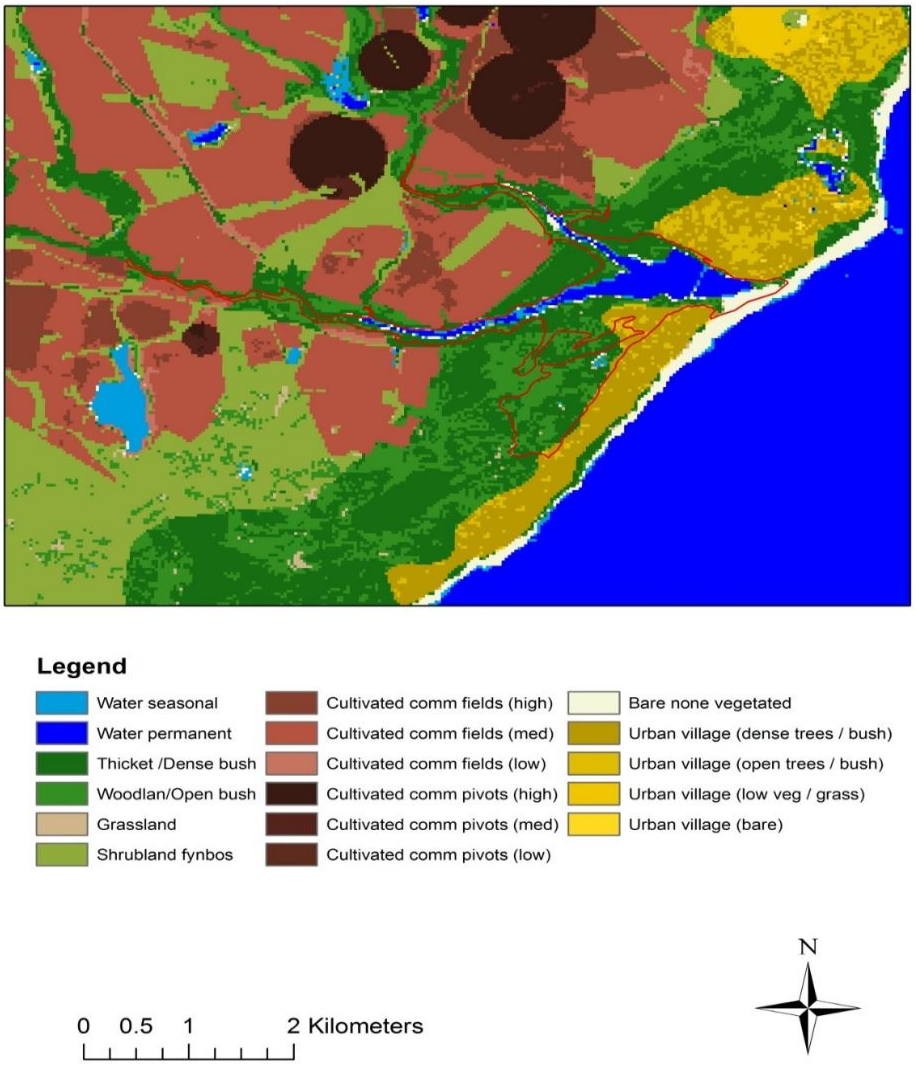

Figure 3 **Land use patterns around the Seekoei Estuary. Note the numerous water storage reservoirs associated with the two tributaries.**

Climate change impacts such as sea level rise are likely to pose various risks on coastal infrastructure in the 5 m contour high risk zone. This 5 m contour line is currently proposed as an exclusion or "no-go" zone with regards to future development. The 10 m contour line is recommended for future development lines.

Assessment of the health condition of estuaries is also referred to as the Present Ecological State (PES). Six "PES" classes were used to describe the condition of the estuaries. The physical conditions of estuaries are highly dynamic when compared to other aquatic ecosystems. Therefore, a shift from a dynamic to a more stable system is an indicator of severe degradation of an estuarine system. The six categories are described in the table below:

Table 1 Estuarine Health Classes used to indicate the PES relationship between ecosystem condition and functionality of South Africa's estuaries.

