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Klein Brak River Estuary Draft Estuarine Management Plan

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DOCUMENT USE

The National Estuarine Management Protocol (the Protocol), promulgated in May 2013 under the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008, as amended by Act No. 36 of 2014), sets out the minimum requirements for individual estuarine management plans.

In 2014, a review was conducted by the National Department of Environmental Affairs: Oceans and Coasts (DEA, 2014) on existing estuarine management plans to ensure, *inter alia*, the alignment of these plans with the Protocol.

This revision of the Draft Klein Brak River Estuarine Management Plan, including the Situation Assessment Report and the Management Plan itself, is in response to the comments received during the DEA review process only, to ensure compliance with the minimum requirements for EMPs as per the Protocol. In summary, this entailed:

- Adjusting the terminology as per the Protocol;
- Including a summary of Situation Assessment Report;
- Confirmation of whether the zonation maps are officially approved or represent “intended” use zonation;
- Reshuffling of the contents of the Management Action Plans from zones into ‘sectors’;
- Extending the monitoring plan to explicitly include a performance monitoring plan to gauge progress towards achieving EMP objectives (i.e. using performance indicators); and
- Updating information on institutional structures and arrangements to reflect requirements of ICMA and the Protocol.

The work of the original authors and input received from stakeholders remains largely unchanged, although certain editorial changes and factual updates will be evident. This revision does not represent, or replace, the customary full five-year review process required to re-evaluate the applicability of the plan and to provide new information. Such a full review process is therefore still required and should be part of a future revision undertaken by the nominated management and implementation agents. Nonetheless, this EMP must be considered a living document that should be regularly updated and amended as deemed necessary.



EXECUTIVE SUMMARY

Introduction

Estuaries are recognised as particularly sensitive and dynamic ecosystems, and therefore require above-average care in the planning and control of activities related to their use and management. For this reason, the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008, as amended by Act 36 of 2014) (ICMA), via the prescriptions of the South African National Estuarine Management Protocol (the Protocol), require Estuary Management Plans (EMPs) to be prepared for estuaries in order to create informed platforms for efficient and coordinated estuarine management.

Accordingly, SSI Engineers and Environmental Consultants (Pty) Ltd were commissioned by CapeNature, with funding from the Garden Route District Municipality, to develop an EMP for the Klein Brak River estuary. The EMP comprises two essential documents. The first document, the situation assessment report prepared by SSI (2010), provides an account of the current state of the system and related issues, and serves as the platform for the second document, this EMP.

This current revision of the Draft Klein Brak River EMP, including the Situation Assessment and the Management Plan itself, is in response to a review conducted by the National Department of Environmental Affairs: Oceans and Coasts (DEA:O&C) in 2014, to ensure compliance with the minimum requirements for estuary management plans as per the Protocol.

Situation Assessment

In terms of social structure, the area is polarised in nature, with urbanised, affluent sectors of society occupying the northern and southern banks of the estuary, and the hinterland floodplain being characterised largely by informal settlement and a lack of access to basic services, such as sanitation and piped water. Informal settlements occupied approximately 30-67% of the study area in 2001. The large Power Town informal settlement has been subject to extensive damage from flooding due to its location within the floodplain. The settlement is in process of being relocated to Sonskynvallei.

The Klein Brak is adjacent to numerous areas of archaeological importance, and is also located on a 'mass tourism route' which receives between 120 000 and 150 000 visitors per annum. The endemic character of the vegetation/thicket types which occur in the area, in combination with the high potential for tourism, make conservation and protection of the Klein Brak Estuary an extremely high priority.

The Klein Brak Estuary is situated within the southern coastal belt, and is approximately 12 km north of Mossel Bay. Two major tributaries, the Brandwag River and the Moordkuil River join approximately 3 km from the coast to form a flood-tidal delta. Land use within the catchment is comprised of dry land crop production, irrigated crop farming, forestry and livestock grazing. Klein-Brakrivier is the only relatively large town with other urban areas in the catchment being Brandwag and Ruitersbos (Forestry Station). The settlement of



Friemersheim is also located within the catchment. Water is abstracted from the lower reaches of the Moordkuil River and transferred to the Klipheuwel Dam to supply Mossel Bay.

The Klein Brak River estuary was classified as a temporarily open/closed estuary with the mouth closed for about 10% of the time but has remained permanently open since 1991. Consequently, Harrison et al. (2000) classified the Klein Brak River estuary as a warm-temperate, permanently open, medium-large, Type F barred system (supratidal barrier). An analysis of the tidal variation in the Klein Brak from May 2009 to May 2010 year indicated that even under the current extreme drought conditions the tidal variation is approximately 1.0 m, which is comparable with most permanently open South African estuaries.

The salinity of the estuary generally exhibits pronounced vertical and horizontal stratification with surface salinities lower than those recorded at the bottom and decreasing upstream from the mouth. However, a relatively recent survey recorded a relatively homogenous salinity throughout the estuary with minor vertical and horizontal variations. This was attributed to the extreme drought conditions experienced in the Southern Cape and is further exacerbated by obstructions to freshwater inflow.

Oxygen levels vary spatially within the estuary. Oxygen values are suitable within the lower and mid reaches of the estuary but decrease in the middle reaches and Brandwag arm, and are a cause for concern in the Moordkuil arm wherein it is as low as 2.6 mg/l (34% saturation). These low oxygen values are largely contributed to organic enrichment of the system, most likely caused by agricultural return flow.

At a coarse scale, the Gouritz Initiative identified three vegetation types in the vicinity of the Klein Brak River estuary, namely Herbertsdale Renoster Thicket (60% transformed), Hartenbos Strandveld – endemic (60% transformed) and Estuary/Floodplain (35% transformed). Alien invasive plant species are prevalent in the area. A sparse proportion of the vegetation in the study area is protected, and the vegetation types are described as critically endangered, surrounded by endangered areas. The Estuary/Floodplain biome in particular does not meet conservation targets and is under severe pressure from coastal development and upstream activities.

At a finer scale, four main vegetation communities have been identified in the Klein Brak River estuary; supratidal saltmarsh, intertidal saltmarsh, reeds and sedges and submerged macrophytes. Supratidal saltmarsh is the dominant vegetation type of the estuary. *Juncus kraussi* and *Phragmites australis* are the dominant reed and sedge species in the Klein Brak Estuary and are found predominantly in the lower reaches of the estuary. The *Zostera capensis* beds support diverse and abundant invertebrate and juvenile fish communities. In the uppermost reaches of the Moordkuil arm of the estuary there are relatively small stands of riparian woodland.

A total of 25 species of intertidal macrobenthos have been recorded in the Klein Brak River estuary, with amphipods being the most diverse group. There have been no surveys of the zooplankton and subtidal macrobenthos of the Klein Brak River estuary to date.

The state of knowledge of the Klein Brak fish fauna is very limited. A total of 18 fish species from 11 families were recorded for the estuary and the fish species assemblage is



dominated by marine migrant fish species. Many of these species are dependent on estuaries for breeding purposes. Based on their distributional ranges, 12 (67%) of the fish species recorded in the Klein Brak River estuary are southern African endemics. The high degree of endemism can be attributed to the locality of the Klein Brak within the warm-temperate bio-geographic region.

Only 34 bird species (excluding vagrants) have been recorded on the Klein Brak River estuary, representing eight orders of birds. Of the species recorded, 24 were recorded in summer and 25 in winter. *Charadriiformes* (waders, gulls and terns) comprise 44% of the bird species recorded on the estuary.

The National Biodiversity Assessment 2010 categorised the Klein Brak River estuary as currently in a moderately modified state, i.e. Category C. The degradation of the system's health is largely attributed to:

- Loss of estuarine and riparian habitat (i.e. destruction of saltmarshes, loss of buffers);
- Modification of streambeds, i.e. closure of estuary by culverts in upper reaches;
- Increase in the nutrient and sediment load from the floodplain and catchment;
- Overexploitation of fish and bait in the system;
- Some reduction in the freshwater inflow (especially baseflows) to the system;
- Increase in the nutrient load from various sources including storm water and the water treatment works located within the catchment; and
- Failure by the relevant authorities to deal decisively with historic issues related to the management of the Water Treatment Works.

The Klein Brak River estuary is exhibiting a decline in ecosystem wellbeing. If the above-mentioned pressures are not controlled, and reversed in the case of the destruction of the saltmarshes and the culverts in the upper reaches, the Klein Brak River estuary will become a largely degraded estuary.

An overview of key activities and linkages to potential environmental problems if managed inappropriately is detailed in the table below.

CATEGORY	ACTIVITY	PROBLEM								
		Siltation	Physical habitat alteration/ destruction	Alteration of salinity regime	Eutrophication	Toxic chemical pollution	Microbial contamination	Littering	Suspended solids	Direct Alteration of biomass/ species
Land-use & Infrastructure	Alien vegetation infestation in flood plain of estuary and throughout catchment	x	x	x						x
	Infilling of saltmarshes		x							x



	Road Infrastructure (including roads, bridges)	x	x	x					x	
	Riparian Infrastructure (including fences, low-lying developments)	x	x	x					x	
	In-stream infrastructure (e.g. jetties, pumphouse)	x	x							
	Recreational activities (boating, windsurfing, swimming)		x					x		x
	Agriculture: Crop production & Livestock in catchment	x	x		x	x	x		x	
Water Quantity & Quality	Water abstraction		x	x	x					
	Alien vegetation infestation in catchment causing flow reduction		x	x	x					x
	Wastewater disposal, effluent from septic tanks, stormwater runoff from informal settlements, effluent from farms and from WWTW in urban areas				x	x	x			
	Agricultural return flow			x	x	x	x			x
Living Resources	Removal of reeds and sedges	x	x						x	x
	Gill netting of indigenous fish species							x		x
	Introduction of alien fish species								x	x
	Agriculture: Livestock grazing of riparian zone	x	x							x

Vision and Objectives

The following Vision for the Klein Brak River estuary was developed and agreed upon at a meeting of relevant stakeholders held at the Eden Country Inn Klein Brak River estuary on 22 July 2010.

“We, the stakeholders, will vigorously strive to promote and support conservation and remedial (flood alleviation) measures that will enhance the ecological functioning of the Klein Brak River estuary, provide goods and services to all in a sustainable manner and ensure the long-term survival of the system, its living resources and the well-being of all its user groups.”

This Vision essentially captures the need to conserve the functioning and biodiversity of the Klein Brak River estuary, which ultimately supplies ecosystem goods and services. It also highlights the benefits drawn from the system by various user groups, which commands active involvement of these groups for successful management of the estuary.



The ideals of the Vision are then translated into overarching objectives that address:

Water Quantity & Quality	Sustain and work towards improving the present ecological health, natural functioning and biodiversity of the Klein Brak River estuary by securing the ecological Reserves for adequate water supply and suitable water quality.
Biodiversity Conservation	Provide protection for the biodiversity of the Klein Brak River estuary (e.g. species, populations, communities, habitats, ecological processes and ecosystem services) from over-exploitation, habitat loss, pollution and other negative impacts.
Land-use & Infrastructure	Assess and control all developments and proposed change in land-use, including infrastructure and agriculture, which impacts or could impact on the Klein Brak River estuary, in terms of sustainability, biodiversity conservation value and aesthetic integrity.
Institutional & Management Structures	Secure effective management and co-operative governance of the Klein Brak River estuary through the active involvement and effective operation of an Estuary Advisory Forum, comprising the Responsible Management Authority, Mossel Bay Municipality; Garden Route District Municipality, and other relevant spheres of government and civil society, including private stakeholders.
Awareness & Education	Enhance awareness of the importance of the Klein Brak River estuary, the ecosystem goods and services it provides, the current threats it faces, the applicable legislation, and enhancing scientific knowledge for better management of the system.

Spatial Zonation

A habitat map was used as the baseline for the identification of sensitive estuarine habitats on the Klein Brak River estuary, and together with legislated development control lines, was used to develop of the following zones:

- Conservation/protection zones

Differential conservation and protection needs for different habitats and vegetation types imply a fine-scale zonation that can inform conservation of representations of estuarine habitats and associated species, rehabilitation of artificially disturbed areas and control of invasive alien plant infestations.

- Development buffer zones

A Development Buffer Zone surrounding the Klein Brak River estuary was identified as a conglomerate of the coastal protection zone, 5 m amsl contour, 32 m watercourse buffer, as well as the 'HWM plus 100 m' estuary boundary determinant. The development buffer zone is directed at adhering to legal requirements, as well as protecting the integrity of the estuarine environment, controlling future development and mitigating the negative impacts of current development.

- Recreation-based zones

The main activities on the Klein Brak River estuary are recreational fishing, boating and skiing. Other peripheral uses include wind-surfing and wake-boarding. Skiing is perhaps the activity which potentially conflicts with more activities, than any other individual activity, and for this



reason “No-skiing” and “Skiing” zones have already been enforced by means of Municipal by-laws.

Institutional Arrangements

The Protocol identifies the DEA&DP, or its assigned representative, as the Responsible Management Authority (RMA) responsible for the development of the Klein Brak River EMP as well as being responsible for the co-ordination of its implementation. This implementation function can be effected through a range of different forums and actors.

According to the Protocol, the role of the Klein Brak River Estuary Advisory Forum is interpreted as providing an advisory service to the RMA on issues specific to the management and implementation of the EMP, as well as being the hub that links all stakeholders, which serves to foster stakeholder engagement and to facilitate the implementation of the project plans identified. The broader community will be able to voice concerns and raise issues via the Forum. This includes Ratepayers' Associations, NGO's, community groups, conservancies, etc., as well as representatives from surrounding industry and agriculture. Any representatives are obliged to raise issues identified by their constituents and to provide feedback to the constituents. Importantly, the Forum will not represent or supplant the individual positions of its members unless specifically mandated to do so.

The successful implementation of the EMP is dependent on the contribution of a number of governmental role players, including:

- Mossel Bay Municipality and Garden Route District Municipality: Responsible for legislative support and funding;
- Western Cape Government departments: Responsible for legislative support, including compliance, funding, research and monitoring;
- Relevant National government departments, especially DEA, DWS (via the regional office), DAFF, Department of Rural Development and Land Reform; and
- Organs of State (SANparks, CapeNature, BGCMA).

The DEA is generally responsible for national standardisation of estuarine management and approval of provincially-compiled estuarine management plans. Direct involvement in individual estuaries, such as the Klein Brak, will occur via existing forums for intergovernmental coordination. These forums will have the management of the Klein Brak River estuary on their agendas from time to time, and include:

- Western Cape Provincial Coastal Committee: Responsible for facilitating co-management, effective governance and provincial co-ordination of estuarine management; and
- Garden Route District Municipal Coastal Committee: Responsible for facilitating co-management and effective governance.



Management Priorities

Five project plans have been compiled for the efficient and effective management of the Klein Brak River estuary. Each plan corresponds to a key objective and contains applicable management actions, supporting regulations, responsible institution(s), and required resources, if such information is available.

These are arranged in general order of priority, but nevertheless recognize that the neglect of any leg will compromise overall success:

- Institutional and management structures;
- Sustaining water quality & quantity;
- Conservation of biodiversity;
- Land use and infrastructure; and
- Public education and awareness and knowledge enhancement

It should be noted that there is some interconnectedness between the plans and some management actions, as they all ultimately contribute to the conservation of ecosystem function and patterns of biodiversity, which in turn leads to the conservation of a sustained supply of ecosystem goods and services delivered by the estuary.