Estuarine health class	Description	Ecological state	Functionality
A	Unmodified, natural.	Excellent	Retains Processes or Patterns
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions and processes are essentially unchanged.	Good	
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions and processes are still predominantly unchanged.	Fair	Loss of Process or Patterns
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions and processes have occurred.		
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions and processes are extensive.	Poor	Little/No Process or Patterns
F	Critically/Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions and processes have been destroyed and the changes are irreversible.		

The ***Ecological Health state*** for the Seekoei Estuary was determined in 2006 (DWAF 2006). At the time the study was completed, the recommended ecological category suggested by the Directorate: Resource Directed Measures (RDM) for the Seekoei Estuary was a D: Largely modified with a large loss of natural habitat, biota and basic ecosystem functions and processes have occurred.

It is very important to note that although the Habitat Health of the systems equates to a D (50), the Biotic Health is in a Category E (35). It is therefore believed that the Seekoei Estuary is on a trajectory of change to a Present Ecological Status of a Category E. Management intervention is urgently required to prevent further degradation. A summary of the individual abiotic and biotic component categories in the Seekoei Estuary and the PES for each is summarised in the table below:

Variable	Weight	Score	Weighted score
Hydrology	25	58	14
Hydrodynamics and mouth condition	25	40	10
Water quality	25	40	12
Physical habitat alteration	25	61	15
Habitat health score			50
Microalgae	20	35	7
Macrophytes	20	35	7
Invertebrates	20	30	6
Fish	20	35	7
Birds	20	40	8
Biotic health score			35
Estuarine health score			42

2.3. Ecosystem Goods, Services and Threats to Ecological Functioning

The table below identifies the ecosystem goods and services that are provided by the Seekoei Estuary. Both direct and indirect users rely on the resources provided by the Seekoei Estuary. Direct users utilise resources provided by the Seekoei Estuary for financial or recreational purposes and directly benefit from the utilisation of the resources provided by the estuary. Examples of direct users associated with the Seekoei Estuary include: members of the public utilising natural resources for both subsistence and recreational purposes such as Subsistence and recreational fishermen, Bait collectors and Boaters. Indirect users are defined as users that indirectly rely on resources the Seekoei Estuary provide. Examples of ways in which the Seekoei Estuary is indirectly utilised include the following: Tourism and Waste disposal/water purification.

With regards to ***threats to ecological functioning*** of the Seekoei River Estuary, the NBA (2011) Estuary Technical Report identifies the major pressures that affect the ecological functioning of the Seekoei River Estuary as change in water flow and the causeway. Habitat loss and fishing effort were considered minor threats to the Seekoei River Estuary's ecological functioning. With regards to specific ecological goods and services provided by the Seekoei River Estuary, a variety of factors threaten the sustainability of these ecological goods and services. The nature of the threats that impact the provision of these ecological goods and services are discussed in the table below.

Table 2 The ecosystem goods and services provided by the Seekoei Estuary.

Clean air	Air quality is improved and greenhouse gas emissions are reduced through the photosynthetic processes associated with the vegetation that is found along the banks of the Seekoei Estuary.
Improved water quality	The Seekoei Estuary contributes to the dilution and assimilation of waste that that enters the estuary resulting from activities both within the Estuarine Functional Zone (EFZ) and the wider catchment area. Waste is diluted by the water column as well as through the influence of tidal movements. Organic and inorganic wastes are also assimilated and accumulated in the sediment of the Seekoei Estuary.
Natural resources	Small scale subsistence and recreational fishing and bait collection is practiced in the Seekoei Estuary. However, the estuary does not support large scale or commercial fishing.
Habitat	The Seekoei Estuary provides a nursery for fish and invertebrate species that utilize estuaries during part of their life cycle. Examples of the species that have been recorded in the Seekoei Estuary include: the Southern mullet, *Liza richardsonii,* the Spotted Grunter *Pomadasys commersonnii*, the Cape Mooney, *Monodactylus falciformis* and the threatened White steenbras, *Lithognathus lithognathus.*
Migration route	The Seekoei Estuary provides a migratory corridor between the sea and rivers for those organisms utilizing either freshwater habitats or the sea, sometimes on a temporary basis. An example is the freshwater mullet, *Myxus capensis.*
Recreation	Recreational activities on the estuary include boating, board-sailing and recreational angling, although these activities have probably become less popular in recent times as the estuary became shallower over time. However, birding still remains popular, particularly with day-trippers.
Tourism	Paradise Beach and Aston Bay are popular holiday destinations and there are numerous accommodation facilities to support tourism. Both the estuary and pristine beaches are strong attractants to the area, including day-trippers.
Research opportunities	The Seekoei Estuary is one of numerous Temporarily Open/Closed Estuaries (TOCEs) along the south coast of the Eastern Cape Province and because of its proximity to regional Research Centres, represents an important opportunity for research programmes. The value of the estuary for research is strongly linked to the numerous freshwater wetland habitats adjacent to the estuary to the west.
Aesthetic/ Scenic value	The location of the estuary in a clean-air environment and minimal traffic congestion and noise provides a sought-after aesthetic experience for residents and visitors.

Table 3 The nature and significance of identified threats to the ecosystem goods and services provided by the Seekoei Estuary.

Freshwater supply in terms of the general functioning of the estuary	Supply of freshwater from the catchment to the estuary is seriously compromised, with abstraction levels now estimated to be equal to, or exceeding the average annual runoff. Without an adequate supply of a freshwater, the system is no longer a functional estuary. Although some baseflow will reach the estuary intermittently, it is mostly the medium to larger floods that will temporarily restore some functioning of the estuary. The lower photograph on the cover of this report reflects the situation of zero flow for much of 2017. This photograph was taken a few days after about 60 mm of rain fell over two-three days (17 Nov 2017).
Freshwater supply and estuarine salinity gradients	Plants and animals distribute themselves according to salinity preferences along salinity gradients in an estuary (freshwater to seawater). Reduced freshwater inflow compromises these gradients and some species disappear from the estuary.
Freshwater supply in terms of baseflow and state of the mouth	Because of freshwater abstraction, the frequency and duration of mouth opening to the sea is reduced. Salinity patterns in the estuary therefore change, often affecting components of the estuarine biota in a negative way.
Extended periods of inundation of marginal vegetation	If the mouth of the estuary remains closed for extended periods, germination of salt marsh seeds will be compromised.
Freshwater supply and its importance to the bird sanctuary	Both abundance and species richness of water fowl will decline if salinity in the estuary persistently remains at relatively high levels.
Migration of biota between rivers and the sea.	If the estuary remains disconnected from the sea for extended periods, natural migration of numerous species through the estuary ceases. Recruitment patterns are disrupted and some species may become locally extinct from these rivers.
The estuary as a nursery	Estuaries are obligatory nursery areas for numerous species of fish, including many of those important to recreational anglers. Temporal changes in breaching events because of reduced freshwater baseflows will reduce the importance of the estuary as a nursery for juvenile fish.
Ebb-tidal plumes in the nearshore	Ebb-tidal plumes provide migratory cues to young fish migrating to estuarine nursery areas or even for those species using the habitat temporarily.
Reduced freshwater baseflow vs evaporation rate	If the evaporation rate exceeds baseflow per unit time, salinity in the estuary increases and the structure of the biotic community changes. Species richness also decreases.
Hypersalinity	Because freshwater baseflow to the estuary is significantly reduced, hypersaline conditions develop more frequently that at times, become lethal to the biota. Freshwater supply less than the rate of evaporation from the water body. Salinity levels above ca 50 become lethal to most species, although breeding will cease at lower levels for some.
PES or Present Ecological State	Evidence suggests that since 2006, freshwater abstraction has been further reduced. The PES has likely slipped below a score

	of 50, relegating the Seekoei Estuary to a Category E system. The estuary is therefore seriously modified and one of the most degraded estuaries in South Africa. At the time of the 2006 study, it was estimated that approximately 56% of the MAR still reached the estuary (see Section 6.7 of the Situation Assessment Report).
Position of the mouth channel across the berm	The estuary mouth channel is now forced to the south by the presence of the carpark. Because natural east-west movement of this channel is compromised over time, natural tidal exchange patterns have changed.
Connectivity of the estuary with the nearshore	Historically, evidence suggests that the estuary remained open to the sea most of the time. As freshwater baseflows decreased because of increasing abstraction, functioning of the estuary declined progressively. The value of goods and services therefore also declined.
Presence of the causeway	Connectivity between north and south parts of the estuary water body reduced, negatively impacting mixing processes, tidal ebb and flow, salinity distribution and sedimentary processes. Evidence suggests that fine sediments (e.g. clay) become trapped behind the causeway and compact. These compacted sediments therefore require floods of a greater magnitude to remove them, the potential scouring benefit of these floods further offset by the barrier-effect of the causeway.
Accumulation of pollutants	Because of intense farming activity in the catchment, organic and inorganic pollutants are likely to be flushed into the estuary after heavy rainfall.
Artificial breaching of the mouth	Breaching at a lower water level compared to natural will result in less efficient removal of accumulated sediment. Sediment removal increases exponentially with increasing current velocity. There is currently discussion on the correctness of the original survey data relative to MSL and associated with the causeway.