The table below provides a summary of the Management Objectives per priority area as part of the Performance Monitoring Plan:



MANAGEMENT OBJECTIVES	PERFORMANCE INDICATOR	TIMING	LEGISLATION	RESPONSIBILITY
1. Institutional and Management Structures				
1.1 Maintain a fully functional estuary advisory forum that will facilitate co-management and effective governance	<ul style="list-style-type: none"> • Constituted Klein Brak EAF • Terms of Reference and Constitution developed and agreed • Ongoing record of meetings held 	Assess twice a year	ICMA	RMA Klein Brak River EAF DEA&DP DEA
1.2 Secure appropriate funding and legal support for implementation of the Klein Brak River EMP	<ul style="list-style-type: none"> • Guaranteed annual allocation of funds • Specific by-laws developed 	Assess twice a year	ICMA MSA	RMA, Mossel Bay and Garden Route District Municipalities Klein Brak River EAF
2. Water Quantity & Quality				
2.1 Determine and secure the Ecological Reserves for Water Quantity and Quality	<ul style="list-style-type: none"> • Improved estuarine health and function • Improved river flow • Good water quality 	Biannual for BGCMA	NWA: RDM	RMA DWS DEA&DP BGCMA Klein Brak River EAF
2.2 Improve flow patterns to improve ecosystem functioning of the Klein Brak River estuarine system	<ul style="list-style-type: none"> • All obstructions identified and assessed • Remedial plan developed and implemented • Improved functioning of the estuary 	Assess twice a year	NWA NEMA DMAA	RMA, DEA&DP: Provincial Disaster Management DWS: WfW Mossel Bay
2.3 Minimise water pollution	<ul style="list-style-type: none"> • Number and volume of sources of pollution reduced • Water quality monitoring programme established 	Annually for DWS Monthly LBRCT	NWA NEM:WA	RMA, DEA DWS Garden Route DM DEA&DP Mossel Bay LM



MANAGEMENT OBJECTIVES	PERFORMANCE INDICATOR	TIMING	LEGISLATION	RESPONSIBILITY
2.4 Reduce bank de-stabilization and erosion, and habitat degradation	<ul style="list-style-type: none"> Number of degraded areas and habitats rehabilitated and secured Rehabilitation programme implemented 	Ad hoc visual monitoring during normal daily activities or responsibilities	ICMA CARA NWA	Mossel Bay LM DWS: WfW Klein Brak River EAF RMA DPW, SANRAL, Transnet Private Landowners
2.5 Control the spread and densification of both aquatic & terrestrial invasive alien plant species	<ul style="list-style-type: none"> Increased number of tons removed/ hectares cleared 	Annually for disturbed sites	CARA NWA NEMA NEM:BA	DEA: WfW DEA: WfC Municipalities Landowners RMA
3. Conservation of Biodiversity				
3.1 Ensure the conservation of the full suite of existing, especially vital, estuarine habitats & associated species	<ul style="list-style-type: none"> Conservation areas secured through by-laws and enforced 	Once a year	Municipal By-laws ICMA	DEA DAFF DEA&DP Klein Brak River EAF CapeNature Local municipalities RMA
3.2 Ensure sustainable resource use through effective compliance management	<ul style="list-style-type: none"> Healthy populations of all species Low levels of non-compliance Recovery of degraded areas 	Ongoing for compliance and MLRA appointed personnel; daily patrols and inspections.	MLRA NWA ICMA NEM:BA SB&SPA	DEA DAFF CapeNature Local municipalities RMA
3.3 Regulate recreational use in and around the estuary, including water-based activities to reduce habitat degradation and disturbance to fauna and flora	<ul style="list-style-type: none"> Low levels of non-compliance 	Ongoing for compliance monitors and appointed personnel; daily patrols and inspections.	Municipal By-laws	Local municipalities Klein Brak River EAF DWS RMA



MANAGEMENT OBJECTIVES	PERFORMANCE INDICATOR	TIMING	LEGISLATION	RESPONSIBILITY
4. Land-use and Infrastructure				
4.1 Implement an estuary zonation plan that directs infrastructural development and other land use practices (e.g. agriculture) within the various floodlines, coastal management lines, buffer zones and overlay zones	<ul style="list-style-type: none"> Reduction/cessation of inappropriate development and activities in and around the estuary 	Every 5 years	ICMA MSA NEMA CARA	Klein Brak River EAF DEA&DP DAFF Mossel Bay LM CapeNature
4.2. Ensure the incorporation of the EMP into the Local and District and Provincial Integrated Development Plans and Spatial Development Frameworks	<ul style="list-style-type: none"> EMP is adopted into IDPs and SDF 	Every IDP/SDF review cycle	MSA ICMA	Mossel Bay & Garden Route municipalities Klein Brak River EAF RMA DEADP
4.3 Ensure that all proposed developments within the development buffer zones, adhere to the EIA process in terms of the full suite of relevant environmental legislation	<ul style="list-style-type: none"> Each development lawfully constructed 	Depends on number of developments and EA granted	NEMA ICMA Municipal by-lawss	Klein Brak River EAF DEA&DP DAFF DWS Mossel Bay LM RMA
4.4 All jetties and slipways authorised and licensed	<ul style="list-style-type: none"> Reduction in illegal development and operations of jetties and slipways 	Every 6 months	Seashore Act NEMA	CapeNature RMA
4.5 Ensure that all water uses* within the CPZ are be duly authorised by DWS	<ul style="list-style-type: none"> Effective monitoring and compliance management system in place 	Every 6 months	NWA	DWS Mossel Bay LM BGCMA RMA
5. Public Education and Awareness and Knowledge Enhancement				
5.1 Promote high levels of public awareness and appreciation of the ecosystem services provided by the Klein Brak Estuary, threats posed to its integrity, and compliance management	<ul style="list-style-type: none"> Increase in number of newsletters Sufficient number of public notice boards 	Once year		Klein Brak River EAF Mossel Bay LM Relevant Gov depts. RMA



MANAGEMENT OBJECTIVES	PERFORMANCE INDICATOR	TIMING	LEGISLATION	RESPONSIBILITY
	<ul style="list-style-type: none"> • Increase in number of forum members and voluntary monitors • Increase public participation in coastal/ estuary/river clean ups and other initiatives 			
5.2 Enhance our scientific knowledge, through research and monitoring	<ul style="list-style-type: none"> • Increase in number of research projects and monitoring programmes 	Once a year		Klein Brak River EAF Mossel Bay LM DEA&DP DST DWS DAFF RMA



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ACRONYMS AND ABBREVIATIONS

amsl	Above mean sea level
C.A.P.E.	Cape Action for People and the Environment
CapeNature	Western Cape Nature Conservation Board
CARA	Conservation of Agricultural Resources Act (Act No. 43 of 1983)
CFR	Cape Floristic Region
CMP	Coastal Management Programme
CPZ	Coastal Protection Zone
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs (now DFFE)
DEA&DP	Western Cape Government's Department of Environmental Affairs & Development Planning
DEA: O&C	Department of Environmental Affairs: Oceans & Coasts Branch (formerly MCM)
DFFE	Department of Forestry, Fisheries and Environment (Previously DEA and DAFF)
DM	District Municipality
DWS	Department of Water and Sanitation (formerly DWAF)
EAF	Estuary Advisory Forum
EFZ	Estuarine Functional Zone
EIA	Environmental Impact Assessment
EMP	Estuary Management Plan
EZP	Estuary Zonation Plan
ha	hectares
HWM	High-Water Mark
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
LM	Local Municipality
MCM	Directorate Marine and Coastal Management (
MEC	Member of the Executive Council
MLRA	Marine Living Resources Act (Act No. 18 of 1998) as amended
MSA	Municipal Systems Act (Act No. 32 of 2000)
NEM: BA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004) as amended
NEM: ICMA or ICMA	National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008) as amended
NEM: PAA	National Environmental Management: Protected Areas Act (Act No.57 of 2003)
NEM: WA	National Environmental Management: Waste Act (Act No. 59 of 2008) as amended
NEMA	National Environmental Management Act (Act No. 107 of 1998) as amended
NGO	Non-governmental Organisation
NWA	National Water Act (Act No. 36 of 1998) as amended
RDM	Resource Directed Measures
RMA	Responsible Management Authority
SDF	Spatial Development Framework
The Protocol	National Estuarine Management Protocol
TPC	Threshold of Potential Concern



1 INTRODUCTION

In accordance with Section 34 of the Integrated Coastal Management Act (Act 24 of 2008) as amended in 2014 (ICMA) as well as the National Estuarine Management Protocol (the Protocol), SSI Engineers and Environmental Consultants (Pty) Ltd were commissioned by CapeNature, with funding from the Garden Route District Municipality, to develop an estuarine management plan (EMP) for the Klein Brak Estuary. The EMP comprises two essential documents. The first document, the situation assessment report prepared by SSI (2010), provides an account of the current state of the system and related issues, and served as the platform for the draft of the second document, this EMP.

The co-ordination of the implementation of the EMP vests with the responsible management authority (RMA), in this instance the Department of Environmental Affairs and Development Planning (DEA&DP), as per the Protocol. One of the key objectives of this EMP is to promote and facilitate the cooperative governance relationship between the RMA and the existing estuary advisory forum (EAF). The Protocol, while acknowledging that effective institutional structures and arrangements are crucial elements for the successful implementation of EMPs, no longer requires the mandatory establishment of additional institutional structures. The local estuary institution, or advisory forum, is regarded as an informal additional advisory body, which will foster continuous stakeholder engagement, facilitate co-operative and effective governance, and motivate for appropriate long-term funding for the management of the estuary.

This EMP is a strategic planning document, and as such does not provide detailed, routine planning for the management of the estuary. This detail should be captured by the RMA or its assigned representative, in its annual budget, Plan of Operations, Integrated Development Plan (IDP), and Annual Performance Plan (APP) etc. (as applicable) with the management plan forming the platform for more fine-scale planning. It must also be captured in the strategic planning and budget plans of all the other authorities who have a duty to perform functions pertaining to estuary management.

Furthermore, the ICMA provides for a report to be submitted to the National Department of Environmental Affairs (DEA) every two years in respect to implementation once an EMP has been signed off and approved. The EMP should also be recognized as a dynamic document, whereby certain components could be revised as important new information becomes available and management priorities change. Adaptive management should be continually pursued through a process of annually reviewing the progress made in achieving the management objectives. Finally, the management plan should be subject to a comprehensive revision on a five-year cycle, as required by the Protocol (Figure 1).

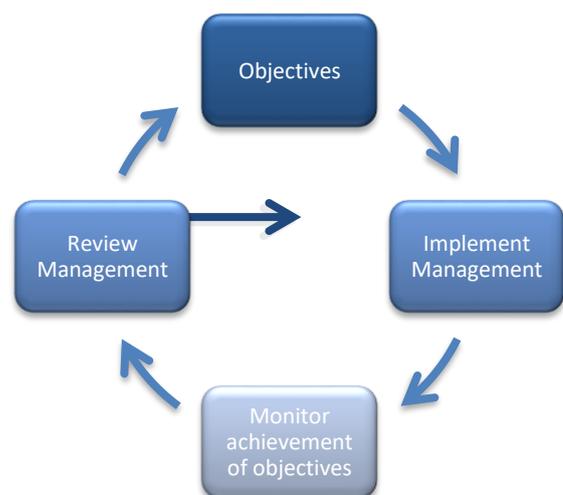


Figure 1: Adaptive Management

2 FRAMEWORK FOR THE DEVELOPMENT OF AN ESTUARINE MANAGEMENT PLAN

2.1 Approach

This Klein Brak River EMP was initially developed using the generic framework for EMPs, as proposed in Van Niekerk & Taljaard (2007a). The current update places it in line with the National Protocol. Figure 2 is a graphical representation of this framework. Essentially, it highlights that successful management of human impacts in relation to an estuary requires, in the first instance, assessing the current situation or *status quo* of the system through the collection of various forms of information. These form the basis for the Objective-Setting phase which encompasses the setting of a “Vision” of the future desired state of the estuary, followed by the development of several key objectives and detailed management objectives to achieve this state. At the finer scale, project plans containing numerous management actions, and an Estuary Zonation Plan (EZP) with accompanying operational objectives, are then developed as a blueprint for the implementation of the EMP.

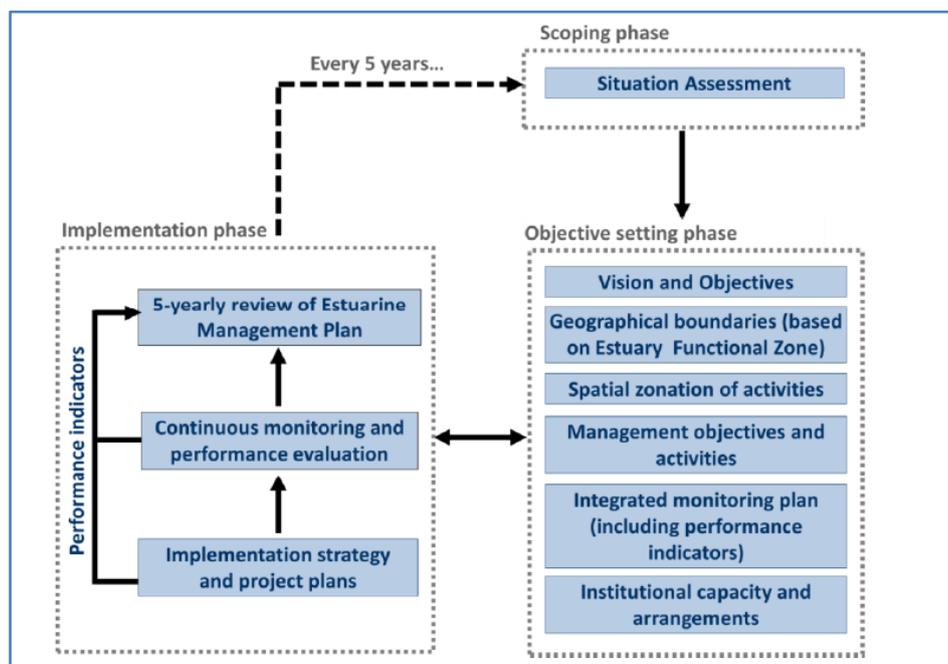


Figure 2: A framework for integrated estuarine management in South Africa

The implementation of the EMP should be continually monitored in terms of successes and shortcomings through performance monitoring methods, and the availability of new data (gleaned from both monitoring and research studies); and adjusted accordingly. In such a way, management becomes adaptive, and the attainment of the Vision more realistic.

During the development of this EMP, a vision for the future desired state of the Klein Brak River Estuary and the management objections required to attain this vision, were developed during engagements with the relevant role players and stakeholders from both the government and private sectors. These included the Department of Environmental Affairs: Oceans and Coasts (DEA: O&C), the Department of Water and Sanitation (DWS, formerly

DWA), the Department of Agriculture, Forestry and Fishers (DAFF), the Western Cape Department of Environmental Affairs and Development Planning (DEAD&P), the Garden Route District Municipality, the Mossel Bay Municipality, CapeNature, South African National Roads Agency Limited (SANRAL), Transnet, the Midbrak Conservancy, the Tergriet Residents Association and private landowners from the Riverside community.

2.2 Summary of Legal framework

Chapter 4 of the ICMA aims to facilitate the efficient and coordinated management of all estuaries, in accordance with:

- a) The Protocol (Section 33) approved by the Ministers responsible for the environment and water affairs; and
- b) Estuarine management plans for individual estuaries (Section 34).

The Protocol, promulgated in 2013, provides a national policy for estuarine management and guides the development of individual EMPs. It must be ensured that the EMPs are aligned with the Protocol and the National Coastal Management Programme (CMP) (DEA, 2014). The Protocol lays out the following:

- a) The strategic vision and objectives for achieving effective integrated management of estuaries in South Africa;
- b) The standards for the management of estuaries;
- c) The procedures regarding how estuaries must be managed and how the management responsibilities are to be exercised by different organs of state and other parties;
- d) The minimum requirements for EMPs;
- e) Who must prepare EMPs and the process to be followed in doing so; and
- f) The process for reviewing EMPs to ensure that they comply with the requirements of the ICMA.

One of the pillars of successful integrated coastal (including estuarine) management is the establishment of effective institutional arrangements to underpin both cooperative government and cooperative governance. Cooperative governance is a system that allows government and civil society to communicate and contribute to shared responsibility in respect of coastal management objectives and must be well-organized and widely representative of all coastal stakeholders. The ICMA details the institutional arrangements that will contribute to cooperative coastal management in South Africa. These arrangements are made at national, provincial and municipal government levels, and the embodiment of cooperative coastal governance is vested in what is known as coastal committees. The ICMA provides for the permissive, i.e. if so required, establishment of municipal coastal committees, but at a national and provincial level however, the Minister and MECs of coastal provinces are directed to establish national and provincial coastal committees, respectively. Provincial coastal committees must be established within one year of the commencement of the ICMA.

The National Coastal Committee (the MINTEC Working Group 8) is established by the Minister, and its powers determined by notice in the Government Gazette. It is supported

administratively by the DEA. The Premier of each coastal province must identify a lead agency (organ of state) that is responsible for the coordination, monitoring and implementation of the provincial coastal management programme, monitoring the state of the environment in the coastal zone, and identifying relevant trends and priority issues. The lead agency for coastal management is directly responsible to the MEC. Each metropolitan, district or local municipality which has jurisdiction over the coastal zone may establish a municipal coastal committee. The establishment of Municipal Coastal Committees is discretionary.

The lowest tier of institutional arrangements for estuarine management comprises the RMA and the estuary advisory forums. The role of the estuary advisory forum is to act as the hub which links all stakeholders, including both organs of state and civil society, so as to facilitate cooperative management and effective governance in terms of the EMPs, as well as facilitate and monitor implementation of an EMP.

2.3 Mandate and responsibilities of the RMA

The Protocol identifies the DEA&DP as the management authority responsible for developing and co-ordinating the implementation of the Klein Brak River EMP, as the entire estuary is contained within the municipal boundary, (Figure 3).

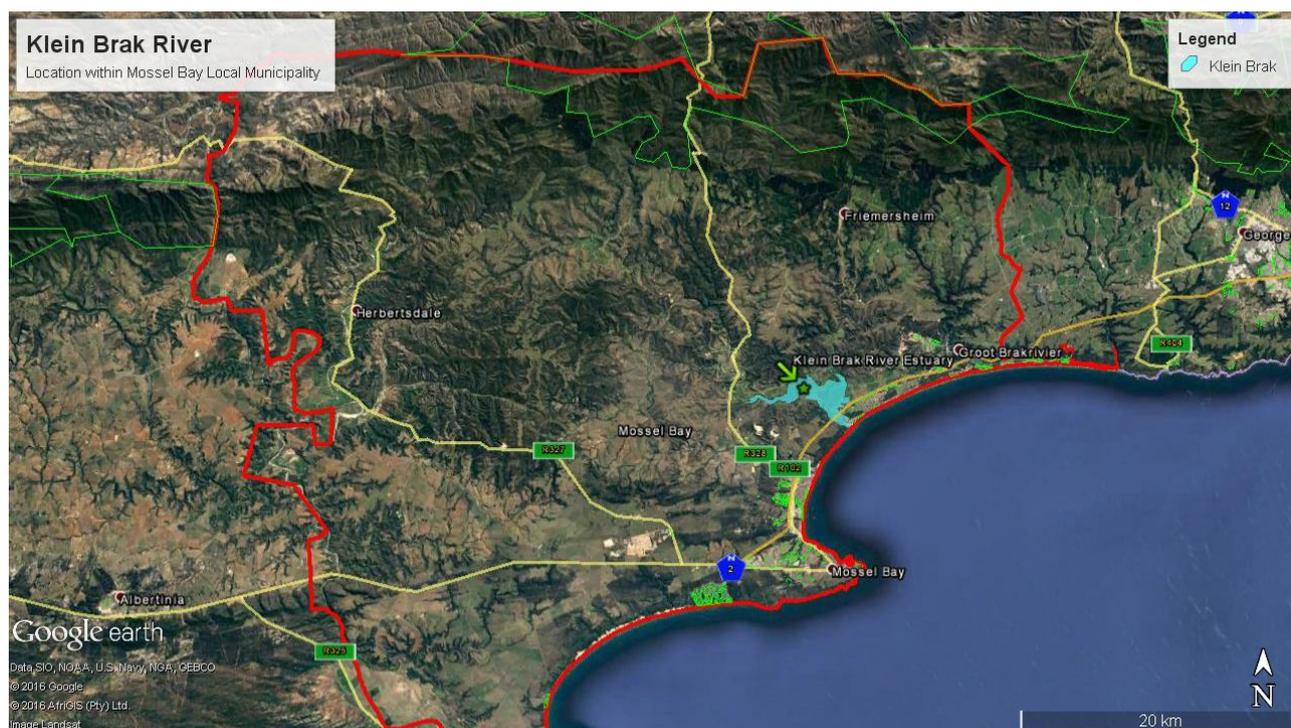


Figure 3: Location of the Klein Brak River Estuary within Mossel Bay Municipality

The RMA is responsible for the development of the EMP and the overall co-ordination of the actions of other implementing agencies, and not the implementation actions themselves. Section 7.3 of the Protocol indicates that:

“...management actions...shall be translated into project plans by the responsible government department that is responsible for certain aspects of estuary management (as per legislative mandates...”