2.4. Opportunities and Constraints for Consideration in the Estuarine Management Plan

The ***opportunitie***s for effective integrated management of the Seekoei Estuary were identified through the desktop assessment and site visits as well as through stakeholder engagement. Opportunities that were identified are listed below.

- Current conditions impacting the Seekoei Estuary in a negative way can be partly reversed, improving the Ecological Health of the system. This is in line with recommendations outlined in the Ecological Water Requirement Study. Because of the proclaimed Provincial Bird Sanctuary on the Seekoei, the status of the estuary should be improved to Level B (currently the estuary is classified as Level D). Level B probably represents the best attainable level under present circumstances.

- To restore the estuary as a functional system supporting a rich biotic community. This will attract visitors to the area and promote tourism and business opportunities for the local community.
- Further development of the tourism industry. Send local people on training courses to become bird guides. They could then earn an income from guiding birders visiting the area.
- Minimize potential threats of climate change through informed decision making around infra-structure development and management strategies.
- Establishment of a co-operative estuarine management forum including residents, municipal management, and other relevant authorities.

The ***constraints*** for the effective implementation of estuarine management objectives are listed below. Some of these became apparent during the Reserve Study undertaken by the Department Water Affairs Forestry (2006);

- Because of intermittent incidents of reduced or zero baseflows (zero baseflows may persist for months), salinity levels may rise to excessive levels (a salinity of 98 is on record) and no estuarine biota survives such levels. Such events may become more common in future.
- Over- and possible illegal abstraction of freshwater upstream.
- Alien vegetation increasing in extent in the catchment.
- Increased pollution from river runoff or agricultural return flow from farming activities in the catchment.
- Injury or loss of human life in the event of an accident on the causeway during inclement weather conditions and/or water levels overtopping the crossing.
- Freshwater and seawater flooding leading to erosion and removal of causeway.
- Socio-economic issues that lead to higher crime rates.

2.6 Recommendations to address major information gaps

The major information gaps pertaining to the Situation Assessment Report include the following:

A. Lack of freshwater inflow data and mouth management data specific to the Seekoei Estuary
B. Lack of water quality data specific to the Seekoei Estuary
C. There is a lack of biotic data specific to the Seekoei Estuary
D. Potential changes in the rate and volume of sand moving alongshore on the beach
E. Sedimentation in the estuary, regular bathymetric surveys needed

Universities, and other relevant institutions must assist in providing relevant information where available. Information gaps should be prioritised in the Seekoei EMP as research opportunities.

3. Local Vision and Objectives

3.1 Vision

The vision for the Seekoei Estuary should reflect the desired state of the estuary and should provide the starting point for the identification of management objectives for the estuary. The vision for the Seekoei Estuary has been developed through stakeholder input and their expectations for the overall

outcome of the effective management of the estuary. From the stakeholder input, the following vision for the Seekoei Estuary has been proposed:

Vision Statement

Restore the Seekoei Estuary as a functional estuary that is ecologically resilient, clean and safe for all users. Resources must be used in a responsible manner that encourages tourism and recreation. Equitable access to the estuary must be provided and users of the estuary acknowledge that they are custodians of and are accountable for the estuary and, through the development of partnerships and integrated management of the estuary, ensure its longevity and sustainability.