Specifically, the RMA responsibilities are described by the Protocol as:

- Section 5: *“...authorities are **responsible for the development of EMPs and coordination of the implementation process...**”*
- Section 5(e): *“The identified responsible management authority to develop the EMP needs to **budget accordingly for the development of these plans.**”*
- Section 8(1): *“The responsible management authority developing an EMP must **actively engage all the relevant stakeholders** including government departments, non-government organisations and civil society in the development and implementation of the EMP.”*
- Section 9.1(1) and 9.2: *“...it **must obtain formal approval** for the EMP...” and “Once approved...the EMP shall be... **Integrated..**” and “**incorporated** into the Provincial Coastal Management Programme.”*

The responsible body contemplated in Section 33(3)(e) of the ICMA who develops an EMP must:

- a) follow a public participation process in accordance with Part 5 of Chapter 6 of the ICMA; and
- b) ensure that the EMP and the process by which it is developed are consistent with:
 - i) the Protocol; and
 - ii) the National CMP and with the applicable provincial CMP and CMP referred to in Parts 1, 2 and 3 of Chapter 6 of the ICMA;
- c) If applicable, ensure that relevant legislation is enacted to implement the EMP; and
- d) Submit an annual report to the Minister on the implementation of the EMP, the legislation and any other matter.

Coordination of the implementation actions by the RMA and its strategic partners (CapeNature, DEA, Garden Route District Municipality, Western Cape Provincial Government, DWS, DAFF), will be supported by the Klein Brak River Estuary Advisory Forum (EAF) representing all key stakeholder groups on the estuary.

3 SUMMARY OF SITUATION ASSESSMENT

3.1 Ecological characteristics & functioning of the estuary

3.1.1 Location and Physical Description

The Klein Brak River Estuary is situated within the southern coastal belt, and is approximately 12 km north of Mossel Bay. Two major tributaries, the Brandwag River and the Moordkuil River join approximately 3 km from the coast to form a flood-tidal delta. Land use within the catchment is comprised of dry land crop production, irrigated crop farming, forestry and livestock grazing. Klein-Brakrivier is the only relatively large town with other urban areas in the catchment being Brandwag and Ruitersbos (Forestry Station). The settlement of Friemersheim is also within the catchment. Water is abstracted from the lower reaches of the Moordkuil River and transferred to the Klipheuwel Dam to supply Mossel Bay. There are a number of water treatment works within the catchment namely Klein Brak Water Treatment Works, the Friemersheim WWTW, Sandhoogte WWTW and Brandwacht WWTW.



Figure 4: Aerial view of the Klein Brak River Estuary mouth

The Klein Brak River estuary was classified as a temporarily open/closed estuary with the mouth closed for about 10% of the time but has remained permanently open since 1991. Consequently, Harrison et al. (2000) classified the Klein Brak River estuary as a warm-temperate, permanently open, medium-large, Type F barred system (supratidal barrier). An

analysis of the tidal variation in the Klein Brak from May 2009 to May 2010 year indicated that even under the current extreme drought conditions the tidal variation is approximately 1.0 m, which is comparable with most permanently open South African estuaries.

The salinity of the estuary generally exhibited pronounced vertical and horizontal stratification with surface salinities lower than those recorded at the bottom and decreasing upstream from the mouth. However, a survey recorded a relatively homogenous salinity throughout the estuary with minor vertical and horizontal variations. This was attributed to the extreme drought conditions experienced in the Southern Cape at the time and was further exacerbated by obstructions to freshwater inflow.

Oxygen levels vary spatially within the estuary. Oxygen values are suitable within the lower and mid reaches of the estuary but decrease in the middle reaches and Brandwag arm, and are a cause for concern in the Moordkuil arm wherein it is as low as 2.6 mg/l (34 % saturation). These low oxygen values are largely contributed to organic enrichment of the system, most likely caused by agricultural return flow.

3.1.2 Vegetation

At a coarse scale, the Gouritz Initiative collated and analysed environmental and biological data used to delineate Management Sectors for the Gouritz planning domain for the Western Cape Nature Conservation Board (WCNCB). This study identified a number of vegetation types in the vicinity of the Klein Brak River estuary, and indicates the degree to which these vegetation types had been transformed; these included Herbertsdale Renoster Thicket (60% transformed), Hartenbos Strandveld – endemic (60% transformed) and Estuary/Floodplain (35% transformed). Alien invasive plant species were prevalent in the area. A sparse proportion of the vegetation in the study area is protected, and the vegetation types are described as critically endangered, surrounded by endangered areas. The Estuary/Floodplain biome in particular does not meet conservation targets and is under severe pressure from coastal development and upstream activities.

At a finer scale, four main vegetation communities were identified in the Klein Brak River estuary; supratidal saltmarsh, intertidal saltmarsh, reeds and sedges and submerged macrophytes. Supratidal saltmarsh was the dominant vegetation type of the estuary and is characterized by five species: *Sarcocornia pillansii*, *Conyza scabrida*, *Cynodon dactylon*, *Disphyma crassifolium* and *Stenotaphrum secundatum*.

Juncus kraussi and *Phragmites australis* are the dominant reed and sedge species in the Klein Brak River estuary and are found predominantly in the lower reaches of the estuary. The *Zostera capensis* beds support diverse and abundant invertebrate and juvenile fish communities. In the uppermost reaches of the Moordkuil arm of the estuary there are relatively small stands of riparian woodland.

Alien Invasive Plant Species are found in upper sections of the Estuary Functional Zone and throughout the catchment. These Alien Invasive Plant species are having a negative impact on the system and need to be addressed. Riparian landowners have indicated that they are prepared to work together with authorities to deal decisively with Alien Invasive Plant Species.

3.1.3 Invertebrates

A total of 25 species of intertidal macrobenthos have been recorded in the Klein Brak River estuary. Amphipods were the most diverse group being represented by seven species. Amphipods (mainly *Grandidierella lignorum*), prawns (*Upogebia africana* and *Callinassa kraussi*) and Decapoda (*Palemon pacificus* and *Bateus jucundus*) numerically dominate the intertidal benthos.

There have been no surveys of the zooplankton and subtidal macrobenthos of the Klein Brak River estuary to date.

3.1.4 Fish

The state of knowledge of the Klein Brak fish fauna was very limited. A total of 18 fish species from 11 families were recorded for the estuary and the fish species assemblage was dominated by marine migrant fish species. *Mugilidae* (four species), *Gobiidae* (three species) and *Sparidae* (three species) dominate the taxa in terms of species diversity with five of these species dependent on estuaries for breeding purposes. Based on their distributional ranges, 12 (67%) of the fish species recorded in the Klein Brak River estuary are southern African endemics. The high degree of endemism can be attributed to the locality of the Klein Brak within the warm-temperate bio-geographic region.

The State of Rivers Report (2003) described the following alien species as occurring in the Klein Brak River; Bass, Sharptooth Catfish, Carp, Mozambique Tilapia, and Banded Tilapia. In terms of indigenous species, the following are listed by the same report as resident in the Klein Brak River; Cape Galaxias (*Galaxias zebratus*), Cape Kurper (*Sandelia capensis*) and Eastern Cape Redfin (*Pseudobarbus afer*).

3.1.5 Birds

A total of only 34 bird species (excluding vagrants) have been recorded on the Klein Brak River estuary, representing eight orders of birds. Of the species recorded, 24 were recorded in summer and 25 in winter. *Charadriiformes* (waders, gulls and terns) comprised 44% of the bird species recorded on the estuary. The swift tern was overwhelmingly the most common bird on the estuary during winter.

3.1.6 Estuary Health Condition

Harrison et al. (2000) rated the ichthyofauna of the Klein Brak River estuary as moderate, water quality as good and aesthetics as moderate. Whitfield (2000) rated the overall condition of the estuary as fair, although information on the system was limited/poor.

The health of Klein Brak estuarine systems was assessed at a desktop level as part of the National Biodiversity Assessment 2011 (Van Niekerk & Turpie, 2012). The Klein Brak system was estimated to be in a **moderately modified** ecological state (**Category C**) (see Appendix A for more detail on this initial report).

More recently, a series of detailed ecological Reserve studies were conducted in the Gouritz Water Management Area (WMA) for selected surface water, groundwater, estuaries and wetlands to inform licence applications, to determine the conservation status of various resources in the catchment and impacts on them, and to investigate development pressures and associated impacts on the availability of water in the area (DWA, 2014). Under this project, the rapid level assessment for the Klein Brak system confirmed the Present Ecological State as **moderately modified** (DWS, 2014). This state was characterised by a loss and/or change of natural habitat and biota but the basic ecosystem functions and processes remain predominantly unchanged. Table 1 presents a summary of the present health status of the estuarine system.

Table 1: Present Ecological Health Status for the Klein Brak River estuary (DWS, 2014)

ESTUARINE COMPONENT	WEIGHT	SCORE
HABITAT ASSESSMENT		
Hydrology	25	59
Hydrodynamics & mouth condition	25	96
Water quality	25	82
Physical habitat alteration	25	54
HABITAT SCORE		72%
BIOLOGICAL ASSESSMENT		
Microalgae	20	64
Macrophytes	20	50
Invertebrates	20	70
Fish	20	60
Birds	20	31
BIOLOGICAL SCORE		55%
ESTUARINE HEALTH SCORE		64%
PRESENT ECOLOGICAL STATE		C

Flow related impacts specifically relate to changes caused by a modification in river (volume) inflow (i.e. either base flows, seasonal distribution of flows or flood characteristics) brought about through construction of dams in the catchment. In addition to flow modification, non-flow related factors also contributed significantly to ecological modification in the Klein Brak Estuary, specifically related change and degradation of estuarine habitat through development in the estuarine functional zone, weir construction in the Brandwag and Moordkuil arms, nutrient inputs from agricultural activities, fishing pressures and human disturbance of birds (DWS, 2014).

Turpie and Clark (2007) ranked the Klein Brak River estuary as being of **average importance**. While on a national scale, the system may be of average importance, it is certainly a large estuary in this region and plays a very important role as fish nursery for exploited and endangered fish species and providing an open estuary along a coast where a significant number of systems are seasonally closed. At a finer, regional scale the Klein Brak River estuary is, therefore, important.

As an estuary of average importance, the Klein Brak should at least be managed in a Category C (maintain PES with Category C as minimum). In addition, it is highly unlikely that the flow reduction, nutrient loading from agriculture and habitat loss in the system can be alleviated in its entirety. It is therefore recommended that the Best Attainable State is a **moderately modified system** (i.e. Category C).

Note that the estuary is on a negative trajectory of change. If the above-mentioned pressures are not controlled, and reversed in the case of the destruction of the saltmarshes and the culverts in the upper reaches, the Klein Brak River estuary is likely to move into a Category C/D, even a Category D. These issues therefore need to be addressed in order to maintain the REC (Category C) in future. It is of the utmost importance that significant rehabilitation work be undertaken to restore habitat and allow for estuarine functioning.

To account for some of the loss in base flows, Scenario 1, i.e. **Present inflow, including the Ecological Water Requirement (EWR) for an Ecological Category C river just upstream of the estuary (MAR of 38.97 million m³)**, was selected as the recommended ecological water requirement. However, in order to further address the negative trajectory of change, additional interventions in terms of non-flow related impacts are essential to maintain the ecological health of the estuary in a Category C, namely:

- On both the Brandwag (34°03'43.51''S; 22°06'47.95''E) and Moordkuil arms (34°03'15.32''S; 22°07'55.24''E) there are obstructions across the estuary (i.e. roads) that prevent saline intrusion/tidal variation extending further upstream. To improve tidal connectivity these obstructions should either be removed or proper bridges should be constructed. In doing so, the REI (roughly defined as the reach where salinity ranges between 10 and 0) will be introduced more readily, enhancing nursery function in the upper estuaries and thus contributing to the recovery of collapsed and endangered fish species, e.g. dusky cob and white steenbras. Further upstream in the Moordkuil arm there is also a DWS weir (34°03'11.14''S; 22°08'02.85''E). As this weir fulfils an important gauging function it may not have to be removed, but fish ladders should be installed on both sides of the weir to allow migrating species (e.g. eels) to move upstream. It is important that authorities work with riparian landowners to reach amicable solutions. Any action taken should be based on scientific analyses.
- Rehabilitate degraded areas in the estuary functional zone, e.g. consolidate present access routes so as not to have a web of small roads on the salt marshes. This will require the assistance of DPW, as most of the land in lower reaches of estuary functional zone is un-surveyed state owned land.
- Removal of invasive alien plant species in the estuary functional zone and the rest of the catchment. This will require DEA to enforce NEM:BA.
- Reduce fishing pressures and (illegal) bait collecting through increased compliance (existing DAFF initiative).
- Institute a ban on night fishing to reduce the pressure on breeding stock of collapsed and endangered fish species, e.g. dusky cob (proposed DAFF initiative).

3.2 Management issues

3.2.1 Potential Protection for the Klein Brak River estuary

The Klein Brak River estuary only rates as the 93rd most important estuary in South Africa from a conservation perspective. The rating is calculated on the basis of size, habitats, type rarity within its biogeographical zone and biodiversity. Nevertheless, the estuary was identified as a high priority estuary for rehabilitation (Turpie and Clark, 2007). The types of rehabilitation identified included pollution mitigation, alien clearing, mouth management and saltmarsh rehabilitation.

3.2.2 Pressures on the Klein Brak River estuary

3.2.2.1 Physical Structures

There are numerous physical structures that potentially negatively influence the ecological wellbeing of the Klein Brak River estuary. These include bridges, roads, the two resorts on the eastern bank and several jetties. Furthermore, a derelict structure, possibly a pumpstation, extended into the channel downstream of the N2 road bridge. Cognisance is taken that even though there is no firm evidence suggesting that the Pumpstation negatively impacted on the environment action has been taken and the removal of this structure has been completed. There were remains of old jetties and pipes extending into the channel at a number of sites.

More considerably, a causeway with culverts creates a physical barrier at the upper reaches of the Moordkuil and Brandwag arms of the estuary and the former essentially forms the upper limit of tidal exchange in this arm of the estuary.

3.2.2.2 Flow Reduction

No flow reduction data is available for the Klein Brak River catchment, but it was estimated that there was a significant reduction in inflow to the system. This was due to the freshwater abstraction from the Moordkuil River to supply Mossel Bay as well as numerous small farm dams in the catchment capturing first flushes and freshettes. The status of Brandwag dam was unknown. Matters relating to flooding in the Kleinbrak were considered to be critically important and need to be addressed in the Estuary Management Plan by way of inclusion in strategic objectives and management strategies. The reasons for the observed reduction in flow may include: reduced average rainfall, increased water abstraction and / or the proliferation of Alien Invasive Plant Species. Sedimentation in Moordkuil, upstream of the DWS extraction point is also a concern. It is necessary that DWS conduct the Water Use Verification Process in the catchment so that any discussion on flow reduction can be properly informed. Riparian landowners suggest that there are no small instream dams on the Moordkuil. It is also suggested that the extraction occurring at the Moordkuil DWS point is the major factor in flow reduction. This needs to be verified by DWS. It needs to be noted that the agriculture water abstraction 'infrastructure' e.g. the Robertson furrow has existed since 1902.

3.2.2.3 Garden Route District Early Warning System

The Garden Route District Municipality, in response to the need to ensure an integrated and co-coordinated approach to flooding of the Kleinbrak River, have developed and

implemented a “Little Brak (Klein Brak) River Flood Contingency Plan”. The aim of this plan was to enable a flexible response to problems caused by flooding which are caused by tidal or storm surges as well as prolonged or intensive rainfall, abnormally high river levels as well as major storms. The plan included details in respect to flood warnings issued, roles and responsibilities of the various agencies, general advice, places of shelter, emergency contact numbers, early warning details, priority evacuation lists for both Riverside residents as well as the Power Town informal settlement. The findings and recommendations of this document were incorporated into the Estuary Management Plan component of this project.

3.2.2.4 *Pollution*

The Land Use activity in the catchment can result in sedimentation, excessive nutrient loading (from fertilizers, septic tanks) and introduction of agro-chemicals into the system. Urban areas in the lower part of the estuary functional zone is serviced by septic tanks, which could also contribute to nutrient loads. Although no industrial activities occur in the catchment, enrichment of copper, lead, zinc, cobalt, nickel, cadmium and chromium in the sediment were recorded at the confluence of the Brandwag and Moordkuil Rivers. There are a number of Water Treatment Works within the catchment which represent potential sources of pollution. Concentrations of these metals did not, however, constitute a pollution threat. Possible sources of contamination identified were the road and railway.

3.2.2.5 *Formal and Informal Settlements*

There are extensive formal and informal settlements on the floodplain of the lower reaches of the Klein Brak River estuary. Stormwater runoff from these settlements is likely to comprise suspended solids, litter, hydrocarbons and untreated waste from humans. Such runoff holds a high risk for both humans and the environment and should be collected at a central retention area and treated before discharge. Cognisance is taken that the informal settlement of Powertown in the process of being relocated.

3.2.2.6 *Exploitation of Living Resources*

The estimated annual catch in the Klein Brak River estuary increased from 3.1 tons estimated in 1997 to 10 tons in 2009. This substantial increase is largely attributed to increased illegal gillnet and seine activities. In addition, bait fishery/harvesting is seen as extensive in this system, with cast netting and sand prawn collection being recorded for the Klein Brak.

3.3 Socio-economic context

The data relating to demographic and socioeconomic information within and around the study area has been derived predominantly from the Statistics South Africa Census of 2001.

3.3.1 Demography

The study area is overlapped by three of the small enumerator areas, the two smaller (but more densely settled) areas being urban in nature with 244 and 287 households respectively, whilst the rural enumerator area contained 362 households in 2001. The 2001 survey

revealed a distinct lack of access to sanitation in all but the urban areas abutting the coast. Furthermore, a similar spatial pattern was recorded for access to piped water.

Informal settlements occupied approximately 30-67 % of the study area in 2001. The obvious exception to this trend was on the northern banks of the Klein Brak River estuary. A literature search highlighted the informal settlement of Power Town as the most prominent of the informal settlements in close proximity to the study area. This settlement had previously been subject to extensive damage from flooding due to its location within the floodplain. This settlement is currently being relocated.

3.3.2 Economic Value of the Klein Brak River estuary

In terms of specific attributes that may render the estuaries economically valuable, viz. subsistence, property, tourism, nursery function, and existence; the Klein Brak River estuary ranks within the top 20 Cape estuaries for its subsistence value, with an estimated income of R 128 632.00 per annum. Conversely, the system is not highly rated for any other economic attributes.

3.3.3 Archaeological and Cultural Value of the Klein Brak River estuary

The Klein Brak is adjacent to numerous areas of archaeological importance, and is also located on a 'mass tourism route' which receives between 120 000 and 150 000 visitors per annum. The endemic character of the vegetation/thicket types which occur in the area, in combination with the high potential for tourism, make conservation and protection of the Klein Brak River Estuary an extremely high priority. In terms of social structure, the area is polarised in nature, with urbanised, affluent sectors of society occupying the northern and southern banks of the estuary. In addition to the Power town informal settlement the hinterland floodplain is being used for agricultural activities.

4 VISION AND OBJECTIVES

4.1 Vision Statement

According to the Generic Framework for Estuary Management Plans (Van Niekerk & Taljaard, 2007a), the vision for an estuary should be inspirational, representing a higher level of strategic intent. The vision and overarching objectives must be aligned with that of the Protocol, and for the Klein Brak River Estuary, with that for the greater Cape Floristic Region (CFR). The Vision of the Protocol is:

“The estuaries of South Africa are managed in a sustainable way that benefits the current and future generations”

The Vision for estuaries of the Cape Floristic Region is:

“The estuaries of the CFR will continue to function as viable systems which are beautiful, rich in plants and animals, attract visitors, sustain our livelihoods and uplift our spirits.”

The following Vision for the Klein Brak River Estuary was developed and agreed upon at a meeting of relevant stakeholders held at the Eden Country Inn Klein Brak River Estuary, on 22 July 2010.

“We, the stakeholders, will vigorously strive to promote and support conservation and remedial (flood alleviation) measures that will enhance the ecological functioning of the Klein Brak River estuary, provide goods and services to all in a sustainable manner and ensure the long-term survival of the system, its living resources and the well-being of all its user groups.”

This Vision essentially captures the need to conserve the functioning and biodiversity of the Klein Brak River Estuary, which ultimately supplies ecosystem goods and services. It is also imperative that remedial measures are undertaken to alleviate flood risk which will further contribute to improving the natural flow patterns and overall ecological functioning of the

system. It also highlights the benefits drawn from the system by various user groups, which commands active involvement of these groups for successful management of the estuary.

The ideals of the Vision are then translated into management objectives that address firstly, the water reserve (and hence hydrological, biophysical and ecological functioning), the biodiversity and the development needs, as well as management strategies required in order to achieve these objectives, e.g. effective governance, and stakeholder support and continuous engagement. The following key objectives have been identified as the cornerstones to the achievement of the Vision developed at the stakeholder workshop mentioned above (Figure 5).

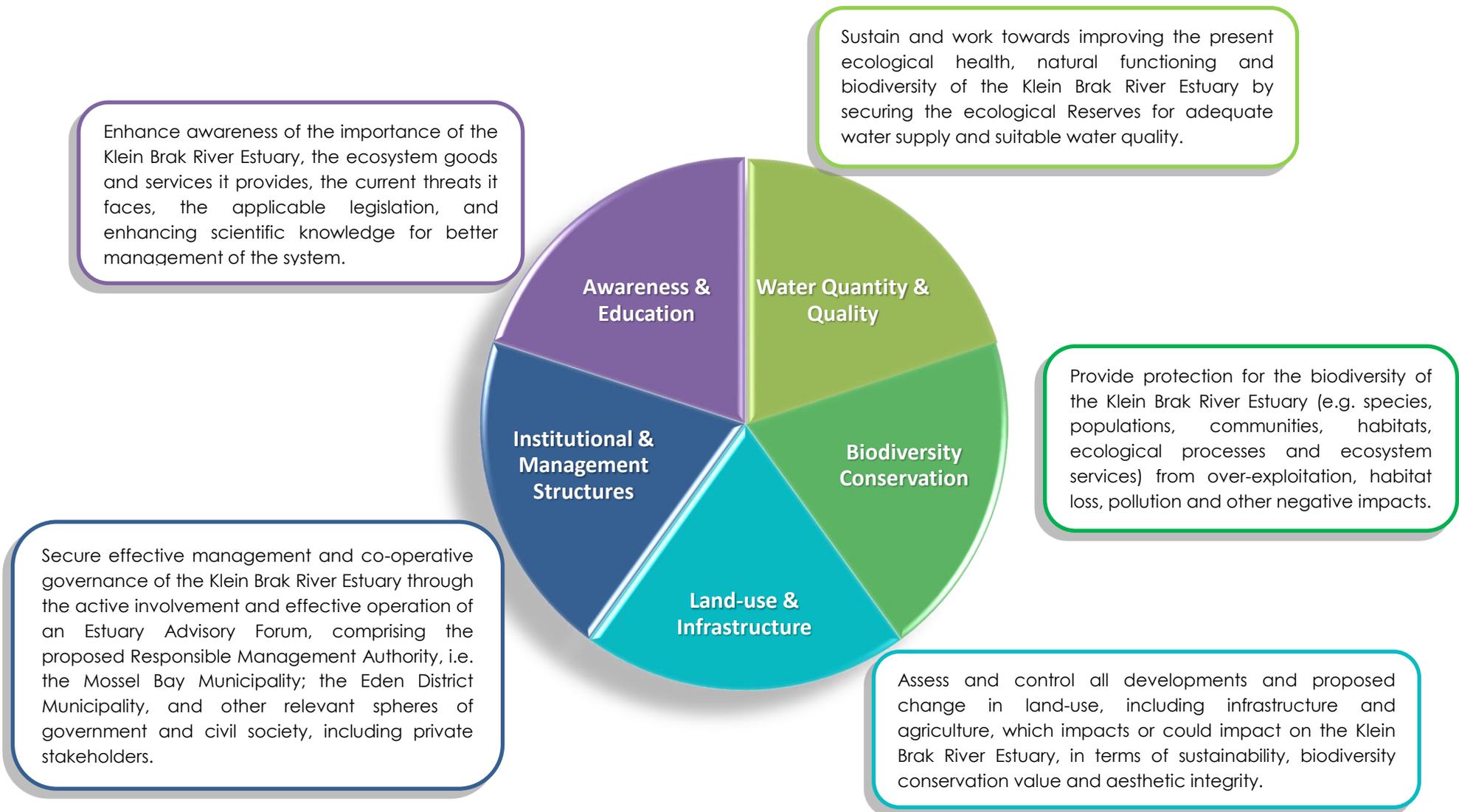
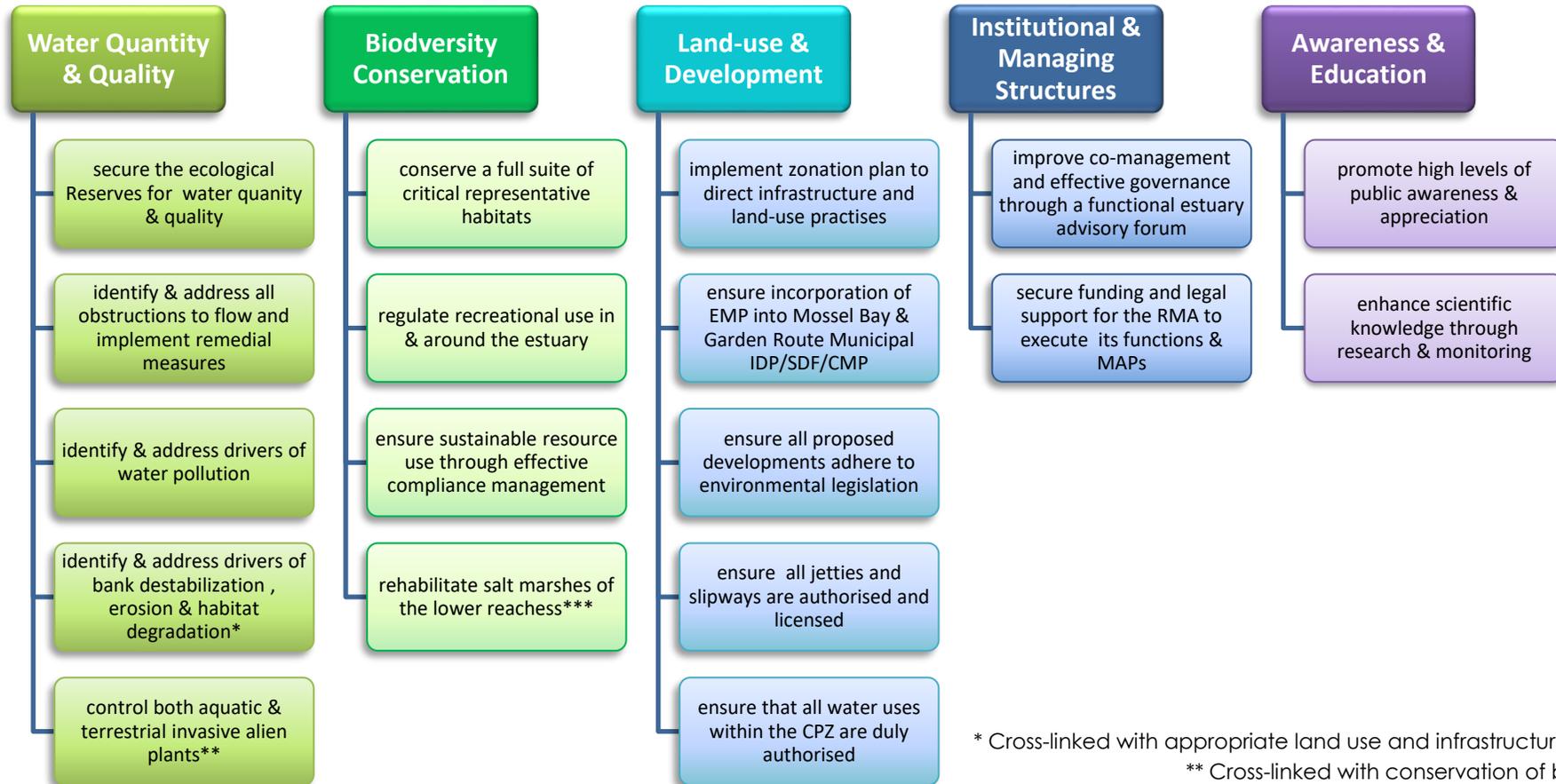


Figure 5: Key Objectives for the Klein Brak River Estuarine Management Plan

4.2 Detailed Management Objectives

The vision and key objectives can be achieved through the implementation of the following management objectives (Figure 6). Detailed explanations are provided hereunder .



* Cross-linked with appropriate land use and infrastructure planning
 ** Cross-linked with conservation of biodiversity
 *** Addressed under habitat degradation

Figure 6: Summary of Management Objectives

4.2.1 Water quantity and quality

1. Secure the ecological Reserves for Water Quantity and Water Quality determined in the Estuarine Reserve (RDM) study and promoting cooperative catchment management;
2. Improve flow through the Klein Brak River estuary by identifying and addressing all obstructions (e.g. culverts) in the estuary that influence flow regimes and lead to negative ecological and social impacts (e.g. flooding) (see Appendix I)¹;
3. Improve flow through the Klein Brak River estuary by addressing sedimentation in the water course upstream of the DWS extraction point and by addressing the spread of Alien Invasive Plant species in the catchment.
4. Minimise water pollution by identifying and addressing activities that lead to poor water quality, e.g. siltation, agricultural chemicals and sewerage run-off²;
5. Reduce habitat degradation and poor water quality by identifying and addressing activities that lead to bank de-stabilization, erosion and the subsequent lowering of water quality, e.g. detrimental agricultural activities such as ploughing and grazing in the riparian zone², certain types of water-based recreation, and removal of reed beds¹; and
6. Control the spread and densification of both aquatic and terrestrial invasive alien plant species, which negatively impact on water quantity and quality and have knock-on effects for aquatic life³.

4.2.2 Conservation of biodiversity

1. Ensure the conservation of the full suite of existing habitats, especially those that fulfil the role of zones of primary production, fish nurseries, wader feeding grounds (e.g. salt marshes etc.), and bank stabilization (*i.e.* Reed beds);
2. Ensure sustainable resource use through an effective level of compliance management, under the Marine Living Resources Act (Act 18 of 1998), in terms of sustainable utilization of fish and bait species, e.g. quotas, closed seasons, size limits, collection methods. The stopping of illegal gill netting and bait collecting should be prioritised; and
3. Regulate recreational use in and around the estuary, including water-based activities to reduce habitat degradation and disturbance to fauna and flora. The wakes of boats on the river can contribute towards erosion of river banks and it therefore must be regulated; and
4. Undertake rehabilitation work on the salt marshes in the lower reaches⁴. Natural debris should be left on beaches near the estuary mouth.

¹ Approximately 33 potential obstructions to the flow regime have been identified by the Riverside community

² Cross links with appropriate land use and infrastructure planning

³ Cross-links with conservation of biodiversity

⁴ Addressed under reducing habitat degradation (Section 4.2.1)

4.2.3 Undertake rehabilitation work on the salt marshes in the lower Land-use and infrastructure

1. Implement an estuary zonation plan that directs infrastructural development and other land use practices (e.g. agriculture) within the various development management lines/buffer zones as defined in the relevant environmental legislation, e.g. ICMA, National Environmental Management Act (Act No. 107 of 1998)(NEMA), National Water Act (Act No. 36 of 1998) and the Conservation of Agricultural Resources Act (Act No. 43 of 1983), in terms of the Coastal Protection Zone, Coastal Management Lines, 100m buffer, 32m buffer, 100 year flood line, and either the 5m contour or 1: 100 year flood line;
2. Ensure the incorporation of the estuary management plan into the Integrated Development Plans and Spatial Development Frameworks of the Garden Route District Municipality and the Mossel Bay Municipality; It must also be included in the strategic plans of State Owned Entities and the various government departments involved in estuary management;
3. Ensure that all proposed developments within the development buffer zones, adhere to the EIA process in terms of the full suite of relevant environmental legislation; and
4. Ensure that all water uses (surface and groundwater uses) within the Coastal Protection Zone are be duly authorised by DWS.

4.2.4 Institutional and management structures

1. Support a recommended functional estuary advisory forum (EAF) that will facilitate effective governance between Local and National government agencies, catchment management agencies (CMA), the responsible management authority (RMA), and the full suite of relevant private stakeholders (see Figure 4 and Figure 5); and
2. Actively support as well as motivate for the appropriate funding and legal support for the National as well as local RMA for the execution of its functions as well as the attainment of the objectives set out in this EMP.

4.2.5 Education and awareness and knowledge enhancement

1. Promote high levels of public awareness and appreciation of the ecosystem services provided by the Klein Brak River Estuary, threats posed to its integrity, and compliance management; and
2. Enhance our scientific knowledge, through research and monitoring, to: improve the confidence of the RDM study of the Klein Brak River Estuary; estimate more accurate carrying capacity thresholds, and identify, understand and mitigate indirect and/or cumulative impacts of human activities, both within the estuarine zone, as well as those beyond its boundaries.

5 SPATIAL ZONATION

5.1 Introduction

The management objectives identified in the previous section have been translated into a draft Estuary Zonation Plan (EZP). The zonation of any estuary is necessary to guide sustainable utilization without degradation of the estuarine environment (Clark, 1977). Zonation should therefore, essentially demarcate:

- The geographical boundary of the estuary (i.e. the estuarine functional zone);
- Important habitats (e.g. open water, sandflats and floodplain);
- The surrounding land uses and existing infrastructure;
- Areas designated for the conservation and protection of biodiversity;
- Appropriate buffers in which land use and development are strictly controlled and monitored; and
- Zones for where certain types of recreational activities are permissible and carrying capacities thereof.