This vision to be revised after Stakeholder input

3.2 Strategic Objectives

In order to achieve the vision for the Seekoei Estuary, the following objectives have been identified that describe specific outcomes that aim to achieve the vision:

- To promote the Seekoei Estuary as a tourism and recreation asset.
- To facilitate equitable safe access to Paradise Beach with a disaster management plan and early warning detection system of potential threats. Implement a mouth management plan including a maintenance management plan.
- To ensure adequate freshwater inflow to the estuary to maintain open mouth conditions and a healthy, functional ecosystem.
- To promote custodianship of the Seekoei River Estuary through awareness, education and the integrated management of the estuary by the formation of partnerships between the general public, surrounding industry and all spheres of government.
- To implement effective management of the estuary to ensure that future generations appreciate the estuary as an asset and are able to utilize and enjoy the estuary.
- Ensure that the alternate route from Paradise Beach to Humansdorp/Jeffrey's Bay is upgraded and safe to drive under all conditions. The possibility of an additional route connecting Aston Bay with other centres should be explored.

This section to be revised after Stakeholder input

4 Management objectives and associated activities

The management objectives for the Seekoei Estuary have been developed from the opportunities and threats identified during the Situation Assessment as well as from the local vision and objectives for the estuary. These are:

1. Restore best attainable level of ecological functioning and improve the health of the Seekoei Estuary.
2. Conserve and protect the remaining estuarine habitat within the Estuarine Funcitonal Zone.
3. Implement monitoring programmes within the Seekoei Estuary.

4. Provide reasonable and safe public access to Paradise Beach. Implement a mouth and maintenance management plan. Provide a new and alternative route for residents in Aston Bay and environs should the causeway across the Seekoei be flood-damaged or removed at some time in the future. The potential also exists that the current road from Aston Bay/Marina Martinique to Jeffrey's Bay may become impassable on occasions. Expansion of existing townships will increase.
5. Promote local economic development through eco-tourism and recreation activities.
5.1. Promote the bird sanctuary as an attractive habitat for water birds particularly.
5.2. Train local guides to lead birding trips.
6. Promote education and awareness of the Seekoei Estuary.
7. Develop partnerships between residents and municipal management authorities for the integrated management of the Seekoei Estuary.

The management objectives have been assigned proposed activities and where applicable, a description of the ecological impact or socio-economic consequence, the responsible implementing agent, a cost estimate as well as the expected duration in which the action should be implemented have been provided.

Table 4 Management Objective 1: Restore best attainable level of ecological functioning and improve the health of the Seekoei Estuary.

PROPOSED ACTIVITY	**ECOLOGICAL IMPACTS/SOCIO ECONOMIC CONSEQUENCES**	**PROPOSED IMPLEMEN-TING AGENTS**	**ESTIMATED COST**	**EXPECTED DURATION**
1.1 Review legality and capacity of existing dams in the Seekoei Catchment	Provide a more accurate assessment of freshwater supply available for improved estuarine functioning.	**DWS**	***To be completed***	**6 months**
1.2 If required, implement legal procedures to ensure that landowners in the catchment adhere to water abstraction agreements	Improve freshwater supply to the Seekoei Estuary, particularly baseflows. Coupled to Objective 1.1	**DWS**		**3 years**
1.3 Review and improve the confidence level of the ecological reserve study done in 2006.	Using results from Sections 1.1 and 1.2, generate more accurate estimates of freshwater inflows to the estuary – floods and baseflows.	**DEDEAT**		**6 months**

1.4 **Improve freshwater baseflows to the Seekoei estuary.**	Restore best attainable level of Estuarine health as recommended in the Reserve Study.	**DEDEAT, DWS**		**2 years**
1.5 **Initiate research programmes to identify and map the extent of alien species distribution in the wetlands and catchment.**	Results will inform an alien species eradication programme and therefore contribute to the improved health of the aquatic system – wetlands, catchment and estuary. Improve the natural functioning of the aquatic system as a unit, including increased baseflow volumes from the catchment if invasive plant infestation is high.	**DEDEAT, DWS, Kouga Municipality and Regional Research Institutes.**		**2 years**
1.6 Develop an alien species eradication programme, guided by the results from 1.5 above.		**As above**		**2 years**

Table 5 Management Objective 2: Conserve and protect the remaining estuarine habitat within the Estuarine Functional Zone.