A habitat sensitivity analysis should be the baseline which guides the differentiation of the various zones, identifying threatened, ecologically important habitats as no-go or minimal disturbance zones; those areas which can support controlled, sustainable exploitation of marine living resources; and those where various forms and levels of appropriate water-based recreation are acceptable. The habitat map developed by Adams (unpublished) was used as the baseline for the identification of sensitive estuarine habitats on the Klein Brak River Estuary (Figure 8), and together with legislated development control lines (See Section 5.4), was used to develop of the following zones:

- Conservation/protection zones;
- Development buffer zones; and
- Recreation-based zones.

5.2 Estuarine Boundaries

According to the Protocol, the geographical boundary for the estuary is that which encompasses the Estuarine Functional Zone (EFZ), delineated by the 5 m contour line prescribed by the South African National Biodiversity Institute (SANBI). This extends from the estuary mouth, as the downstream boundary, to the point at which the 5 m contour crosses the river course, as the upstream boundary, and laterally to the 5 m contour along each bank. This particular line incorporates essential estuarine habitats including open water area, sandbanks and mudflats, plant communities and the floodplain. In the case of the Klein Brak River Estuary, this also includes shifting sand banks (flood-tidal delta) and dune habitat of the mouth.



Figure 7: Geographical boundaries of the Klein Brak River Estuary according to the 5m topographic contour

5.3 Conservation/Protection Zone

The identification of conservation/protected zones should be based on studies such as Adams (unpublished), Wooldridge (1999), Turpie *et al.* (2004), and James and Harrison (2008), wherein the ecological importance of habitats that fulfil the role of zones such as primary production, fish nurseries, wader feeding grounds (e.g. *Zostera* beds and salt marshes), and bank stabilization (*i.e.* Reed beds), are highlighted (see Figure 9). The challenge will be to identify the high priority sites and conserve adequate representation thereof. Only then can different levels of compliance management be afforded to these areas in terms of how much disturbance, if any, is permissible. Conservation measures must include regulation of activities such as bait collection, anchoring, beaching of boats, access by boat, grazing and trampling, whilst the more sensitive/irreplaceable areas, that are indeed locally threatened, could be protected by a total restriction of any direct human activity. Innovative forms of compliance management will be required to afford adequate conservation of representative areas of these habitats. It is recommended that restrictions in by-law are enacted, to assist in conserving/protecting these zones.

Salt marsh areas⁵ and *Zostera capensis* beds have been identified as ecologically important habitats in the estuary, which are sensitive to disturbance and require conservation (Whitfield 1998, Adams *et al.* 1999) (Figure 9). Salt marshes have a number of important functions: these include sediment stabilization and bank protection; filtering of sediments and pollutants; and providing food for marine and estuarine organisms (Adams 1991). Similarly, *Zostera* beds are important as they provide sheltered rich habitats for many estuarine invertebrates and juvenile fish, and feeding grounds for invertebrate feeding waders (Whitfield 1998). *Zostera* beds are easily disturbed by bait digging, trampling and the beaching of boats. Once the root and rhizome systems have been disturbed, the plants may take years to recover. The plants are also sensitive to increases in turbidity as a result of boating activities that stir up bottom sediments and reduce light available for photosynthesis.

OPERATIONAL OBJECTIVES:

- To conserve an optimal representation of estuarine habitats and associated species;
- Rehabilitation of artificially disturbed areas; and
- Control of invasive alien plant infestations.

⁵ Including supratidal, intertidal and floodplain salt marshes

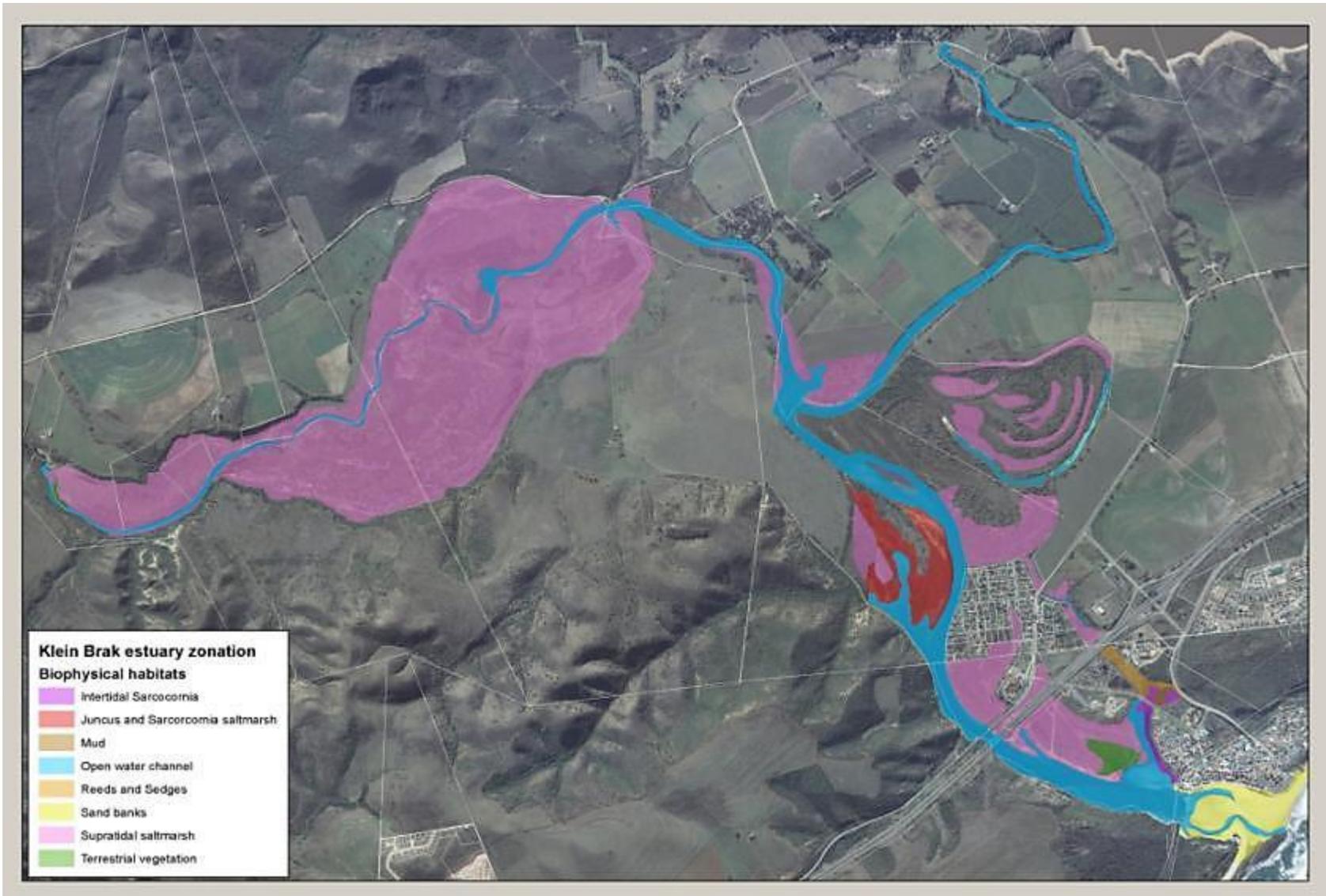


Figure 8: Biophysical habitats of the Klein Brak River Estuary

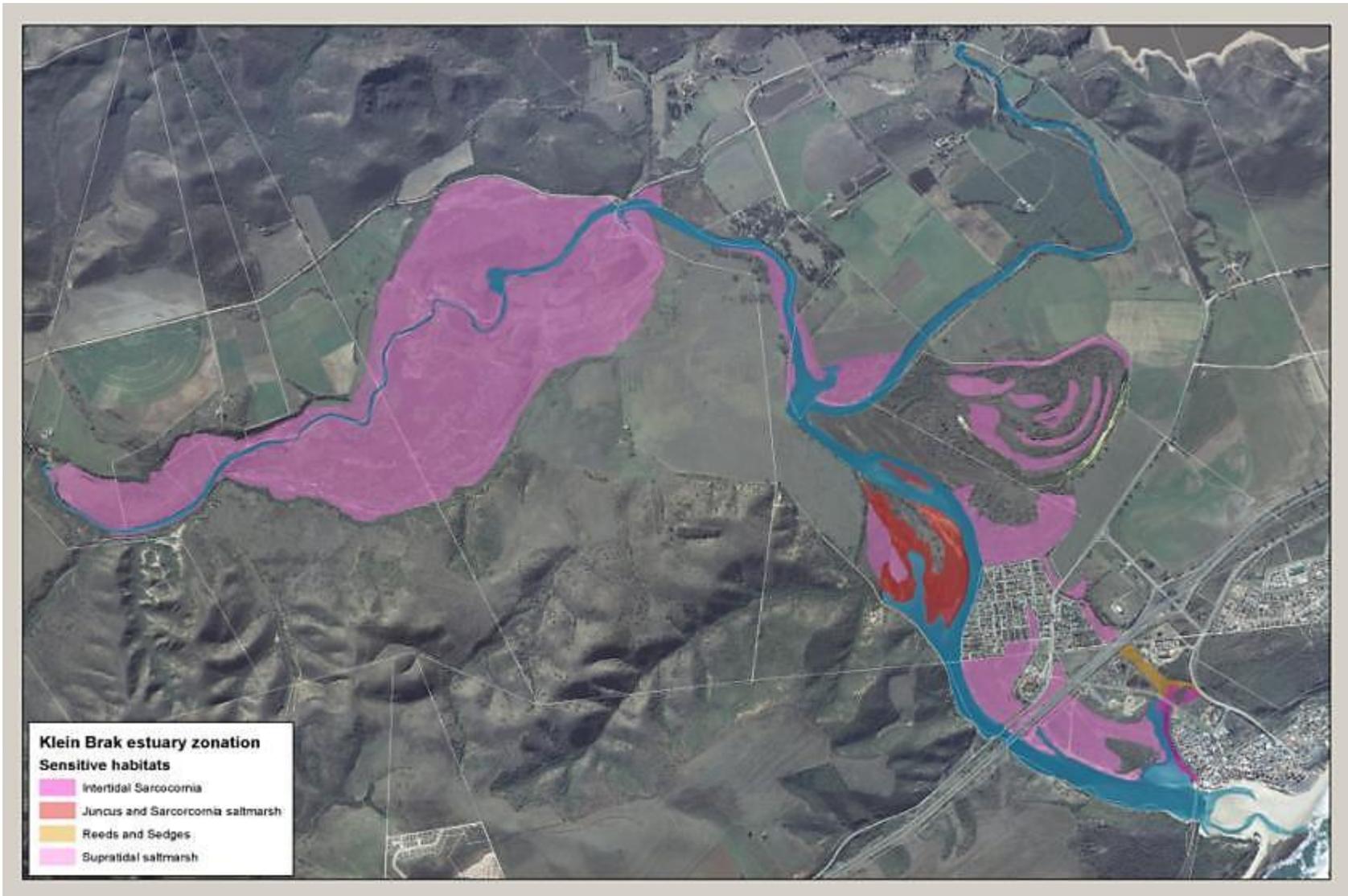


Figure 9: Sensitive habitats of the Klein Brak River Estuary

5.4 Development Buffer Zone

The Development Buffer Zone was informed by four development control zones identified in existing environmental legislation, namely the ICMA, and NEMA. These lines are illustrated in Figure 10. It is important to note that where existing infrastructure of critical importance is located within a development buffer zone, the owning entity reserves the right to maintain, use and upgrade subject to the appropriate environmental authorisations being obtained.

5.4.1 Coastal Protection Zone (CPZ)

The Coastal Protection Zone (CPZ), as defined in the ICMA, is a continuous strip of land, starting from the High-Water Mark (HWM) and extending inland. The CPZ is established to manage and regulate the use of land that is adjacent to coastal public property, or that plays a significant role in coastal ecosystems. As detailed in the ICMA, the CPZ includes:

- Any land falling within an area formally declared as a sensitive coastal area;
- Any part of the littoral active zone that is not coastal public property;
- Any coastal protected area, or part of such an area, which is not coastal public property;
- Any rural land unit that is situated within 1 km (1000 m) of the HWM which is zoned as agricultural or undetermined;
- Any urban land unit that is situated completely or partly within 100 m of the HWM;
- Any coastal wetland, lake, lagoon, dam or river which is situated completely or partially within a land unit situated within 1000 m of the HWM that was zoned for agricultural or undetermined use, or is within 100 m of the HWM in urban areas;
- Any part of the seashore which is not coastal public property (including all privately-owned land below the HWM);
- Any Admiralty Reserve which is not coastal public property; and
- Any land adjacent to the above stated areas that would be inundated (submerged or covered) by a 1:100 year flood or storm event (this includes flooding caused by both rain storms and rough seas).

The CPZ is intended to manage, regulate and restrict the use of land that is adjacent to coastal public property, or that plays a significant role in the coastal ecosystem. More specifically, the coastal protection zone aims:

- To protect the ecological integrity, natural character, and the economic, social and aesthetic value of the neighbouring coastal public property;
- To avoid increasing the effect or severity of natural hazards;
- To protect people, property and economic activities from the risks and threats which may arise from dynamic coastal processes such as wave and wind erosion, coastal storm surges, flooding and sea-level rise;
- To maintain the natural functioning of the littoral active zone;
- To maintain the productivity of the coastal zone; and
- To allow authorities to perform rescue and clean-up operations.

It is finally noted that in terms of Section 26(1)(b) only the MEC may determine or adjust the boundary of the CPZ after considering items listed in Section 28(3) of the ICM Act.

5.4.2 5 m Contour Line

The 5 m contour line is identified by SANBI as well as leading estuarine scientists in South Africa, as the boundary of an estuary. As such, this line is critically important as a development control measure and should be afforded a level of status which prohibits any development within the boundaries of the estuary. It is recommended that the 5 m contour be deemed as the Coastal Management Line until such time as a coastal management line and/or development set-back line is formally determined.

5.4.3 NEMAs EIA Regulations

Assessment of environmental impact is governed by the recently updated NEMA Environmental Impact Assessment Regulations, 2014, and accompanying listing notices 1, 2 and 3. Listing notice 2 identifies activities requiring scoping and environmental impact assessment prior to authorisation being issued with listing notices 1 and 3 identifying activities requiring basic assessment only. Listing notice 3 applies to listed activities in specific geographical areas only. In summary, activities requiring prior environmental authorisation from the WC DEA&DP in respect to listing notices 1 and 2 relate to:

- Aquaculture;
- Development near or within watercourses (exceeding prescribed thresholds) *;
- Development of structures in Coastal Public Property;
- Desalination of water;
- Development within the sea, estuary, littoral active zone or 100m inland from the high-water mark (exceeding prescribed thresholds) *;
- The prevention of the free movement of sand in the littoral active zone;
- The movement of material greater than 5m³;
- Marine telecommunication facilities and/or infrastructure;
- The development and relation operation of islands, anchored platforms or other structures below or along the sea bed; and
- The expansion of the above activities.

*It should be noted that activities indicated with a * are excluded in ports or harbours, urban areas as well as existing roads or road reserves.*

Activities included in Listing Notice 3, relating to specific geographical areas and within specified thresholds, are in respect to:

- Billboards;
- Reservoirs;
- Masts or towers;
- Roads;
- Resorts, Lodges, Hotels and tourism/hospitality facilities;
- Aircraft Landing strips and runways;
- Above ground cableways and funiculars;
- Zip-lines or foefie-slides;
- Tracks or routes for outdoor motor racing;

-
- Facilities or infrastructure for the storage and handling of a dangerous good;
 - The clearance of indigenous vegetation;
 - Aquaculture;
 - Development near or within watercourses in specified areas; and
 - The transformation of >1000m² of land.

5.4.3.1 32 m River and Wetland Development Buffer

A buffer area of 32 m from the edge/bank of all rivers, water bodies and wetlands/salt marshes is intended to protect the ecological functioning of the riparian system. Activities proposed within this area are controlled by the NEMA EIA regulations, where the construction or expansion of facilities within this buffer beyond a certain size trigger a requirement to undertake an environmental assessment and obtain environmental authorisation before continuing if such activities are not proposed in ports or harbours, urban areas as well as existing roads or road reserves. It is noted that on adoption of a coastal management line relevant to the Klein Brak River estuary, this notice will exclude all activities that occur behind this line.

The inclusion of this buffer in the Development Buffer Zone is proposed in order to facilitate the protection of river banks and the sensitive vegetation along these banks. It is also proposed as a rehabilitation priority area where current agricultural/development encroachment into this zone can be controlled and damage caused, mitigated or reversed. In such areas (e.g. wherever ploughing is occurring within this 32 m buffer) the priority is to discourage and control such activities and rehabilitate existing disturbed areas.

5.4.3.2 100 m from the High-Water Mark

The 100 m from the HWM of the sea and estuary is a zone listed in terms of both the ICMA and the EIA regulations. In terms of the ICMA, this zone is included within the CPZ in urban areas (see Section 5.4.1 above). In the EIA Regulations, this indicative zone is identified and linked to various activities requiring environmental authorization.

This development management line is included in the determination of this Development Buffer Zone, in order to facilitate the protection of estuary banks and sensitive vegetation along these banks, as well as allowing for rehabilitation and the formation of an ecological corridor along the coast, and to the interior. Existing farming, recreational and conservation activities should be reviewed in order to prioritise any areas where current activities are detrimental to the estuarine environment (including the terrestrial environment) and these should be remedied, curtailed or modified to reduce the impact.

5.4.3.3 Floodlines

The 1:50 and 1: 100 flood line level has recently been determined through a detailed floodline assessment project commissioned by the DEA&DP. The floodline spatial information should be included in Municipal Planning, Zoning Schemes and should inform decision-making.