PROPOSED ACTIVITY	**ECOLOGICAL IMPACTS/SOCIOECONOMIC CONSEQUENCES**	**PROPOSED IMPLEMENTING AGENTS**	**ESTIMATED COST**	**EXPECTED DURATION**
21 **Establish an Estuarine and Wetland Management Committee.**	Inform decision-makers on the health status of the estuary and wetlands and advise of any remedial action that should be taken.	**DEDEAT, Kouga Municipality.**		**6 months**
2.2 **Develop a Conservation Plan for the Paradise Beach Wetlands**	Ensure Natural Functioning of the wetlands to maximize benefits of Goods and Services provided by the wetlands	**DEDEAT, Kouga Municipality and Estuarine and Wetland Management Committee**		**1 year**
2.3 Research, and if necessary restore the connectivity of wetlands in the estuary	Restore natural functioning of the wetlands, including through-flow to the estuary. This will provide localized habitat in the estuary for	**DEDEAT, Kouga Municipality and the Estuarine and Wetland Management Committee**		**1 year**

functional zone with the estuary.	biota that favour low salinity conditions.			

Table 6 Management Objective 3: Implement monitoring programmes within the Seekoei Estuary

PROPOSED ACTIVITY	ECOLOGICAL IMPACTS/SOCIOECONOMIC CONSEQUENCES	PROPOSED IMPLEMENTING AGENTS	ESTIMATED COST	EXPECTED DURATION
3.1 **Develop and implement monitoring programmes on the Seekoei Estuary and Wetlands**	Provide specific information to the Estuarine and Wetland Management Committee that will help guide decision-making making (see detail in the Monitoring section and Mouth management plan) Encourage research and understanding of the rate of sedimentary processes in the estuary and along the beach, including the origin of sediment types.	**DEDEAT, Kouga Municipality**		**1 year**

Table 7 Management Objective 4: Provide reasonable and safe public access to Paradise Beach and Aston Bay. Implement a mouth and maintenance management plan (see separate Mouth Management Plan document)

PROPOSED ACTIVITY	ECOLOGICAL IMPACTS/SOCIOECONOMIC CONSEQUENCES	PROPOSED IMPLEMENTING AGENTS	ESTIMATED COST	EXPECTED DURATION
4.1 Upgrade the existing loop road to a tarred surface	Provide a safe route for residents of Paradise Beach to access essential services when the causeway road is not open to traffic.	**Provincial Government and Kouga Municipality.**		**2 years**
4.2 Temporarily maintain and upgrade (if necessary) the road across the causeway	Provide pedestrians and traffic safe movement across the causeway. School children, essential and emergency services are included.	**Kouga Municipality**		**Up to end of 2023**
4.3 Additional connecting road	The potential exists that Aston Bay and environs may temporarily become isolated, should the present	**Kouga Municipality**		**Up to end of 2023**

between Aston Bay environs and other centres	road to Jeffrey's Bay be closed indefinitely.			
4.4 Ultimate removal of the causeway after objectives are met	Ecologically and from a maintainance perspective, the causeway is highly problematic and should eventually be removed. From an economic and social perspective, the causeway is currently beneficial. Alternate options must be explored. The causeway should only be removed after Objectives 1.4. and Objectives 4.1 – 4.3 are satisfactorily resolved.	**Kouga Municipality**		**After 2023**
4.5 Implement estuary mouth and maintenance management plan	Implement estuary mouth and maintenance management plan	**Kouga Municipality and DEDEAT**		**Immediately (2018)**

Table 8 Management Objective 5: Promote local economic development through tourism and recreation activities.

PROPOSED ACTIVITY	**ECOLOGICAL IMPACTS/SOCIOECONOMIC CONSEQUENCES**	**PROPOSED IMPLEMENTING AGENTS**	**ESTIMATED COST**	**EXPECTED DURATION**
5.1 **Promote local economic potential and tourism**.	The local economy will benefit considerably, particularly when all Objectives noted above are realized (1 to 4). Promote the bird sanctuary as an attractive habitat for water birds particularly. Train local guides to lead birding trips.	**Jeffrey's Bay Tourism** **Kouga Municipality** **DEDEAT**		**ongoing**

Table 9 Management Objective 6: Promote education and awareness of the Seekoei Estuary.

PROPOSED ACTIVITY	ECOLOGICAL IMPACTS/SOCIOECONOMIC CONSEQUENCES	PROPOSED IMPLEMENTING AGENTS	ESTIMATED COST	EXPECTED DURATION
6.1 **Promote education and awareness of the estuary and wetlands**.	Job opportunities for trained guides will benefit residents. Design and construct informative displays of bird species. Initiate series of educational workshops.	**Jeffery's Bay Tourism** **Kouga Municipality** **DEDEAT**		ongoing

Table 10 Management Objective 7: Develop partnerships between residents and municipal management authorities for the integrated management of the Seekoei Estuary.

PROPOSED ACTIVITY	ECOLOGICAL IMPACTS/SOCIOECONOMIC CONSEQUENCES	PROPOSED IMPLEMENTING AGENTS	ESTIMATED COST	EXPECTED DURATION
7.1 Establish a representative Estuary and Wetland Management Committee	A direct channel of communication between the committee and managing authorities will enhance accurate and prompt decision making. This is necessary for the implementation of the mouth management plan.	Kouga Municipality		Ongoing

5 Proposed zonation of activities

The development of zonation plans, particularly within aquatic environments, is becoming an important component of any integrated management plan. Spatial planning tools aim to assist in finding cohesion between the demand for growth and development of infrastructure and the need for biodiversity conservation. With regards to estuarine management, the process of zonation is 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". Zonation and spatial planning typically allows for:

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

The zonation plan for the Seekoei Estuary was developed by incorporating the Vision and Management objectives to achieve the desired state of the estuary.

Zonation maps - need to investigate whether necessary. Currently implemented no motorized craft used for recreational purposes allowed on the water and no fishing off the causeway.

6 Recommended management priorities

Completed after stakeholder input

Table 11 Recommended management priorities

Management Priority 1: Restore best attainable level of ecological functioning and improve the health of the Seekoei Estuary.

ACTION	RELEVANT LEGISLATION	RESPONSIBLE AUTHORITIES	PERFORMANCE INDICATOR	PRIORITY ALLOCATED (H/M/L)

Management Priority 2: Conserve and protect the remaining estuarine habitat within the Estuarine Funcitonal Zone.

ACTION	RELEVANT LEGISLATION	RESPONSIBLE AUTHORITIES	PERFORMANCE INDICATOR	PRIORITY ALLOCATED (H/M/L)

To be continued……..

7 Integrated monitoring plan

The integrated monitoring plan for the Seekoei Estuary comprises of three primary categories. These categories include:

A. Resource monitoring
B. Compliance monitoring
C. Performance monitoring

A. Resource monitoring

The resource monitoring component is aimed specifically towards the monitoring of ecological indicators. The ecological indicators are used to monitor the ecological state of the Seekoei Estuary. The requirements for the monitoring of the ecological indicators of the Seekoei Estuary have been guided by the Methods for the Determination of the Ecological Water Requirements Reserve for estuaries (DWA, 2013). Abiotic and biotic components were selected from this guideline. An annual report should be produced that summarises the results from the monitoring programme. This report should be made available to the public.

Should guidelines be exceeded, an alert must be forwarded to the Municipality (contact person to be identified). In the case of water levels rising above monitoring thresholds (designed to avoid flooding of the causeway or damage to adjacent low-lying properties), an artificial breach of the mouth could be initiated. This situation will persist until the end of 2023 when monitoring data will guide the decision on the future of the causeway (in conjunction with acceptable outcomes of the Management Objectives listed in Section 4).

B. Compliance monitoring

The compliance monitoring component aims to monitor the effectiveness of the implementation of the EMP by assessing the intensity and nature of the activities occurring within the Seekoei Estuary and will identify activities that are not compliant with the relevant legislation, policies and guidelines as described in the EMP.

C. Performance monitoring

The performance monitoring component is important when assessing the effectiveness of the overall implementation of the Seekoei EMP. The performance monitoring component will assess the effectiveness of the implementation of the EMP by determining whether the actions associated with each Management Objective have been achieved or not. The performance indicator allocated to each action will form the basis of the performance monitoring component.