5.4.4 Proposed Coastal Management Line:

The Coastal Management Line (CML), once determined by the Western Cape Department of Environment Affairs and Development Planning (DEA&DP), should be incorporated into the Klein Brak River estuary zonation plan. This line will be determined via an initial scientific process, which reviews the HWM, projected sea level rise, both short- and long-term erosion, as well as a comprehensive public participation process. The purpose of the CML is to:

- To protect coastal public property, private property and public safety;
- To protect the CPZ;
- To preserve the aesthetic values of the coastal zone; or
- For any other reason, consistent with the objects of the ICMA.

Specific development regulations or restrictions may be set by the MEC for any development seaward of the CML.

Operational objectives for the Development Buffer Zone surrounding the Klein Brak River estuary are directed at adhering to legal requirements, as well as protecting the integrity of the estuarine environment, controlling future development and mitigating the negative impacts of current development.

OPERATIONAL OBJECTIVES:

- To facilitate the process of capturing the estuary zonation and associated prescriptions into IDPs and SDFs;
- To ensure that proposed developments in CPZ adhere to the EIA process;
- To establish a coastal management line(s) for future development for climate change preparedness (e.g. flooding);
- To set “no-go” areas for development and vegetation transformation within the CPZ;
- To ensure that all jetties & slipways authorised & licensed in terms of the Seashore Act & NEMA;
- To enforce existing municipal by-laws regarding the approval of building plans for new development from the local municipality;
- To enforce existing DWS water use licensing system for all water use (both groundwater and surface water) within the CPZ, irrespective whether it is in the general authorisations of DWS (except drinking water); and
- No effluents to be discharged into any aquatic system in the CPZ without authorisation from DWS.

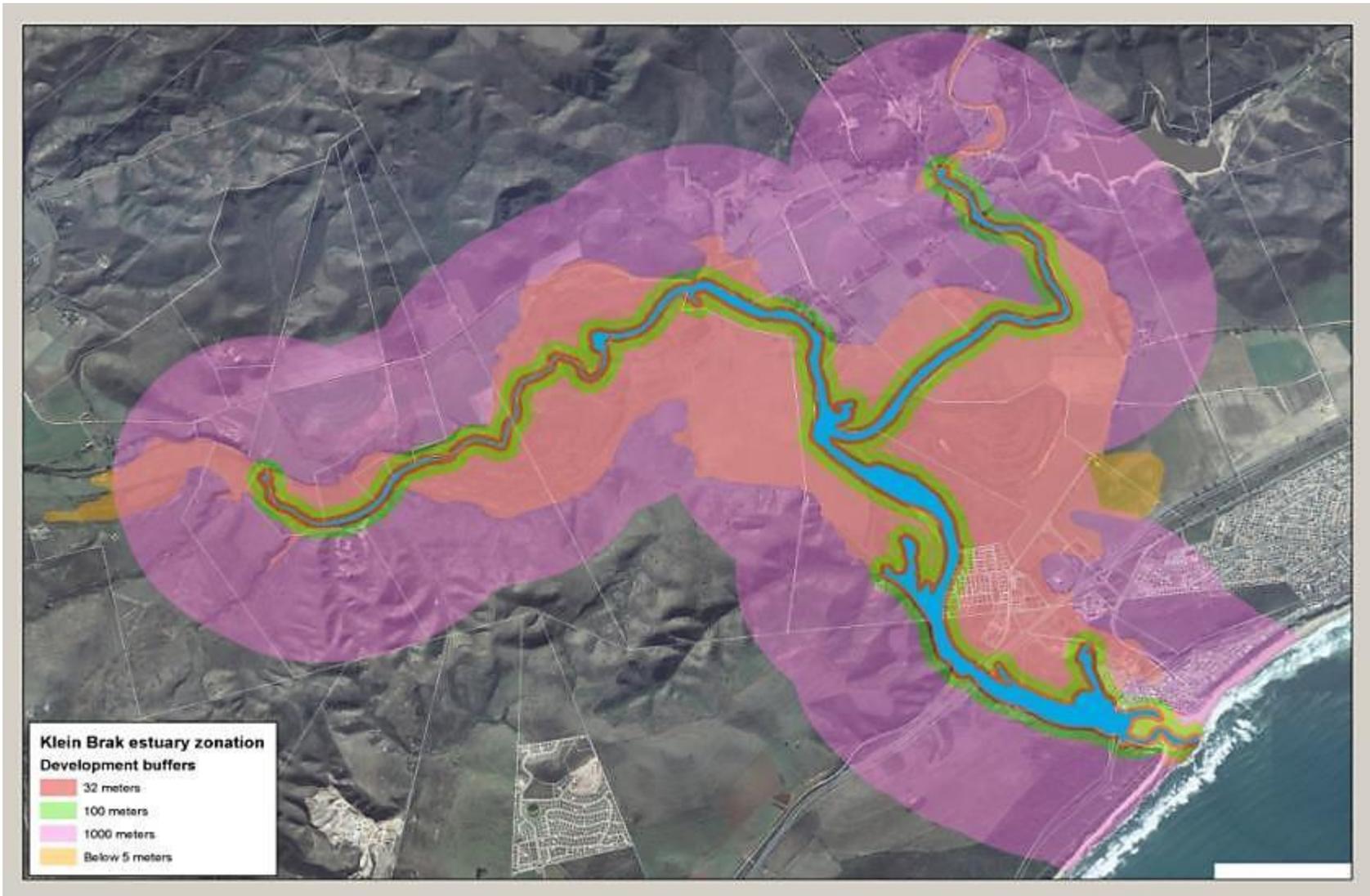


Figure 10: Proposed development buffers for the Klein Brak River estuary

5.5 Recreation-based Zones

The main activities on the Klein Brak River estuary are recreational fishing, boating and skiing. The section of the estuary adjacent to the sand bar area near the mouth is popular with bathers. It serves as an extension of the Klein Brak beach area and is managed as such by Mossel Bay LM. Other peripheral uses include wind-surfing and wake-boarding. Skiing is perhaps the activity which potentially conflicts with more activities than any other individual activity, and for this reason, a **“No-skiing” zone** and a **“Skiing” zone**, has already been enforced by means of Municipal by-laws (Figure 11). The enforcement of this zonation is complex due to the locality of the Riverside Holiday resort, upstream of the existing non-skiing zone. As this resort is frequented by visitors who come to ski, accessing the skiing zone is problematic, as they first have to cross the non-skiing zone. This situation will need to be investigated and a satisfactory solution / compromise found.

Wake-boarding is also an activity that may only take place in the “Skiing” zone. It has the potential to affect environmental impacts, particularly in terms of bank erosion, and hence, should not take place closer than 30 m to the banks of the estuary.

OPERATIONAL OBJECTIVES:

- To enforce the existing by-laws in terms of the current suite of water-based activities, e.g. skiing and non-skiing zones, speed limits, etc.;
- To estimate the carrying capacity for recreational boating activities in terms environmental impacts; and
- To monitor and regulate the number of boats through boat permit fee collection.



Figure 11: Proposed recreation zones for the Klein Brak River estuary

6 MANAGEMENT PRIORITIES

The project plans discussed hereunder give effect to the various management objectives and the EZP by identifying the priority management interventions that are required to ensure their realisation.

Five project plans have been compiled for the efficient and effective management of the Klein Brak River estuary. Each plan corresponds to a key objective and contains applicable management actions, supporting regulations, responsible institution(s), and required resources, if such information is available. These are arranged in general order of priority, but nevertheless recognize that the neglect of any leg will compromise overall success:

- Institutional and management structures;
- Sustaining water quality & quantity;
- Conservation of biodiversity;
- Land use and infrastructure; and
- Public education and awareness and knowledge enhancement.

It should be noted that there is some interconnectedness between the plans and some management actions, as they all ultimately contribute to the conservation of ecosystem function and patterns of biodiversity, which in turn leads to the conservation of a sustained supply of ecosystem goods and services delivered by the estuary.

6.1 Institutional and Management Structures

Co-management and effective governance is the keystone for achieving the vision set by the stakeholders for the Klein Brak River estuary, and therefore attainment of the overall objective of conserving the system's ecological functioning and biodiversity. Without well-structured and efficient institutional and management arrangements, integrated environmental management of the estuary may be no more than a series of uncoordinated reactions to immediate problems. Ensuring effective governance is therefore probably the most important objective to be achieved. To this end, DEA&DP is in the process of developing the Western Cape Estuaries Framework and Implementation Strategy to assist with conformance with respect to establishing institutional and management structures for estuarine management within the province.

The main 'institutions' will be in effect regarding the management of activities in and around or relating to the Klein Brak River estuary. These are the **Responsible Management Authority, the Mossel Bay Municipality;** and the **Klein Brak River Estuary Advisory Forum (EAF)**, the collection of stakeholders with vested interest in the estuary and the vehicle through which the implementation of the EMP can be coordinated and monitored.

The Klein Brak River EAF is pivotal to effective governance, provided it is administered proficiently and remains functional. It should champion the integration of the EMP into

the Integrated Development Plans and Spatial Development Frameworks of the local and district municipalities. Through this, on-going funding of the management of the estuary can be secured. In addition, co-operative governance is required for identifying, lobbying, and promulgation of additional by-laws or amendments to existing by-laws.

The RMA will need to ensure that funding is allocated by the relevant departments for building sufficient capacity to perform various actions within this EMP as per the mandate and responsibilities of each department. Funding will also be required to perform activities such as provision of interpretative and compliance signage, and information material, while funding may be solicited from the relevant national departments for specific actions, for example, rehabilitation of degraded areas, and assistance with research and monitoring of biophysical indicators and human use.

In addition, the Mossel Bay Municipality may need to promulgate, and amend from time to time, municipal by-laws in order to provide the necessary legal support for the execution of their functions and ultimately give effect to the EMP management objectives, particularly in terms of compliance management.

Table 2: Management Actions for institutional and management structures

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
Management Objective 1: Maintain a fully functional estuary advisory forum that will facilitate co-management and effective governance*			
Review of roles and responsibilities of Klein Brak River EAF as an advisory forum in light of the Protocol as well as the WC EMFIS & finalise institutional arrangements	ICMA/The Protocol	<ul style="list-style-type: none"> • Reconstitution of Klein Brak River EAF • Terms of Reference and Constitution developed and agreed • Roles and responsibilities agreed • Implementation protocols confirmed with relevant organs of state • Regular and minuted EAF meetings 	RMA, Mossel Bay LM DEA&DP Klein Brak River EAF members
Active collaboration of Klein Brak River EAF with other institutions through shared responsibilities and active representation on municipal Coastal Committee(s)	ICMA	<ul style="list-style-type: none"> • Representation on provincial & municipal coastal committees • Representation on BGCMA • Klein Brak River estuary issues raised on agendas • Minutes of meetings 	RMA, DEA&DP Klein Brak River EAF DEA: O&C BGCMA
Management Objective 2: Secure appropriate funding and legal support for implementation of the Klein Brak River EMP			
Develop long-term financing plan	ICMA/The Protocol MSA	<ul style="list-style-type: none"> • Action plan for future funding developed • MOUs signed • Sufficient & effective use of funding • Project plans implemented 	RMA DEA: O&C DWS DPW DAFF DEA&DP

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
		<ul style="list-style-type: none"> Income generated from key partners 	CapeNature Garden RouteDM Klein Brak River EAF
Secure funding for applicable project plans			RMA DEA: O&C DWS DPW DAFF DEA&DP CapeNature Garden RouteDM Klein Brak River EAF
Investigate income generation opportunities (e.g. access fees, competition fees)			Klein Brak EAF Mossel Bay LM, RMA

* Cross cutting with water quantity & quality in terms of cooperative governance with BGCMA

6.2 Water quantity and quality

Securing an appropriate quantity and quality of freshwater input into the estuary, is the primary action that must be taken to conserving functioning and biodiversity. Other conservation management activities aimed at sustaining the integrity of patterns and processes are the ameliorating obstructions to flow, rehabilitation of degraded areas, (e.g. bank erosion, trampling, etc.) as well as the effective control of invasive alien plant species. The latter is cross cutting in terms of preserving biodiversity.

Table 3: Management Actions for water quantity and quality

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
Management Objective 1: Secure the Ecological Reserves for Water Quantity and Quality			
Ensure that Estuarine Reserve Determination study is signed off by the Minister of DWS	NWA	<ul style="list-style-type: none"> • RDM study undertaken • Study signed off by Minister • Results published 	DWS RMA, DEA&DP
Illegal uses to be identified	NWA	<ul style="list-style-type: none"> • Action taken against illegal use 	DWS Klein Brak River EAF, RMA
Klein Brak River EAF and Mossel Bay LM to participate and influence catchment management planning and classification	NWA	<ul style="list-style-type: none"> • Recorded attendance at catchment meetings; • Report back to Klein Brak River EAF meetings; • Estuarine matters included in agenda of BGCMA 	Klein Brak River EAF DWS RMA, DEA&DP Mossel Bay LM
Active representation of Breede-Gouritz Catchment Management Agency on Klein Brak River EAF		<ul style="list-style-type: none"> • Recorded attendance at Klein Brak River EAF meetings; • Catchment related matters included in agenda of Klein Brak EAF • Signed membership of BGCMA on Klein Brak River EAF 	Klein Brak River EAF BGCMA RMA, DEA&DP
Compile an action plan for the control of Alien Invasive Plant Species	NEM:BA	<ul style="list-style-type: none"> • Survey of Alien Invasive Plant species in catchment. 	DEA, RMA, Riparian landowners,
Ensure Klein Brak River estuary, (including early warning and reaction protocols in response to for e.g. riverine flooding, sea-	Disaster Management Amendment Act	<ul style="list-style-type: none"> • Estuary-specific disaster issues included in existing management plan 	RMA, Provincial Disaster Management Centre Mossel Bay LM, Garden

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
level rise, storm events) included in the Garden Route District Disaster Management Plan and obtain necessary approvals and cost recovery protocols for breaching of the mouth	(DMAA) (Act No. 16 of 2015)	<ul style="list-style-type: none"> • Database of disasters and emergency events created and maintained • Mouth Management Plan as well as Maintenance Management Plan for artificial breaching developed and approved 	Route DM, RMA, Klein Brak River EAF
Management Objective 2: Improve flow patterns to improve ecosystem functioning of the Klein Brak River estuarine system			
Identify and assess the impacts of obstructions on the Klein Brak River estuary <i>(the removal of some obstructions noted)</i>	NWA NEMA DMAA	<ul style="list-style-type: none"> • All obstructions identified • Impact assessment undertaken • Legal status established • Remedial plan developed to remove structures (legal and illegal) • Funding secured for priority areas • Implementation of remedial plan • Improved functioning of the estuary 	RMA, DEA&DP Provincial Disaster Management Centre DWS: WfW DAFF Mossel Bay Transnet SANRAL
Develop and implement remedial plan			
Management Objective 3: Minimise water pollution by identifying and addressing drivers of poor water quality			
Identify sources & types of pollution & prioritise mitigation measures. Interact with agriculture sector.	NWA NEM:WA	<ul style="list-style-type: none"> • Pollution sources identified • Mitigation measures devised • Database of offenders developed 	DWS, BGCMA, RMA, DEA&DP DEA, Garden Route DM
Establish source of effluent pollution and address appropriately, focusing on treatment plant	NWA NEM:WA	<ul style="list-style-type: none"> • Pollution sources identified • Mitigation measures devised • Effluent appropriately treated 	DWS DEA&DP DEA, BGCMA, RMA, Garden Route DM

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
			Mossel Bay LM (in terms of by-laws re. illegal discharges to sewer & stormwater)
Management Objective 4: Reduce bank de-stabilisation and erosion, and habitat degradation			
Establish water quality monitoring programme within the estuary	NWA	<ul style="list-style-type: none"> Water quality monitoring programme developed & maintained Database & analysis of data 	DWS, BGCMA. Garden Route DM, DEA&DP, RMA DEA
Identify, estimate costs, prioritise and rehabilitate areas of bank erosion, trampling, disturbed riparian vegetation (priority areas and hot spots) etc.	ICMA CARA	<ul style="list-style-type: none"> Fine scale GIS map generated Site-specified rehabilitation methods identified Illegal stabilisation identified and offenders prosecuted 	Mossel Bay LM DWS: WfWetlands Klein Brak River EAF, DPW, RMA
Identify illegal stabilisation taking place and prepare plan and action list	ICMA CARA	<ul style="list-style-type: none"> Funding secured for priority areas 	
Initiate and maintain rehabilitation programme	NWA	<ul style="list-style-type: none"> Implementation of rehabilitation programme 	
Management Objective 5: Control the spread and densification of both aquatic and terrestrial invasive alien plant species			
Identify, prioritise and control invasive alien plant infestation	CARA NEMA	<ul style="list-style-type: none"> Fine scale GIS map generated Priority infestations identified 	DEA: WfW DEA: Working for the Coast Mossel Bay LM
Initiate and maintain eradication programme (<i>cleaning in upper catchment acknowledged</i>)	NEM:BA NWA	<ul style="list-style-type: none"> Long term budget estimated Funding sourced Staff employed Volume/ weight/ ha of areas cleared 	

6.3 Conservation of Biodiversity

Conservation of the functional attributes and biodiversity patterns and processes of the Klein Brak River estuary is crucial to securing the environmental goods and services that the estuary provides. In terms of conserving estuarine biodiversity, more specific actions relate to compliance management, both in terms of sustainable consumptive use (e.g. fishing, bait collecting) as well as non-consumptive use (e.g. minimizing damage caused by boating-related activities in sensitive habitats, building of jetties etc.). In addition, rehabilitation of important estuarine habitat, namely the salt marshes in the lower reaches of the estuary will make a meaningful contribution to conserving the biodiversity of the system. The Klein Brak River Estuary Advisory Forum has indicated that the demarcation/zonation of a bait sanctuary should be investigated. DAFF should be approached to demarcate this area and appropriate enforcement should be catered for.

Table 4: Management Actions for conservation of biodiversity

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
Management Objective 1: Ensure the conservation of the full suite of existing, especially vital, estuarine habitats & associated species			
Workshop with key role players to: <ul style="list-style-type: none"> Identify high priority habitats and areas for active conservation (aligned with the WC Provincial Spatial Biodiversity Plan); Identify potential priority listings (DAFF stock recovery) Identify Thresholds of Potential Concern (TPCs) for habitats & species; Identify conservation measures for each zone Assess need for specific bait sanctuary 	ICMA, NEM: PAA	<ul style="list-style-type: none"> Demarcation of all areas targeted for conservation TPCs set for water quality, habitat surface area, & estuarine biota Conservation measures identified for each zone 	DEA DAFF CapeNature Klein Brak River EAF DEA&DP, RMA
Enact conservation zone and associated measures	Municipal by-laws	<ul style="list-style-type: none"> Municipal by-laws developed to enact conservation zone and enforce associated measures 	RMA, Mossel Bay LM Klein Brak River EAF CapeNature

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
Management Objective 2: Ensure sustainable resource use through effective compliance management			
Develop and maintain compliance management system to enforce conservation measures for living and non-living resources (including fish & bait species related quotas, closed seasons, bag limits, collection methods, trampling, turbulence, shoreline erosion) <i>(allowable bait harvesting by fishing permit holders noted)</i>	CARA NWA ICMA MLRA Sea Birds & Seals Protection Act Seashore Act NEM:BA MPRDA MSA Municipal By-laws	<ul style="list-style-type: none"> Existing compliance management supported Illegal bait harvesting controlled Habitat surface area & health maintained Healthy populations of all species Low levels of non-compliance Recovery of degraded areas 	RMA, Mossel Bay LM DEA DAFF CapeNature
Management Objective 3: Regulate recreational use in and around the estuary, including water-based activities to reduce habitat degradation and disturbance to fauna and flora			
Maintain existing compliance management system pertaining to water-based activities, e.g. skiing and non-skiing zones, speed limits, wake-boarding etc. <i>(Current limitations in respect of skiing noted due to depth of system)</i>	Historic CapeNature skiing control guidelines	<ul style="list-style-type: none"> Compliance management system effective, well maintained & ongoing adherence to by-laws Number of infringements reduced 	Mossel Bay LM Klein Brak River EAF RMA
Identify, enact & demarcate zones, and access, for other activities such as kite-surfing, and windsurfing etc.	Municipal By-laws	<ul style="list-style-type: none"> Zones established and implemented (including no-wake zone and potential limit in engine size) Beacons erected Monitoring & compliance enforcement regularly undertaken By-laws developed & enforced 	Mossel Bay LM Klein Brak River EAF RMA

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
Determine carrying capacities for each water based activity using the 'Recreational Water Use Manual' (DWA, RW GP2.2) in consultation with relevant organs of state	Municipal By-laws	<ul style="list-style-type: none"> Carrying capacities set for each activity. Consideration given to peak user day's regulation. Carrying capacities enacted into by-laws 	Mossel Bay LM Klein Brak River EAF DWS RMA DEA, DEA&DP
Monitor and regulate the number of boats on the river	Municipal By-laws	<ul style="list-style-type: none"> Boat permit fee collection Database developed to manage & analyse historical data, fee collection, no. of boats, etc.	Mossel Bay LM Klein Brak River EAF RMA

6.4 Land-use and infrastructure

The Western Cape DEA&DP, in consultation with the Garden Route and Mossel Bay Municipalities, is able, in terms of the ICMA, to designate coastal management line(s) which can fall either within or outside of the designated CPZ. Such management lines must be integrated into SDFs and IDPs of municipalities and have a specific impact on listed activities relating to the coastal zone. Additional special planning regulations or coastal by-laws, in terms of style and sustainability, can also be identified and implemented. These lines, once determined, must be incorporated into this EMP as well as draft zonation plan.

Table 5: Management Actions for sustainable development

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
Management Objective 1: Implement an estuary zonation plan that directs infrastructural development and other land use practices (e.g. agriculture) within the various floodlines, coastal management lines, buffer zones and overlay zones			
Workshop with key role players to identify and enact "no-go areas" for development and vegetation transformation based on habitat sensitivity and irreplaceability	ICMA NEMA CARA MSA	<ul style="list-style-type: none"> "No-go" areas enacted in relevant legislation 	CapeNature Klein Brak River EAF Mossel Bay LM DEA&DP

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
			DAFF
Identify appropriate coastal management line(s) & obtain legal status	ICMA MSA NEMA	<ul style="list-style-type: none"> Coastal management lines determined Coastal management line gazetted in relevant legislation Coastal management lines integrated into IDPs & SDF 	DEA DEA&DP Mossel Bay LM Garden RouteDM Farmers Assoc.
Engage with farming association to negotiate agricultural activities within buffers, CMLs and EFZ		<ul style="list-style-type: none"> Agreements reached/memorandums signed with farming associations 	
On-going process of reviewing the zonation plan, with the view of including an up-to-date revision in the next full revision of the EMP	ICMA	<ul style="list-style-type: none"> Revised zonation ready for next full review of EMP 	Mossel Bay LM DEA&DP
Management Objective 2: Ensure the incorporation of the estuarine management plan into the Municipal Integrated Development Plans and Spatial Development Frameworks			
Ensure capturing of zonation & associated recommendations into the IDPS, SDFs, and CMPs	ICMA MSA	<ul style="list-style-type: none"> EZP & recommendations appearing in all relevant IDPs and SDFs, and CMPs 	Klein Brak River EAF Mossel Bay LM, Garden Route DM
Management Objective 3: Ensure that all proposed developments within the development buffer zones, adhere to the EIA process in terms of the full suite of relevant environmental legislation			
Register the Klein Brak River EAF as an I&APs for all development & re-zoning applications	ICMA NEMA & EIA regulations NWA CARA NEM:WA	<ul style="list-style-type: none"> Database of all new development and comments made by Mossel Bay LM through EIA process Developments tabled at Klein Brak River EAF meetings 	DEA&DP DWS DAFF Mossel Bay Klein Brak River EAF

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	RESPONSIBILITY
Develop & maintain database to monitor adherence to building plan system	Municipal By-laws	<ul style="list-style-type: none"> Data with current information i.t.o. applications, designs & approvals Mossel Bay LM to coordinate information collation & sharing 	Mossel Bay LM Klein Brak River EAF
Management Objective 4: All jetties and slipways authorised and licensed in terms of the Seashore Act and NEMA			
Development & maintenance of spatially-explicit database on which existing jetties and slipways are capture	Seashore Act	<ul style="list-style-type: none"> Database of jetties and slipways developed & maintained 	CapeNature, DEA&DP, RMA, DEA
Surveys/patrols to monitor for new structures being built without authorisation		<ul style="list-style-type: none"> Low incidence of new unauthorised structures being built 	
Efficient authorisation & leasing system		ICMA ORV Regulations	
Management Objective 5: Ensure that all water uses* within the CPZ (and catchment) are be duly authorised by DWS			
Maintain a monitoring system which captures all existing and proposed ground water and surface water use within the CPZ (and catchment)	NWA	<ul style="list-style-type: none"> Efficient system for monitoring and compliance management developed and effectively maintained 	DWS BGCMA RMA

*Water uses inclusive of surface and groundwater resources

6.5 Public education and awareness, and knowledge enhancement

Raised public appreciation in terms of the environmental goods and services provided by the estuary, and the compliance management rules and regulations necessary to protect these resources, is crucial. Educational and compliance signage will need to be provided at strategic points. These efforts must be sustained in the long term, through funding secured within the Mossel Bay Municipality, as well as relevant government departments, e.g. DWS and DEA.

Table 6: Management Actions for public education and awareness and knowledge enhancement

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	WORK PLAN RESPONSIBILITY
Management Objective 1: Promote high levels of public awareness and appreciation of the ecosystem services provided by the Klein Brak River estuary, threats posed to its integrity, and compliance management			
Raise and maintain public awareness of the values of the estuary, threats & compliance measures	ICMA	<ul style="list-style-type: none"> Strategically placed signage; Dissemination of information via a website, newsletters, pamphlets etc., relating to both compliance awareness & environmental education Education & Awareness campaigns conducted Identify local sustainable livelihoods opportunities (e.g. prawn beds steward) 	RMA, Mossel Bay LM Klein Brak River EAF, CapeNature, Relevant Government departments
Promote public involvement in data collection and estuary monitoring (through Citizen science and Adopt-a-Beach initiatives)		<ul style="list-style-type: none"> Number of public events held Number of participants Annually updated database maintained by Klein Brak River EAF 	RMA, Mossel Bay LM, CapeNature, DEA, DEA&DP, Klein Brak River EAF
Management Objective 2: Enhance our scientific knowledge, through research and monitoring			
Establish a comprehensive monitoring programme (as per Appendix 1 Resource Monitoring Protocol)	MLRA, NWA, ICMA, NEM:BA	<ul style="list-style-type: none"> Research projects and publications; Specific bio-indicators identified to monitor the state of the estuary; Monitoring database produced & maintained; 	RMA, DEA&DP DWS, BGCMA, Klein Brak River EAF DAFF
Investigate carrying capacity (i.r.t. resource use, users, boat numbers, etc.)	NEMA	<ul style="list-style-type: none"> Monitoring reports; 	DST,

ACTION	RELEVANT LEGISLATION	PERFORMANCE INDICATOR	WORK PLAN RESPONSIBILITY
Engage Department of Science and Technology, academic and research institutions to undertake scientific research		<ul style="list-style-type: none"> <li data-bbox="1088 244 1637 276">• Active research network 	Mossel Bay Municipalities, Universities, Research Institutions
Investigate the environmental impacts of the existing water-based activities and identify mitigation measures			

7 INSTITUTIONAL ARRANGEMENTS

7.1 Key role players

It is essential that this EMP is regarded as a strategic plan that can guide the detailing of implementation actions and identification of implementing agents. Therefore, it does not specify the required resources (human and financial) required for proper management of the estuary. However, it does offer a schedule or phased planning approach that incorporates capacity building and implementation at the local level over a five-year period. It is crucial that champions/project leaders/teams are identified who will be responsible for the formulation of detailed action plans and the implementation thereof. Ways of empowering historically disadvantaged individuals with regards to the local management of the Klein Brak River estuary must be explored and implemented.

Co-management and effective governance has already been identified as the keystone to the efficient and effective management of the Klein Brak River estuary.

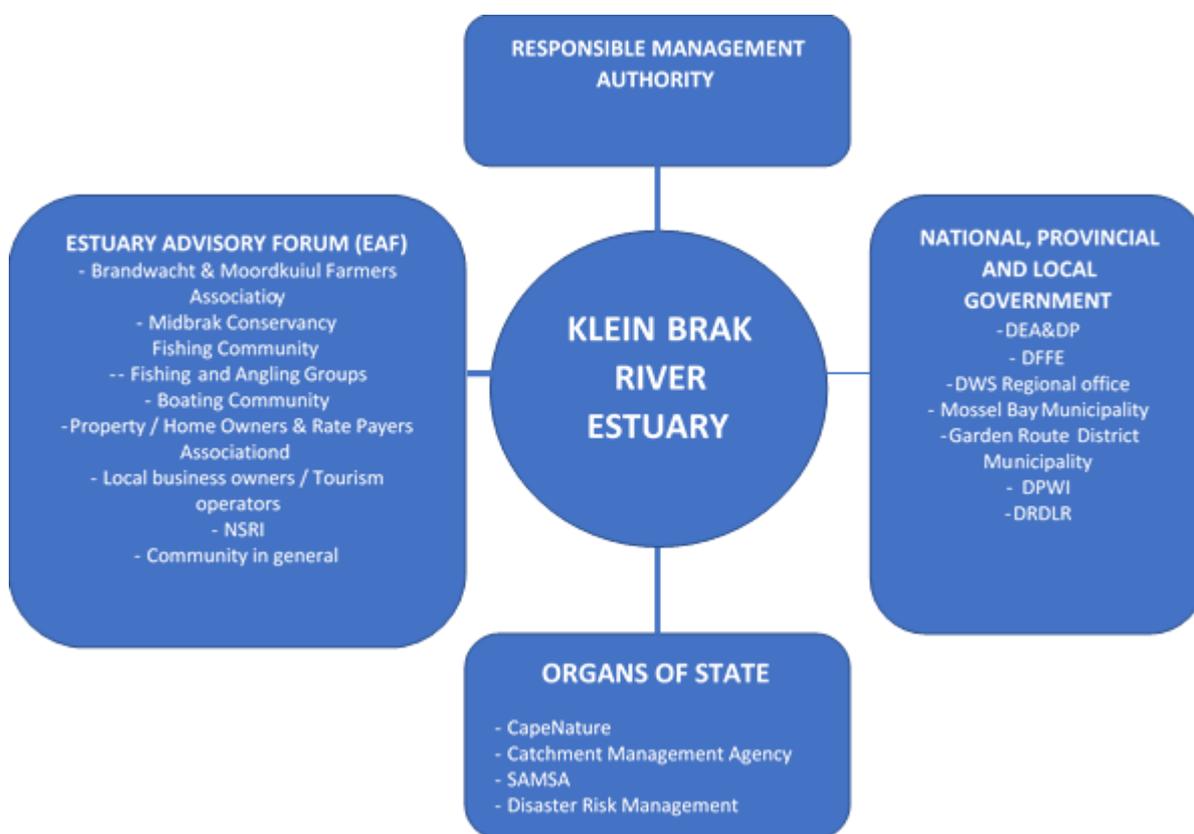


Figure 12: Key role players for the management of the Klein Brak River estuary

7.1.1 Estuary Management Authority

The 2021 NEMP identifies the **Department of Environmental Affairs & Development Planning (DEA&DP) (provincial environmental department)**, or its assigned representative, as the **RMA** responsible for the co-ordination of the implementation of the Klein Brak River Estuary EMP. **It is noted that the NEMP allocates such responsibilities to the DEA&DP (provincial environmental department) unless agreement / or until agreement is reached with the**

respective body to undertake the coordination of the implementation process. Ultimately, the role of the RMA must be designated through formal signed agreement. This implementation function can be effected through a range of different forums and actors.

7.1.2 Klein Brak River Estuary Advisory Forum

According to the Protocol, the role of the **Klein Brak River Estuary Advisory Forum** is interpreted as providing an advisory service to the RMA on issues specific to the management and implementation of the EMP, as well as being the hub that links all stakeholders, which serves to foster stakeholder engagement and to facilitate the implementation of the project plans identified. The broader **community** will be able to voice concerns and raise issues via the Forum. This includes Ratepayers' Associations, NGO's, community groups, conservancies, etc., as well as representatives from surrounding industry and agriculture. Any representatives are obliged to raise issues identified by their constituents and to provide feedback to the constituents. Importantly, the Forum will not represent or supplant the individual positions of its members unless specifically mandated to do so.

7.1.3 Government Departments and organs of state

The successful implementation of the EMP may be seen as also dependent on the contribution of a number of governmental role players, including:

- **Mossel Bay Municipality and Garden Route District Municipality:** Responsible for legislative support and funding;
- **Western Cape Government departments:** Responsible for legislative support, including compliance, funding, research and monitoring;
- Relevant **National government departments**, especially DEA, DWS via the regional office), DAFF, Department of Rural Development and Land Reform;
- State-Owned Enterprises (e.g. SANRAL, Transnet); and
- Organs of State (SANparks, CapeNature, BGCMA).

The DEA is generally responsible for national standardisation of estuarine management and approval of provincially-compiled estuarine management plans. Direct involvement in individual estuaries, such as the Klein Brak, will occur via existing forums for intergovernmental coordination. These forums will have the management of the Klein Brak River estuary on their agendas from time to time, and include:

- **Western Cape Provincial Coastal Committee:** Responsible for facilitating co-management, effective governance and provincial co-ordination of estuarine management; and
- **Garden Route District Municipal Coastal Committee:** Responsible for facilitating co-management and effective governance.

7.2 Review and Evaluation

This EMP should be reviewed and updated on a five-yearly from the date it was approved and adopted to ensure that objectives and targets are being achieved. An audit should be undertaken alongside the review and evaluation to determine and grade the success

and failures with the implementation of the management plan according to the specified performance indicators (Appendix1). This audit (and resultant implementation and continual review) is the responsibility of the RMA supported by the Klein Brak River EAF.

The review will involve revisiting the Situation Assessment Report to determine the progress or changes that have come about as a result of the EMP in terms of the objectives that were originally set as well as any changes in legislation or policies, and followed by revisions or refinement of the objectives and where necessary, aspects of the actions plans or monitoring protocol(s), after which public participation will be required as per Section 8 of the Protocol, before the updated EMP can be approved.

Ideally, technical working groups comprising experts in the following components should evaluate the efficiency of the EMP in the context of their field of expertise:

- Conservation;
- Social (and cultural issues);
- Land-use and infrastructure;
- Water quantity and quality (water supply/demand and waste); and
- Exploitation of living resources.

The Klein Brak River estuary would not justify the establishment of separate working groups due to insufficient manpower, and a single working group comprising experts in each of the abovementioned components, is probably more suitable. The availability of local expert resources within the government and private sectors should be assessed. The Klein Brak River EAF should strive to ensure continued communication and cooperation between the different fields. Specific Terms of Reference as well as financial and time requirements should be stipulated for this group. Members should be mandated by their respective institutions. Due to resource constraints, it may be necessary to prioritise the activities to be undertaken by the different experts as part of the management strategy evaluation.