A summary of 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 12 Resource monitoring

Ecological component	Indicator	Spatial/temporal scale	Target	Responsible authorities
Water Level Recorder to be installed	Water level from the roof of the main causeway culvert. This level co-incides with the top of the concrete buttress on the south side. Refer to Figure.	Once a week or more frequently if a flood passes through the estuary	Water level should not rise above the 450 mm from the top of the concrete buttress at the main causeway culvert.	DEDEAT Kouga Municipality
Water quantity: freshwater inflows at the head of the Seekoei tributary – floods and baseflows.	Mouth dynamics and estuarine water level. Frequency of events.	Weekly, but flood inflows should trigger more frequent monitoring – alternate days if possible during a flood event.	Best attainable baseflow rates and monitoring of flood inflows	DEDEAT Kouga Municipality
Water quality: freshwater inflows at the head of the Seekoei tributary	Levels of sediments, nutrients and pollutants.	Monthly, or when a flood passes through.	No target applicable	DWA
Water quality: bacterial contamination at the head of the Seekoei tributary and in wetland inflow canal to the estuary	Coliform counts	Monthly, or when a flood passes through	To be determined.	Kouga Municipality
Water Quality: concentrations of water quality parameters.	Examples include: concentration of oxygen, nutrients, turbidity and salt content of the water.	At four sites along the estuary – head of each tributary. Just above present causeway and about 30 m to the east of the main culvert.	DWS water quality guidelines for the marine environment. Salt content of the estuary water should not exceed 45	DEDEAT

		Measurements to be done monthly.		
Alien vegetation	Area of cover	Within 30 m on either side of all tributaries in the catchment every three years.	Remove all alien vegetation	DWA, DEDEAT, Kouga Municipality
Maintenance of fish populations	Catch per unit effort counts (CPUE)	Summer and winter at two sites along the estuary.	Fish population target not yet determined.	NMU, DEDEAT
Nursery function	Sample small fish populations with appropriate gear	As Above	Abundance and species present will inform success or otherwise of the mouth management programme	NMU, DEDEAT
Co-ordinated Water Bird Counts (CWAC)	Identify species present together with specific counts of individual species.	Minimum of Mid-summer and mid-winter on the freshwater wetlands and estuary.	To be determined, linked to the overall health of the estuary.	To be arranged

8 Institutional capacity and arrangements

The estuary management protocol states that provincial and municipal coastal committees shall serve as the forums for monitoring the implementation of EMPs and reporting of progress and achievements relating to EMPs. Estuary forums are informal advisory bodies that ensure the effective facilitation and implementation of project plans for estuary management. These are essential to foster continuous stakeholder enjoyment. For the Seekoei Estuary it is recommended that a local Estuary and Wetland Management Committee (EWC) is established to ensure effective management of the Seekoei Estuary, adjacent wetlands and their respective catchments. The forum should serve in an advisory capacity on issues threatening the health of the afore-mentioned environments. This committee must be representative of all stakeholder groups including local, regional and national government Institutions. A qualified estuarine specialist should also be represented on the committee. This committee will act in an advisory capacity, reporting directly to the relevant Sector Department of the Kouga Municipality (Line Manager to be identified). Reporting will follow conventional procedures with formal minutes submitted to the Municipality. *Inter alia*, the following are suggested as key functions of the EWC:

- To review and interpret information gathered from the monitoring programme,
- To review and report on the health status of the estuary, mouth, wetlands and catchments on an ongoing basis,
- Monitor traffic and pedestrian use of the causeway with the view of contributing to final discussion (at the end of 2023) on the future of the causeway. Monitoring programmes to be partnered with Neighbourhood Watch groups.
- Advise on use of causeway by heavy transport vehicles (Delivery trucks) with the view of closing the causeway to such vehicles due to safety issues and damage to the road crossing,
- Advise on safety issues and possible improvements to the causeway with the view of reducing potential accidents,
- Develop threshold points that signify a specific level of alert (e.g. increasing estuary water levels may threaten the well-being of residents using the causeway. At a specific level, the causeway may be closed to traffic. Increasing salinity in the estuary may threaten the health of the biota is another example),
- The highest level of alert must be immediately conveyed to the relevant authority for the implementation of appropriate action,
- Provide early warning to residents of an approaching threat to human well-being - impending floods and heavy rains, storm seas etc,
- Foster a working relationship with local schools and research groups to provide opportunities for education and research,
- Review grievance issues centered on the estuary and causeway. If a grievance is not satisfactorily resolved by the EWC, communicate the issue to the relevant authority for further action.

Once the Estuarine Management Plan has been finalised and gazetted, the relevant Implementing Agents will be required to refine and finalise the proposed EMPPs.

9 References

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10 Appendices

e.g. list of stakeholders to be added