8 MONITORING AND RESEARCH

8.1 Future resource monitoring requirements

The collection and analysis of appropriate and reliable quantitative data is essential for the adaptive and sustainable management of estuaries. Monitoring is a means of tracking the condition of the Klein Brak River estuary in response to management interventions as well as the progress in achieving the strategic objectives and the overall Vision for the system. Requirements for monitoring depend on the types of activities and the developments which can range from monitoring boating activities or angling licenses to detailed scientific surveys. Monitoring should be practical and include site-specific physical, biochemical and ecological characteristics, and the variability thereof, as well as compliance monitoring (Appendix 2). The following parameters are proposed as the minimum suite of indicators that should be monitored for the Klein Brak River estuary:

- Monitoring of biota as an indication of ecosystem health:
 - Microalgae;
 - Zooplankton;
 - Macrophytes;
 - Macrobenthos;
 - Ichthyofauna; and
 - Birds;
- Monitoring exploitation of living resources:
 - Fish; and
 - Bait;
- Monitoring water quality in the:
 - Freshwater dominated reach;
 - Marine dominated reach; and
 - River-Estuarine Interface reach;
- Bacteriological monitoring at pre-selected sites of potential concern;
- Monitoring sedimentation in pre-selected problem areas;
- Monitor groundwater:
 - Quality; and
 - Water level;
- Monitor chemical pollution on an ad hoc basis;
- Monitor estuarine usage in different zones – carrying capacity:
 - Angling;
 - Bait collection;
 - Water skiing; and
 - Boating.

Monitoring should be conducted in alignment with the Methods for the Determination of the Ecological Water Reserve for Estuaries (DWA, 2010), where possible, thereby ensuring consistency in the manner in which field data are collected in estuaries throughout South Africa (Van Niekerk and Taljaard, 2007b) and in preparation for a reserve determination study for the Klein Brak River estuary. The results should be reported to the EAF after each sampling period and an Annual Report card produced. A detailed Provisional Health

Assessment should be conducted toward the end of the 5-year review period. The responsibility for monitoring these components of the Klein Brak River estuary is assigned to the national lead agents, DWS, DEA and DAFF. These bodies must ensure that all levels of the National Estuarine Monitoring Programme is rolled out as recommended in the estuary management component of the National Biodiversity Assessment and the National Estuary Management Protocol. The responsibility for gathering information related to recreational use may reside with the local authority.

In addition, to improve the confidence of the proposed Intermediate determination of RDM of the Klein Brak River estuary, the following monitoring surveys are also recommended:

- Atypical rain patterns during the study period prevented specialists from measuring the extreme extent of saline intrusion typically encountered during low flow periods in the Klein Brak River estuary. To improve confidence, particularly for the low-flow period, salinity distribution patterns as well as water quality conditions at such times still need to be monitored;
- To improve confidence of the predictions that need to be made in RDM determinations requires more data on the relationships between different biotic and abiotic variables. This requires in-depth research – a cross-sectional analysis across different states or systems to determine these relationships. Some of these issues are being addressed in a Water Research Commission Project aimed at improving information requirements and understanding in terms of determination of Resource Directed Measures;
- Plant habitat monitoring: Area of intertidal flats should distinguish *Zostera* beds, and area of un-vegetated sandflat versus mudflat;
- Microphytobenthos species and biomass assays need to be conducted to determine the extent of species change with seasons;
- Monitoring the distribution of fringing macrophytes along the banks of the estuary, particularly *Phragmites australis*. If average salinity increases in an upstream direction, dieback of macrophytes may occur as a consequence. Sampling during the wet and dry season;
- Monitor distribution and abundance (hole counts) of intertidal macrobenthos, particularly large burrowing forms. If average salinity increases in an upstream direction, more suitable conditions provided by higher salinity values may allow colonization of new intertidal banks by some species. At the same time, subsurface sediment samples should be collected at high, mid and low tide levels for particle size analysis;
- For fish, four sampling exercises at 25 sites from the mouth to 10 km upstream during spring, summer, autumn and winter need to be undertaken. At least one sampling exercise must be done over a complete weather cycle or 7 days to get some idea of the short-term responses of fish to changes in flow; and
- To improve confidence and to evaluate performance in the long term, the following would be required for birds: all water birds need to be counted in the different estuarine section described in this report during late summer (Feb-Mar) (essential),

midwinter (Jun-Jul) (important), and spring (Sep) (could be important) at spring low tides. Also, birds in the lower estuary should be counted in one low tide period, upper estuary in one day (the following day at low tide), and count on days of low human disturbance.

- It is important to note that most of the above is encapsulated in the different tiers of the National Estuary Monitoring Programme.

8.2 Proposed Research

Although there have been numerous scientific studies that have investigated important aspects of the ecology and conservation of the Klein Brak River estuary, there are still obvious gaps that will need to be addressed through appropriate research projects. The lead authorities responsible for monitoring in estuaries must make provision for the research studies required and should approach tertiary and research institutions such as Universities, CSIR, SAIAB and SAEON, as well as the Department of Science and Technology (DST) for assistance. The following is a proposed list of research projects required to facilitate effective monitoring, and ultimately, management of the Klein Brak River estuary:

- Investigate the influence of all potential obstructions on water flow regimes, both from an ecological and social impact perspective;
- Undertake a Resource Directed Measures (RDM) study to estimate the freshwater requirements for the estuary, in terms of the Ecological Reserve;
- Investigate the levels of water quality variables, such as suspended solids and toxic substances (e.g. pesticides and herbicides) in inflowing water in order to establish the Present State;
- Reference conditions for water quality variables need to be established for inflowing river water;
- Investigate the sediment dynamics within the estuary, including both marine and catchment sediments;
- Investigate the perception of accelerated siltation at the river mouth;
- Determine the value of the ecosystem goods and services provided by the Klein Brak River estuary;
- Investigate the perceived impacts of existing farming activities on the water quality and sediment yields in the estuary;
- Determine ground water surface water interface with the estuary. Map aquifer types and potential yields of groundwater discharge or recharge to and from the estuary;
- Determine the importance of sub-surface water input for the health of the river;
- Determine the impact of boats on the river and river banks;
- Determine the impacts of aquatic recreation activities on the estuary. The carrying capacity of the estuary needs to be determined so that the EMI can make an informed decision about the numbers of users utilizing the system at any given time. Some data can be collected as part of the fishery survey, but some aspects such as

sense of place, pollution due to engine emissions and incidents of confrontation between all user groups will need to be addressed by a dedicated project;

- Invertebrate organisms primarily used for bait. Key elements should include densities (in and outside sanctuary areas and in control areas), recovery periods after disturbance (collecting and trampling that alter habitat), community structures before and after disturbance, effect of pollutants in the sediment, mortality due to birds foraging after collection activities, effect on birds by bait collectors (both use same area at low tide) and larval settlement times & location along the tidal cross-section (avoid these areas at specific times);
- Fishery survey comprising both bait and fish. Key elements include fishing/collecting effort, CPUE, user dynamics, target fish species, catch composition, bait utilization in relation to existing regulations (waste), motivation for using resource, economic value of the fishery, degree of compliance and conflict between different fishing fraternities;
- The utilisation of microphytobenthos needs to be better established, i.e. "who eats what" is not well understood;
- A social based project to determine the effectiveness of the education and awareness programme and the attitude toward the EMP and those management actions which have directly affected users, e.g. restrictions on developments and restricted access to sanctuary areas needs to be conducted; and
- A comparison between biodiversity and habitat health within the sanctuary areas compared to the conservation areas in the rest of the system needs to be undertaken. An aspect that should be included is the response of communities (plant and animal) to freshwater pulses, in-stream flows and contaminants in order to monitor the efficacy of the recommended RQOs.

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APPENDIX 1: RECOMMENDED PERFORMANCE MONITORING PLAN

The following table provides a performance monitoring plan indicating the list of desired management outputs (and accompanying performance indicators) as per the management priorities to assess the achievements of the Klein Brak EMP

MANAGEMENT OUTPUTS	PERFORMANCE INDICATOR	TIMING	LEGISLATION	RESPONSIBILITY
1. Institutional and Management Structures				
1.1 Maintain a fully functional estuary advisory forum that will facilitate co-management and effective governance	Constituted Klein Brak EAF Terms of Reference and Constitution developed and agreed Ongoing record of meetings held	Assess twice a year	ICMA	RMA, Mossel Bay LM Klein Brak EAF DEA&DP DEA: O&C
1.2 Secure appropriate funding and legal support for implementation of the Klein Brak EMP	Guaranteed annual allocation of funds Specific by-laws developed	Assess twice a year	ICMA MSA	RMA, DEA: O&C DWS DPW DAFF DEA&DP CapeNature Garden Route DM Klein Brak River EAF Mossel Bay LM
2. Water Quantity & Quality				
2.1 Determine and secure the Ecological Reserves for Water Quantity and Quality	Improved estuarine health and function Improved river flow Good water quality	Biannual for BGCMA	NWA: RDM	DWS RMA, DEA&DP BGCMA Klein Brak EAF Mossel Bay LM

MANAGEMENT OUTPUTS	PERFORMANCE INDICATOR	TIMING	LEGISLATION	RESPONSIBILITY
2.2 Improve flow patterns to improve ecosystem functioning of the Klein Brak estuarine system	All obstructions identified and assessed Remedial plan developed and implemented Improved functioning of the estuary	Assess twice a year	NWA NEMA DMAA	Provincial Disaster Management Centre RMA. Mossel Bay LM DWS: WfW
2.3 Minimise water pollution	Number and volume of sources of pollution reduced Water quality monitoring programme established	Annually for DWS Monthly LBRCT	NWA NEM:WA	RMA, DEA&DP Provincial Disaster Management Centre DWS: WfW DAFF Garden Route DM and Mossel Bay LM Transnet SANRAL
2.4 Reduce bank de-stabilization and erosion, and habitat degradation	Number of degraded areas and habitats rehabilitated and secured Rehabilitation programme implemented	Ad hoc visual monitoring during normal daily activities or responsibilities	ICMA CARA NWA	RMA, Mossel Bay LM DWS: WfW Klein Brak EAF
2.5 Control the spread and densification of both aquatic & terrestrial invasive alien plant species	Increased number of tons removed/ hectares cleared	Annually for disturbed sites	CARA NWA NEMA NEM:BA	RMA, DEA: WfW DEA: WfC Municipalities Landowners
3. Conservation of Biodiversity				
3.1 Ensure the conservation of the full suite of existing, especially vital, estuarine habitats & associated species	Conservation areas secured through by-laws and enforced	Once a year	Municipal By-laws ICMA	RMA, DEA DAFF Klein Brak EAF CapeNature Local municipalities

MANAGEMENT OUTPUTS	PERFORMANCE INDICATOR	TIMING	LEGISLATION	RESPONSIBILITY
3.2 Ensure sustainable resource use through effective compliance management	Healthy populations of all species; Low levels of non-compliance; Recovery of degraded areas	Ongoing for compliance and MLRA appointed personnel; daily patrols and inspections. BREAf & angling club members may assist.	MLRA NWA ICMA NEM:BA SB&SPA	RMA, DEA DAFF CapeNature Local municipalities
3.3 Regulate recreational use in and around the estuary, including water-based activities to reduce habitat degradation and disturbance to fauna and flora	Low levels of non-compliance	Ongoing for compliance monitors and appointed personnel; daily patrols and inspections.	Municipal By-laws	Local municipalities Klein Brak EAF DWS RMA
4. Land-use and Infrastructure				
4.1 Implement an estuary zonation plan that directs infrastructural development and other land use practices (e.g. agriculture) within the various floodlines, coastal management lines, buffer zones and overlay zones	Reduction/cessation of inappropriate development and activities in and around the estuary	Every 5 years	ICMA MSA NEMA CARA	RMA, Klein Brak EAF DEA&DP DAFF Mossel Bay LM CapeNature Farmers Assoc.
4.2. Ensure the incorporation of the EMP into the Integrated Development Plans and Spatial Development Frameworks	EMP is adopted into IDPs and SDF	Every IDP/SDF review cycle	MSA ICMA	Mossel Bay & Garden Route municipalities Klein Brak EAF RMA
4.3 Ensure that all proposed developments within the development buffer zones, adhere to the EIA process in terms of the full suite of relevant environmental legislation	Each development lawfully constructed	Depends on number of developments and EA granted	NEMA ICMA Municipal by-laws	Klein Brak EAF DEA&DP DAFF DWS RMA
4.4 All jetties and slipways authorised and licensed	Reduction in illegal development and operations of jetties & slipways	Every 6 months	Seashore Act NEMA	CapeNature Mossel Bay LM RMA, DEA&DP

MANAGEMENT OUTPUTS	PERFORMANCE INDICATOR	TIMING	LEGISLATION	RESPONSIBILITY
4.5 Ensure that all water uses* within the CPZ are be duly authorised by DWS	Effective monitoring and compliance management system in place	Every 6 months	NWA	DWS BGCMA RMA
5. Public Education and Awareness and Knowledge Enhancement				
5.1 Promote high levels of public awareness and appreciation of the ecosystem services provided by the Klein Brak Estuary, threats posed to its integrity, and compliance management	Increase in number of newsletters; Sufficient number of public notice boards; Increase in number of forum members and voluntary monitors; Increase public participation in coastal/estuary/river clean ups and other initiatives	Once year		RMA, Mossel Bay LM Klein Brak River EAF Relevant Government departments
5.2 Enhance our scientific knowledge, through research and monitoring	Increase in number of research projects and monitoring programmes	Once a year		RMA, Klein Brak EAF Mossel Bay LM DEA&DP DST DWS DAFF

APPENDIX 2: RECOMMENDED RESOURCE & COMPLIANCE MONITORING PLAN

The following table provides a list of recommended abiotic and biotic parameters that should be monitored for the Klein Brak Estuary in line with the monitoring / studies required in the Resource Directed Measures methodology. Additional recommendations have been included for monitoring estuarine usage. To be implemented by the lead authorities tasked with rolling out the National Estuary Monitoring Protocol

Monitoring projects	Monitoring objectives	Monitoring parameters (indicators)	Spatial and temporal scales	Sampling/analytical techniques
Biota: <ul style="list-style-type: none"> • Microalgae • Zooplankton • Macrophytes • Macrobenthos • Ichthyofauna • Birds • Inter/sub-fidal vegetation 	To assess population trends of the different organism types associated with the Klein Brak Estuary to inform management actions	Population dynamics <ul style="list-style-type: none"> • Growing • Shrinking • Population structure – age and sex ratios 	Designated sites (existing and new ones to be identified) QUARTERLY	Microalgae Zooplankton Macrophytes Macrobenthos Ichthyofauna Birds - Coordinated water bird counts (CWAC)
Exploitation of living resources <ul style="list-style-type: none"> • Fish • Bait 	To assess extent of living resources exploitation to inform management actions	Relate exploitation of fish and bait to population dynamics <ul style="list-style-type: none"> • Amount of permits issued • Amount of non-compliance documented 	Throughout estuary for fish Lower part of estuary for bait (sand- and mud banks) QUARTERLY	Permits issued Non-compliance data
Water quality: <ul style="list-style-type: none"> • Freshwater reach • Marine reach • REI reach 	To assess integrity of water quality To assess effectiveness of management actions	Physical and chemical parameters: <ul style="list-style-type: none"> • Nitrate • Ammonium • Phosphate • pH • EC/Salinity • Oxygen concentration • Temperature 	Sampling sites in each respective reach QUARTERLY	Collect water quality samples according to laboratory specifications pH, EC, salinity, Temp and Oxygen measured in situ
Bacteriological monitoring	To detect timeously bacteriological pollution as an early warning system of pollution to inform recreational use	Bacteriological concentrations: <ul style="list-style-type: none"> • Total coli form bacteria • Faecal coli form bacteria • Must be less than 100 per 100ml for full contact recreation 	Sampling at problem sites where full-contact recreation is exercised QUARTERLY	Collect water quality samples according to laboratory specifications and sending it for analysis
Sedimentation	To assess sedimentation at problem sites and monitor efficiency of management actions	Increasing or stable sedimentation/sandbanks: <ul style="list-style-type: none"> • Fixed photo points • Landsat imagery • Bathymetry 	At pre-selected sites QUARTERLY	Secchi measurements as at water quality sites – filter and weigh Fixed photo monitoring (annually) Landsat interpretation Bathymetric measurements
Groundwater: <ul style="list-style-type: none"> • Quality 	To assess groundwater quality and water levels	Groundwater quality: <ul style="list-style-type: none"> • EC 	Groundwater usage within CPZ and within 10 km there off	Collect water quality samples according to laboratory

Monitoring projects	Monitoring objectives	Monitoring parameters (indicators)	Spatial and temporal scales	Sampling/analytical techniques
<ul style="list-style-type: none"> Water level 	To inform management interventions and effectiveness	<ul style="list-style-type: none"> pH Hydrogeochemistry Aquifer "type" characteristics <p>Groundwater level data:</p> <ul style="list-style-type: none"> Rising Declining Rainfall relation 	QUARTERLY	specifications and sending it for analysis pH and EC can be measured in situ
Chemical pollution	To assess level of chemical pollution at problem sites To intervene with management where appropriate	Chemical compound and concentration: <ul style="list-style-type: none"> Presence or absence Concentration Possible source 	At pre-selected sites only (<i>ad hoc</i>) QUARTERLY	Collect water quality samples according to laboratory specifications and sending it for analysis
Estuarine usage: <ul style="list-style-type: none"> Angling Bait collection Water skiing Boating 	To assess level of estuarine use by different user groups To relate estuary use to all of the above To inform management interventions where appropriate	<ul style="list-style-type: none"> Number of boats registered Numbers of permits issued Number of non-compliance documented Number of organized events and participants Number of reported incidents 	Through-out estuary: Access points (public slipways, boat permits etc.) QUARTERLY	Permits issued Non-compliance data for each respective activity Ad hoc counts

